2025 Going Global

Report Update

PTAC PETROLEUM TECHNOLOGY ALLIANCE CANADA

Global Affairs Canada
Trade Commissioner Service

Affaires mondiales Canada
Service des délégués commerciaux

Alberta Canada

CGEF CANADIAN GLOBAL ENERGY FORUM

ENSERVA™

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Message from **PTAC**

PTAC Petroleum Technology Alliance Canada is a neutral, non-profit association dedicated to managing and facilitating innovation, collaborative research, and technology development, demonstration, and deployment for a responsible Canadian hydrocarbon energy industry.

For nearly three decades, PTAC has helped enhance operational performance, environmental stewardship, and cost-effective innovation across Canada's oil and gas sector. Through its diverse membership base, PTAC has cultivated an innovation ecosystem that connects stakeholders to identify challenges, explore opportunities, and drive collaboration to address industry's most pressing needs.

PTAC's work supports a clear vision: to position Canada as a global technology leader in the oil and gas sector while enabling more sustainable and environmentally responsible practices.

PTAC 2023-2024 Results

Our contribution to this report reflects our ongoing commitment to supporting small and medium-sized enterprises (SMEs) operating within the Canadian energy industry and facilitating the adoption of Canadian cleaner technology.

We are proud to be a part of this important initiative, which will not only facilitate the export of Canadian technologies but also showcase Canada's leadership in collaborative technology innovation on a global scale.

With gratitude,

Lauren Savoie
President & CEO

PTAC PETROLEUM TECHNOLOGY ALLIANCE CANADA

Message from **CGEF**

The Canadian Global Energy Forum (CGEF) is the only registered organization that serves and promotes Canadian junior and intermediate energy companies internationally. Our organization extends across Canada and includes 65 corporate, associate and individual members. CGEF facilitates cooperation between Canadian international energy companies, and associated equipment and services, through the promotion of Canadian energy and cleaner-tech expertise and technology abroad and by seeking strategic opportunities for Canadian companies in CGEF's focused markets. CGEF supports its members and grows the energy industry by hosting and participating in events that drive business development and networking opportunities.

CGEF is a 100% volunteer run organization and has over the course of its existence reached far beyond the Canadian borders to complete valuable projects including monthly webinars, Global Energy Show Markets (GESM) participation, Going Global participation, Global Opportunities (GO) Report Series Project, annual conferences and participation at international events, where CGEF develops and maintains relationships that attract key people in foreign National Energy Companies (NECs) and regulatory agencies to become interested in, and to support, Canadian-based energy companies' ability to compete for opportunities in those host countries.

CGEF embraces the many, new opportunities offered by the current energy transition as we approach 2050 net zero targets. We continue to expand our mandate and membership by including new and renewable energy sources while bringing environmental, social and governance (ESG) and corporate social responsibility (CSR) best practices and cross over technologies to the global stage.

CGEF is delighted to be part of this continuing “Going Global” initiative alongside PTAC, GAC, Prairies EDC, Enserva and the Government of Alberta. We hope you will benefit from this update and that the information will inspire your company to leverage your technical expertise and grow internationally.

Roger McMechan

President

CANADIAN GLOBAL ENERGY FORUM

Message From **Enserva**
"The energy behind the energy"

Welcome to the latest edition of Going Global. As we look out at the global energy landscape in 2025, it is clear that oil and gas continue to be vital to meeting the world's growing energy needs. Canada, as a leading energy producer, plays a crucial role in supplying that energy responsibly.

However, we cannot look at meeting this rising demand with a choice between oil and gas or renewables—it's about using every energy source responsibly and sustainably. Canadian energy services have long been at the forefront of this balanced approach. The knowledge and expertise developed within our oil and gas sector have given rise to new, cleaner technologies and more efficient practices.

Canada's energy services sector has a history of exporting cutting-edge solutions, from horizontal drilling to heavy oil production. Now, we have the opportunity to extend that legacy with our advanced technologies for oil and gas. The knowledge and innovation that originated in our traditional energy sector are now driving advancements in cleaner, more efficient technologies, helping to lower emissions and reduce the environmental impact of energy production.

Our industry has long operated under some of the world's highest environmental standards. By constantly improving operational efficiency and adopting new technologies, Canadian energy companies are reducing emissions and optimizing the use of resources. This puts us in a unique position to export our knowledge and lessons learned around the world, helping other nations meet their energy needs while being responsible users of our natural resources.

As demand for energy continues to rise, particularly in emerging markets, responsibly produced Canadian energy offers a reliable and affordable solution. It's not just about meeting domestic needs; it's about stepping up to support global economic growth and improve standards of living. By sharing our expertise, technologies, and values, we contribute to a more secure and sustainable future for everyone.

