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COMMUNITY TRIBUTE
Children's book honours local stories through unique project

STEM IN ACTION
Science, technology, engineering and math at work at Imperial

GOING DIGITAL
The Review moves to new online format

On the cover: Artwork from Our Danse Help the Northern Lights Dance, a children's book produced by Imperial to honour the tradition of storytelling across generations. Learn more about the project on page 18.
4 Securing Canada’s energy future
Abundant, affordable, reliable, responsible
By Rich Kruger

FEATURE STORY

STEM in action
Meet Imperial employees working in science, technology, engineering and math-related fields
By Marcia Kaye

16 Looking for a better way
Emerging technology in oil sands mining takes on tailings
By David Leggin

18 Honouring a tradition of storytelling
Children’s book features elders’ stories and locally inspired art

20 A workplace for the future
Imperial’s new Calgary campus designed to foster innovation through collaboration
By Margo Pfeiff

23 A Review for the next century
The Review magazine moves to an online format
By Lisa Schmidt
SECURING CANADA’S ENERGY FUTURE
Abundant, affordable, reliable, responsible
By Rich Kruger, CEO of Imperial Oil

Through innovation and technology, Canada’s vast resources will play an increasing role in meeting the world’s long-term energy needs.

Global population continues to rise and is projected to grow from seven billion today to about nine billion by 2040. World economic output is expected to double over the same period, with the developing world leading both economic and population growth.

That economic output is going to require additional energy as people in developing nations seek to improve their quality of life and enjoy the living standards to which we have become accustomed. Global energy demand will be up about 35 percent over the 30-year period from 2010 to 2040.

To provide larger supplies of reliable, affordable energy we will need to pursue all economically competitive sources. Alternative sources, including renewables, will play an increasingly important role; however, oil and natural gas will continue to provide about 60 percent of the world’s energy needs.

Canada has world-class potential in its oil sands and natural gas resources, but these opportunities are not without their challenges. Research, technology and innovation will be central to developing these vast resources in a safe and environmentally responsible manner.

With more than three decades in oil sands operations, Imperial continues to drive improvements through its research centres in Calgary and Sarnia. At our Cold Lake operations, we are testing new solvent recovery technologies that have great potential to reduce water use and greenhouse gas emissions. We are now producing bitumen at our Kearl oil sands facility, the next generation of oil sands mining. Through our proprietary paraffinic froth treatment technology, Kearl is an oil sands mining operation producing bitumen for market without an upgrader – the first in the world. This results in significant cost savings and reductions in the level of greenhouse gas emissions per barrel. This is good for business and good for the environment.

The operation will use energy-saving cogeneration to further reduce greenhouse gas emissions. Cogeneration is also an efficient method of capturing waste heat to produce steam and electricity at the same time. By reducing the amount of power required from Alberta’s coal-fired electricity grid to run Kearl’s operations, emissions per barrel will be lowered further.

Our improvements don’t stop there. Imperial will use a tailings thickening technology to capture valuable metals in the mine. By intercepting and treating tailings, the surface area of Kearl’s fluid tailings storage site will be reduced by approximately 50 percent compared with industry’s traditional approach. By using an on-site water storage and pipeline system, Kearl is also the first oil sands operation able to avoid drawing water from the Athabasca River during low-flow winter periods.

Looking ahead, there is more to come. In this edition of The Review, you will learn about a new technology that Imperial is working on called non-aqueous extraction. The goal is to ultimately find a way to recover oil sands using minimal amounts of water. This would be a game-changing technology for oil sands mining. Imperial will also play a major role in future innovation outside the company. We are investing in science, technology, engineering and math education programs. Featured in this edition are Imperial employees working in these areas. By inspiring Canadian students to prepare for careers in these fields, we are investing in the next generation of innovation – innovation that is needed to responsibly develop energy supplies to meet growing global demand and further develop Canada’s economic potential.

As the global energy map evolves, Canada can build on its proven track record of innovation to become a global energy leader. Attaining this goal requires a commitment to new technology investments and continuous improvement – a commitment we are prepared to make.

For Imperial, this also means continually challenging ourselves to do better.

Through collaboration on these priorities, I am confident we will secure Canada’s future as a source of reliable, abundant, affordable energy.
Across Imperial, science, technology, engineering and math are keys to finding ways to do things better every day. It’s no wonder the company is making the investment to inspire a future generation of innovators.

By Marcia Kaye
Bryce McGarvey calls himself 'a chemist in a chemical engineer's world.' While many workplaces make a clear distinction between the two professions, McGarvey finds fortune in moving freely between the two worlds. "It's unusual for a chemist to be working so closely with refinery engineers."

