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Canada

Canadian Capabilities in End of Producing Life Well Technologies

Guide and Company Directory for the Oil and Gas Sector

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TRADE COMMISSIONER SERVICE (TCS)

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This document has been prepared by Petroleum Technology Alliance Canada (PTAC) for the Trade Commissioner Service, Global Affairs Canada.

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Introduction

A natural characteristic of oil and gas operations is that as older resources become depleted, new wells are drilled to replace them, leaving behind millions of legacy oil and gas wells of different types. In the US, for example, it is estimated that roughly 4 million oil and gas exploration and production wells, and an additional 1 million supporting wells[1], have been drilled since 1859. Of those roughly 5 million wells, over 3 million are no longer in operation with most of them having been plugged, capped, and abandoned, and the leases returned to other uses. However, there are also a substantial number of wells which are shut-in and non-producing; over 100,000 wells in the U.S. are estimated to be defined as "orphan wells", which require abandonment but where there is no clear responsible party with ownership of the wells. Responsibility for orphan wells usually reverts to the individual states to manage the required capping and plugging. Both the US states and Canadian provinces have policies dealing with the backlog, while in other global jurisdictions the fate of legacy wells is less certain. Ideally, all oil and gas related wells will eventually be plugged, capped, abandoned, and the sites reclaimed so there is no legacy of environmental problems related to the wells, and that the locations of the wells will be tracked for future reference. Many of the more challenging abandonments still require new technologies to address wells of various types, conversion of oil and gas wells to other uses, and due the wide range of onshore and offshore environments where currently active and legacy wells are found.

The global demand for new oil and gas resources is forecast by the US Energy Information Administration to continue increasing to at least 2050[2], even as the share of primary energy consumption generated from renewable energy sources grows. While a range of factors contribute to this forecast, it is primarily due to continued growth in energy demand by developing countries and the increased energy intensity of producing lower greenhouse gas (GHG) emission fuels. Other forecasts have different projections of future energy demands; however, it is clear that technologies for oil and gas operations will be in demand for a long time to come, making it a priority to develop and utilize more sustainable technologies at every level of production, including at the well.

Other new wells will be required in the future for a variety of reasons, not exclusively related to oil and gas production. For example, carbon capture and storage (CCS), lithium mining for battery manufacturing, nuclear waste disposal and other processes proposed to reduce GHG emissions will also require wells for producing, disposing of, and monitoring the environmental distribution and impacts of materials related to those processes. There is potential for reusing some oil and gas wells for other purposes, as long as the wells meet the needs of the new function. For example, depressurised oil and gas formations may be valuable for monitoring deeper CCS and other disposal zones, or used for storage of natural gas, hydrogen, or other materials. Often, oil and gas wells pass through many hydrocarbon and non-hydrocarbon bearing formations meaning these wells could be reused for a process requiring different geologic zones in the same well. Additionally, drilling and geologic records from oil and gas wells can be used to assess the potential for siting other types of wells in the same or nearby locations. For some new technologies, such as deep aquifer based CCS wells, the challenges of well abandonment are even more complex than for oil and gas wells, requiring new technology developments to address these challenges.

[1] https://visualizingenergy.org/four-million-wells-and-counting-the-history-of-oil-and-gas-drilling-in-the-u-s/#:~:text=If%20you%20count%20other%20types,closer%20to%205%20million%20wells.
[2] Based on US Energy Information Administration forecasts in 2021 https://www.eia.gov/outlooks/ieo/pdf/IEO2021_Narrative.pdf

The objective of this guide and company directory is to share Canada's experience and expertise in extending producing well life and end of producing life well repurposing, abandonment, reclamation, and post abandonment monitoring technologies, which have been or can be applied in the upstream oil and gas sector and could potentially be extended to non-oil and gas related wells. The guide highlights Canadian capabilities with the purpose of assisting both Canadian producers and other oil and gas producing countries in taking advantage of technologies in similar applications.

