

Presented by the Daily Oil Bulletin



BUILDING A COLLABORATIVE CULTURE

How the *Daily Oil Bulletin* Energy Excellence Awards nominees worked together to answer Canada's oil and gas challenges

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INTRODUCTION



Canada's oil and gas industry is in the midst of a great disruption.

Rapid advancement in extraction technologies has altered the global supply/demand balance, resulting in long-term oversupply of both oil and gas and – inevitably – lower prices.

A similar technological storm in renewable and alternative energy generation and storage is lowering costs and providing genuine competition in power and transportation markets.

Explosive growth in U.S. production has shifted international energy supply patterns, leaving Canadian production in the hunt for new markets. Greenhouse gas emissions regulation is increasing in Canada and globally as the world moves towards a lower carbon energy future.

Digital technologies like data analytics, machine learning and artificial intelligence are fundamentally changing business processes, skills requirements and operational processes.

Pressures on energy producers to improve environmental performance and operate in a socially responsible manner are intensifying particularly when it comes to working in Indigenous communities.

Through all this turmoil a new competitive model is emerging led by technologically advanced energy

sources that are the lowest cost, most socially conscious and emit the least greenhouse gases.

Over the last five years the *Daily Oil Bulletin*'s parent company JWN Energy and partners have been interacting with industry, academia, governments and other stakeholders via dozens of workshops, speaker events, surveys and indepth interviews to gain an understanding of the disruption the industry is facing and to identify the opportunities and challenges.

A number of key issues emerged from these consultation efforts, including the need for:

- An improved Canada's technology and innovation pipeline to move new products or processes through to commercialization
- More collaboration up and down the supply chain to lower costs and improve productivity
- Greater sharing of knowledge within the industry to answer challenges like greenhouse gas emissions and other environmental concerns

- A strategy to build on Canada's oil and gas technical expertise to diversify into other energy production
- Greater exporting of Canadian technologies and expertise to help answer global challenges
- A sharing of success stories within industry and with the public to show industry is making progress on issues of concern

The Daily Oil Bulletin's Energy Excellence Awards were conceived to measure and celebrate the progress industry is making on meeting these challenges and to share the industry's successes with a broader audience. We received more than 90 nominations – all are working to make Canada's oil and gas industry the low cost, low carbon, socially conscious, technology-driven energy supplier of the future.

The hope is that these success stories will inspire further collaboration and innovation to take advantage of the great energy disruption now under way.











BACKGROUND

The *Daily Oil Bulletin*'s Energy Excellence Awards were launched in December 2018. The awards were defined in three broad categories based on consultation with industry:

- Operational & Project Excellence
- Innovation & Research Excellence
- Exporting Excellence

Within these categories, 12 subcategories were selected:

- Operational and Project Excellence:
 - Oilsands
 - Oil and gas
 - Pipelines and facilities
 - Industry accelerators

A total of 25 applications were submitted in the four subcategories, which were judged based on: project and environmental performance; collaboration; unique technologies and processes; and corporate social responsibility

- Innovation and Research Excellence:
 - Drilling through completions technologies
 - Production technologies
 - Digital oilfield
 - Cleantech
 - Power transmission and storage.

A total of 48 nominations were submitted in the five subcategories, which were judged on: collaboration; potential impact on industry; and business impact.

- Exporting Excellence:
 - Advanced technology
 - Oilfield services and manufacturing.
 - Professional services.

The exporting excellence category was judged on export revenues, annual export growth, new market expansions and unique export partnerships or collaborations.

In March judges drawn from a broad spectrum of industry reviewed all nominations. Finalists and champions were recognized at a reception held May 3 in Calgary. They were also profiled in two series of stories running on the *Daily Oil Bulletin* and jwnenergy.com websites. These stories were further amplified to reach the broader public via JWN and partner social media channels and directly to government representatives.

This report builds upon these efforts by illustrating the innovations that industry is undertaking to solve its economic, social and environmental challenges.

RETHINKING THE INNOVATION ECOSYSTEM

Technology adoption can be a slow, methodical and challenging process in the oil and gas industry. New technologies tend to be long-lead-time, capitalintensive solutions that are not easily tested and rolled out in a 'big iron' sector like energy.

As a result, technology adoption can create tensions within the supply chain structure, making it challenging for tech developers to move new products or services through the process of commercialization. Risktaking is often discouraged and the rewards can be unevenly distributed, further stunting progress.

The situation has prompted calls for a deeper level of collaboration to streamline and improve the process in ways that benefit both operators and suppliers.

Progress, however, has been slow.