Much of McGarvey's work centers on optimizing refinery operations. Based at Imperial's research center in Sarnia, he provides research and technical support services primarily to the refining business unit, as well as technology-related research to ExxonMobil in the United States.

His expertise includes dealing with corrosion and equipment fouling and investigating process upsets. "In the lab, we develop processes that might be taken into refineries," says McGarvey, who holds one patent for sulfur removal from commercial fuel and has another pending in the works.

As a boy growing up in Kincardine, Ont., McGarvey was always interested in science and nature, but chemistry gained a certain mental spark in him. "It was intriguing to me that you could take quite mundane things and, by thinking your way through how the molecules would react, combine them into a much more exciting chemical compound," he says. Naturally, he loved high school science labs. "This was hands-on learning, not just an equation in a book."

After graduating with a B.Sc. in chemistry from the University of Waterloo, McGarvey began a master's program and went straight for his Ph.D. Specializing in catalyst technology, he developed new model catalysts and tested their properties. His post-doctoral research included stints at the Institut français du pétrole near Paris and the University of Calgary. Before joining Imperial 15 years ago, he worked for AECL as a research scientist dealing with corrosion and fouling of steam generators and heat exchangers. His wife, Colette, is also a chemist at Imperial, working as team lead in the analytical services group.

McGarvey, 53, father of two daughters, is a tireless science booster. He's involved in a school board-business partnership to enhance science education in elementary schools. And he's a longtime member of the Chemical Institute of Canada and a current member of the Lambton County Science Fair, where last spring of the 110 competitors, the top five were girls, a first in the fair's 40-year history.
Leslie Dawson had been searching for years for the perfect career. After more than a decade in the service industry in restaurants and bars and working as an assistant retail manager, she obtained her real estate license and sold houses. "But these jobs weren’t invoking the passion I wanted to feel," she says.

On a friend’s recommendation of the program at Nova Scotia Community College, Dawson started researching the field of power engineering technology. "I just knew right away that this was right for me," says Dawson. It would involve being outdoors, solving technical problems and doing work that was physical – perfect for someone like Dawson. She enjoys working on her car and riding her bike and her motorcycle.

As soon as she could, Dawson enrolled in the one-year program at Nova Scotia Community College in Sydney. Imperial, which helps fund the program, hired her on a co-op work term, then in December 2012 offered her a full-time job at the Dartmouth Refinery. As a process technician her job was to monitor temperatures, pressures and flows in the processing equipment, troubleshoot concerns, and prepare equipment for maintenance, ensuring safety and efficiency. She would check the gauges that were hard-wired to the vessels, while an inside technician monitored the operations on a screen. "I am the outside eyes for the inside operator," says Dawson, who has her third-class power engineering certification.

Dawson is now preparing to move to Ontario in early 2014 to work at the Sarnia site. In 2013, Dartmouth refinery started a conversion to a naphtha operation.

Not only has Dawson, 35, found her ideal occupation, but she says Imperial is the ideal company, too, for three reasons. First, Imperial Oil has one of the highest standards for safety in the industry, and that’s very important to me." Second, the company is continuing to help develop her career. Third, despite being in a male-dominated occupation, she’s always felt welcomed and supported. "The company is excellent at valuing diversity in the workplace," she says.
Working as a camp counselor the summer after his first year at university, Duncan Nixon was leading a group of 14- and 15-year-olds on a five-day hike through the Tinda mountain prairie in western Alberta when he noticed some interesting geological formations. Called bedforms, these ripple patterns on the dry sandstone riverbed had been moulded by the flow of water millions of years before. Nixon, whose favorite course in his engineering program had been geological engineering, was excited to explain the feature to the kids. He says now, “It really hit home then that ‘Yes, this is what I want to be doing’.”

Nixon, 26, is a geotechnical engineer at the Kinsel Oil Sands operation in northern Alberta. He works with the mine technical team, which includes more than 40 geotechnical engineers and technologists, hydrogeologists, and mining engineers, and surveyors and geologists.

Nixon starts his 12-hour shifts by touring the site, monitoring conditions of haul roads and ramps, and ensuring stability of the mine face and dumping areas. He then helps create the daily mine plan, which may include such preparations as where to place waste material, where to store equipment when it’s not being used, and specifications for those structures. A significant part of the job is ensuring safety and smooth operations by understanding the soil mechanics of existing.

