Pushing the boundaries

Petroleum Technology Research Centre
2004/2005 Annual Report

ptrc
Petroleum Technology
Research Centre

Front Cover

A young province—100 in 2005—

Saskatchewan has a long history of sowing smart ideas here that take root and bear fruit far beyond our borders. We push the boundaries of what we can achieve with our resources by ingenuity, teamwork and tenacity. We at the Petroleum Technology Research Centre, based in Regina, Saskatchewan, live this attitude.

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Description and Mission Statement of PTRC

Description of PTRC

The PTRC is a non-profit petroleum research and development corporation located in Regina, Saskatchewan. It brings a fresh approach to finding, developing and applying innovative technologies and engineering solutions for the petroleum sector. The PTRC delivers world-class-quality basic and applied research to benefit its customers and the people of Saskatchewan and Canada.

The PTRC is a collaborative initiative of Natural Resources Canada (NRCan), Saskatchewan Industry and Resources (SIR), the University of Regina and the Saskatchewan Research Council. The Centre has financial support from the federal and provincial governments to sponsor research and development projects. To complement this support, the PTRC will attract support for its research projects from the Canadian and international petroleum industries.

PTRC Mission Statement

The PTRC will initiate and support research and development projects aimed at enhancing the production and recovery of Canadian petroleum resources by drawing primarily but not exclusively upon the expertise of the Energy Division of the Saskatchewan Research Council and the Engineering Faculty of the University of Regina.

In addition, the PTRC will ensure that the findings of the work it supports are applied by the petroleum industry. The avenues for this effective application of results will include very close collaboration with the industry participants, presentation of technical papers, and the organization of technical conferences.

Below: The PTRC Building in Regina, Saskatchewan. The pump-jack in front stands as an emblem of the province's vibrant oil industry.

Message from the Chair

In this, Saskatchewan's Centennial year, the PTRC is very proud to be augmenting this province's history of innovative, internationally recognized research. Starting from nothing more than an idea some ten years ago, the PTRC has established itself as a "world class" institution.

This year we continued to build on our founding principles. We added further members to our Board from industry to ensure that we achieve our objective of being "industry driven". We were able to spend a higher percentage of our revenues to support research projects conducted within the province. We assisted our key partners—the University of Regina and the Saskatchewan Research Council—in acquiring additional research personnel and state of the art equipment.

The PTRC continues to support research projects that will enhance oil production from known reservoirs in an economically viable and environmentally sustainable manner. A key example of this initiative is the work being done in EnCana's carbon dioxide enhanced oil recovery project in the Weyburn field. This project has shown not only that using carbon dioxide to increase oil production from old oil fields is economically viable, but also that large quantities of the CO_2 remain in the reservoir, thus reducing the amount of the greenhouse gas that would otherwise have been released into the atmosphere. The first phase of this International Energy Agency research project was very successful and attracted attention from every continent. The international interest in carbon dioxide sequestration and the next phase of the Weyburn Project is very high. Financial support and research assistance have been committed from several organizations and companies internationally for the next phase.

As we prepare to engage in more and more projects, the Board has taken steps to ensure that our governance and financial oversight model and controls are exemplary.

On behalf of the Board, our Founding Partners, and the staff of the PTRC, we are pleased to showcase the PTRC as an example of a good idea that is working. The Governments of Canada and Saskatchewan, who took a big risk in starting the PTRC, have received very good value for the taxpayers' dollars committed to this project.

On behalf of the Founding Partners I want to thank all of the members of our Board of Directors who dedicate many hours of totally volunteer time to ensure that we continue to accomplish what we set out to do. Their commitment to the PTRC, to the importance of research to the future of Canada, and to freely giving their knowledge and time to "make it happen" is nothing short of remarkable. Thank you! I also want to thank our Executive Director, Mike Monea, and his staff for a great year. The advice and commitment from the Government of Canada and the Government of Saskatchewan are crucial and the Board thanks them for their continuing support and guidance.

Frank Proto, Chairman

Message from the Executive Director

This year, we at the PTRC broadened our horizons, taking what we have learned and developed in Saskatchewan and moving beyond our borders to engage in opportunities throughout the world. And the world, in turn, is recognizing us as a leader in the fields of enhanced oil recovery and greenhouse gas sequestration technologies.

We continue to push our efforts along the research and development spectrum from basic to applied investigation. Increasingly, our core research program aims at addressing industry's need for field-ready research, while still supplying the fundamental knowledge that underpins true innovation.

Our major research projects are also venturing into new territory. This year, a program known as JIVE advanced to the planning stage and is set to launch in October 2005. This program involves a joint industry pilot project for implementing vapour extraction technology, which, like horizontal well drilling 20 years ago, is viewed as the next step change in oilfield operating practice. Proving this technology in the field will be a major step forward for western Canada's heavy oil industry and a sign of the PTRC's progress toward a more applied research agenda.

The first phase of the IEA GHG Weyburn CO_2 Monitoring and Storage Project was successfully concluded in 2004 to much international acclaim. Following a long gestation period, the second phase is proceeding with the worthy and attainable goal of expanding the program into risk assessment and policy development. This will position us to drive the wide-scale adoption—at home and abroad—of geological CO_2 storage as the most relevant means of addressing climate change for both government and the fossil fuel industry.

We lay the groundwork for much wider collaboration in 2004-2005, establishing new relationships with major oil and gas companies from around the world: China National Petroleum Corporation, Pemex (Mexico), Petrobras (Brazil), Saudi Aramco (Saudi Arabia), BP, Shell International, Schlumberger, and Statoil (Norway). These relationships will enrich the resources and opportunities for technology development and adoption.

We also cast a wide net to establish relationships with research institutes whose interests and expertise complement ours: the Australian research group CO_2CRC, the European group CO_2GeoNet, and TNO of the Netherlands, among others.

With these groups, we are building an international forum for sharing knowledge and research. This will enable us not only to spread the positive results of the Weyburn project, but also to continue to advance the technology needed to implement and monitor geological storage of greenhouse gases.

The PTRC now has in place the necessary relationships to develop a network of excellence in research that will allow us to extend our knowledge beyond Saskatchewan and, at the same time, bring new ideas and technologies to our fields and producers, right here at home.

Michael Monea, Executive Director

Organization Chart & PTRC Board of Directors

Organization Chart

The PTRC Board of Directors, as of March 31, 2005:

Frank Proto, Chairman, Petroleum Technology Research Centre

Allan Cahoon, VP Research & International, University of Regina

Philip Chan, Senior Manager, Petroleum Engineering, Talisman Energy Inc.

Judy Fairburn, VP Weyburn Business Unit, EnCana Corporation

Mike Langley, VP Business Development, North American Oil Sands Corp.

David Long, General Manager, Heavy Oil & Gas Business, Husky Energy Inc.

Bob Mitchell, retired VP, Talisman Energy Inc.

Brian McConnell, VP Exploration, Tundra Oil & Gas Ltd.

Dan O'Byrne, VP Technical Services, Nexen Inc.

Carolyn Preston (acting), Strategic Planning & Special Projects Manager, CANMET, Natural Resources Canada

Laurier Schramm, President, Saskatchewan Research Council

Mike Singleton, Director, Technology Planning & Integration, Suncor Energy Inc.

Larry Spannier, Deputy Minister, Saskatchewan Industry and Resources

John Zahary, President & CEO, Viking Energy Royalty Trust

Pushing the Boundaries of Opportunity

Saskatchewan is the second-largest oil-producing province in Canada (after Alberta), with nearly 20% of crude oil and equivalent production.

- A major contributor to the provincial economy, the oil and gas industry invested $1.7 billion in Saskatchewan in 2004. Provincial revenues from crude oil and natural gas royalties and taxes and sales of petroleum leases were $1.1 billion in fiscal 2004/05.
- Average daily oil production totals roughly 67,400 cubic metres (Dec. 31, 2003) from over 22,000 wells.
- The proven oil resource in the province is 5.5 billion cubic metres. Between 9 and 23 percent of this is considered recoverable with available technology.
- The PTRC is advancing technology whose application can potentially recover an additional 700 million cubic metres in Saskatchewan alone.
- This technology will be applicable in many other parts of Canada and the world.

An opportunity to push the boundaries

The Saskatchewan government extended the Saskatchewan Petroleum Research Incentive (SPRI) program to March 2010. It makes available $30 million in the form of credits against future oil and gas Crown royalties and freehold production taxes. The program has been expanded to include all field pilot EOR, oil shale and oilsands projects.

The SPRI provides a royalty/tax credit of (potentially) $4 million, including 50 percent of eligible expenditures directly involving the PTRC (up to $1 million in credits) plus 30 percent of all other eligible expenditures.

PTRC Core Area:
Heavy Oil (Post) Cold Flow

Bernard Tremblay examines sand deformation surrounding a wormhole after butane injection and production cycles as part of a wormhole stability visualization experiment.

Heavy oil cold flow (or cold production, as it's called in Alberta) is a heavyweight among oil recovery methods used by western Canada's industry. In Saskatchewan, it accounts for 20,000 cubic metres (126,000 barrels) per day, or about 30 percent of the province's total production.

The PTRC is helping operators optimize the process and take advantage of opportunities to extend the life of the reservoir after depletion by cold flow.

In cold flow, solution gas in the heavy oil supplies the drive towards a vertical producer well by forming methane bubbles. The oil and sand are pumped to the surface by progressive cavity (screw) pumps. The method entails the deliberate production — more or less aggressively — of unconsolidated reservoir sand along with the oil to boost oil production rates.