Several issues that slow technology development and collaboration have been identified by industry. These include:

- The lowest-cost bid procurement process
- A perceived imbalance between risk and reward in terms of technology adoption
- Challenges in navigating the technology-funding ecosystem
- The need to develop technologies throughout oil and gas price cycles
- Difficulties finding industry partners to pilot new technologies
- Challenges in scaling-up technologies after they are 'proven' in pilot projects

Many energy excellence award nominees have found their

own formula for successfully navigating the technology adoption process. Among the success stories:

- Sandintel collaborated up and down the technology pipeline to develop and commercialize its sand separation technology. Montney operator Seven Generations Energy was a key partner during its ramp-up, ensuring that Sandintel could rapidly develop. NRC-IRAP also provided tremendous initial funding support, while Tech-Edmonton provided early advice, market research and guidance. Sandintel is now working with its fabrication partner to improve its product and lower costs.
- HEAL Systems took a different approach when pushing its technology to improve the performance of horizontal wells towards



to commercialization. It partnered with energy services giant Schlumberger to prove its technology and advance commercialization through a partnership called TriAxon Energy Services after proving the technology at the TriAxon Energy's Harmattan field.

TriAxon Energy Services Inc. was a small producer and did not have the capacity to adequately fund the HEAL System's technology development and rapid growth. Government funding was awarded from IRAP in 2016/2017 and in 2017 Schlumberger formed a joint venture with TriAxon to fully develop the technology on a global scale. Within last three years the technology has rapidly been used in every major producing basin in Canada and the United States, Installed well

count is now over 400 since commercialization occurred in mid to late 2015.

Blue Spark Energy partnered with a major client in Canada to field test the original prototype WASP (Wireline Applied Stimulation Pulsing) tool for oil and gas well remediation. Blue Spark modified the WASP tool based on the results of the initial pilot project and subsequent work. This led to many improvements to the original design of the tool. The second-generation version of the WASP tool was developed with and for this same client to resolve a specific challenge. In the Danish North Sea, a major client was directly involved in the development and testing of an auxiliary tool that would help establish and maintain a fluid column covering the WASP tool, as the WASP tool needs to be in a noncompressible fluid to realize the full benefit of the pulsing.

Bluesource Methane partnered with numerous organizations up and down the supply chain to launch its methane reduction program. The program focuses on switching out high-bleed pneumatic controllers for lower emissions units at no cost to the operator. Bluesource covers the capital outlay and recovers its costs through the reduction in fuel gas used as well as via carbon offset credits. Bluesource relies on partners across the province, such as Tarpon Energy Services Ltd., Techmation Electric and Controls Ltd. and Pronghorn Controls Ltd. for the inventory process on existing highbleed controllers and the installation of new low-bleed devices. It relies on Spartan Controls Ltd. as its primary equipment supplier, with

additional support provided by CVS Controls Ltd. Drakken Inc. is the lead project management and logistics partner, and coordinates all aspects of field work and supply chain management. Lukla Inc. provides a worldclass data management platform to support the data management requirements of the program. And it relies on ongoing engagement with oil and gas companies in Alberta (currently 15 and counting) that have embraced this opportunity.

 LCO Technologies' Solar Instrument Air Compressor is a small instrument air compressor that improves reliability and reduces the cost to eliminate venting. The compressor requires less energy than existing solutions and can be installed at a lower total cost. The challenge that this technology was designed to address is two-fold. Specifically, the compressor was designed to reduce or eliminate onsite venting for remote well sites with no nearby grid connection. Broadly speaking, the technology is intended to mitigate GHG emissions as an alternative to flaring and works towards the federal government's policy goal of reducing methane emissions by 45 per cent by 2025.

Pilot tests were conducted in collaboration with LCO Technologies, PTAC, Spartan Controls and Husky Energy. Spartan Controls collected project data and worked alongside Husky to ensure such data was available 24/7. Husky Energy provided administrative, operational and technical support. PTAC



Building a collaborative culture

provided fund management support.

Additionally, LCO Technologies' compressor made significant contributions to PTAC's Advanced Methane Detection, Analytics and Mitigation (AMDAM) project and has been favourably reviewed by end-users in PTAC's network. The AMDAM project was a large, collaborative endeavour with more than 12 project supporters from various stakeholder groups within the oil and gas industry, including end-users, research organizations and government.

 Compact Compression's (CCI) new hydraulic casing gas compressor (HCG) also had a unique development pathway. Compact had built hundreds of portable gas compression trailers for the gas-well-boosting market that extracts gas from end-oflife wells. Virtually overnight that market disappeared in 2009 when natural gas prices sharply declined. CCI decided to target the oil production market.

Sparked by a conversation with a customer who asked if CCI could build casing gas compressors similar to what other suppliers were providing, the company conceptualized, engineered and developed in-house its hydraulic casing gas compressor (HCG). Key to its success was taking a clean-sheet approach to the challenge in directly addressing customer needs.