Dealing with End of Producing Life Wells in Canada

As in many other areas, Canada is known for having rigorous regulatory and environmental protection requirements for oil and gas development, which cover the entire lifecycle of a well, from exploration to abandonment, and even post-abandonment long-term monitoring. Producing provinces each have their own specific requirements for abandonment, based on the types of wells and geography of the areas surrounding the wells, which are continually being upgraded and enhanced based on experience and the development of new technologies. The Province of Alberta has the largest oil and gas well population in Canada with approximately 470,000 wells, and new wells are being drilled every year to add to this inventory. Currently, roughly a third of Alberta oil and gas wells are active, with about one fifth being certified as reclaimed, and the remainder shut-in and not currently producing. While every province and territory in Canada has at least a few exploratory wells, many that were drilled by the Geological Survey of Canada to inventory resource potential, the other main oil and gas producing provinces with onshore wells are[3]:

1. Saskatchewan with approximately 145,000 wells, roughly 20% of which are active;
2. British Columbia with approximately 30,000 wells, roughly 30% of which are active;
3. Ontario with approximately 27,000 wells, roughly 5% of which are active; and
4. Manitoba with approximately 12,000 wells, roughly 40% of which are active.

In 2022, Alberta oil and gas producers alone spent over C$700 million to move approximately 8,000 wells to fully abandoned and reclaimed status. About 50% of that amount was funded by the Federal government through a short-term C$1 billion Site Rehabilitation Program, intended to accelerate well abandonments and create employment to counter the effects of the COVID-19 pandemic on industry employment. Estimates for the total cost of abandoning wells in Alberta vary widely depending on the sources, methodologies, and projections for continued drilling and cost inflation, but range from C$30 billion up to C$90 billion. There are currently approximately 7,000 wells in the provinces which are designated orphan wells and their abandonment and reclamation is being undertaken by an industry-funded Orphan Well Association[4].

Policy and Regulation

Most jurisdictions have specific policy and regulatory requirements for well drilling, use, repurposing, abandonment, capping, and reclamation. A common challenge is a general reluctance by producers to abandon wells which might economically produce if commodity prices were to sufficiently increase, might be used for an alternate purpose or to access a different hydrocarbon bearing formation, or simply to conserve corporate cash

[3] Data on provincial well counts from provincial government websites as of 2024/01/29
[4] FAQs on the Orphan Well Association of Alberta https://www.orphanwell.ca/wp-content/uploads/2023/11/OWA-Fact-Sheet-2023.pdf

flows for drilling new wells. This is also true for orphan wells which are the responsibility of the provinces, as the pace of abandonment is balanced against other pressing demands for funding. As indicated above, Canadian jurisdictions like Alberta require all operators to pay into an orphan well fund to help fund abandonment and reclamation of wells in the cases where the well owner has gone bankrupt or is unable to cover the costs. Occasionally, repayable loans from government departments are used to fund abandonment and reclamation of wells. Requirements for abandonment in Alberta tend to also be followed by other Canadian onshore jurisdictions and can be found in the Alberta Energy Regulator Directive 20 Well Abandonment[5]. Descriptions below expand on reasons why shut-in wells may not be immediately decommissioned and abandoned.

Changes in Commodity Prices

Normally the decision to shut-in a well is based on the economics of whether remaining production revenues can sufficiently offset on-going operating and maintenance costs. Operating costs can increase due to high water production from a well as oil rates decline or high well maintenance costs as a well ages. With the volatility of oil markets in recent years it may be economic to restart a shut-in well if oil prices increase. With natural gas wells, pools are often shut-in as gas rates and wellhead pressures drop and it is uneconomic to add compression. However, as gas prices increase it may become economic to add compression to extend production. Changes in commodity prices may also trigger an operator to convert shut-in onshore assets to some type of enhanced hydrocarbon recovery method, as there are often still hydrocarbons in the depleted reservoirs (~70% in oil pools and 40-50% in gas pools on average in Canada). Enhanced recovery is a trade-off against getting the same or higher production by investing in drilling new wells. Maintaining economic production is a benefit to both the producer and the Crown or other holder of mineral rights receiving production royalties.

Alternate Uses

Depleted oil or gas pools may be used for other purposes after they can no longer produce economic volumes of oil. These uses may include:

1. **Zone Abandonment and Recompletion to Other Hydrocarbon Formations**
   There could be many hydrocarbon bearing formations underlying the same well location which could contain oil or gas. Wells are typically drilled to the deepest formation first, as they are generally the most productive. In some areas, the same producer may have access rights to the entire geologic column while in other areas a number of producers or mineral rights owners may control the rights in different formations over a range of depths. When the deepest zone is depleted and unlikely to provide additional economic production a well can be partially abandoned without abandoning it entirely, and a new zone can be opened higher in the well to gain additional production before full abandonment. Even when a well is fully abandoned and reclaimed there may be cases where it may be "re-entered" to avoid drilling a new well.