Canadian energy is not merely an asset for our country; it is a solution for the world. Working together, we can unlock its full potential and help build a brighter future.

Enserva represents Canada's energy services, supply, and manufacturing sector. Our members are the energy behind the energy, and we are proud to be a continued partner in the Going Global series.

Gurpreet Lail

President and CEO

ENSERVA™

Acknowledgements

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We extend our deepest appreciation to the authors, Julia Weissenberger at **PTAC** and Bruce Peachey at **New Paradigm Engineering**, whose dedication, expertise, and thoughtful analysis shaped the foundation of this work. Special thanks are due to Marc Godin, Christine Hoeppner, Marianna Trujillo, Bhavjit Kailey and Braden Kimoff at PTAC, whose editorial support and visual contributions significantly enhanced the clarity and quality of the final report.

We would also like to recognize the contributions of the advisory committee members: Nicole Harbauer, Greg Mann, Peter Cahill, and Ian Murdoch, from the **Trade Commissioner Service**; Ryan Ward, Jacob Diner, Baharnesh Teshome, Julia Hassard, Karina Laudahn, from **Global Affairs Canada**; Benigno Rojas-Moreno, from the **Government of Alberta**; Gurpreet Lail and Taylor Hides from **Enserva**; Tim Hazlett from **PrairiesCan**, and Kevin Borger from **CGEF**. We are grateful for their invaluable guidance, strategic insights, and critical perspectives throughout the research process. Their support ensured the report remained grounded, rigorous, and aligned with broader objectives.

This report is the product of a collective effort, and we are thankful to all who played a role in bringing it to completion.

A Note from
Global Affairs Canada

Whether you're looking to export, invest abroad, attract investment or develop innovation and research and development (R&D) partnerships, the Government of Canada's Trade Commissioner Service's global network of business professionals can help.

The Canadian Trade Commissioner Service (TCS) helps companies navigate the complexities of international markets and make better business decisions. The TCS is on the ground in more than 160 cities worldwide, helping gain market intelligence, uncover opportunities for Canadian companies and help reduce business costs and risks. The TCS is a free service of the Government of Canada, helping companies to prepare for international markets, assess market potential, find qualified contacts and resolve business problems. Learn more at www.tradecommissioner.gc.ca.

Global Affairs Canada
Trade Commissioner Service

Affaires mondiales Canada
Service des délégués commerciaux

Executive Summary

Canada's clean technology story is rooted in practical problem-solving. At home, our energy sector has developed solutions to cut emissions, use water wisely, and run operations more efficiently—innovations now well-tested in real conditions and ready for the world. This report, an update to Alberta's 2018 Going Global study, helps Canadian small and medium-sized enterprises (SMEs), exporters, and policymakers focus their efforts where demand for these solutions is strong and growing.

What this report covers

We analyze 17 priority markets selected for their scale, near-term demand, and openness to Canadian technology and energy exports: **Australia, Argentina, Brazil, China, Colombia, Ghana, Guyana, Indonesia, Iraq, Kuwait, Malaysia, Mexico, Nigeria, Pakistan, Saudi Arabia, the United Arab Emirates**, and the **United States**. For each, we summarize the energy mix, trade flows, transition plans, emissions-reduction and net-zero targets, and near-term opportunities for Canadian companies—all viewed through an energy-transition and environmental-management lens. The report draws on insights from Canadian Trade Commissioners and an advisory committee of Canadian industry and government partners.

Why now?

Countries are moving to cut emissions and improve energy security. Canada's own commitments—including ambitious reductions in oil and gas methane emissions by 2030, a nationally determined contribution (NDC) of a 40% economy-wide greenhouse gas (GHG) reduction (from 2005 levels) by 2030 and reaching net-zero by 2050—have accelerated innovation at home. Those technologies—many de-risked in tough Canadian conditions—are in demand abroad.

What we have found

- **Broad, near-term demand for practical decarbonization**. Across regions, buyers are seeking technologies that deliver measurable results quickly: methane detection and reduction, Leak Detection and Repair (LDAR) and digital monitoring, carbon capture and storage (CCS/CCUS), energy efficiency and electrification, water and waste management, and digital intelligence that increase reliability and cut costs.
- **Market-specific openings**. Examples include offshore and pipeline integrity in Brazil; hydrogen, storage, and grid modernization in Australia; CCUS, hydrogen, and large-scale renewables in Saudi Arabia and the UAE; geothermal and industrial efficiency in Indonesia; emissions tracking and small-scale CCUS in Colombia; gas-to-power and grid upgrades in Ghana and Nigeria; and methane abatement, CCUS, and infrastructure in the United States.
- **Financing and partnerships matter**. Many markets favour solutions delivered with a credible local partner and clear financing. Perceptions that Canadian technology is "premium-priced" can be

overcome with proof of lifecycle value, performance data, and creative funding (e.g., export finance, blended capital).