CCI's solution was to apply both new technology and a

new business model to the problem. Firstly, it created a fit-for-purpose, simple and reliable electric-over-hydraulic reciprocating compressor configurable for a wide range of pressures and volumes. For sites with no available power, a natural gas engineover-hydraulic option was

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developed. Secondly, CCI developed an all-inclusive, fixed-rate service plan that provides cost savings and cost certainty for ongoing equipment maintenance. The all-inclusive aspect of the plan drives CCI, in partnership with its customers, to make continuous improvements to the equipment and field processes to increase reliability and uptime. Upgrades that enhance reliability are implemented at no additional cost to the customer, recognizing that these improvements reduce service costs. Moving equipment between sites and any reconfiguration to match compressor performance to well deliverability is included, too.

CCI worked with several customers during field tests and implementation of HCG technology to test real-world performance at various rates, pressures and liquid fractions. Customers helped define performance expectations and criteria for success, which included reducing casing annulus pressure, reducing operator intervention, increasing uptime and lowering the cost of ownership compared to other systems.

 VizworX stepped into the augmented reality (AR) domain with a product created specifically for engineering design reviews that enables users to walk through any kind of AR model in full 1:1 scale.

Its stand-alone product, Panoptica, was created to address the significant amount of overspend required to rework projects in the construction phase, which accounts for up to 30 per cent of overall project costs. Errors in the original design that were not caught during the initial design review are the main reason for rework.

Unlike traditional tools that display 3D models on a 2D screen, and lack the context needed to fully comprehend scale differences, Panoptica accurately conveys the true sense of size and space in relation to realworld surroundings. During engineering design review meetings, teams are able to walk up to, around, duck underneath and engage with the 3D models using natural human interactions as if the models were physically present.

Panoptica also enables project teams situated in different locations to review designs in a virtual space, interacting with their 3D models as though they are in the same physical space. That facilitates a collaborative approach that allows teams to work together to increase the likelihood of catching potential design errors before the project progresses to construction phase.

A spin-off of the University of Calgary-led NSERC Strategic Network SurfNet (a cross-Canada research network), VizworX maintains close ties with the university as well as collaborating with companies in oil and gas and other sectors.

Initial development of Panoptica came out of a joint digital twin project in collaboration with Cenovus Energy Inc., where Panoptica evolved into a design review product based on client feedback.

 Hifi Engineering Inc.'s high fidelity dynamic sensing (HDS) system provides fully distributed pipeline monitoring using a specialized fibre optic cable designed to detect high fidelity acoustics, temperature and vibration/ stain. In addition to providing high confidence leak detection across every centimetre of the pipeline in real time, preventative conditions can also be detected, such as third party interference, machinery operating too close to the pipeline, thermal anomalies or geotechnical events such as earthquakes and landslides.

Hifi recently validated the ability to retrofit the technology to existing pipelines with a pilot with TransCanada Corp. on a section of the Keystone pipeline into Houston. The companies collaborated together with Alberta Innovates and the Alberta Small Business Innovation and Research Initiative program to develop a real time verification and diagnostic system to ensure the ongoing operation of the technology remained finely tuned and effectively operated.

While already an established commercial product, the company continues to refine the technology, working with the University of Calgary on how to enhance it further.

Hifi has had a strong relationship with the university's Schulich School of Engineering over the past number of years, including collaboration on the development of the company's leak detection algorithms. Given the oil and gas industry's urgent need for enhanced pipeline safety, this industrialacademic partnership has potential national and global significance.

Pandell has applied digital

technology to solve a longrunning problem for the oilpatch: invoicing. In 2018, the Calgary-based company introduced the final link in the chain for digital end-to-end billings management between oil and gas producers and oilfield services providers.

That link is the new cloudhosted vendor invoice portal Pandell VP, which ties directly into Pandell AP invoicing and coding approvals and JV accounting and financial reporting to deliver a seamless invoice-to-pay workflow solution.

A Pandell analysis of 50 Alberta-based service companies using a paper invoicing process showed an average invoice-to-pay cycle of greater than 60 days.

Many of the over 400 users of Pandell's JV financial accounting software provide input on a quarterly basis through the company's client advisory board sessions. Through these sessions, two digital workflow opportunities were identified that could reduce industry challenges and improve the invoiceto-pay process - one between the producers' accounts payable and financial accounting groups and the second between their payables groups and service vendors. The first was solved via a cloud-based accounts payable system that automates invoices through a configurable approval process via the web, and the second with a web portal that extends AP and JV's financial validation tools, audit controls and digital workflow to the supply chain in real time.

KEYING IN ON OPERATIONAL COLLABORATION



There may be little the industry can do about future uncertainty and challenging oil and gas prices but there are ways to deal with the other side of the equation: costs. There are many opportunities available to create efficiencies and trim expenses, not least via the procurement process.