As sand is produced, highly permeable channels — wormholes — tunnel throughout the reservoir and the oil drains into them. Wormhole networks can cause problems for producers, but they also suggest intriguing possibilities for accessing the reservoir in post-cold flow processes.

Other issues include estimating the extent of oil reserves available to cold flow, optimal spacing between wells, appropriate schedules for drilling in-fill wells, watering-out tendencies of oil-bearing formations, and water shut-off strategies. The PTRC is funding an ongoing effort to develop a predictive, multi-well numerical model which addresses all of these concerns. Reservoir engineers will be able to use this model, which requires only basic formation properties to run, to help them decide how best to exploit a cold production field.

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In Saskatchewan, heavy oil cold flow accounts for about a third of the province's total production.

PTRC Researcher Profile: Dr. Bernard Tremblay

"I've always liked hybrid areas," states Bernard Tremblay. "My former boss said that I actually developed a new research area by working in cold production, since I combined areas that by themselves are specialties — flow through porous media, geomechanics (tunnel stability), and sand transport."

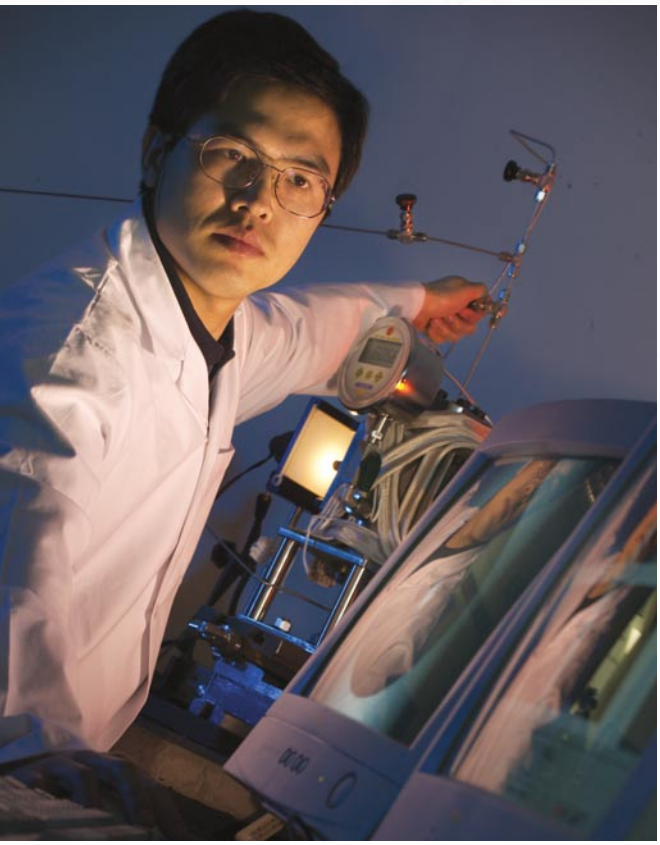
Tremblay obtained his BSc and MSc degrees in mechanical engineering, respectively, from the University of Ottawa (his home town) and the University of Toronto. He earned his PhD in mechanical engineering from the University of Grenoble in France, where the multidisciplinary nature of the Mechanics Institute appealed to him. He joined SRC in 2003, after a dozen years as a senior research engineer at the Alberta Research Council.

Tremblay has spent his entire career as a researcher, attracted by the predictive capability of mathematics and science. But he also strongly appreciates the ability to develop real-world applications for his research that the PTRC consortium affords.

His curiosity extends to travel and art. "I like to discover new places. Even in Saskatchewan, I love to go driving around, discovering new towns, the history, the natural attractions."

Keeping the Channels of Communication Open

Only about seven percent of the six billion stock tank barrels under cold flow in Saskatchewan is likely to be recovered using current practices. Vast reserves will remain, awaiting appropriate enhanced methods. A major issue in development of post-cold flow processes is if wormholes will stay intact—and help to distribute injected recovery agents like solvent and steam deep within the reservoir—or if they will collapse.



Above: Daoyong (Tony) Yang measures interfacial tension and wettability in oil-brine-CO_2-rock systems under different pressures and temperatures. This research will improve understanding of the interfacial interactions among the oil, fluid, and rock for gas flooding and post-cold production.

"It makes a big difference in terms of the production of the diluted oil by gravity drainage, which requires the low pressure gradients achievable by keeping the wormholes open," says Bernard Tremblay, principal research engineer at the Saskatchewan Research Council. He led all three PTRC projects offered in this core area in 2004/2005, including "Wormhole Stability to Solvents and Steam."

Will wormholes stay intact or will they collapse?

His experimental results so far in this project indicate that wormholes may indeed be unstable, not necessarily good news depending on the type of post-cold flow process being considered. "But I'm suggesting ways of keeping these wormholes open," says Tremblay.

He has proposed development of a gel system that can be injected before a solvent to form a permeable network system that will hold the sand grains together. "The gels are not too expensive and the volume required is small."

Tremblay tested a variety of such gels in another project this year, "Drilling through Wormholed Reservoirs," with the intent of blocking neighbouring wormholes during drilling of horizontal wells. ■

PTRC Core Area:
Miscible/Immiscible Solvent Injection

Micromodels are being developed and used at PTRC to examine oil recovery mechanisms at the pore scale. Patrick Zhang, at left, observes the progress of an EOR flood while Susan Fletcher, at right, acquires the digital images for future analysis.

Solvent injection offers the benefits of being more energy efficient and environmentally sustainable…than competing thermal methods.

In western Canada, being thin and shallow does not give an oil reservoir celebrity status. In fact, these are just two of the features that make it so difficult to exploit much of the region's vast heavy oil resource. Other factors compounding the challenge include complex geology, lack of a significant drive mechanism, and the presence of bottomwater. Conventional technology can recover only about 10 percent of the estimated 2.5 billion cubic metres of heavy oil in Saskatchewan alone.

Injection of gaseous solvents (such as carbon dioxide, methane, or propane) to dilute and drive the oil is proving to be a viable alternative for reservoirs depleted by primary production or waterflood.

In thin reservoirs, thermal methods like steamflooding are uneconomic because the heat they use to mobilize the oil is easily lost outside the pay zone. Even for thicker reservoirs, solvent injection offers the benefits of being more energy efficient and environmentally sustainable, and less capital intensive, than competing thermal methods.

Thicker reservoirs, especially those containing lighter oils, present the opportunity to capture and store greenhouse gases (GHGs) that are injected to enhance oil recovery. Although the PTRC's effort in this core area focused on heavy oil this year, a project advancing miscible CO_2 injection in light oil reservoirs is upcoming. It will enable participants to assess and apply the technology that is proving so successful in the Weyburn CO_2 flood in southeast Saskatchewan.

Making Gas Injection Work for Heavy Oil

A project funded by the PTRC is bringing CO_2 injection—proven to work well for lighter oils—closer to field application for heavy oils. Project leader Patrick Zhang, Senior Research Engineer with the Saskatchewan Research Council, says that promising results were obtained in laboratory tests for a Lloydminster-area oil.

"Recovery in coreflood tests averaged 7.6 percent of the initial oil in place. If that were achieved in the field, the current recovery would be nearly doubled," states Zhang. Although the CO_2 does not thoroughly mix—or become miscible—with the heavy oil as it might with a lighter oil, it does dissolve in it at moderate pressures, dramatically reducing the oil's viscosity and making it easier to flow. It also swells the oil's volume, making it an easier target for a subsequent waterflood.

CO_2 injection is a mature technology; the challenge lies in applying it properly for the reservoir conditions. "Poor recovery is usually due to poor design of the injection sequence," Zhang asserts. His team tested several operating procedures and varied parameters to arrive the optimum strategy for the study oil. Future work will focus on other oils from western Canada's heavy oil belt to expand the applicability of immiscible CO_2 and flue gas flooding. ■

Shuliang Li records test data in a phase behaviour experiment to evaluate CO_2 solubility in oil, an important parameter in the design of carbon dioxide flooding projects.

PTRC Core Area: Enhanced Waterflooding

With over 500 active waterflood projects in Saskatchewan and Alberta, waterflooding is the workhorse of the oil industry. This oil recovery method—which involves injecting water to sweep out partially depleted reservoirs—is considered a reliable, uncomplicated follow-up to primary production by the reservoir's natural pressure drive.

Waterfloods can be profitable even when the process water—usually salty aquifer water—makes up 95 percent or more of the produced fluids. However, many projects are currently reaching their economic limits.

Left: Mingzhe Dong, at right, explains the operation of the spinning drop tensiometer to graduate student Wei Zhou, at left. This instrument is used to determine the interfacial tension between chemical systems and oils for enhanced oil recovery.

Innovations are being developed at the PTRC to inject new life into existing waterflood projects. These include design and process optimizations, and the addition of soap-like chemical agents. The purpose of these agents is to alter the injected water's interaction with the oil, enabling it to coax the oil off the rock, and/or to modify its density and viscosity to enhance the sweep of the reservoir.

Waterflooding of heavy oil reservoirs is a practice that is nearly unique to western Canada. However, techniques that succeed for light and medium oils cannot be applied wholesale to heavier oils. A PTRC survey of western Canadian waterfloods revealed that little is understood about the physical and chemical mechanisms underlying the recovery method. Future work at the PTRC will delve into this territory while continuing to explore more immediate improvements.

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Innovations are being developed at the PTRC to inject new life into existing waterflood projects.