[5] Alberta Energy Regulator Well Abandonment Directive 20: https://static.aer.ca/prd/documents/directives/Directive020.pdf

2. **Water Disposal**
   Occasionally, wells can be converted to enable disposal of produced water, flowback water from fracturing operations, or wastewaters from other industries. In other cases, wells may be converted to water injection for enhanced oil recovery where water is injected to push or sweep remaining oil in the formation to remaining active producing wells.

3. **Storage**
   Wells may undergo conversion to storage zones for natural gas or oil to maintain strategic reserves, or pre-emptively for future hydrogen storage. Currently there is approximately 950 billion cubic feet (or 27 billion cubic meters) of gas storage in Canada to manage seasonal demand changes with the majority in Alberta (58%), Ontario (28%), and British Columbia (10%). A small amount of gas storage is also utilized in Saskatchewan and Quebec. Over 98% of the gas storage volume is contained in depleted gas reservoirs and the remainder is contained in salt caverns. In the US, there is about five times more natural gas storage capacity than in Canada. The U.S. also maintains strategic oil reserves to ensure a continuous supply even if oil imports are curtailed, or to offset the economic impacts of high oil prices.

4. **Production of Minerals or Thermal Energy**
   Aquifers encountered in many oil and gas wells can be potential sources of minerals such as lithium or various salts. Additionally, these aquifers can be potential sources of geothermal energy as the reservoirs may be at temperatures between 25°C to over 130°C depending on depth. These additional products can extend the economic life of a well by co-producing additional commodities, while oil and gas production is still occurring, or by converting a shut-in well to a new purpose.

5. **Carbon Capture and Storage (CCS)**[6]
   As CCS expands, some existing oil and gas wells may be converted to receive CO_2 in the form of gas, liquid, supercritical fluid, or carbonated water if they are found to be suitable for that purpose. They may also be useful to maintain and monitor pressures in gas or oil zones overlying CCS formations, helping to detect any CO_2 migration from the underlying sequestration zone.

Budget Priorities

Producers, mineral rights owners, and governments are also driven by budget priorities. When oil and gas prices are high, pressure mounts to increase production by drilling new wells, which inherently then reduces commodity prices. Abandonments take away funds, equipment, and personnel from new well drilling so are often undertaken when commodity prices are low and equipment and personnel are available, however, cash flows are also reduced during this time.

[6] Note CCS (Carbon Capture and Storage) is a subset of CCUS (Carbon Capture Utilization and Storage). In CCS the CO_2 injected is for disposal only and generates no direct economic benefit or useful products except potentially reducing GHG penalties.

Investment in Research and Development

The Canadian petroleum industry is heavily involved in research and development of new ideas and technologies, with oil and gas producers providing substantial investment in clean technology development. This includes associations, including Petroleum Technology Association of Canada (PTAC), Canada's Oil Sands Industry Alliance (COSIA), the Clean Resource Innovation Network (CRIN), and other organizations which provide a collaborative framework for developing appropriate technologies. These organizations assist entrepreneurs and companies at various stages of development, from start-up to testing and proving new technologies. A hurdle that many entrepreneurs face is in gaining access to field sites to test their technologies. Through these collaborative associations, technology developers have access to producers assets which enable them to develop and test their technologies. This is especially relevant for end of well life activities which are driven by regulation and where lower costs due to new and improved technologies are needed.

Industry Collaboration

One major attribute the Canadian oil and gas industry possesses and demonstrates for clean technologies is collaboration. There are many associations, such as the Canadian Association of Petroleum Producers (CAPP) and the Petroleum Services Association of Canada (PSAC), that enable employees and companies to easily associate with each other and develop solutions to address common issues. Federal and Provincial governments, as owners and regulators of the resource, are active in many of these associations and help to guide the discussions and suggest areas of research. Researchers are involved as well, providing the unique and detailed perspective on the science that the industry relies on to improve their performance. Technology vendors and service providers, highlighted in this guide, collaborate to understand the needs of industry and develop appropriate solutions. In this spirit of sharing and collaboration, technologies and services develop faster, and risk is shared between industry producers and the supply chain.

In recent years, several new initiatives have been created with the goal of encouraging the capping and reclamation of wells to reduce environmental impacts and potential future liabilities. Of note is Orphan Well Association in Alberta that was formed in 2002 to manage orphan wells and the CAPP, funded by PTAC facilitated Alberta Upstream Petroleum Research Fund (AUPRF), which supports collaboration and research in five key focus areas of: Well Abandonment, Reclamation and Remediation, Water, Air and Ecosystem issues.