The Canadian oilpatch is characterized by a proliferation of service and supply companies that are an essential component of the sector. These companies feed into long and complex supply chains operated – in some cases – by increasingly outmoded procurement processes.

Collaboration is one avenue to seek efficiencies. Two of the biggest barriers to successful collaboration are:

- The low-bid mentality that is a product of a business culture that excessively rewards price over value
- A procurement process that tends to focus on the price of each component of a project, to the exclusion of an overarching procurement

program focused on risk management and total value

Also cited was the lack of institutional knowledge and difficulty in transferring this knowledge. Industry has also pointed to a lack of industrywide standardization, best practices and government involvement in standards and compliance.

A failure to bring suppliers in early in the project planning process, resulting in added costs later, was another issue raised, as was a failure to enable collaboration at appropriate levels within organizations.

Oilfield service and supply companies appear to be increasingly recognizing the benefits of co-operation, both internally and with peers, but it is still early days. There is much untapped potential. Collaboration appears to be taking place primarily between companies that have complementary services.

The nominees for the Energy Excellence Awards provided a number of models where collaboration can improve project performance.

The WhiteFox Pipeline is a uniquely collaborative project. It represents the integration of four industrial sectors: forestry (trees), pulp and paper (wood chip residuals), the Town of Whitecourt, and the oil and gas sector (offtaker for treated effluent). The improved water supply chain increases energy efficiency and provides a reliable water supply year-round for the oil and gas sector. The project also provides opportunity to share infrastructure among all oil and gas players, enabling operators to share costs and avoid redundant infrastructure for roads, water storage and supply.

The project developers, ANC and Integrated Sustainability, have unique industrial water management expertise, regulatory frameworks, operational technology systems, commercial relationships and understanding of customers and their water usage needs. A key advantage is the ability for WhiteFox to enable crossbasin transfers of water – unlike fresh water, regulations permit the transfer of treated effluent water across drainage basins. This allows WhiteFox to serve a larger geographic area.

STEP Energy Services has Canada's largest fleet of bi-fuel hydraulic fracturing pumps representing 97,500 HP. These pumps use a mixture of natural gas and diesel that can reduce diesel usage, improve operational

The improved water supply chain increases energy efficiency and provides a reliable water supply yearround for the oil and gas sector.

efficiency and minimize the environmental impact. Since working with Shell, STEP has built a mutual commercial agreement based on the measuring of key performance indicators, such as specific bifuel substitution percentages. By obtaining the Shell's gas analysis, STEP could predict gas substitution, which was mutually beneficial to Shell, Finning Canada (the partner vendor) and STEP.

 The Avatar Program is a collaborative effort between Beaver Drilling and the

University of Calgary to accelerate new technology adoption in the drilling industry and empower the workers to become champions of a new energy future. Part training program, part tech accelerator, The Avatar Program placed 16 field employees in a two year module based university program assisted by e-learning platforms. The program required employees to implement new technologies and business models at the rig site in collaboration with E&P and tech partners to lower the cost curve of production in Canada. The program created leadership and career opportunities for front-line energy workers plus an unparalleled collaborative hub for E&P drilling departments. It also opened the door to technology learnings from the tech and aerospace sectors.

Well optimization company Ambyint provided Husky Energy with an end-toend solution to automate Husky's remote well sites via collaboration with partners including Amazon Web Services (AWS) as the cloud provider and Spartan Controls. Spartan Controls provides industrial process automation and is the exclusive representative of Ambyint in Western Canada. The partnership leverages Ambyint's technologies and Spartan's customer experience model to deliver customer needs. For Ambyint, AWS has proven to be an advanced and reliable provider for managing software infrastructure and ensuring a secure environment. The partnership

with Spartan Controls and AWS provided seamless integration that has enabled Ambyint to improve well economics for its customers across many regions and plays.

Calfrac Well Services was contracted by Paramount Resources to provide technical and operational expertise in the form of a 50-day hydraulic fracturing project for two pads in the Duvernay formation of the Kaybob region of Alberta. This took place during May/ June 2018. The two companies took a unique approach to the project. For 60 days leading up to it, the companies embarked on an extensive pre-planning initiative that involved scrutinizing every

aspect of the completion to ensure maximum efficiencies could be achieved. Operational items such as well heads, frac manifolds, water supply and heating, proppant logistics, custom fluid additives, pump-down configuration, mechanical diversion (downhole) and personnel were streamlined. Technical aspects such as geo-mechanical models, reservoir analytics, fracture modeling, job placement, screen-out mitigation techniques and innovative completion design strategies/ methodologies were all employed. The fracturing fleet was even re-engineered to ensure that it could withstand the intensity of operations in this region.