PTRC Researcher Profile: Dr. Mingzhe Dong

Mingzhe Dong has a simple approach to life: "Be loyal; work hard; welcome new ideas." This philosophy, along with his solid background in enhanced oil recovery, guides his research and teaching activities at the University of Regina. Therefore, Dong is highly regarded by colleagues, clients, and students. He received an "Inspiring Teaching" award from the U of R in 2003. His research has recently attracted over $250,000 in non-PTRC funding.

An often-cited expert in the areas of surface chemistry and multiphase flow in porous media (e.g., oil/water flow in reservoir rock), Dong earned his PhD in Chemical Engineering at the University of Waterloo, Ontario. He obtained his BASc and MASc from Northwestern University (Xi'an) and University of Petroleum (Beijing), respectively, in his native China.

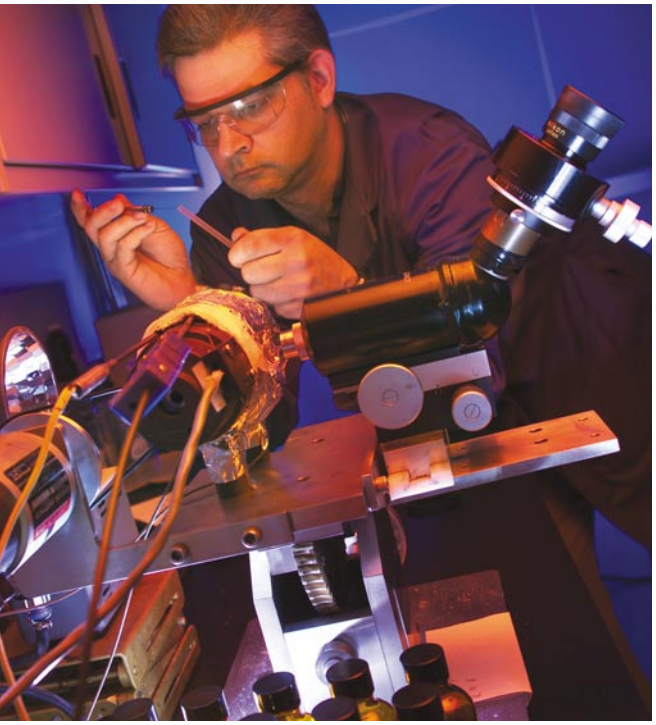
"Engineering and research are a good match for my personality, because I'm very practical," says Dong. Outside work, he enjoys spending time with his family and playing badminton and tennis, competitively but "not to win."

His career goal, though, is to develop a winning field application that will significantly contribute to the success of industry and to Canada's economy.

Enhanced Waterflooding | continued

Positive Interface between Industry Clients and Research Team

"In 2003, Canada's heavy oil production surpassed its conventional oil production for the first time," states Mingzhe Dong, associate professor in Petroleum Systems Engineering at the University of Regina. "Heavy oil will play a major role in the world's energy future, but we need innovative recovery techniques to deliver on this potential."



Above: Kevin Rispler uses the spinning drop tensiometer to screen chemicals for the optimal ASP (alkaline-surfactant-polymer) combination which will obtain minimum interfacial tension and boost oil recovery.

Dong is working with an industrial client to develop a viable enhanced waterflooding method to improve recovery from a heavy oil reservoir in the oil sands region of Alberta. Because the project is very close to the pilot test stage, it is now being offered as part of the PTRC's Field Development Program.

"Our tests got pretty high tertiary recovery, so the company is very happy with our research," says Dong. And he, in turn, is delighted to work with clients who ask challenging questions and provide important input.

Dong's original concept was to take advantage of a period of "interfacial instability" during the chemical flooding process when the oil can be more easily detached and broken into small droplets, which would then be swept out of the oil sands along with the injected water.

Because they were eager to confirm that the process would actually work in the field, the clients suggested shifting the focus of the study from interfacial properties (of the oil, water, and rock) to sweep efficiency and minimizing chemical use. Their reservoir is experiencing low oil- and high water-production because of water channeling in the heterogeneous formation. They proposed alternating slugs of a low-chemical-concentration solution with procedures to block the channels.

Dong and his team are now testing this with new chemical formulas and different injection strategies in a newly designed model that better represents the channeled reservoir. ■

Heavy oil will play a major role in the world's energy future, but we need innovative recovery techniques to deliver on this potential.

PTRC Core Area:
Near-Wellbore Conformance Control

Shahryar Ali Khan installs well completions in a high-pressure reservoir model to simulate a water coning scenario.

Near-Wellbore Conformance

The impact of effective conformance control treatments can be great in terms of reduced costs, improved recovery, and extended reservoir life.

Water in a waterflood operation channels through the more permeable regions of a reservoir, bypassing the oil. Asphaltenes precipitate out of the oil and plug the reservoir. These are two, all-too-common examples of conformance control problems that often lead to underperforming wells being abandoned. These issues affect the degree to which oil can be appropriately targeted and uniformly swept out of the reservoir by injected water or gas.

Very often, the solutions are elegantly simple and economical. But the impact of effective conformance control treatments, such as gel blocking agents, can be great in terms of reduced costs, improved recovery, and extended reservoir life.

The PTRC is working to adapt and advance a range of promising technologies for the Saskatchewan setting, which includes thick, viscous oils; thin fractured or wormholed reservoirs; and the frequent presence of active bottomwater. We are also investigating ways to modify the reservoir environment to actually stimulate oil production.

While the PTRC is probing the scope for novel applications, by far the greatest need for conformance control methods is posed by excess water production. Oil recovery projects may be economic up to a water cut of 95 percent or even higher; however, limiting such huge volumes of produced water will provide a significant payoff. It will curb the cost of environmentally safe disposal, and improve producers' profitability by allowing additional oil to be recovered economically from mature wells.

Dual Completion: Producing Water on Purpose

Muhammad Ayub is advancing a technique to control excess water by purposely producing it. The associate professor at the University of Regina is developing the application of dual completion methods to heavy oils to maximize oil recovery and prevent a phenomenon known as water coning.

When oil is produced, the reservoir pressure drops, allowing a cone of underlying water to swell upwards in the area around the wellbore. The concept of dual completion involves simultaneous but segregated pumping from the oil zone and the water zone. The aim is to keep the oil-water contact in the reservoir as level as possible. Ayub points out that removing the water kills the reservoir drive, but the produced water can be reinjected to restore pressure.

Most studies on dual completion have involved light oils. "They won't help in the Saskatchewan case," says Ayub, "because the oil is often heavy, the reservoirs are thin, and water production is high." His project will determine the range of oil viscosity for which dual completion is feasible.

Ayub's team of enthusiastic students is testing several completion scenarios and operating strategies in a specially designed and constructed physical model. The experimental results are also being simulated to scale up the processes.

According to Ayub, the process can be economical to implement because it uses existing wellbores. The sticking point is a lack of available high-capacity pumps. Ayub foresees collaborating with a pump manufacturer in the future.

Investing in Equipment

Shahbaz Masih checks a steam generator used in steam-assisted gravity drainage projects. The PTRC's investment in laboratory equipment builds research capacity at the SRC and the U of R.

Pushing the Boundaries:

The PTRC is "pushing the boundaries" when it comes to national and international partnerships and clients. Here is an overview of the relationships we have recently established or are actively pursuing.

Canada:

PTRC has signed memoranda of understanding (MOUs) with Permedia Research Group—to develop new models and simulators for CO_2 geological storage—and with Nexen Inc. to develop the JIVE Program for vapour extraction implementation.

United States:

PTRC has maintained a strong relationship with the United States Department of Energy (USDOE) in developing the next phase of the Weyburn Project and the future directions of geological storage research.

Mexico:

PTRC is negotiating a working relationship with state oil company Pemex to provide expertise in enhanced oil recovery and reservoir engineering. We are also working on a partnership with the State University of Campeche to establish a Centre of Studies on the petroleum industry. This centre will aid PTRC in providing training and educational services to Mexico's petroleum industry.

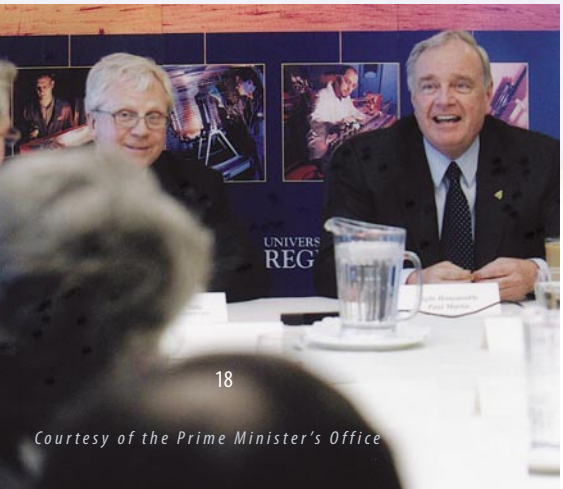
European Union:

PTRC has signed MOUs with CO_2GeoNet (the European Network of Excellence on Geological Storage of CO_2) and TNO (the major national research institution of The Netherlands) to work collaboratively on the next phase of geological storage and risk assessment research.

Brazil:

PTRC is exploring opportunities to work on one-to-one projects with oil and gas giant Petrobras, which is looking to PTRC for expertise in enhanced oil recovery and in dealing with issues specific to its reservoirs.

Below: In March 2005, PTRC was pleased to host Prime Minister Paul Martin, at right, in a round table discussion on geological storage and other technologies that PTRC and its partners can provide as potential climate change solutions.



Courtesy of the Prime Minister's Office

PTRC's Global Activities

Saudi Arabia:

PTRC is partnering with Saudi Aramco on the second phase of the Weyburn Project and is developing potential one-to-one projects with the company.