- **Policy environments vary**. Most countries are tightening climate and methane rules, but the pace and policy direction differ. Companies should track local regulations, permitting timelines, and content requirements, and expect adjustments over election cycles.

What this means for Canadian SMEs

- Lead with **evidence**: real-world performance, measurable emission reductions, and a clear payback period.
- Build **local relationships** early—work with local sales representatives, engineering, procurement and construction firms, and long-term buyers—and plan for after-sales support.
- Make adoption easier by offering **financing options** alongside proposals, such as export credit, buyer financing, or leasing.
- Prioritize **practical solutions**: durable, low-maintenance equipment that is simple to install and integrate with existing systems.

The Bottom Line: Global demand for Canadian cleaner technology is rising— especially solutions that reduce emissions in oil and gas and strengthen energy systems. With targeted market entry, credible partners, and bankable value propositions, Canadian firms can grow exports, create jobs at home, and help partners abroad meet their climate and energy goals.

Introduction

Canada is emerging as a powerhouse in cleaner and more efficient energy technology, a result of sustained investment in energy transition solutions and efforts to reduce greenhouse gas and methane emissions. Endowed with extensive natural resources, including significant energy reserves, Canada has historically transformed the complexities of these resources into pioneering energy innovations, products, and services that are now **exported to over 100 countries**.

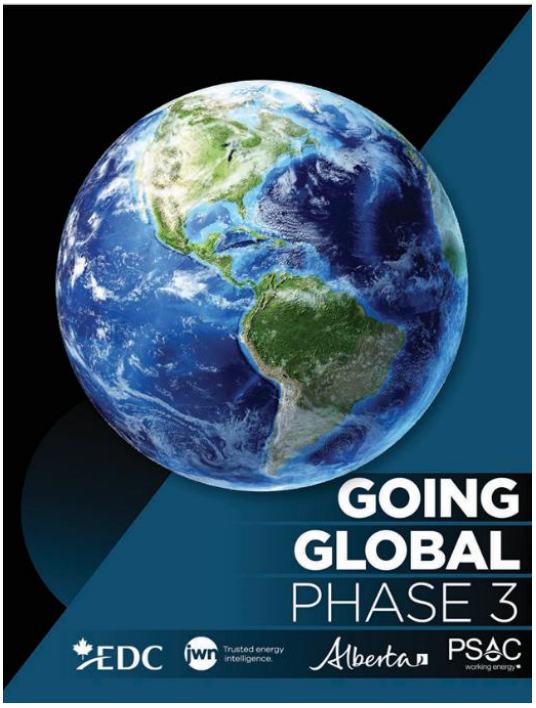
In its commitment to combating climate change, Canada's current plan focuses on reducing methane emissions from the oil and gas industry. This is a critical move toward achieving its ambitious national targets: a **40% reduction in overall GHG emissions below 2005 levels by 2030, and ultimately, net-zero emissions by 2050**. Reaching these goals necessitates the development of innovative and effective environmental and energy transition technologies. Crucially, many of these de-risked and commercialized products and services were first developed in Canada to meet its own needs, making them thoroughly tested and export-ready for the global market.

Canada's strength and expertise in cleaner energy technology also represent a significant opportunity to contribute to the global strategy against climate change. As both a global cleaner-tech leader and a developed nation, Canada is dedicated to sharing its knowledge and technology with other countries, particularly developing nations.

This international support is essential for the effectiveness of global efforts to reduce emissions, address inequalities, and mitigate the impacts of climate change worldwide.

Scope, Approach & Methodology

The original "Going Global" reports were commissioned by the Alberta Government in 2017 to identify potential export markets for oil and gas technologies and services.



These reports were prepared by JWN and were edited by CGEF and the Petroleum Services Association of Canada (now Enserva). Further sponsorship was provided by the Business Development Bank of Canada, Export Development Canada, and Global Affairs Canada.

The previous Going Global reports were published in three phases. Phase 1 identified the most promising markets for export, and Phase 2 further analyzed these markets across a range of indicators. Phase 3, which was published in 2018, combined and updated the information presented in Phases 1 and 2. It also provided an in-depth analysis of the United States market, which was determined as the most attractive market for Canadian exports.