Growing up in Calgary just a 45-minute drive from the mountains, Nixon says he’s been hiking since he could walk. He also enjoys rock climbing and camping. “I’m a big outdoors guy,” he says, “so a mix of fieldwork and office work, as I have here, is ideal.

“I really like working in a team environment, interacting with different groups on an ongoing operation,” he adds. “It keeps things exciting.” Having been a part of Kinsel from the development phase right through to start-up, Nixon says the first dumping of ore into the crusher was one of his most exciting moments.
For Shane Stark, math is more than his career; it’s also his hobby. When he’s waiting to pick up his daughter from ballet class, he’ll launch an app on his phone for Sudoku. When he reads a novel, it has to be a whodunit, preferably puzzles involving numbers and symbols. “I really enjoy looking at a problem and seeing the solution,” he says. “I don’t think in pictures, but for me numbers just click into place.”

Stark is a senior reservoir engineering advisor with oil sands development and research in Calgary, pursuing new recovery technologies for Imperial’s Cold Lake operation in northeastern Alberta. With the company for 30 years in March, he started in a computer programmer for reservoir engineers. “They wanted me for my math background, because I would be building software for scientific systems,” he says.

Born in Cape Breton, N.S., Stark excelled in math throughout high school and placed in the top 10 in the Canadian Mathematical Olympiad. He majored in math at Queen’s University in Kingston, Ont. When he graduated — as the year’s top B.Sc. student in the entire university — he suddenly thought, “Okay, what do I do next?”

Stark chose to do a master’s at the University of Toronto in industrial engineering. After completing his degree and working for Imperial for a year, he wanted to become more involved in reservoir engineering. He thought that while he wasn’t officially an engineer and didn’t yet understand all the technical scientific processes, he could add value with his math expertise by seeing trends, identifying patterns, making correlations and programming software to analyze data.

Stark had to work hard, but he proved himself an asset. He spent a year at Exxon Production Research, now called Upstream Research Company, in Houston, then seven years in Cold Lake, before returning to Calgary. After completing his engineering exams, he received his professional designation. Stark, 34, married and with two daughters, has mentored dozens of fellow employees and in 2016 was honored with an Outstanding Mentor Award by the Association of Professional Engineers and Geoscientists of Alberta. “I get more excitement seeing somebody else solve something than if I’d done it myself,” he says.
LOOKING FOR
A BETTER WAY

Emerging technology in oil sands mining takes on tailings

By David Coglon

When Sol Aedyinka talks about the potential impact of one of Imperial Oil's emerging technologies — non-aqueous extraction — on the oil sands mining industry, he uses words like "step-change." The excitement is audible in his voice.

"It has the potential to change the whole landscape of the industry," says Aedyinka, a research engineer who is part of a team helping to develop the technology at Imperial's Calgary Research Centre.

It's a bold claim, but one backed by years of work by researchers at the centre that point to non-aqueous extraction (NAE) being a game changer.

Currently, oil sands mining operations rely on a hot water separation process to extract the bitumen ore from the sand and clay. This process also results in leftover material — a mixture of water, clay, silt and sand — that must be stored in large tailings ponds over long periods of time in order to let it settle.

NAE would eliminate the need for wet tailings storage altogether, dramatically accelerating the pace of reclamation.

The process involves mixing the ore with a solvent and a small amount of water. This slurry is then transported in a segment of pipe. As the contents mix in the pipe, the solids — sand, silt and clay — fall together to form agglomerates about the size of a grain of sand. The bitumen and solvent pass through a filter, while the solids are left behind, ready to be washed, dried and placed back into the mine.

The bitumen is produced and the solvent is collected for reuse.

"It's an elegant solution," says Aedyinka. "The fine particles are naturally attracted to the water. The solvent dissolves the bitumen but doesn't like to mix with the solids and water, so everything comes together."

While water-based extraction methods primarily rely on thermal and mechanical energy to recover bitumen from oil sands ore, solvent-based extraction also uses chemical energy to dissolve the bitumen. By using mostly solvent, NAE could reduce water use by more than 90 percent and eliminate the need for wet tailings ponds. The dry tailings generated by the NAE process enable rapid reclamation, which, in turn, means the mine footprint is much smaller than typical oil sands mining operations. And because the solvent does a better job than water at dissolving bitumen, bitumen recovery for NAE is expected to exceed water-based extraction across a wide range of ores.

Keith Abel, an Imperial Oil research scientist at the centre, says the technology provides improved environmental performance and a smaller mine footprint. "And it's not sacrificing anything on the recovery side — in fact, it actually offers better recovery performance, so it's a win-win," he says.