Pre-planning and coordination was key. The project achieved early buy-in from all stakeholders and the two companies were constantly engaged in proactive initiatives derived from each party's experience. Together, they completed several CWOPs ("complete well on paper") before executing a number of "dry runs" in the field.

Both Calfrac and Paramount understood the full scope of operation well in advance and had mutually negotiated a compensation model that benefitted both parties when efficiencies were realized and mutual gains were made.



COMPETING AS AN INDUSTRY

Canada isn't the only jurisdiction struggling to find a place in a carbon-constrained future. Across the globe, petroleumproducing regions are working to differentiate their production as the lowest cost, low carbon fuel of the future.

While the Canadian industry in the past has generally competed company versus company, increasingly it is working together to solve shared environmental challenges.

For example, the \$35-million Emissions Reduction Alberta (ERA) Grand Challenge: Innovative Carbon Uses and the \$20-million NRG COSIA Carbon XPRIZE competition to develop breakthrough carbon conversion technologies are working to reframe carbon from a waste product and a bad thing into a valuable commodity.

The challenge facing the industry is steep. Meeting

emissions reductions targets while maintaining economic growth will require a tenfold increase in carbon productivity — the amount of GDP produced per unit of carbon equivalents emitted — by 2050. That is roughly equivalent to accomplishing the productivity gain that occurred during the industrial revolution, but in one third of the time.

While Alberta and Canada have been very successful at creating new ideas, there has been much less success at translating those ideas into commercial successes, many industry representatives have said. Larger capital funding sources to help scale up, demonstrate and deploy projects, especially in capitalintensive industries, are needed.

ERA, which invests the carbon levy paid by large industrial emitters into later-stage clean technology solutions, has provided some of that innovation. By leveraging private funding sources, ERA has seen the commitment of more than \$572 million in funding to 164 projects with a total value of about \$4.3 billion. The projects are estimated to deliver cumulative greenhouse gas emissions reductions of 43 million tonnes by 2030.

The Petroleum Technology Alliance of Canada's (PTAC) collaborative model is another proven approach in developing the technologies needed to solve many of the issues the energy industry is facing today — from climate change, pipelines and abandonment liabilities, to disruptive digital technologies and cost control.

PTAC, along with other energy excellence awards nominees, show how Canada can collaborate to compete on a global level.



- The launch of PTAC's Fugitive **Emissions Management Program Effectiveness** Assessment (FEMP-EA) Phase II project last August, focused on methane leak detection, quantification and repair. FEMP-EA is PTAC's largest applied research project to date, covering 2,500 square kilometres in the Red Deer region. Involving participation from 30 producers and nearly 200 oil and gas facilities, it will improve understanding of fugitive emissions and provide the data needed to guide industry decisions.
- Ten years in the making, Suncor's Water Technology Development Centre (WTDC) will allow its partners to test new water technologies to improve the sustainability performance of thermal in situ oilsands projects.

The \$143 million "live fluid"

test facility is located at Suncor's Firebag SAGD project. Established collaboratively through Canada's Oil Sands Innovation Alliance (COSIA) by Suncor, Canadian Natural Resources, CNOOC, Devon Canada and Husky Energy, the WTDC responds to the industry challenge of developing technologies past the lab or bench scale to the pilot or near-commercial scale.

The WTDC allows the partner companies to test more technologies than each could on their own, while sharing the risks and costs of development.

The roster of pilot opportunities includes more effective emulsion separation, oil removal, water treatment, steam generation, water waste management, chemical usage, instrument and analyzers, advanced process controls, and other facets of in situ operations.

The initial incremental technology tests will target existing assets to cut water consumption by five or 10 per cent and to reduce GHG emissions. Later, more aspirational testing is expected to lead to changes in the design of central facilities, how SAGD facilities are built and how they operate.

Each of the five partners in the WTDC has an equal vote on which technologies are tested. Representatives from each partner company then work collectively on the chosen projects.

A new province-wide collaboration between industry and the Alberta Energy Regulator (AER) is making infrastructure decommissioning and reclamation an open-source proposition by enabling companies to work together.

For participants in the program, a key benefit is reducing their costs. For companies with at least 20 wells to decommission and reclaim, economies of scale take effect and drive down the costs per well when that work is pooled with another company in the area planning a similar closure. Working together also lowers the cost of the learning curve. In a challenging environment. closure of the first few wells may take time to figure out before becoming routine. Instead of each producer

paying for this learning curve individually, sharing that information lowers the cost of those learnings.

Efficiently sequencing Area Based Closure (ABC) also provides benefits. Separate crews working simultaneously down the road from each other doesn't make sense in closure work because it's not that time sensitive. Doing the work in sequence effectively lets producers share the cost of mobilizing and demobilizing people and equipment.