This publication aims to update the Phase 3 report. It provides updated oil and gas market metrics for the countries determined to be the most ideal (best opportunity and "High-Return/Low-Risk") markets in the previous reports. These markets include Australia, Colombia, Mexico, the United Arab Emirates, and the United States. It also presents information on other potentially ideal markets as recommended by the advisory committee. These additional markets are Argentina, Brazil, China, Ghana, Guyana, Indonesia, Iraq, Kuwait, Malaysia, Nigeria, Pakistan, and Saudi Arabia. Given the global shift towards emissions reduction, this report focuses on clean technology market information and presents all information through an energy transition and environmental management lens.

This report also presents Canada's expertise as a leader in energy-related cleaner technology and provides example technologies across the areas of energy technology that are most relevant internationally. The intended audience for this report will be expanded to include all Canadian companies, particularly small and medium enterprises (SME's), with export-ready clean technology developed for energy markets. This publication also serves as a tool for trade commissioners and policymakers who are looking to enhance and promote the export of Canadian cleaner technology.

Canadian innovators, small and medium-sized enterprises (SMEs), policymakers, and exporters can make practical use of this report to expand their business and exports, and to create new jobs by leveraging its comprehensive market insights and strategic guidance. For SMEs and exporters, the report helps them focus their efforts where demand for Canadian cleaner technology solutions is strong and growing by analyzing 17 priority markets selected for their scale, near-term demand, and openness to Canadian cleaner-tech and energy exports. It provides market-specific opportunities such as methane detection and reduction, carbon capture and storage (CCS/CCUS), energy efficiency, and digital intelligence

across various regions, along with insights into financing, partnerships, and policy environments. The report advises these firms to lead with evidence of real-world performance, build local relationships, and develop creative financing options. For policymakers, the report serves as a tool to enhance and promote the export of Canadian cleaner and more efficient technology, showcasing Canada's strength in collaborative technology innovation on a global scale. It outlines Canada's expertise in various technology areas like carbon capture, environmental management, methane emissions reduction, and offshore technologies, which are export-ready and de-risked through testing in tough Canadian conditions. By supporting the export of these advanced technologies, the report facilitates their adoption abroad, which in turn helps create jobs at home. The report emphasizes that with targeted market entry, credible partners, and bankable value propositions, Canadian firms can grow exports, create jobs at home, and help international partners meet their climate and energy goals.

This report provides an overview of the energy industry for each of the 17 selected countries. These overviews include energy production mix, energy imports and exports, plans for energy transition, emissions reduction commitments, and current opportunities for Canadian oil and gas and clean technology companies. The aim is to present a fact-based, objective, and non-political summary of the status and short-term future of each country’s energy industries and their openness to import Canadian technologies.

The advisory committee for this project was comprised of representatives from the organizations listed in the table below. This committee provided advice on the selected countries and information that informed the writing of the report. The main sources of the information for this document were the Canadian trade commissioners of each country (contacted either directly or through Global Affairs Canada), internal and public reports from the advisory committee members and official online sources (see reference section).

Organization	Description and Expertise
Alberta Ministry of Jobs, Economy and Trade, Trade, Export and Expansion Branch	The Government of Alberta's Trade and Export branch helps local businesses expand globally by providing market insights, strategic support, international connections, trade missions, and access to funding programs.
Canadian Global Energy Forum (CGEF)	CGEF takes Canadian energy expertise and technology around the globe by facilitating internationally focused networking and learning opportunities for Canadian energy companies and service providers. They host dynamic events in Canada and attend international conferences to promote the Canadian industry globally.
Enserva	Enserva is the national association representing the service, supply, and manufacturing sectors of the Canadian energy industry.
Global Affairs Canada	Global Affairs Canada defines, shapes and advances Canada's interests and values in a complex global environment. They manage diplomatic relations, promote international trade and provide consular assistance. They lead international development, humanitarian, and peace and security assistance efforts. They also contribute to national security and the development of international law.
Trade Commissioner Service	
New Paradigm Engineering	A consulting company focused on providing unique solutions to non-standard problems. With over forty years of experience, New Paradigm provides insight by challenging the status quo and asking tough questions to find the why not answers.
Prairies Economic Development Canada (PrairiesCan)	Prairies Economic Development Canada (PrairiesCan) is the department that diversifies the economy across the Canadian Prairies. PrairiesCan leads in building a strong, competitive Canadian economy by supporting business, innovation and community economic development unique to Alberta, Saskatchewan and Manitoba.
Petroleum Technology Alliance Canada (PTAC)	Petroleum Technology Alliance Canada (PTAC) is a neutral, not-for-profit association dedicated to managing and facilitating innovation, cooperative research, technology advancement, demonstration, and implementation for a responsible Canadian hydrocarbon energy industry.