Summary

Canada is contributing to the goal of enhancing the environmental performance of oil and gas operations by working to minimize the impacts of legacy wells on the landscape and return those lands to other productive or natural uses. Now, Canada has the opportunity to export these innovations and expertise to the world.

Important Clean Technology Areas Related to End of Well Producing Life

The following technology areas have been identified as those where Canadian companies have developed or deployed clean technology solutions in Canada and internationally for converting oil and gas wells to other purposes or returning them to natural landscapes. These areas cover a wide range of needs as conversion and abandonment are highly dependent on the type of well, its condition, and the state of the reservoir(s) it connects to at the end of its life. Key technology areas address both the downhole state of the well and the surface conditions, so that the legacy wells have minimal impact on follow up developments. End of well life technologies relate to either full capping of wells with abandonment and site reclamation, repurposing of wells to other uses, or monitoring of well locations post abandonment, along with research for development of technology improvements.

Assessment for Reuse for Other Purposes	Technologies to assess wells for other purposes before they are abandoned, primarily geological evaluations. It has been proposed that wells can be used for CCS, lithium production and geothermal energy (heating or low efficiency power production).
Producing Zone Plugging and Abandonment	Technologies such as cementing off of well perforations or plugs to permanently block well production zones, and to verify the integrity of intermediate barriers installed in wells to minimize the risk of communication with other zones.
Up-hole Capping for Abandonment	Alternate methods of cutting and capping well casings below the surface, which is a regulated requirement depending on assumed requirements of future land use.
Well Monitoring Pre- and Post-Abandonment	Process monitoring technologies to ensure that plugs, packers, or other barriers to flow are working. Technologies to check for any potential behind casing leakage of methane from shallower zones or indications of flows in the wells.
Surface Reclamation	Reclamation and monitoring of surface well sites for some period of time to ensure no problems are encountered that may require additional measures to ensure the site is viable for the alternate use.
Maintenance of Records	Technologies to ensure that abandoned well locations are know to urban planners and others wishing to avoid building on top of legacy wells. Also maintenance of geological and abandonment information from well records which may be useful in locating old or new wells.

Case Studies

These case studies provide examples of Canadian technologies and services applied in the field, along with the impacts on clients. In some examples, multiple technologies and services are used to provide the best solution to the client.

Well Conversion Technologies

ABCleanEnergy

Has a technology based on converting thermal wells which are no longer economic to steam or produce into a thermal energy recovery mode. Over the life of a thermal well, a great deal of steam or other thermal energy is injected to allow the bitumen or heavy oil to flow. Some of this energy is produced back with the oil and produced water, some would have been lost to surrounding formations over time, but a considerable amount has been stored in depleted formations where the remaining sand or rock retains the thermal energy. If the wells are shut-in, this energy will be lost to surrounding formations over time. Clean Power – Steam Assisted Gravity Drainage (CP-SAGD) uses a unique well completion to allow remaining energy to be recovered and converted to clean power similar to a geothermal well but with much more favourable economics, as the wells are already drilled and they are shallow and hotter than most deep geothermal wells.

General Energy Recovery Inc. (GERI)

Converts wells to low emissions recovery through single well enhanced oil recovery to increase energy production. A Direct Contact Steam Generator (DCSG) is deployed into a well to recover otherwise unrecoverable oil reserves by co-injecting steam and combustion gases to add heat, pressure, and CO_2 to the reservoir. Much of the CO_2 remains in the reservoir so the technology contributes to converting the wells to CCUS. Pilot tests have shown oil production increases with up to 70% of the CO_2 remaining in the formation. This requires no new drilling which reduces environmental impacts, all while utilizing combustion water and any produced water for heat transfer.

Inert Well Stimulation Ltd.

Has technology which can supply a high pressure stream of flue gas to wells, which can be used for immiscible or miscible well stimulation, water shut-off, or to provide inert gas for injection tests of aquifer formations for potential use for CCS. Systems consist of a natural gas or propane fired engine to provide power, while exhaust gas from the engine is treated and compressed for injection. This system can provide ~9 units of gas for injection for ~1 unit of gas burned as fuel, with no emissions. Units are fully relocatable.

Petrospec Engineering

Improves efficiency and safety in oil and gas production using their turn-key reservoir monitoring systems and various coiled tubing services. The Hot-Tube™: Downhole Electric Heating System can be used to improve project economics by enabling access to new reservoirs and improving oil production in low producing wells. The system can be used for heavy oil production optimization, in low pressure applications where steam is not practical, and to improve project economics for already drilled wells.