To facilitate industry participation in ABC, the AER added a mapping tool to OneStop, its application submission portal. Service companies can now see what closure work is planned across the province, allowing them to prioritize and plan better. This reduces their costs and flattens their seasonal hiring cycles.

At a higher level, ABC is making Alberta's oil and gas industry more resilient by reducing producer liabilities. Lower costs allow for more reclamation work to get done, which improves public health and safety in Alberta. Industry associations including CAPP, PSAC, and EPAC worked together to make ABC a reality.



MANAGING CARBON DIOXIDE

Carbon capture and storage can be a pricey way to reduce GHG emissions if CO2 is strictly seen as a waste product for disposal. But technologies like carbon dioxide miscible flooding in enhanced oil recovery and CO2 sequestration in concrete to make stronger building products show that carbon dioxide is a valuable feedstock for other applications.

Re-envisioning waste streams will, ultimately, drive the shift to a more sustainable "circular" global economy.

A variation on this theme is Canadian Natural Resources Limited's Non-Segregating Tailings (NST) process. This includes the capture of CO2 and its injection into oilsands tailings to further accelerate the settling of fines and other tailings components.

NST are tailings that have been significantly dewatered to form a homogeneous, semicohesive mass for deposit into a tailings area. The dewatering process includes the use of cyclones to separate out coarse sand and thickeners to capture and remove water from the fines. The warm water that is removed and recovered from the NST process is then reused in bitumen extraction, which reduces GHG emissions by minimizing reheating requirements. The coarse sand and thickener underflow are then mixed and further combined with CO2, which has been proven to speed the settling of fines.

The NST and CO2 sequestration process is fully deployed at Canadian Natural's Horizon mine. Combined with the water reuse in bitumen extraction, Horizon has been able to reduce its direct GHG emissions by 24 per cent over the last five years.

The mine has also achieved a significant reduction in water usage, a smaller tailings

footprint and less time to reclamation.

"We now have tailings that meet and exceed regulatory prescriptions. This is why you hear much less about tailings issues," CNRL's VP of technology and innovation Joy Romero said.

Canadian Natural's investments into tailings research, technologies and projects over the years have topped \$3.5 billion. This includes the construction of its Applied Process Innovation Centre (APIC) in 2015.

The APIC is a 3,600 square-foot research facility that a dedicated workspace and resources for scientists and engineers to investigate and accelerate the application of tailings technologies and bring them to commercial scale. It also facilitates collaboration on research with other industry members directly and through COSIA.

"What COSIA has done is remove the barriers to intellectual property. So now, we have really tight legal agreements in place and absolutely everything in the tailings project is shared between the operators. There is nothing that is held back," added Romero.

This open-source technology approach is accelerating the development and deployment of technologies that are putting bitumen production on the same environmental and economic footing as conventional oil production.

"We are leaders in innovation and, as an industry, we don't talk about it enough. If you look at, for example, just oilsands GHG emissions levels, and compare the average barrel produced in the United States, we, as individual companies and as an industry, are well below [U.S. levels] or just above it. So there is no dirty oil in Canada. It is absolutely a comparable product and Canadians need to know this."

WORKING WITH INDIGENOUS COMMUNITY PARTNERS

Canada's energy industry has a long history of working with local communities, including Indigenous communities to create jobs and forward economic development. More recently, the effort has been on helping Indigenous communities share in ownership of businesses involved in producing oil and gas and servicing the industry.

Three energy excellence award nominees are taking their own approaches bringing Indigenous partners into the fold. Japan Canada Oil Sands Ltd. (JACOS) took a variety of approaches to engaging First Nations communities with its Hangingstone SAGD expansion project. This included a direct supply chain management initiative to work with the Northeastern Alberta Aboriginal Business Association (NAABA) and other aboriginal communities to provide ongoing services for Hangingstone. This resulted in 30-40 per cent of contracted vendors for ongoing operations sourced from local (aboriginal) or NAABA affiliated businesses.

Participation in opening ceremonies by numerous leaders from stakeholder groups in addition to providing blessings and traditional singing and drumming were part of its outreach effort as well.

There is also continued and regular involvement (3-4 formal meetings annually) of Indigenous stakeholders (Local Bands, Metis, and trappers) in the review of and input into environmental monitoring programs for air and water quality assessments, wildlife surveys and reclamation activities working in close contact with company personnel responsible for these programs.

Involvement of local indigenous representatives from stakeholder groups is also mandated when gathering field samples for analysis and maintaining infrastructure for environmental monitoring alongside third party consultants. Participation in a field tour of operations by a diverse group of representatives from a number of First Nations and Metis organizations is an annual event.

 MEG Energy (MEG) partnered with the Chipewyan Prairie Dene First Nation (CPDFN) and Horizon North Logistics (HNL) to contract a new company called Sekui ("Home" in Dene), an equity-based partnership to manage camp and catering services provided to MEG at the Christina Lake Project. Prior to the establishment of Sekui, CPDFN had mainly participated in MEG's camp business via joint venture marketing partnerships and not via actual business ownership.