Country Profiles

North America

United States

The United States is one of the most dynamic and influential players in global energy. As the world's largest producer of oil and natural gas, a major exporter of LNG, and a rapidly growing clean energy market, the U.S. combines resource abundance with technological innovation. Its evolving regulatory landscape and climate policy decisions are reshaping the energy sector, creating far-reaching implications for international trade, emissions reduction, and cleantech collaboration. For Canadian companies, the U.S. offers proximity, familiarity, and unparalleled opportunity across both conventional and low-carbon energy domains.

Oil and Gas: Growth, Innovation, and Export Strength

The United States produced 13.2 million barrels of oil per day in 2024, making it the world's top producer. Output is driven by shale basins such as the **Permian, Bakken, and Eagle Ford**, where advanced drilling and hydraulic fracturing technologies have unlocked massive unconventional reserves.

Natural gas production was nearly 38 trillion cubic feet in 2024 (113 billion cubic feet per day). The U.S. is now the world's largest LNG exporter, with terminals along the Gulf Coast serving markets in Europe, Asia, and Latin America. Pipeline infrastructure also supports significant exports to Canada and Mexico.

The U.S. refining sector is among the most sophisticated globally, with capacity concentrated in Texas, Louisiana, and California. While demand for fossil fuels remains high, decarbonization and fuel substitution trends are influencing investment in alternative fuels, bio-refineries, and carbon-reduction retrofits.

Energy security, price stability, and emissions performance remain key drivers of federal and state policy. In this environment, technologies that improve efficiency, reduce methane emissions, and support cleaner fuels are increasingly in demand.

Climate Policy and Net-Zero Commitments

The landmark Inflation Reduction Act (IRA) of 2022 provides over US$370 billion in tax credits, grants, and loan guarantees for clean energy deployment, manufacturing, and emissions reduction. It is one of the most significant climate investments in U.S. history.

Complementary legislation—including the Bipartisan Infrastructure Law and CHIPS and Science Act—further supports energy innovation, domestic manufacturing, and grid modernization.

In 2025, policy started to evolve at the federal level. However, state-level leadership remains strong. California, New York, Colorado and Washington are among the jurisdictions advancing aggressive targets for renewable energy, electrification, and zero-emissions transportation.

Together, these measures are accelerating private investment and demand for cleantech solutions across sectors—from utilities and oil and gas operators to heavy industry and transportation networks.

Innovation and Clean Technology Leadership

The U.S. is a global leader in clean energy R&D, commercialization, and deployment. With world-class universities, national labs, and private-sector innovation hubs, the country drives advancements in:

- **Carbon Capture, Utilization, and Storage (CCUS)**
- **Green and Blue Hydrogen Production**
- **Renewable Power and Grid Integration**
- **Battery Storage and Long-Duration Energy Systems**
- **Methane Emissions Monitoring and Abatement**
- **Digital Twins, AI, and Predictive Maintenance in Oil and Gas**
- **Biofuels, RNG, and Sustainable Aviation Fuel (SAF)**

Federal agencies such as the Department of Energy (DOE) and ARPA-E fund early-stage technologies, while state programs—especially in California, Texas, and New York—provide targeted support for commercialization and regional deployment.

This ecosystem of innovation creates space for collaboration, supply chain partnerships, and export development for foreign firms with complementary solutions.

Energy and Cleantech Opportunities

The U.S. remains the world's most mature and competitive cleantech market. Yet, its size, regional variation, and incentives continue to create entry points for foreign firms—especially those offering cost-effective, scalable, and proven solutions. Key areas include:

- **Upstream Oil and Gas**: Methane mitigation, digital optimization, and low-carbon extraction
- **LNG and Pipelines**: Cryogenic systems, leak detection, and emissions monitoring
- **Carbon Management**: Capture systems, transport networks, utilization technologies, and MRV tools
- **Hydrogen**: Electrolysis, fuel cells, storage, and system integration
- **Renewables**: Balance of system components, software, and EPC partnerships
- **Grid Solutions**: Smart inverters, energy management, and transmission upgrades
- **Energy Storage**: Battery chemistry, thermal storage, and dispatch optimization
- **Industrial Decarbonization**: Waste heat recovery, electrified equipment, and process redesign

There is also growing demand for ESG advisory, carbon offset validation, and clean technology financing tools.

Market Considerations for Canadian Companies

The U.S. is Canada's largest trading partner and closest energy ally. Cross-border supply chains, shared infrastructure, and regulatory compatibility make the market accessible to Canadian exporters and investors. However, the U.S. is highly competitive and regionally fragmented. Success often depends on forming local partnerships, securing project-level financing, and tailoring offerings to specific state and sector needs.