China:

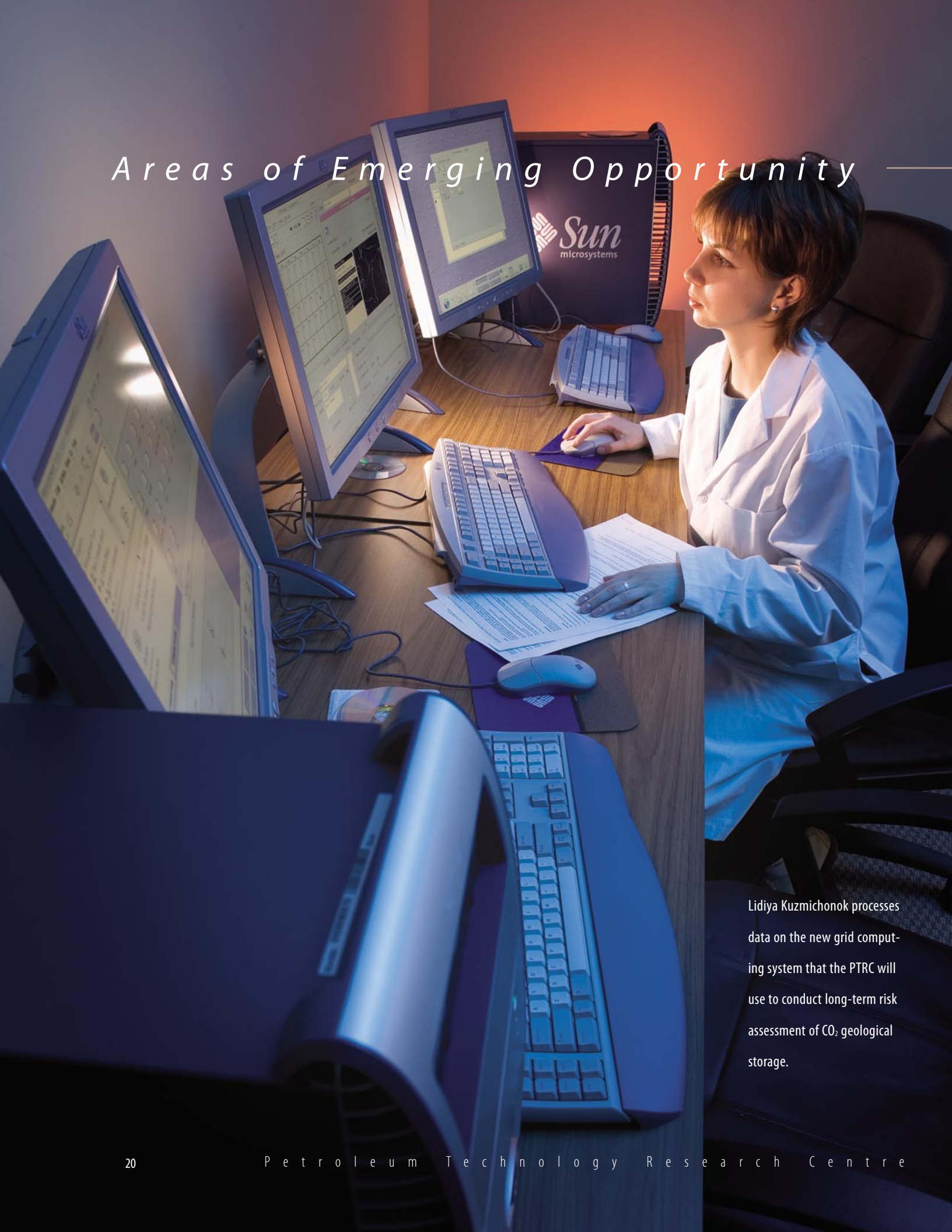
PTRC has been working with representatives of China National Petroleum Company to establish joint research programs and exchange of scholars to share knowledge and technology. PTRC has signed MOUs with China National Petroleum Corporation's Department of Research and Development and with China National Oil and Gas Exploration and Development Corporation to develop collaborative research initiatives.

Australia:

PTRC is establishing working relationships and has signed an MOU with Australian research group CO_2CRC (Cooperative Research Centre for Greenhouse Gas Technologies) to develop a more global and collaborative approach to the study of CO_2 geological storage.

Left: Mr. Song Yiwu, VP, China National Oil and Gas Exploration and Development Corporation, and Michael Monea, PTRC, shake hands after unveiling the creation of a $2 million joint research fund.

Areas of Emerging Opportunity



Lidiya Kuzmichonok processes data on the new grid computing system that the PTRC will use to conduct long-term risk assessment of CO_2 geological storage.

In addition to the Core Program, the PTRC also leads three large projects in areas of significant emerging opportunity.

The IEA GHG Weyburn CO_2 Monitoring and Storage Project

This major international project, now beginning its second phase, was initiated in 2000 by the PTRC to study the technical and economic feasibility of storing carbon dioxide (CO_2) long-term in partially depleted reservoirs. A prevalent greenhouse gas (GHG), CO_2 has also been used for several decades in enhanced oil recovery (EOR) processes because it is a highly effective solvent (a substance that dissolves into oil, making it less viscous and easier to produce).

"Until recently, and even now, most of the CO_2 used in EOR comes from natural sources," says project manager Ray Knudsen. "However, with the advent of coal gasification and CO_2 capture technologies, which allow CO_2 to be 'captured' from anthropogenic sources such as coal-fired power plants, 'man-made' CO_2 is becoming increasingly available for use in EOR." As a result, there is now the possibility of using EOR operations to actually facilitate the storage of large quantities of our most abundant GHG in oil reservoirs rather than releasing it to the atmosphere.

To implement this breakthrough technology, researchers needed to demonstrate, using real commercial EOR operations, that geological storage is both safe and economic. Experts from around the world in a range of disciplines were solicited to do the most intensive research possible on EnCana Corporation's EOR operations at the Weyburn oil field in southeast Saskatchewan. The project's over 50 research tasks were categorized into four overlying themes, each led by a prominent expert in the primary discipline of the theme.

The allure of the project was, according to Steve Whittaker of Saskatchewan Industry and Resources (theme leader for Geological Characterization), "being involved in a project that is actually applying new technology towards finding solutions for a problem that potentially may have global significance." In fact, his position at SIR was created specifically for the project.

Researchers were attracted by the scale of the project, the commercial setting, and the multi-disciplinary approach, and for many, like Don White of the Geological Survey of Canada (theme leader for Prediction, Monitoring and Verification), it was a chance to test and apply innovative technologies. "When I heard there were plans to use 9-component seismic data for monitoring purposes, I decided that I had to be involved."

One of the most important achievements of the project was the unparalleled data set acquired at the Weyburn field, which, says White "provided a challenging but rare opportunity for leading-edge research." A key accomplishment, according to Rick Chalaturnyk of the University of Alberta (theme leader for Risk Assessment), was the

A challenging but rare opportunity for leading-edge research.

Above: Seismic monitoring activities at a Weyburn field borehole.

Above: Process piping in Weyburn Unit plant yard.

Courtesy of EnCana Corporation

reconciling of the seismic monitoring results with reservoir simulation predictions. "This effort showed the power of integrated efforts in understanding the response of the reservoir to CO_2 injection and the use of reservoir surveillance technology to constrain reservoir simulation predictions."

Beyond the project's technical achievements, states David Law of the Alberta Research Council (theme leader for Storage Capacity/Distribution Prediction and Application of Economic Limits), it "showcased the Canadian technologies in the CO_2 storage research area. Also, the international reputation gained from this project allowed Canada to be recognized as one of the first countries in the world to operate commercial-scale geological storage of CO_2."

But there is still work to be done to begin wide-scale implementation of this technology. All of the researchers agree that integration will be crucial in the next phase of research, but one of the most important technical arenas will be, suggests Chalaturnyk, "the development of a consistent framework for approaching performance (and then risk) assessments for the storage components of a CO_2-EOR project — one that follows Canada's guidelines for risk management studies."

In addition to further assessing CO_2 sequestration at EnCana's Weyburn operations, the upcoming phase will also encompass a carbon dioxide flood that Apache Canada Ltd. is initiating in the Midale Unit adjacent to Weyburn. Like its predecessor, this second phase is endorsed by the International Energy Agency's Greenhouse Gas

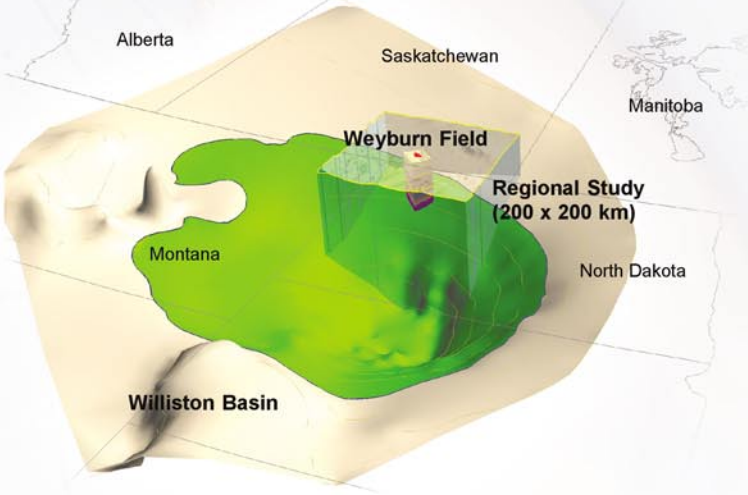
R&D Programme, and it is expected to attract a similar level of participation. The first phase involved 15 industry and government sponsors and 25 research and consulting organizations.