While NAE's merits are apparent, it's taken time for the process to emerge as a technological contender. Its history goes back to a concept originally conceived at Canada's National Research Council (NRC) in the 1970s and later abandoned for economic reasons.

"Solvent extraction is an idea that's been around for a long time, but the industry also recognized that it's a difficult and costly technology to develop," says Abel.

Seven years ago something happened to spark renewed interest. With Imperial building its oil sands mining business, the company's research team was tasked with intensifying its search for breakthrough oil sands solutions. The group soon identified the NRC concept as a key opportunity.

"The original NRC process had some significant issues at the time, so we did our own studies and began extensive experimentation, drawing on experts across Imperial and ExxonMobil," Aedyinka says of the effort that's involved lab-scale tests and larger stand-alone unit tests at research facilities in Calgary, as well as facilities in the United States, Alberta, Alberta, and Ontario, New Jersey. "The result is we were able to make a number of innovative changes that we've patented and evolved into a viable technology we now call NAE."

Since then, the technology has proved so successful in the laboratory that Imperial is readying for the next step: testing NAE in the field. A team of researchers and process engineers is now designing a pilot plant that could begin operation in Alberta within the next five years.

"It's exciting to see how the technology is evolving," says Aedyinka. "Future oil sands development could be significantly different from what is practiced today."

Learn more about Imperial's research and technology efforts at

16 2014

The Review 17
HONOURING A TRADITION OF STORYTELLING

Children’s book features elders’ stories and locally inspired art

As part of its first celebrations for the Kea oilsands development, Imperial has produced a children’s book that honours traditions of storytelling across generations.

Our Stories Help the Northern Lights Dance features stories collected from Fort Chipewyan and Fort McKay elders by Northwest Territories author Richard Van Camp. The illustrations were inspired by artwork created by local children with the help of Alberta artist George Littlechild.

Imperial supported the publication of this book to give thanks to the residents of Fort Chipewyan and Fort McKay who have shared their deep understanding and respect for the land. Copies of the book have been presented to local communities, schools and libraries.

“We are grateful to them for contributing their time and traditional ecological knowledge to help us shape our plans for our Kea oilsands development and its reclamation,” the book’s dedication reads. “As a good neighbour, we look forward to building on a strong relationship with local communities for generations to come.”
A WORKPLACE FOR THE FUTURE
Imperial's new Calgary campus is designed to foster innovation through collaboration. By Margo Pfieff

Imperial is joining a growing trend among corporations by creating a new open-concept, campus-style headquarters, with the first wave of employees set to make the move to the suburbs in mid-2014.

The new complex, to be completed in 2016, will bring Imperial's staff from multiple downtown locations to work together in a 20-acre park-like setting in Calgary's southeast. Following models pioneered by technology leaders such as Apple and Google, Imperial's design aims to create a dynamic space that encourages teamwork and connecting between staff - improving communication, striking creativity and accelerating problem-solving.

It's a movement on the rise - and one that is producing results. Workplace surveys by Gensler, a San Francisco-based global design and architecture firm, show that employees at top-ranked companies consider collaboration and socializing critical to job success. Four out of five white-collar office workers now feel the need to partner with others to get work done, according to a recent workplace study by Steelcase, a global manufacturer of office equipment.

The most successful workplaces seek to find a balance between bringing employees together while still creating space where individuals can focus on work, says Judy Pesch, Dallas-based regional managing principal for Gensler. "Workplaces designed to enable collaboration without sacrificing focus are more successful," she says. "Research shows that employees with choice are more effective and that choice improves the employee experience."

First announced in September 2012, Imperial's campus will be located in the mixed commercial and residential community of Quarry Park. Construction is well underway on the first phase, which will see the first group of about 300 staff transition to the campus by
The Review

A REVIEW FOR THE NEXT CENTURY

With wireless internet on their laptops. "We believe you should leave work better than when you came," says Donovan. "Transferring from four walls and a desk to an open-concept office takes getting used to," says Hall. White noise will be used to dampen voices, soft furniture is designed to absorb sound and everyone can slip on noise-cancelling headsets. For private meetings, each floor will have meeting rooms, while a separate "family room" offers space for informal chats.

But the real opportunity, those leading the project agree, is the benefits that will come from bringing the company's Calgary employees together in a space that will continue to evolve with the company. "Our Calgary campus will have concepts gleaned from around the globe," says Donovan, who along with his team studied more than 100 buildings ranging from Mercedes' and Sprint's headquarters to museums to gather design ideas. "We've attempted to incorporate the best in office design because we know this is a once-in-a-generation project that needs to be just as relevant today as it is in the future."

The Review