Many public programs—particularly those under the IRA—offer preferential access to U.S. entities, making joint ventures, local subsidiaries, or technology licensing strategic options for Canadian firms. IP protection, product certification, and tax compliance are important operational considerations.

The Canadian Trade Commissioner Service and provincial export agencies can provide targeted support for firms entering or expanding in the U.S. market.

An Energy Giant Accelerating Its Transition

The United States remains a dominant force in traditional energy while rapidly scaling low-carbon technologies. Its policy landscape, industrial capacity, and investment momentum position it as a global leader in both oil and gas and the energy transition. For Canadian firms with proven technologies and flexible business models, the U.S. represents not just a market—but a partner in shaping the future of energy.

UNITED STATES OF AMERICA

Emissions Reduction and Net Zero Commitments

- 61-66% GHG emissions reduction **by 2035**, below 2005 levels
- Net-zero emissions **by 2050**

Key Export Opportunities for Canadian Companies

- **Pipeline** construction and infrastructure
- Environment technologies such as **CCUS** and **water management**
- **Methane leak** reduction

(subject to change under the current administration)

Domestic Energy Production*

- Coal 12.6%
- Crude oil 33.6%
- Natural gas 36.8%
- Nuclear 9.1%
- Hydro 1.0%
- Wind, solar, etc. 2.9%
- Biofuels and waste 4.0%

2023:

$15 BILLION

of Canadian Cleantech Imported^

Crude Oil°

Daily Production: **13,200,000 BOE**
Proven Reserves: **47.1 billion BOE**
5-Year CAGR: **5.3%**

22 Active Canadian O&G Companies†

Natural Gas°

Annual Production: **37.8 trillion ft³**
Proven Reserves: **462.6 trillion ft³**
5-Year CAGR: **5.3%**

* IEA, 2021 ^ Statistics Canada ° EIA, 2024 † CGEF, 2022

Mexico

A Strategic Energy Player Caught Between Tradition and Transition

Mexico sits at a crossroads of energy abundance, geopolitical significance, and evolving environmental responsibility. With vast hydrocarbon reserves, a world-class manufacturing base, and proximity to the U.S. market, the country remains a key energy player in the Americas. Yet recent policy shifts have re-emphasized state control and traditional fuels, complicating Mexico's path toward energy diversification and climate action.

Despite these challenges, the country's expanding energy demand, emissions commitments, and deep integration into North American supply chains continue to create opportunity for international firms—particularly those offering technology and services that enhance operational efficiency and environmental performance.

Oil and Gas: National Strength, State Control

Mexico holds 6.1 billion barrels of proven oil reserves, ranking fourth in the Americas after Venezuela, Canada, and the United States. Oil production was 1.94 million barrels per day in 2021, with most output originating from offshore fields in the southern Gulf of Mexico.

State-owned **Petróleos Mexicanos (PEMEX**) dominates the sector, controlling nearly 90% of crude oil production. In recent years, the Mexican government has rolled back liberalization efforts, limiting the scope of foreign investment in upstream activities and shifting focus to reviving PEMEX's refining capacity.

Despite nationalistic policies, international oil companies (IOCs) continue to hold exploration and production contracts in key basins. The Zama field, co-owned by Talos Energy, Harbour Energy, and Wintershall Dea, remains a prominent example of private-public collaboration in deepwater development.

Mexico is a net exporter of crude oil but imports a significant share of refined products—mostly from the United States. Refinery upgrades and the completion of the Dos Bocas refinery aim to reduce import dependence and improve domestic fuel security.

Natural Gas: Expanding Demand, Rising Imports

Natural gas is increasingly central to Mexico's energy mix, powering over 60% of electricity generation and supplying the growing industrial base. While the country has considerable onshore and offshore gas reserves, production has struggled to keep pace with demand, prompting record-high imports—primarily via pipelines from Texas.

Mexico is actively expanding its gas **pipeline infrastructure**, particularly in northern and central regions, to support manufacturing, **energy generation**, and **LNG export** ambitions. New regasification and storage projects are also in development to enhance energy security and market flexibility.

With high demand for clean and affordable energy, Mexico's gas sector offers near-term opportunities for investment, services, and infrastructure development—especially in regions underserved by existing networks.

Emissions Goals and Renewable Energy Uncertainty

Mexico has committed to reducing greenhouse gas emissions by 35% below business-as-usual levels by 2030 and achieving net-zero emissions by 2050. However, recent energy policy has prioritized fossil fuels and state-owned generation over private renewable projects, resulting in regulatory uncertainty and stalled development.