Risk Assessment Program

The Risk Assessment Program will be a key component of the second phase of the IEA GHG Weyburn CO_2 Monitoring and Storage Project, but it will also extend beyond the project to become part of a major international research network on geological storage risk assessment. As part of the PTRC's primary role in the network, we are developing a risk assessment grid computing centre that will house the Weyburn data set as well as data from other storage projects around the world.

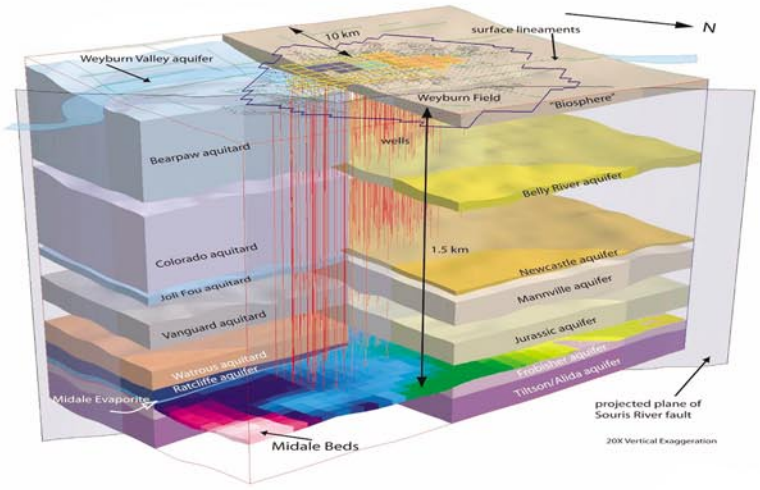
"The goal is to have the PTRC undertake the role of information storage for risk assessment, globally," explains Malcolm Wilson (Director, Office of Energy and Environment, University of Regina). "The key is that Weyburn is the only complete data set [in the world] from which risk assessment tools can be adequately tested and differences determined, making Weyburn extremely important."

The Weyburn data set and this risk assessment data centre will allow the PTRC to become, as Wilson describes, "the core of a group that could be used to assess plans for CO_2 storage, evaluate risk in an objective fashion, and generally provide other advice to people, regulators, companies, banks, etc., on the storage issue." This would allow the PTRC to become the leader in independent monitoring and verification for the future geological storage industry.



Above: The Weyburn oilfield (shown in red) lies at the centre of a 200 x 200 km area studied in the Weyburn CO_2 Monitoring and Storage Project. The Williston Basin is typical of intracratonic sedimentary basins, many of which may contain potential sites for CO_2 injection and storage.

Below: Weyburn Geological Model: an integrated 3D model which serves as the basis for a more comprehensive System Model used for numerical risk and performance assessment modeling.



The potential rewards are huge, given the billions of barrels of oil remaining in the ground.

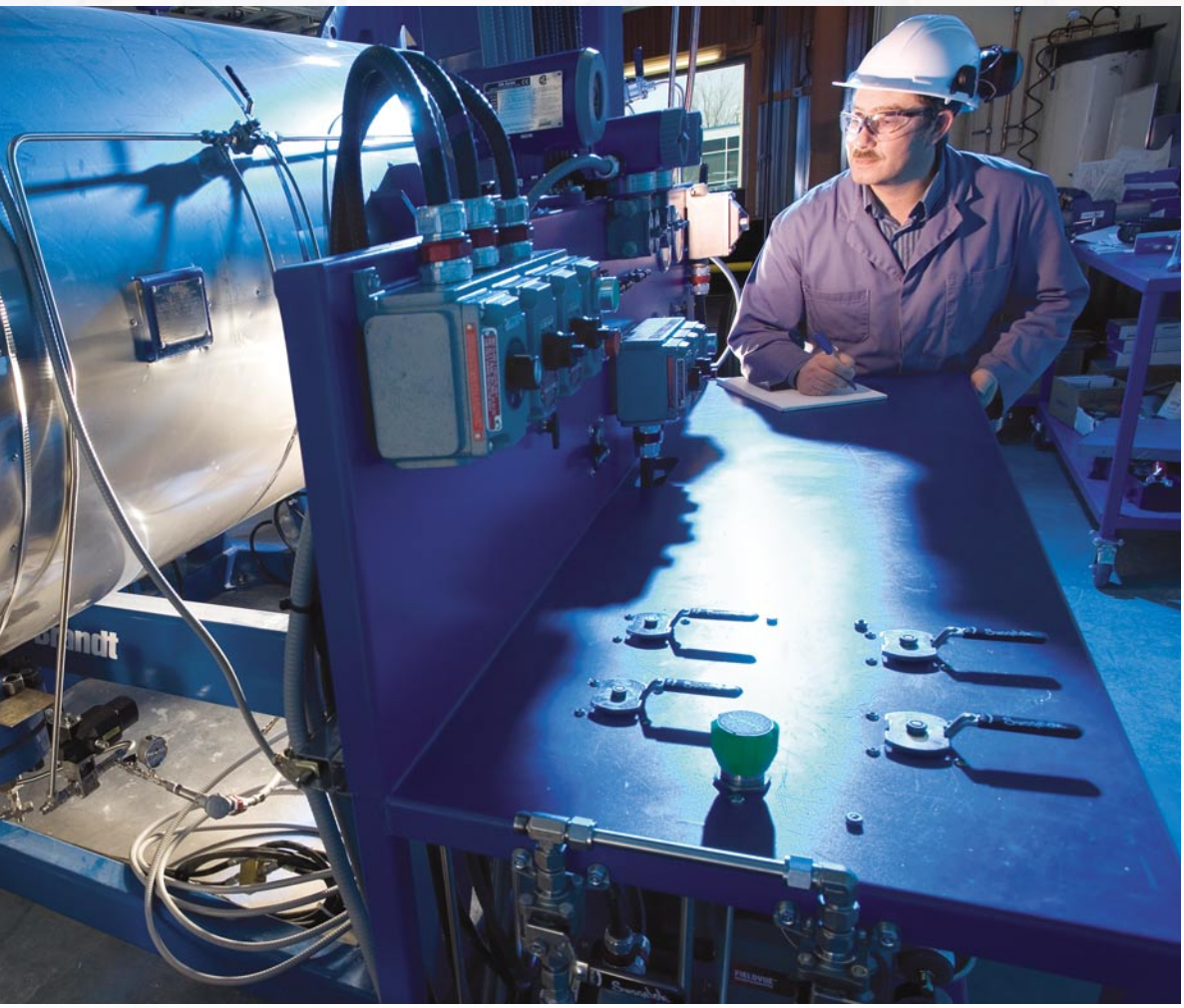
JIVE (Joint Implementation of Vapour Extraction)

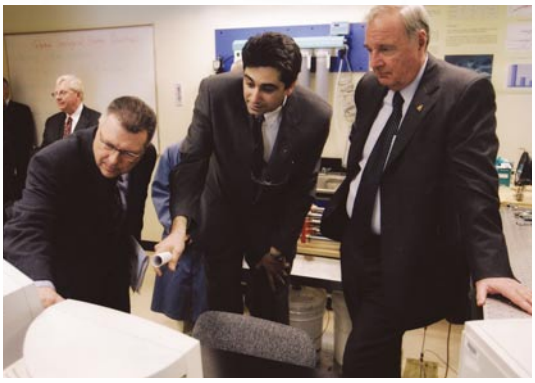
Solvent vapour extraction is an enhanced oil recovery process designed specifically for heavy oil reservoirs. The process involves injecting a gaseous hydrocarbon solvent, typically butane or propane, into the reservoir. The solvent mixes with and dissolves in (through diffusion/dispersion) the heavy oil, reducing its viscosity. The target recovery mechanism (drainage, drive cyclic), solvent selection and well configuration are dictated by the geology of the reservoir, its rock/fluid properties and any previous development of the reservoir.

"The PTRC has assembled a strong and committed group to foster the development, assessment, and demonstration of the solvent vapour extraction process for heavy oil reservoirs in the Western Canadian Sedimentary Basin," says project leader Brian Kristoff, Saskatchewan Research Council (SRC). The PTRC has engaged the expertise of SRC and the Alberta Research Council to provide research and technology development for the project. The primary industry partners, Canadian Natural Resources Limited, Husky Energy, and Nexen Inc., will provide both funding and in-kind contributions and will serve as the demonstration hosts, beginning with a field pilot study.

There are several technical challenges involved in the successful application of the solvent vapour process—challenges the PTRC and its partners in the JIVE program are prepared to address. But, as Kristoff points out, "the potential rewards are huge, given the billions of barrels of oil remaining in the ground."

He adds that solvent vapour extraction is "an EOR process that is also environmentally attractive in application both in terms of low [greenhouse gas] emissions and fresh water use." Unlike thermal processes, such as steam injection, the solvent vapour extraction process uses little energy—as it does not require heat—and it uses no water. Following an intensive planning effort in 2004-2005, the PTRC's JIVE program is slated to be launched in the fall of 2005. ■





Courtesy of the Prime Minister's Office

Above: Kelly Knorr in the final stages of commissioning a high-pressure 3D scaled physical model that will be used to design solvent extraction processes.

Left: Prime Minister Paul Martin, right, and Finance Minister Ralph Goodale, left, shown with Koorosh Asghari, toured the PTRC's facilities in March 2005.