Sekui is 51 per cent owned by the CPDFN. Keeping business

owners – not just core camp and catering specialists – involved throughout the process and via quarterly reviews resulted in greater motivation beyond corporate profits. It provided the mechanism for a direct social benefit.

The business model can be replicated at other oilsands sites. It has already been successful in winning one additional contract beyond MEG. The business structure and lessons learned at MEG allowed Sekui to better prepare for additional contract planning and proposals. It also allowed Sekui to purchase an open camp facility and plan for future business development.

 As an established Canadian pipeline construction contractor, Arnett & Burgess (A&B) identified an opportunity to expand operations to North Dakota.

A&B has a collaborative partnership in place with a fully indigenous owned contracting company. This partnership is building local capacity, unique expertise locally (i.e. fusing capacity), and enables A&B to work hand in hand on the Fort Berthold Reservation to offer a wide range of professional oilfield construction solutions.



TAKING ON THE WORLD

Many Canadian oilfield service companies are increasingly relying on export markets in the face of flat activity and tight margins at home.

Executives from drilling and completions companies said the U.S. market looks like a stable place to invest for the next three or four years. But companies need to be looking at other markets as the unconventional resource revolution moves outside of North America. An executive in the multistage fracturing market said he expects the technology to spread across the world in the next five years, creating plenty of opportunity for Canadian exports.

The challenge facing Canadian oilfield manufacturers is competing on costs. In order to do so, many companies are looking at increasing automation and using artificial intelligence to get more efficient, or moving manufacturing offshore.

While growth opportunities in Alberta and Western Canada are scarce, the resource base and structure of the industry allows for innovation that can be sold to the world. Western Canada has unconventional oil and gas, conventional oil and gas, heavy oil and bitumen, providing plenty of opportunities to develop export technologies. There is also a culture of competing on technology that drives innovation.

Energy export awards nominees have developed a number of models for growing into new markets.

- Chinook Consulting Ltd. has enjoyed long-term success in a variety of export markets through its collaborative efforts with both producers and service suppliers. Chinook partnered with the Algerian National Oil Company, Sonatrach, and oilfield services company Schlumberger. Through this unique collaboration Chinook is responsible for project management of a national scale, large capital, multi-year project.
- Master Flo has also enjoyed long-term success in export markets through its ability to deliver greater value by developing long-term partnerships with customers, in order to deliver custom, life-of-well solutions, from initial production to enhancing production of mature wells and fields. The company has delivered over 2,400 subsea chokes to more than 75 global operators, and they have set numerous world subsea depth records.

Master Flo, headquartered in Edmonton, has a network of sales and service centres strategically to support clients' local operations. Master Flo has locations in Angola, Australia, Brazil, China, Columbia, France, Indonesia, Malaysia, Mexico, Mozambique Nigeria, Scotland and UAE.

Not only does it partner with clients to provide solutions for effective flow management, but it also has access to partnerships and collaborative efforts within the Stream-Flo group of companies. By being connected with other companies within its group globally it can ensure service to clients.

Founded in 1962, Stream-Flo product development is driven by customers and is continuously evolving to solve real world issues. Solutions include a focus on engineering products for speed and time saving that can withstand high temperatures and are engineered for space saving.

Stream-Flo's product development is not only driven by customers, but by direct dialogue between Stream-Flo engineers, field service teams and the customer technical/ engineering staff.



TECHNOLOGY TRANSFER

Citadel Drilling Ltd. initially built its "super-spec" rigs for the western Canadian market but, by the end of this year, 90 per cent of company revenues are expected to come from the U.S.

"We enjoyed working in Canada, but it's been a tough run. It started off as a necessary requirement to export our services to the U.S. [The U.S.] ended up as a really nice place for us to operate," said Dan Hoffarth, Citadel's chief executive officer.

Citadel's transition to the Texas Permian Basin was quick and seemingly painless. In 2017, it made the decision. In 2018, it pulled 40 per cent of its revenue from the States. Currently, five of Citadel's six-rig fleet are in the Permian.

What expedited the shift to the U.S. was Citadel's work for Apache Canada Ltd. before Apache sold its Canadian assets to Paramount Resources Ltd. That track record got Citadel into the Permian, working for Apache, which, today, is its biggest customer.

Citadel's success also involved a lot of sales grunt work.

"Five hundred cold calls narrowed down to 10 call-backs. Then 500 more cold calls," Hoffarth added. "We got really good at being able to discuss who we are openly and quickly, and what differentiates our company from the companies they were using."