Canadian Capabilities in End of Producing Life Technologies

The following table lists the Products and Services available from Canadian experts to assist in the global effort to minimize the impacts of legacy oil and gas wells. Product categories below describe the type of products and processes available to enhance the quality of well abandonment and remediation while also reducing the costs associated with well abandonments to increase activities in this area. Service categories describe the solutions available to manage legacy well inventories in on-shore operations as they decline and are shut-in. Note that many of the products and services listed may also be applied to other types of legacy wells from solution mining, industrial disposal, and water supply wells.

Category	Description
Products	
Downhole Shut-off	Products such as specialized cement, packers, plugs, and other tools for blocking sub-surface well bores.
Casing Cutting, Salvage and Capping	Products used to cut casings sub-surface to allow capping.
Well Conversion to Other Purposes	Products for inspecting and recompleting or reconditioning wells for other purposes such as gas storage, geothermal, mineral recovery, or waste disposal.
Services	
Downhole Sensing	Methods and tools to verify flow shutoff as the abandonment process proceeds. Casing integrity logs and testing.
Surface/Aerial Sensing	Medium and long term monitoring of well leases to ensure no issues related to wells depending on the type and location. Location and assessment of abandoned wells where records are not readily available.
Reservoir/Geology	Assessment of wells pre-abandonment for potential value for additional oil and gas resources or other purposes such as CCS, lithium production, or geothermal.
Research	Primarily focused on new potential uses for wells to understand the potential effects of new fluids and gases such as CO_2, hydrogen, brine, or geothermal activities on existing wells or abandoned wells. Includes research on the impacts of injecting these materials into formations which are penetrated by abandoned wells or impacts of in-situ stresses on abandoned wells due to formation repressuring or temperature changes.
Asset Management	Improved asset management processes to ensure wells are reassessed before abandonment and that well locations, geological information and well completion information is available in the event there are other activities such as CSS in the local area which may affect abandoned wells.

Canadian Company Directory

The Canadian companies listed here have identified a primary product/service category, and each company is listed under its respective primary category. Each company has also identified additional products and services that it offers. Click on a company name to skip to its listing or website. Listing includes companies who have submitted summaries specific to this **Directory (in Bold)** as well as companies listed in the Canadian Energy Export Guide (*).

		Product Categories							Service Categories				
Company	Page Number	Downhole Shut-off	Casing Cutting, Salvage and Capping	Well Conversion	Gas Storage (H_2, CO_2, CH_4)				Downhole Sensing	Reservoir Geology	Surface/Aerial Sensing	Research	Asset Management
Directory													
ABCleanEnergy				■									
Blue Spark Energy Inc.													
General Energy Recovery Inc.				■									
Inert Well Simulation Ltd.					■								
Petrospec Engineering				■					■	■			
Energy Export Guide and Other Sources													
ATCO Gas Storage					■								
Barlon Engineering Group*		■	■							■			■
Capstone Blowout*		■	■						■	■	■		■
Challenger Technical Services*		■	■						■				
E2E Energy Solutions				■									
E3 Lithium				■									
Enbridge Gas Storage					■								

Futura Power														
Great Northern Power*														
Innervision														
Pluto Ground Technologies														
Precise Downhole Solutions														
ProFoxx Asset Retirement Management*														
Seal Well														
TC Energy Gas Storage														
Rock Point Gas Storage														

Canadian End of Producing Well Life Products and Services

ABCleanEnergy

https://www.abcleanenergy.com/

LOCATION
Edmonton, Alberta

PRIMARY CATEGORY
End Of Well Production

CONTACT INFORMATION
Alireza Nouri, President
anouri@ualberta.ca or
info@abcleanenergy.com
(780) 780-803 3239

SECONDARY CATEGORIES
Power Generation

COMPANY DESCRIPTION

ABCleanEnergy Inc. is an innovation company with a primary objective of inventing, developing or facilitating the implementation of new solutions to maximize energy efficiency and increase the sustainability of oil sands operations. ABCE's general interest is clean power generation to lighten environmental impact and reliance on costly alternatives. ABCE is particularly interested in clean energy solutions, including geothermal energy, energy recovery and alternative fuels.

ABCE's current focus is on groundbreaking invention related to "Clean Power Thermal (CP-Thermal)", which recovers end-of-life thermal energy stored in in-situ thermal oil sands or heavy oil reservoirs and uses that energy to produce power to support the concept of a circular energy economy in the oil sands. These systems are mainly based on utilizing existing components, such as wells at the end of their producing life and recovering energy remaining behind in the formations.