Nonetheless, Mexico retains strong potential for solar, wind, and geothermal power. Industrial firms and subnational governments continue to pursue clean energy goals independently, creating niche markets for technology and services that reduce energy costs and emissions—particularly in export-driven sectors.

Hydrogen and carbon capture, utilization, and storage (CCUS) remain in early stages of policy development, but exploratory initiatives are underway.

Energy and Cleantech Opportunities

Mexico's complex but dynamic energy landscape presents several opportunity areas for Canadian and international firms, including:

- **Upstream Services**: Enhanced oil recovery (EOR), subsea engineering, and production optimization
- **Gas Infrastructure**: Pipeline construction, compression systems, and metering
- **Refining Technologies**: Emissions reduction, desulfurization, and waste heat recovery
- **Industrial Energy Efficiency**: Smart manufacturing, process optimization, and electrification
- **Renewables**: Off-grid solar and wind for commercial and industrial clients
- **Water-Energy Nexus**: Wastewater treatment and water reuse in energy operations
- **Emissions Management**: Monitoring, reporting, and abatement technologies
- **Carbon Markets and ESG Advisory**: Voluntary offset development and sustainability frameworks

Mexico's advanced manufacturing sector—particularly in automotive, aerospace, and electronics—also demands energy-efficient and low-emission solutions, opening additional entry points for cleantech firms.

Market Considerations for Canadian Companies

Mexico offers strong fundamentals for trade: it is a party to the Canada–United States–Mexico Agreement (CUSMA) and a member of the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP). However, the regulatory environment is evolving. Recent changes have introduced uncertainty in permitting, contract enforcement, and interconnection for private energy projects.

The market rewards cost-competitive, proven solutions. Canadian firms may need to offer flexible financing or joint venture models to succeed. Strong local partnerships and in-country representation are essential, especially in navigating political sensitivities and bureaucratic hurdles.

Canadian companies are well regarded, particularly in oilfield services, engineering, and environmental technologies. Continued engagement with Mexican industry associations and government stakeholders can help reinforce long-term positioning.

A Strategic Market Demanding Resilience and Innovation

Mexico remains a vital North American energy market. While policy headwinds have complicated the renewable landscape, industrial demand, emissions targets, and infrastructure gaps continue to generate opportunity. For firms with adaptable strategies and regional experience, Mexico offers long-term potential in both traditional and emerging energy segments.

MEXICO

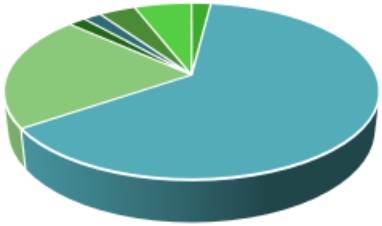
Emissions Reduction and Net Zero Commitments

- Reduce GHG emissions by 22-35% (unconditionally, 40% conditionally) **by 2030**
- 50% of energy will come from clean sources **by 2050**

Key Export Opportunities for Canadian Companies

- Oil and gas **exploration, production, and infrastructure development**, especially **offshore**
- Water technologies
- Professional services
- Green mining

Domestic Energy Production*



- Coal 1.9%
- Crude oil 63.5%
- Natural gas 21.2%
- Nuclear 1.8%
- Hydro 1.8%
- Wind, solar, etc. 3.8%
- Biofuels and waste 5.9%

2023:

$128 MILLION

of Canadian Cleantech Imported^

3 Active Canadian O&G Companies†

Crude Oil°

Daily Production: **1,772,000 BOE**
Proven Reserves: **7.4 billion BOE**
5-Year CAGR: **-4.5%**

Natural Gas°

Annual Production: **3.3 trillion ft³**
Proven Reserves: **7 trillion ft³**
5-Year CAGR: **0.8%**

* IEA, 2021 ^ Statistics Canada ° EIA, 2021 † CGEF, 2022

Insights for North America

Commitments to Emissions Reduction and Net-Zero Targets

In North America, both the United States and Mexico have set emissions reduction and net-zero targets, though their approaches and policy frameworks differ significantly.

Under the Biden administration, the United States has committed to reducing its greenhouse gas (GHG) emissions by 50–52% below 2005 levels by 2030 and achieving net-zero emissions by 2050. President Biden's policies focused on reducing emissions from key sectors—including transportation, hydrofluorocarbons, and methane from oil and gas—while advancing clean energy deployment through major legislative initiatives such as the Inflation Reduction Act (IRA). The IRA provided over US$370 billion in tax credits, grants, and loan guarantees for clean energy, emissions reduction, and domestic manufacturing. Additional legislation, including the Bipartisan Infrastructure Law and the CHIPS and Science Act, supported energy innovation, grid modernization, and decarbonization across industrial sectors. State-level leadership remains strong, with jurisdictions such as California, New York, Colorado, and Washington advancing aggressive mandates for electrification, renewable energy, and zero-emission transportation.