PTRC Research Projects

The following project descriptions are snapshots, as of March 31, 2005, of the work being carried out in the PTRC's core research program and other areas. Project proposals describing the proposed R&D program for 05/06 are available from the PTRC.

Heavy Oil (Post) Cold Flow

Multi-Well Cold Flow (Production) Predictive Numerical Model

Aim: Develop a predictive multi-well cold flow (production) model for reservoir engineers. ***Highlights:*** A single-well cold production model was developed this year. Wormhole growth from each perforation in a vertical well was modelled using a fine grid. So far, the model has predicted that only one-third of the wormholes extend beyond 10 m from a vertical well, suggesting that wells can be perforated at a lower density. ***Status:*** First year completed. Multi-well model to be developed in the second year. ***Project leader:*** Bernard Tremblay, SRC.

Drilling through Wormholed Reservoirs

Aim: Select a gel system which can be used both to reduce circulation loss and to block off connected wormholes. ***Highlights:*** A polymer gel was tested which fulfilled the project's aim. The gel's high viscosity and rapid gelation time (within hours) suggest that it could be used as a circulation loss material. Leak-off tests and subsequent acidization showed that the permeability of the wellbore region could be restored. The high strength of the sand-reinforced gel suggests that it could block off connected wormholes. ***Status:*** Final report nearing completion. ***Project leader:*** Bernard Tremblay, SRC.

Wormhole Stability to Solvents and Steam

Aim: Provide correlations of the stability and permeability of wormholes after solvent or steam injection. ***Highlights:*** A wormhole stability run was performed in which butane gas was injected into an open channel in a sand pack while producing butane and oil out of the periphery. The deformation of the wormhole was observed and the permeability of the collapsed wormhole is being measured. ***Status:*** First year completed. Wormhole stability experiments at reservoir pressures to be performed in the second year. ***Project leader:*** Bernard Tremblay, SRC.

Miscible/Immiscible Solvent Injection

Surfactant-Assisted Gas Huff-n-Puff Oil Recovery in Medium Oil Reservoirs

Aim: To optimize the process by adding a surfactant to the gas stream to maximize recovery. ***Highlights:*** Phase behaviour properties were measured on mixtures of gas (CO_2 and a flue gas) with recombined oil from a candidate reservoir. Oil recoveries for different injection modes (either a surfactant slug followed by CO_2 or vice versa) in the huff process compared favourably with the results of a conventional CO_2 huff injection scheme. ***Status:*** Completed; workshop with industry participants planned. ***Project leader:*** Patrick Zhang, SRC.

Immiscible CO_2/Enriched Flue Gas Injection for Heavy Oil Recovery: II

Aim: To develop—and accelerate application of—a viable, cost-effective EOR method for thin heavy oil reservoirs that overcomes, e.g., high oil viscosity and low reservoir pressures. ***Highlights:*** Phase behaviour properties of pure CO_2 and enriched flue gas (30% CO_2 in N_2) were measured with increasing solvent concentration. Average tertiary recovery for three corefloods was 7.6% initial oil in place. Coreflood tests were history matched. ***Status:*** Completed; new phase will use micromodels to observe immiscible gas injection phenomena in porous media and understand their underlying principles. ***Project leader:*** Patrick Zhang, SRC.

Measurement of Solvent Diffusivity in Heavy Oil and Evaluation of Solvent-Based Oil Recovery Processes

Aims: To significantly improve the existing pressure decay method for accurately measuring the diffusion coefficient of solvent in heavy oil in a much shorter duration; to evaluate solvent-based oil recovery processes. ***Highlights:*** Experiments and theoretical analysis were done to determine which of the three boundary conditions at the solvent-heavy oil interface best describes the interface mass transfer. A numerical model was successfully developed to determine the diffusion coefficient from the pressure-time curve measured in a much shorter time; the accompanying oil swelling effect was quantified. A high-pressure coreflood setup and a physical Vapex model were established. ***Status:*** Ongoing; further tests with the high-pressure coreflood setup and/or the physical Vapex model will be done under reservoir conditions to determine the oil recovery potential of solvent-based EOR processes. ***Project leader:*** Peter Gu, U of R.

Enhanced Waterflooding

Low Cost Chemicals for Enhanced Waterflooding

Aim: To reduce the costs of chemically enhanced waterfloods by identifying, and testing effectiveness of, low-cost sources of alkaline. ***Highlights:*** Smelt waste from a Saskatchewan pulp mill was purified in a two-step flocculation/oxidation process. The cleaned smelt effectively lowered the interfacial tension to a level suitable for ASP flooding. The cost of obtaining and transporting the smelt waste compares favorably with the price of caustic soda; however, alternate, less expensive methods of oxidation need to be assessed. ***Status:*** Final report and presentation to clients completed. ***Project leader:*** Cindy Jackson, SRC.

Enhanced Waterflooding Using Colloidal Gas Aphron (CGA) Solutions

Aim: To examine the use of microbubble solutions to lower the density and raise the viscosity of injected water to sweep previously unaccessed portions of a reservoir. ***Highlights:*** A visualization model was constructed, in which floods with a high-density network foam and a low-density dispersed solution were simulated. Unexpectedly, the aphron solutions did not sweep out higher regions of the 'reservoir', but rather followed the same water channels cut in the preceding waterflood. Despite this, aphron flooding produced up to 89% more incremental oil. ***Status:*** SRC final report completed; ARC portion of the report pending; final presentation to the clients pending. ***Project leader:*** Doug Soveran, SRC, Alex Turta, ARC.

Optimized Waterflooding

Aims: To improve understanding of the fundamental mechanism of heavy oil waterflooding, and numerically simulate the effects of incorporating horizontal wells into heavy oil waterfloods. ***Highlights:*** Two glass micromodels were constructed, in which heavy oil waterfloods were simulated. Results indicated that emulsification of brine and heavy crudes may be due to physical mechanisms rather than to the chemical nature of the natural surfactants present in the fluids. ***Status:*** Final report completed; presentation to the clients pending. ***Project leader:*** Cindy Jackson, SRC.

Assisted Oil-Bank Formation (AOBF) during ASP Flooding

Aim: To develop a cost-effective AOBF technology by visualizing the flow of alkaline/surfactant/polymer solution and its effect on residual oil mobility in porous media. ***Highlights:*** A new micromodel was developed for direct observation of pore-scale flow phenomena and packed with glass beads or quartz sands to represent the rock pore patterns. Effective equilibrated interfacial tension (IFT) between oil and water was found to better represent actual reservoir conditions and is thus an important criterion for improving oil recovery. ***Status:*** Completed; new phase to focus on improving observation/analysis of the interfacial phenomena of oil detachment at conditions of ultra-low IFT. ***Project leader:*** Patrick Zhang, SRC.

Modified Polymers for Water Relative Permeability Reduction

Aim: To develop a means to overcome excessive water production, improve sweep efficiency, and increase oil recovery. ***Highlights:*** Flow tests with cationic starches modified by our partner at the University of New Brunswick showed that the relatively high-molecular-weight and high-charge-density polymers resulted in a high residual resistance factor after a polymer flood. ***Status:*** Ongoing; more flow tests will be carried out and the project will be completed in August 2005. ***Project leader:*** Mingzhe Dong, U of R.

Near Wellbore Conformance Control

Controlling Water Coning by Dual Completion

Aim: To develop dual completion—simultaneous, segregated production of water and oil—for heavier oils as a means of controlling water coning. ***Highlights:*** The physical model was built, including horizontal and vertical wellbore models, to replicate different geometries of well completion methods. Different types of pumps were tested for injection and effluent portions of experimental work. ***Status:*** Literature survey and a simulation study using CMG are ongoing. Testing is underway of the role of completion methods in water coning and the effects of oil flow rates and viscosity, and reservoir height and pressure. ***Project leader:*** Muhammad Ayub, U of R.

EOR by Seismic and Mechanical Vibration Stimulation of Reservoirs with Multi-Vibro-Energy Sources

Aim: To develop an efficient, reliable seismic and vibration stimulation technique for industrial applications. ***Highlights:*** Relationships were established among pressure, geometric dimensions of oil slug, oil viscosity, and flow volumetric velocity on the basis of experiments. The effects of elastic waves on mobility of multiphase liquid in porous media were studied. A finite element model for an idealized porous medium saturated with liquid was developed. ***Status:*** Experimental models designed, static tests in progress. The mathematical model for the motion of the medium saturated with fluid established; the program for numerical analysis completed. ***Project leader:*** Liming Dai, U of R.

Active Bottomwater Reservoirs

Aim: To develop new techniques and predictive models to enhance oil recovery from oil reservoirs under active bottomwater by using different production/ injection strategies and chemicals. ***Highlights:*** Phase I was completed and the numerical models were constructed based on real field data. ***Status:*** Ongoing; numerical simulation is underway. ***Project leader:*** Ezeddin Shirif, U of R.

Development of Bottomwater Reservoirs in Sandstone and Carbonate Formations Implementing Flow Barrier

Aim: To develop field operation strategies that will increase oil production from bottomwater reservoirs with little or no incremental capital cost. ***Highlights:*** It was found that existing natural barriers and aquifer energy could greatly benefit oil production and sweep efficiency when the horizontal wells were appropriately placed. A series of simulation tests were performed under different situations to optimize well placement and to examine further production strategies. The results of numerical simulation indicated the proposed strategies were valuable and practical. ***Status:*** Simulation study and report have been completed. Experimental study is ongoing. ***Project leader:*** Gary Zhao, U of R.