COUNTRIES EXPORTED TO:
Targeting the USA, China and other countries with in-situ thermal oil operations.

INTERNATIONAL APPLICATIONS AND EXPERIENCE

- Extensive international experience in petroleum geomechanics and consulting activities
- Offered training courses in the USA, China, Canada, Colombia, and the Middle East on Petroleum Geomechanics and Wellbore Stability
- Hired by Covington & Burling LLP for the Deep-Water Horizon investigation
- Conducted consulting work for BP America in locations such as the Gulf of Mexico, Azerbaijan, and Angola
- Provided analytical methods designing mechanical engineering systems for strength, stability and integrity.
- Designed professional tools, implemented, coordinated processes and activities for high quality products.

TECHNICAL CAPABILITIES

- Innovation in clean power generation technologies.
- Expertise in inventing, developing, and facilitating the implementation of sustainable solutions for oil sands operations.
- Specialization in clean energy solutions, including geothermal energy, energy recovery, and alternative fuels.
- Ability to utilize recovered thermal energy to produce power.
- Expertise is in wellbore completions, thermal reservoir modelling, and well energy transfer modelling.
- Capability of laboratory testing of wellbore and reservoir rock mechanics, completion performance, and wellbore integrity.
- Capable of designing power machine/tool and energy systems.
- Capability of creating new products/revising existing product for optimum performance.

Blue Spark Energy Inc.

www.bluesparkenergy.com

LOCATION
#130, 3510 29th Street NE
Calgary, Alberta
T1Y 5W4
Canada

PRIMARY CATEGORY
Well Integrity, Decommissioning & Reclamation

CONTACT INFORMATION
Amy Miller
a.miller@bluesparkenergy.com
1-403-719-8003

SECONDARY CATEGORY
Environmental Protection and Management

COMPANY DESCRIPTION
Blue Spark Energy is a trailblazer in the field of subsurface wellbore remediations. With proven results on over 650 projects for more than 50 companies worldwide, the innovative BLUESPARK® technology is driving transformative change in a responsible energy transition. By converting a small amount of electrical energy to create powerful effects downhole, Blue Spark can achieve results once unimagined in wellbore interventions.

Unlike traditional methods that rely on extensive preparation, logistics, people power, and the use of potentially harmful fluids, toxins, and explosives, our simple solution is safe to use, ensuring both wellbore integrity and longevity. With our targeted approach that focuses precisely where the impediments exist, we streamline the remediation process and reduce associated risks with a reduced carbon footprint.

Driven by our relentless pursuit to understand what is possible, we are challenging expectations and shattering conventions in the energy industry. Blue Spark Energy is inspiring energetic change as we continue to pave the way towards a sustainable future.

COUNTRIES EXPORTED TO
Austria, Azerbaijan, Bahrain, Brunei, Cameroon, Democratic Republic of Congo, Denmark, Equatorial Guinea, India, Iraq, Japan, Kuwait, Malaysia, Netherlands, Nigeria, Norway, Oman, Romania, Saudi Arabia, Turkmenistan, United Arab Emirates, United Kingdom, United States.

INTERNATIONAL APPLICATIONS AND EXPERIENCE
Blue Spark Energy has operated in 24 countries globally. We have sales representatives in the UK, Malaysia, and the USA in addition to our globally based, mobile field team. We have completed over 650 operations for 50 companies worldwide and continue to expand our footprint.

TECHNICAL CAPABILITIES
The **BLUESPARK®** technology converts a small amount of electrical energy from the surface to create powerful hydraulic impulses downhole.

That hydraulic impulse is a high-power shockwave traveling at more than 1,500 meters per second and is followed by a **+10,000psi** high-pressure pulse. These pulses can be repeated up to **12,000** times per run in the wellbore.

Delivering these rapid, high-power impulses at the precise depth where blockages or damage exist can be used to restore or enhance flow in the wellbore.

GERI (General Energy Recovery Inc.)

www.geri.com

LOCATION
Suite 850, 635-8th Ave S.W.
Calgary, Alberta
T2P 3M3

PRIMARY CATEGORY
End of Producing Well Life

CONTACT INFORMATION
hello@geri.com
1-403-297-0230

SECONDARY CATEGORY
Carbon Capture and Storage (CCS)

COMPANY DESCRIPTION

GERI is a Canadian Energy Transition Technology company that provides enhanced heavy-oil recovery solutions to simultaneously recover more oil and reduce GHG emissions. With a mission of "Recovering More, Emitting Less", we aim to enable oil producers to achieve the balance of boosting recovery, decarbonizing at speed, and ensuring healthy returns on abatement investments.

