



CLEAN
RESOURCE
INNOVATION
NETWORK
(CRIN)

2019

IMPACT & STRATEGIC IMPORTANCE

Canada's oil & natural gas industry has an established track record for driving innovation

Canadian resourcefulness and ingenuity found a way to take the oil out of the sand and natural gas out of the rock. Oil and gas development was founded in technology and innovation, and has continued to drive improved environmental performance and bring prosperity to Canadians.

More energy & world-leading environmental performance

World energy demand will continue to grow and oil and natural gas will remain an important part of the global energy mix for the foreseeable future. Canada is well-positioned to provide the world with secure, reliable and affordable energy.

Canada's oil and gas sector has an opportunity to transform into a lower carbon, lower cost industry that is able to attract global investments for continued prosperity.

BUILDING ON A HISTORY OF COLLABORATION & INNOVATION

Alberta Oil Sands Technology and Research Authority (AOSTRA) pioneered many of the technologies used within in-situ SAGD projects through a collaborative partnership between the Alberta government, federal government, academia and industry.

Since 1995, significant investments in innovation have enhanced operational efficiencies — horizontal drilling, tailings management and multi-stage shale gas fracking, to name a few.

BUILDING ON A STRONG FOUNDATION TO ACCELERATE INNOVATION & ECONOMIC GROWTH

Alberta's oil and gas sector is a strong regional hub of innovation with national significance and global reach. With a critical mass of large businesses, small and medium enterprises (SMEs), financial institutions, and industry-relevant academic and research institutions with global reach, Alberta is already well-positioned as a large-scale innovation supercluster that is accelerating commercialization of new oil and gas technologies. Alberta has a diverse and skilled workforce and the opportunity to attract new investments, organizations and talent through a focused approach to enhance the sector's profile as a global innovation hub for specified research areas.

The Clean Resource Innovation Network (CRIN) is an industry-led network that leverages the oil and gas industry's strengths in large-scale industrial collaboration by aligning research and technology priorities, addressing gaps, and incenting innovation.

As a collaborative and inclusive approach to the energy innovation ecosystem, CRIN creates efficiencies to accelerate and deliver transformative solutions both within Alberta and the oil and gas nodes across Canada.

A LEADING SECTOR IN R&D INVESTMENT

- Number of patents related to extractive industries more than doubled from 2005 to 2010 (Calgary Economic Dev.)
- Leading R&D investor in the country with increased investments in R&D from 2009 to 2015 by more than 10 times (State of Nation report)
- Calgary has one of the fastest-growing and largest concentrations of workers and small businesses in the professional, scientific and technical services industry in North America (Calgary Economic Dev.)

OUR VISION AS AN INNOVATIVE ECOSYSTEM

Canada is the global leader in producing clean hydrocarbon energy from source to end use.

A strong value proposition

CRIN will accelerate the development of ground-breaking solutions by establishing industry priorities and connecting innovators within the ecosystem (researchers, investors, SMEs, governments, NGOs, other innovators) and resources (funding, talent, labs, and facilities) to focus on world leading environmental performance and cost competitiveness. This will ensure Canada's continued prosperity with new high-skilled, high-value jobs and produce economic diversity through spin-offs and increased technology exports.



CLEAN RESOURCE INNOVATION NETWORK (CRIN)