Export success is always easier if you have something to offer that differentiates your company. In Citadel's case, it's a combination of powerful, technically advanced rigs run by disciplined and efficient crews. Founded in 2013, Hoffarth and his team understood how the horizontal drilling market was evolving and assessed the gaps. The company's "super-spec" rigs were designed to fill the high-performance rig niche.

Environmental concerns may be taking a back seat to full-on oil and gas development in the United States under the Trump administration, but outstanding environmental stewardship is a key ingredient to Citadel's success.

Citadel rigs carry spill containment and their own vacuums to keep oil from contaminating the ground. They are powered by a 70/30 blend of natural gas and diesel to reduce carbon dioxide and particulate emissions..

"We were able to take our Canadian employees with us. We are able to access NAFTA visas for them because of the high-spec nature of the drilling rigs and because of how unique it is to the industry," said Hoffarth.

Initially he wasn't sure how a Texan patriot would take to Canadian rigs operated by Canadians, but it turned out to be an advantage in every way.

"Unemployment rates in West Texas are less than

two per cent. Their view down there is that what is unemployed is unemployable. So you'd better make sure you have your labour scenario figured out."

Canadian employees versed in Citadel company culture help maintain a record of zero turnover and zero-TRIF (Total Recordable Incident Frequency) in safety. Strategic hiring in the U.S. minimizes dilution of those employee efficiencies.

"When we hire Americans, we look to vets who have just been discharged from the military because they understand rank-and-file, which is what our rig employment structure looks like,. These guys are generally fairly technical, they're disciplined, so you get a 24-year-old with a wife and kid who sees this as a great opportunity."

As for Citadel's future growth plans, Hoffarth recognizes that, right now, the Permian is the "crown jewel" of the global oilpatch.

"Every other basin in North America pales to the Permian's output. For our style of rigs, the basin could cut half its rigs and we would still be 100 per cent utilized," he says. "So as a company, we're now in the process of deciding what 'next' looks like for us."



NOMINEES LIST

OPERATIONAL & PROJECT EXCELLENCE

Industry Accelerators

Alberta Energy Regulators (AER) Canadian Association of Petroleum Producers (CAPP)

Emissions Reduction Alberta (ERA) Petroleum Services Association of Canada (PSAC)

Petroleum Technology Alliance Canada (PTAC)

The Explorers and Producers Association of Canada (EPAC)

Oil and Gas

Ambyint Beaver Drilling Ltd. Calfrac Well Services Ltd. CNRL HEAL Systems Modern Resources Inc. Shell Canada

Oilsands

Brighton BEST Dynamkics Ltd. CNRL Imperial JACOS MEG Energy Serafina Energy Ltd. Suncor

Pipelines/Facilities

CNRL Hifi Engineering Inc. Integrated Sustainability

Power Generation/Transmission

E3 Metal Corp

INNOVATION & RESEARCH EXCELLENCE

Cleantech

AMGAS Services Inc. Bluesource Blue Spark Energy Inc. **Borealis Wind** Calfrac Well Services Ltd. Catapult Environmental Inc. CleanO2 Extreme Spill Technology Inc. (EST) GHGSat Inc. Interface Fluidics Limited **Keymay Industries** PTAC PETRONAS PTX Technologies Inc. Shawcor Composite Production Systems

STEP Energy Services

Digital Oilfield

Birchcliff Energy Ltd. Blacklien Safety Corp. Canadian Fibre Optics Corp. Compact Compression Inc. Fuelled GuildOne Inc. Osprey Informatics Ltd. Pandell Pason Systems Corp. Random Acronym Shawcor Composite Production Systems VizworX Inc.

Drilling through Completions

AMGAS Services Inc. Birchcliff Energy Ltd. Evolution Engineering Inc. InFocus Energy Services Inc. Interface Fluidics Limited OSP Microcheck Pason Systems Corp. Sandtinel Thruster Energy Corp.

Production

Birchcliff Energy Ltd. Compact Compression Inc. Sandtinel Shawcor Composite Production Systems

EXPORTING EXCELLENCE

Advanced Technology

Blue Spark Energy Inc. Chinook Consulting Services Ltd. Citadel Drilling Ltd. Sandtinel

Oilfield Services & Manufacturing

Arnett & Burgess Pipeliners Ltd. Belca Soft Corporation/RigER Chinook Consulting Services Ltd. Citadel Drilling Ltd. Master Flo Valve Inc. Sandintel Stream-Flo Industries Ltd.

Professional Services

Aon Cadeon Inc. Chinook Consulting Services Ltd. Tartan Completion Systems Inc.

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Displayco Canada

Explorers and Producers Association of Canada (EPAC)

Petroleum Services Association of Canada (PSAC)

Petroleum Technology Alliance of Canada (PTAC)

Saskatchewan Industrial and Mining Suppliers Association (SIMSA)

The Maritimes Energy Association



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