Our award-winning, multi-patented Direct Contact Steam Generation (DCSG) technology unlocks otherwise un-recoverable oil reserves at low carbon intensity by co-injecting a single stream of steam (or hot water) and combustion exhaust gases (CO2 and N2) into heavy oil reservoirs.

Most GHG emissions in thermal heavy-oil recovery are generated during the creation of high-pressure steam which is injected into reservoirs to get highly viscous oil to flow. By contrast, GERI's technology co-injects steam and combustion exhaust gases downhole, simultaneously improving the efficiency of oil recovery (by adding HEAT, PRESSURE and CO2) and mitigating the atmospheric release of GHGs, permanently storing much of the CO2 in the reservoir.

Initial pilots of GERI's DCSG technology have shown oil production increasing significantly over the baseline rate in all cases, with up to 70% of the CO2 injected downhole remaining underground.

Our DCSG technology also allows producers to extend the life of their existing resources, defer end-of-life remediation costs, and reduce the need for continuous exploratory drilling and new oil projects.

This game-changing innovation is highly portable, fits on a standard well lease and requires no new drilling, thereby limiting land disturbance and costly infrastructure investments. It can be applied to vertical and horizontal well types and can be deployed in both thermally and non-thermally cased wells.

GERI' DCSG technology offers a cost-effective energy transition solution that can rapidly reduce enhanced oil recovery (EOR) emissions. It is also proven and ready-to-go, today.

INTERNATIONAL APPLICATIONS AND EXPERIENCE

Outside Canada, there are more than 30 countries with significant heavy oil deposits that meet the initial screening criteria for GERI's DCSG technology: suitable oil density and a depth of less than 1000m. We are yet to deploy our DCSG technology internationally but look forward to global conversations and opportunities.

TECHNICAL CAPABILITIES

- Portable, Modular
- Fits within a standard well lease (35x45m footprint)
- Up to 40% improvement to SOR
- Up to 70% of CO_2 injected remains retained downhole
- 10 GJ/h heat injection
- 100 m^3/d (CWE) steam or 250 m^3/d hot produced water injection
- 56 e^3m^3/d non condensable gas (N_2 + CO_2)
- 7,000 kPa max injection pressure
- Reduced freshwater water requirements due to water generated from combustion
- Eliminates 100% of freshwater requirements when producing hot produced water

Inert Well Stimulation Ltd.

https://inertwellstimulation.ca/

LOCATION
Calgary, Alberta

PRIMARY CATEGORY
End Of Well Production

CONTACT INFORMATION
Trevor Kramer, President
tkramer@inertwellstimulaton.ca
(403) 542-4870

SECONDARY CATEGORIES
CCUS, Heavy Oil and Oil Sands Production

COMPANY DESCRIPTION
Inert Well Stimulation was formed to promote and supply relocatable Exhaust Gas Systems which capture flue gas from natural gas or propane fueled engines and treat and compress the gases for injection into wells. By capturing flue gas the volume of gas available for injection increases by a factor of nine and at the same time eliminates emissions from the units. Systems can be used for:

- Underbalanced Drilling – The original purpose of the system was to lighten drill fluid columns to avoid formation damage from drilling fluids entering well production zones.
- Flue Gas and Water Stimulation of Oil Wells – Injection of flue gas can mobilize oil remaining in the reservoir and allow it to be produced to surface and extend economic well life.
- Enhanced Gas Recovery – Flue gas is an economic means of maintaining pressure in depleting gas pools to allow increased economic gas production without requiring outside sources of injectant.
- Pressurizing In-situ Oil Sands Gas zones – To maintain SAGD and CCS steam chambers during final depletion.
- Injectivity Testing for Carbon Capture – Provides a steady supply of low cost injectant to establish the performance of CCS aquifer formations and wells before the expenditure of millions building pipeline infrastructure.

COUNTRIES EXPORTED TO
Looking to develop into the USA and other countries including potential offshore applications.

INTERNATIONAL APPLICATIONS AND EXPERIENCE
International applications are anywhere where there is an opportunity to extend production from existing formations through low-cost gas injection or to validate injection assumptions for emerging CCS applications.