Developing Near Wellbore Conformance Technologies for Wormhole Reservoirs

Aim: To develop new and modified gel-foam systems for effectively blocking wormholes in Lloydminister-type reservoirs and increasing ultimate oil recovery from these fields. ***Highlights:*** Various surfactants and gel-stabilizing chemicals were screened. An experimental setup, suitable for simulating wormholes of various sizes, was completed. Flow experiments with and without the presence of oil in the wormhole were conducted. The effect of various wormhole sizes on the performance of the new gel-foam system was tested. Overall, experiments showed that the gel-foam developed in this study can effectively block the wormholes. ***Status:*** Completed. ***Project leader:*** Koorosh Asghari, U of R.

Other Areas

Water-Assisted Pipeline Transport of Bitumen/Heavy Oils and Co-Produced Sand

Aim: To improve water-assisted pipelining technology by developing a better understanding of the flow regime and to determine the conditions required for effective transport of co-produced sand. ***Highlights:*** Improved instrumentation for assessing the oil-water flow regime was acquired, and a 2-D tomography device was built for measuring sand distribution in pipelines. ***Status:*** Pipe flow experiments, designed to generate a comprehensive database, have begun. ***Project leader:*** Randy Gillies, SRC

Analyze the Wormhole Structure in Cold Heavy Oil Production

Aim: To develop comprehensive models and methods to estimate wormhole structures and to analyze the performance of cold heavy oil production wells. ***Highlights:*** Comprehensive models were developed which consider possible wormhole structures and hydraulics, and dynamic wormhole growth processes. A sensitivity analysis was done to ascertain how the given model depends on the wormhole and reservoir parameters. By analyzing transient pressure data and production data, it was possible to estimate wormhole configuration and predict well performance. ***Status:*** Ongoing communication with industry and seeking field application. ***Project leader:*** Gary Zhao, U of R.

Displacement of Heavy Oil via Interfacial Instability

Aim: To develop a viable chemical injection process for thin heavy oil reservoirs, in which self-dispersion of oil in water caused by low interfacial tension and mass transfer and partial wettability change combine to improve sweep efficiency and oil recovery. ***Highlights:*** Phase II of the project was offered under PTRC's Field Development Program and completed for a field sample with promising results in both homogeneous and heterogeneous sandpacks. ***Status:*** Phase III of the project began with the same reservoir and is focused on field pilot test design. ***Project leader:*** Mingzhe Dong, U of R.

Pyrolysis and Combustion Behaviour of Neilburg Oil

Aim: To contribute to evaluation/implementation of air-injection processes by understanding the reaction mechanism of pyrolysis and combustion of coke from Neilburg oil and its derived SARA fractions. ***Highlights:*** The fuel (coke) formation and its decomposition process in different temperature regimes have been evaluated. A simple Arrhenius-type model along with kinetic parameters is established. ***Status:*** Progressing. ***Project leader:*** Nader Mahinpey, U of R.

Auditors' Report

To the Members of Petroleum Technology Research Centre Inc.

We have audited the statement of financial position of Petroleum Technology Research Centre Inc. as at March 31, 2005 and the statements of operations and unrestricted net deficit 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, 2005 and the results of its operations and cash flows for the year then ended in accordance with Canadian generally accepted accounting principles.

Virtus Group LLP

REGINA, Saskatchewan
May 11, 2005

Chartered Accountants

Petroleum Technology Research Centre Inc.

Statement of Financial Position

as at March 31

Statement A

	General Operating Fund	Capital Fund	Weyburn Project Fund	2005 Total	2004 Total
					Restated Note 3
ASSETS					
CURRENT ASSETS					
Cash	$ 24,537	$ -	$ 22,742	$ 47,279	$ 109,902
Accounts receivable	738,010	530,529	281,726	1,550,265	2,334,264
Prepaid expenses	14,603	41,437	-	56,040	625
	777,150	571,966	304,468	1,653,584	2,444,791
PROPERTY, PLANT & EQUIPMENT - Note 4	63,971	1,159,858	-	1,223,829	18,045
	$ 841,121	$ 1,731,824	$ 304,468	$ 2,877,413	$ 2,462,836
LIABILITIES AND NET ASSETS (DEFICIT)					
CURRENT LIABILITIES					
Accounts payable and accrued liabilities	$ 1,275,184	$ 656,854	$ 37,532	$ 1,969,570	$ 2,449,795
DUE TO (FROM) OTHER FUNDS - Note 9	(140,611)	(126,325)	266,936	-	-
DEFERRED REVENUE - Note 5	263,138	1,201,295	-	1,464,433	108,018
	1,397,711	1,731,824	304,468	3,434,003	2,557,813
NET ASSETS (DEFICIT)					
Internally restricted - Note 10	48,750	-	-	48,750	48,750
Unrestricted - Statement B	(605,340)	-	-	(605,340)	(143,727)
	(556,590)	-	-	(556,590)	(94,977)
	$ 841,121	$ 1,731,824	$ 304,468	$ 2,877,413	$ 2,462,836

See accompanying notes

Approved by the Board

Director

Director

Petroleum Technology Research Centre Inc.

Statement of Operations and Unrestricted Net Deficit

for the year ended March 31

Statement B

	General Operating Fund	Capital Fund	Weyburn Project Fund	2005 Total	2004 Total
					Restated Note 3
REVENUE					
Annual Funding					
- Saskatchewan Industry & Resources	$ 1,250,000	$ -	$ -	$ 1,250,000	$ 1,500,000
- Natural Resources Canada	1,000,000	-	-	1,000,000	1,000,000
- Western Economic Diversification Canada	250,000	-	-	250,000	249,682
Project Funding					
- Saskatchewan Industry & Resources	118,749	252,852	-	371,601	137,149
- Western Economic Diversification Canada	-	160,000	-	160,000	
- Natural Resources Canada	120,000	-	-	120,000	1,445,755
- Natural Resources Canada and US Department of Energy	-	-	927,474	927,474	2,556,876
- Industry	402,500	-	160,509	563,009	1,263,300
Interest	225	-	1,391	1,616	176
Other	750	-	-	750	485
	3,142,224	412,852	1,089,374	4,644,450	8,153,423
OPERATING EXPENSES					
Amortization	15,168	-	-	15,168	4,185
Consulting	57,500	29,937	-	87,437	227,782
Financial systems support	132,868	-	-	132,868	121,013
Legal, audit and insurance	23,064	252	-	23,316	16,344
Office, administration and supplies	101,551	12,552	-	114,103	78,236
Publications and promotion	31,315	2,698	-	34,013	44,853
Rent	66,243	-	-	66,243	63,775
Salaries and benefits	213,067	10,675	-	223,742	113,771
Travel and conferences	123,092	34,944	-	158,036	111,561
	763,868	91,058	-	854,926	781,520
PROJECT EXPENSES - Note 6	2,839,969	321,794	1,089,374	4,251,137	7,281,744
EXCESS OF REVENUE (EXPENSES)	(461,613)	-	-	(461,613)	90,159
UNRESTRICTED NET DEFICIT - beginning of year	(143,727)	-	-	(143,727)	(185,136)
RESTRICTIONS - Note 10	-	-	-	-	(48,750)
UNRESTRICTED NET DEFICIT - end of year - Statement A	$ (605,340)	$ -	$ -	$ (605,340)	$ (143,727)

See accompanying notes

Statement of Cash Flows

for the year ended March 31

	2005	Statement C 2004 Restated Note 3
OPERATING ACTIVITIES		
Excess of revenue (expenses)	$ (461,613)	$ 90,159
Item that does not affect cash:		
- amortization	15,168	4,185
	(446,445)	94,344
Net change in current assets	728,584	(263,788)
Net change in current liabilities	(480,225)	303,275
Net change in deferred revenue	1,356,415	(439,143)
Net cash from operating activities	**1,158,329**	**(305,312)**
INVESTING ACTIVITIES		
Purchase of property, plant and equipment	(1,220,952)	(11,883)
Net cash used by investing activities	**(1,220,952)**	**(11,883)**
DECREASE IN CASH RESOURCES	**(62,623)**	**(317,195)**
CASH - beginning of year	109,902	427,097
CASH - end of year	$ 47,279	$ 109,902
REPRESENTED BY:		
Cash balance in chequing accounts	$ 47,279	$ 109,902

See accompanying notes

1. NATURE OF ORGANIZATION

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 most significant policies are as follows:

Fund Accounting

The accounts of the Centre are maintained in accordance with the principles of fund accounting. For financial reporting purposes, accounts with similar characteristics have been combined into the following major funding groups:

i) General Operating Fund

The General Operating Fund reflects the primary operations of the Centre including revenues received from Saskatchewan Industry & Resources (SIR), Natural Resources Canada (NRCan), Western Economic Diversification Canada (WD) and industry to fund its petroleum research operations and administration activities.

ii) Capital Fund

The Capital Fund reflects monetary commitments made by various governmental bodies for the acquisition of buildings and equipment. In the current year, funding from SIR and WD has been allocated to the Capital Fund for the purchase and construction of research equipment and payment of operating expenses associated with transition to Phase 2 of the IEA GHG Weyburn CO_2 Monitoring and Storage Project. Since these costs are directly funded by the above-mentioned agreements they are reported in the same fund as the capital expenditures. The initial commitment of the Government of Saskatchewan to assist in funding a Petroleum Research Building on the campus of the University of Regina as well as the acquisition of equipment to be used by the University of Regina, the Saskatchewan Research Council and the Centre has been fully spent as of March 31, 2005.