CURRENT CRIN MEMBERS & GROUPS BEING DIRECTLY ENGAGED FOR MEMBERSHIP

 <p>INDUSTRY ASSOCIATIONS</p> <ul style="list-style-type: none"> • Canada's Oil Sands Innovation Alliance (COSIA) • Petroleum Research Newfoundland & Labrador (PRNL) • Petroleum Technology Alliance Canada (PTAC) • Petroleum Services Association of Canada (PSAC) • Canadian Association of Oilwell Drilling Contractors (CAODC) 	 <p>PRODUCERS & EARLY ADOPTERS</p> <ul style="list-style-type: none"> • Oil & gas sector • Other sectors 	 <p>ACADEMIA</p> <ul style="list-style-type: none"> • McGill University • Memorial University • NAIT • Queen's University • SAIT • University of Alberta • University of Calgary • University of Regina • University of Toronto • University of Waterloo 	 <p>CAPITAL/ INVESTORS</p> <ul style="list-style-type: none"> • Commercial banks • Global funds • Granting councils (ERA, SDTC, NSERC, others) • Greentech funds • Oil & gas producers • Venture capital
 <p>INNOVATORS</p> <ul style="list-style-type: none"> • Small, medium enterprises (SMEs) • Oil & gas sector • Technology companies 	 <p>ACCELERATORS/ INCUBATORS</p> <ul style="list-style-type: none"> • Innovate Calgary • Technology Edmonton • Start-up Calgary • Start-up Edmonton 	 <p>THINK TANKS</p> <ul style="list-style-type: none"> • Energy Futures Lab 	
 <p>FEDERAL GOVERNMENT</p> <ul style="list-style-type: none"> • Innovation, Science & Economic Development Canada • Natural Resources Canada • Export Development Canada 	 <p>ALBERTA GOVERNMENT</p> <ul style="list-style-type: none"> • Alberta Economic Development & Trade • Alberta Energy Regulator (AER) 	 <p>RESEARCH INSTITUTES</p> <ul style="list-style-type: none"> • Alberta Innovates • CANMET • National Research Council Canada (NRC) • Saskatchewan Research Council (SRC) 	 <p>ECONOMIC DEVELOPMENT</p> <ul style="list-style-type: none"> • Calgary Economic Development • Edmonton Economic Development

*This chart is for illustrative purposes to demonstrate broad reach and subject to change.

Seizing the opportunities for exponential economic growth & industry benefits

Canada's vast natural resources, along with significant oil and gas investments, have brought prosperity to Canadians for decades. CRIN positions the oil and gas sector as a global leader and centre of expertise in developing clean hydrocarbons and clean energy.

We'll be attracting the world to Canada and the industry nodes to invest in oil and gas innovation, resulting in diversification and growing the Canadian economy as a heavy industrial, high-tech hub.

ECONOMIC IMPACTS OF THE OIL & NATURAL GAS INDUSTRY IN CANADA



The oil and natural gas industry is the largest single private investor in Canada.



ENERGY SECTOR CONTRIBUTION TO GDP:
6.1%



CONTRIBUTION TO GOVERNMENT REVENUES:
\$12 billion/year



DIRECT AND INDIRECT EMPLOYMENT:
533,000 Canadian jobs



CAPITAL EXPENDITURE:
\$81 billion in 2014,
\$45 billion in 2017



SUPPLY CHAIN:
Over **3,400** companies in Canada (outside of Alberta) providing goods and services to the oil sands.

Source: NRCAN, 2016 and CAPP

STRONG COMMITMENT TO WORLD-CLASS TECHNOLOGY LEADERSHIP

CRIN will invest to find and advance solutions mapped against industry priorities, aiming to address environmental and cost competitiveness challenges. Innovations are designed to result in transformational impacts on the sector and capture new export opportunities for Canadian technologies.

These activities will create value by fostering growth in the SME entrepreneurial sector, creating new employment, contributing to Canada's GDP, delivering increased revenue to governments in royalties and taxes, and investing in local communities through education, training and social benefits.

LEADERSHIP AREA	TECHNOLOGY OBJECTIVE	SPECIFIC TECHNOLOGY THEME	REDUCED WATER/LAND FOOTPRINT	IMPROVED ECONOMICS & COMPETITIVENESS	REDUCED GHG INTENSITY
1 ENVIRONMENTAL TECHNOLOGY	REDUCED IMPACT	Water technology development centre	H	M	L
		Novel land & wellsite remediation	H	M	
2 CARBON & ECONOMIC COMPETITIVENESS	DECARBONIZATION	Low to zero carbon hydrocarbon production to end use		M	H
		Methane monitoring, quantification & abatement		M	H
	ECONOMIC AND RESOURCE EFFICIENCY	Novel hydrocarbon extraction	M	H	H
		Digital oil & gas	M	H	M
3 ECOSYSTEM INVESTMENTS	INNOVATION EFFECTIVENESS	ALL	< Delivers improvements across all innovation areas >		

L=Low, M=Medium and H=High, refers to the expected impact of the specific technology theme on key strategic objectives.

LEVERAGING INVESTMENTS RESULTS IN CONTINUED PROSPERITY

Canada's oil and gas industry continues to demonstrate its exceptional commitment to technology and innovation, having spent \$1.3 Billion in research and development in 2015 alone. These continued investments in specific focus areas and leveraging other funding opportunities with academia, venture capitalists and government will advance the oil and gas sector more rapidly into a lower carbon, lower cost industry.

That industry investment translates into more activity on the ground by enabling the innovation hubs, technology solution companies and SMEs to prosper — resulting in more capital investments, job growth and economic spin-off opportunities.

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