TECHNICAL CAPABILITIES
Inert Well Stimulation takes great pride in our commitment to delivering high-quality services to our valued clients. With our team of industry-leading professionals, we have pooled expertise and resources, forming a strong ownership group that specializes in providing end-to-end project development solutions. From initial planning and design to final project execution and ongoing operations and maintenance, we have the know-how and experience to ensure that your project runs smoothly from start to finish. If you're looking for a trusted partner to help you realize your project ambitions, look no further than Inert Well Stimulation and our team of dedicated professionals.

Petrospec Engineering

https://www.petrospc

LOCATION
Edmonton, Alberta

PRIMARY CATEGORY
End Of Well Production

CONTACT INFORMATION
Scott Penny, General Manager
scott.penny@petrospec.com
(780) 904-5474

SECONDARY CATEGORIES
Power Generation, Monitoring, Heavy Oil and Oil Sands Production
In-situ Upgrading

COMPANY DESCRIPTION

Petrospec Engineering is an oilfield services and technology provider focused on improving efficiencies and safety in producing oil and gas resources worldwide. The company was established in 1997 and is a leading provider of turn-key reservoir monitoring systems to oil & gas operators producing unconventional resources globally.

1. Hot-Tube™: Downhole Electric Heating System - A field proven technology, delivered as a turn-key system, from the industry leader in downhole electric heating. Improve Project Economics: Access new reservoirs: Improve oil production; Lower capital costs; Eliminate water usage; Reduce Green House Gas emissions.
    - Hot-Tube™ is packaged in coiled tubing for the ultimate downhole heating system for fast deployment, repetitive deployment/retrieval, eliminate damage during deployment, isolate heating elements from produced fluids, integrate fiber optic, temperature and pressure sensors, inject solvents, diluents, acid of water through integrated but independent delivery lines
    - Custom Surface Power and Control Equipment is skid deployed combining commercially available SCRs, transformers, and other power conditioning equipment along with proprietary control modules. In-house design for purpose built units.
    - Applications in; Thermal oil applications, heavy oil production optimization, solvent floods, and low pressure applications.
    - Hot-Tube™ can be powered using intermittent renewables further cutting the GHG profile of the oil production.
2. **Power-Tube™** - a coiled tubing packaged and deployed ESP where all power, process connections and sensor cables are integrated within coiled tubing to allow for rapid hot, live well interventions. This allows for efficient, rig-less service operations, with significantly reduced pump change time and cost. Power-Tube can be combined with Hot-Tube in certain applications to further optimize completions cost.

COUNTRIES EXPORTED TO
United States (California, Alaska, Colorado, Utah), MENA region (Bahrain, Oman), Americas (Mexico, Argentina, Venezuela)

INTERNATIONAL APPLICATIONS AND EXPERIENCE
There are a wide variety of international applications in the United States, MENA, and the Americas that have helped operators reduce oil viscosity to increase production while reducing emissions.

TECHNICAL CAPABILITIES

Petrospec offers turn-key solutions encompassing scoping and front end engineering, manufacturing or integrating products and other technologies, installation using our own fleet of coiled tubing units, spoolers and a deep and capable field installation team. Lastly all products are followed by 24/7 engineering support for the life of the installation.

Canadian Energy Export Guide

The Canadian Energy Export Guide is a searchable database that represents more than 1000 Canadian companies that export products and services in the area of oil & gas and related clean technologies, from grass roots exploration, pipeline construction and operation, to end of production decommissioning, reclamation and remediation. The Canadian Energy Export Guide uses 12 primary categories and 60 sub-categories to identify Canadian companies that are exporting to international markets. The companies listed in this Canadian Capabilities in Clean Technology Directory can also be found online in the Canadian Energy Export Guide under the category of Clean Technology and Environmental Management.

Industry Partners

The following Canadian associations and organizations have members and/or are working in the area in assessing end of well life options for the oil and gas industry.

Canadian Association of Petroleum Producers (CAPP) is an industry association that advocates for economic competitiveness and safe, environmentally and socially responsible performance from its members.

Clean Resource Innovation Network (CRIN) was created to contribute to a future in which Canada is a global leader in producing clean hydrocarbon energy from source to end use.

Petroleum Services Association of Canada (PSAC) is the national trade association representing the service, supply and manufacturing sectors within the upstream petroleum industry. They also maintain the Canadian Energy Export Guide noted above.

Petroleum Technology Alliance Canada (PTAC) is an industry association with production, academia, government, regulator and technology vendor members. It leads the technology development of methane emission reduction devices, and research into many environmental areas. Of note is PTAC's Canadian Emission Reduction Innovation Consortium including 16 producers and 16 research organizations.