With the exception of the current year funded assets, where the funding agreements stipulate that the Centre maintain ownership of the assets until the terms of the funding agreements are fulfilled, ownership of research-related assets will not reside with the Centre but is given to other entities to create an environment of shared access for the Centre's research providers.

iii) Weyburn Project Fund

The Weyburn Project Fund reflects the funding received from government and industry and expenditures made for the IEA GHG Weyburn CO_2 Monitoring and Storage Project. This project is complete as of March 31, 2005.

Revenue Recognition

The Centre follows the deferral method of accounting for contributions. Restricted contributions related to general operations are recognized as revenue of the General Operating Fund in the year in which the related expenses are incurred. All other restricted contributions are recognized as revenue of the appropriate restricted fund. Unrestricted contributions are recognized as revenue of the General Operating Fund in the year they are received or receivable if the amount to be received can be reasonably estimated and collection is reasonably assured.

Property, Plant and Equipment

Assets of the Centre are stated at cost and are amortized over the estimated useful life of the assets on the following basis:

Computers	30% Declining balance method
Furniture and other equipment	20% Declining balance method

One-half year's amortization is recognized in the year of acquisition.

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.

3. RESTATEMENT OF PRIOR PERIODS

In prior years, holdbacks applicable to research provided were neither billed nor accrued. Beginning with the 2005 year, the Centre is accruing these amounts. The accumulated effect on prior years was $180,518 understatement of accounts payable and general project expenses. Prior year net assets and accounts payable have been adjusted to reflect this accounting change.

The Weyburn Project Fund was adjusted for revenue understatement of $87,170 and expense understatement of $30,174 in a prior period. This prior period adjustment results in a $56,995 increase to net assets at the beginning of 2004 and adjustments to the beginning balances of both accounts receivable and accounts payable.

4. PROPERTY, PLANT AND EQUIPMENT

	2005 Cost	2005 Accumulated Amortization	2005 Net Book Value	2004 Net Book Value
Computers	$ 56,334	$ 11,830	$ 44,504	$ 12,435
Office furniture	28,818	9,351	19,467	5,610
Subtotal	85,152	21,181	63,971	18,045
Research assets	1,159,858	-	1,159,858	-
TOTAL	$ 1,245,010	$ 21,181	$ 1,223,829	$ 18,045

WEPA contributions were used to purchase $1,159,858 of research assets, as stipulated in agreements with SIR and WD. At March 31, 2005, these assets were not yet ready for use and have not been amortized.

5. DEFERRED REVENUE

The Centre receives contributions from government and industry for specific projects. 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. As at March 31, 2005, deferred revenue of $263,138 (2004 - $15,167) was held in the General Operating Fund to be matched with future project expenditures.

During the year, the Centre received $1,201,295 in contributions for research assets and a prepaid maintenance contract, which it records as deferred revenue in the Capital Fund until such time as the related assets are put

in use and amortized.

6. PROJECT EXPENSES

During the year, the General Operating Fund incurred project expenses of $2,839,969 (2004 - $2,226,818).

	2005	2004 Restated
Equipment projects	$ 52,402	$ -
Innovation projects	2,772,485	2,036,741
Incubation projects	15,082	190,077
	$ 2,839,969	$ 2,226,818

Equipment project expenditures are related to the purchase of new equipment for research providers that are involved in Innovation or Incubation projects for the Centre. Innovation projects are designed to refine research output into actual field applications that may be used by the petroleum industry. These are usually medium to large sized projects with a timeline of more than one year. Incubation projects are projects aimed at determining if a specific area of research has relevant applications in the petroleum industries. These projects are relatively small with a short time frame.

The Capital Fund expended $321,794 (2004 - $137,149). Management and monitoring activities post-June 30, 2004, for the IEA GHG Weyburn CO_2 Monitoring and Storage Project have been charged to project expenses in the Capital Fund, matching specific funding from SIR and WD. These expenditures, along with other administrative expenses, were required to plan for and transition from the original project to Phase 2 (refer to Note 7).

	2005	2004
Equipment projects	$ 92,852	$ 137,149
Transition to Phase 2, Weyburn Project	228,942	-
	$ 321,794	$ 137,149

For details of the IEA GHG Weyburn CO_2 Monitoring and Storage Project expenses, please refer to Schedule 1 of the financial statements.

7. SIGNIFICANT AGREEMENTS

During the current fiscal year, the Centre entered into agreements with Saskatchewan Industry and Resources and Western Economic Diversification Canada for $1,650,000 funding within the Western Economic Partnership Agreement (WEPA). WEPA is a joint federal/provincial initiative designed to fund projects that will stimulate economic activity in Saskatchewan. The Centre's agreements with SIR and WD provide funding for the construction of a 3D Physical Scaled High-Pressure model ($750,000), the purchase and installation of a grid computing network ($580,000) and the expenditures incurred in preparing for Phase 2 of the IEA GHG Weyburn CO_2 Monitoring and Storage Project ($320,000).

The funding from the WEPA agreements has been allocated to the Capital Fund and as at March 31, 2005, funding

of $1,521,295 has been provided for expenditures to date.

8. ECONOMIC DEPENDENCE

The Centre has received funding commitments from Natural Resources Canada, Western Economic Diversification Canada and Saskatchewan Industry & Resources for the years 2004 through 2007 for research projects and operations:

Natural Resources Canada	$4,000,000 over 4 years
Western Economic Diversification Canada	$1,000,000 over 4 years
Saskatchewan Industry & Resources	$5,000,000 over 4 years

The Centre seeks additional funding for its research projects from other federal sources and from the petroleum industry. Additionally, Saskatchewan Industry & Resources has committed to match approved supplemental federal funding up to a maximum of $1,000,000 over the same time frame.

9. DUE TO (FROM) OTHER FUNDS

The cash of the General Operating Fund and Capital Fund operations is combined for efficiency of operations. As of March 31, 2005, $126,325 (2004 - $92,851) is owed from the General Operating Fund to the Capital Fund.

Although the cash for the Weyburn Project Fund is segregated from the General Operating Fund, payments made from one fund on behalf of the other are occasionally made. As of March 31, 2005, $266,935 (2004 - $(27,234)) is owed from the Weyburn Project Fund to the General Operating Fund.

10. NET ASSETS RESTRICTED FOR EXECUTIVE COMPENSATION

The Executive Director's terms of employment contain a clause for a compensation payout in the event that the Centre is unable to attract funding post-2007 and the Centre ceases operations. This date coincides with the time frame for the firm funding commitments listed in Note 8.

A restriction of net assets has been made of $48,750 to represent the potential risk-assessed cost. This assessment of risk and the calculation of the restriction will be reviewed by Management on an annual basis.

11. 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 on any of its customers.

12. COMPARATIVE FIGURES

Certain of the 2004 financial statement balances have been reclassified to conform to the current year's presentation.

Petroleum Technology Research Centre Inc.

Schedule of IEA GHG Weyburn CO_2 Monitoring and Storage Project Fund

as at March 31

Schedule 1

	2005 Cumulative Project-to-Date	2005 Annual Activity	2004 Annual Activity
			Restated Note (a)
REVENUES			
Government			
Natural Resources Canada	$ 5,930,000	$ -	$ 1,445,755
Natural Resources Canada and US Department of Energy – Note (a)	5,458,373	927,474	2,581,302
	11,388,373	927,474	4,027,057
Industry			
Alberta Environment	300,000	75,000	75,000
Alberta Science and Research Authority	300,000	75,000	75,000
Chevron Texaco	300,000	-	225,000
Engineering Advancement Association of Japan	300,000	-	75,000
PTRC (General Operating Fund)	105,000	-	-
EnCana	100,000	-	-
Saskatchewan Industry & Resources	105,000	-	-
Bureau de Recherches Géologiques et Minières	30,000	10,509	19,491
SaskPower	300,000	-	75,000
BP (Amoco)	300,000	-	70,814
Transalta Utilities	300,000	-	75,000
Nexen Inc.	300,000	-	75,000
Dakota Gasification Company	300,000	-	75,000
Saskatchewan Petroleum Research Incentive – Note (a)	2,038,295	-	(24,425)
TOTAL (Totalfinaelf)	300,000	-	75,000
	5,378,295	160,509	890,880
Interest	15,673	1,391	(160)
	$16,782,341	$ 1,089,374	$ 4,917,777
EXPENDITURES			
Task 1 – Collection of Field Data and Samples	$ 2,193,148	$ 22,322	$ 58,690
Task 2 – Geoscience Framework	2,766,811	207,540	1,365,355
Task 3 – Geochemical Sampling, Monitoring & Prediction	2,162,460	81,955	1,041,179
Task 4 – Seismic Surveys	4,458,698	50,998	473,709
Task 5 – Sequestration Engineering	2,913,131	170,623	1,301,844
Task 6 – CO_2 Storage Economics	118,937	-	57,864
Task 7 – Project Control	1,763,276	150,056	619,136
Task 10 – Communication	405,880	405,880	-
	$16,782,341	$ 1,089,374	$ 4,917,777
ENDING FUND BALANCE	$ -	$ -	$ -

This schedule shows the cumulative funding and expenditures for the IEA GHG Weyburn CO_2 Monitoring and Storage Project since its inception as well as the annual funding and expenditure activity for the years ended March 31, 2005 and 2004. In-kind services provided by industry partners (Tasks 8-9) are not reflected in this schedule. The project is complete as at March 31, 2005.

Note (a) SPRI revenue that was overstated in a prior year has been corrected by restatement of 2004 annual activity. This restatement also affects the revenue recorded from Natural Resources Canada and the US Department of Energy. The funding mechanism within that contract is designed to cover expenses not funded by other sources.

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