However, in January 2025, the political landscape shifted significantly. The Trump administration re-entered office, withdrew from the Paris Agreement, and suspended several key environmental regulations, instead prioritizing the expansion of fossil fuel development. This policy reversal has created regulatory uncertainty and could slow momentum on federal climate initiatives, although many state governments and private-sector actors continue to advance decarbonization goals independently.

In contrast, Mexico has pledged to reduce emissions by 35% below business-as-usual levels by 2030 and to reach net-zero emissions by 2050. Yet, the country's national energy policy has increasingly emphasized fossil fuels and state control, particularly through the dominance of **PEMEX**, Mexico's state-owned oil company. These policy shifts have constrained private investment in renewables and introduced regulatory unpredictability. Still, various industrial sectors and subnational governments are moving forward with emissions reduction and clean energy initiatives, maintaining some level of progress toward Mexico's climate targets.

Energy and Cleantech Opportunities for Canadian Exports

The **United States** offers the most accessible and diverse cleantech market for Canadian exporters, with opportunities across both traditional and low-carbon energy sectors. Key areas include **methane mitigation, digital optimization, LNG infrastructure, carbon capture (CCUS), hydrogen technologies, grid modernization,** and **industrial decarbonization**. While market access is supported by regulatory alignment and cross-border supply chains, success often depends on forming local partnerships, establishing a U.S. presence, and aligning with state-level priorities.

In **Mexico**, opportunities exist despite a more complex policy environment. Canadian firms are well-positioned in oilfield services, gas infrastructure, clean refining technologies, and industrial energy efficiency. Mexico's manufacturing sectors and growing natural gas demand drive the need for energy-efficient, emissions-reducing technologies. While recent reforms have favoured state control and fossil fuels, demand persists in off-grid renewables, MRV systems, and water-energy solutions. Market success requires cost-competitive offerings, local representation, and strong partnerships to navigate regulatory challenges. Agreements like CUSMA and CPTPP enhance trade prospects.

South America

Argentina

A Country of Energy Potential on the Verge of Transformation

Argentina's energy landscape tells a story of unrealized potential beginning to take shape. With vast fossil fuel reserves—particularly unconventional hydrocarbons—and a growing focus on renewable energy, Argentina is laying the foundation to reassert itself as a major energy player. The shift marks a pivotal transformation from a decade of stagnation to a period of cautious resurgence and strategic ambition.

The Vaca Muerta Advantage: A Strategic Asset

At the heart of Argentina's energy promise lies Vaca Muerta, one of the world's largest shale formations, located in the Neuquén Basin. This reservoir ranks second globally in shale gas reserves and fourth in shale oil—an immense resource base that could redefine Argentina's energy trajectory. Although still a net importer of energy, the country is now leveraging these unconventional reserves to reduce dependence and expand export capacity.

After years of underinvestment and decline—between 2004 and 2014, energy production fell by 20%—the sector began recovering in 2015. Since then, production has grown by an average of 2% annually, led by unconventional natural gas. Yet Argentina still imports refined products such as diesel, primarily from the U.S. and the Netherlands, due to infrastructure limitations.

A Concentrated Market with Global Partners

Argentina's energy sector is driven by a few dominant players. **YPF**, the state-controlled oil company, leads the market with over half the country's refining capacity and a quarter of its natural gas production. Alongside Pan American Energy and Vista Energy, these three accounted for nearly 75% of national output in 2023.

International majors such as Chevron, Shell, ExxonMobil, Petronas, and Total have also established a firm presence, bringing the financial resources and technical know-how essential for developing Argentina's unconventional reserves.

Gas Strategy and Seasonal Realities

Natural gas development is at the center of Argentina's energy strategy. In 2023, 63% of gas production came from conventional reserves, with the remaining 37% from shale. Growth has been steady at 2.4% annually since 2015, thanks in large part to Vaca Muerta.

However, seasonal imbalances pose persistent challenges. The country generates a surplus in the warmer months (October to April), but demand spikes during the cold season (May to September), requiring imports—mainly via pipeline from Bolivia and as LNG.

In response, the government launched Plan GasAr in 2020 to stabilize production, reduce imports, and provide investment certainty. The initiative includes incentives such as foreign exchange access and public guarantees to stimulate domestic output and infrastructure development.

Reforms and Infrastructure Investment

Policy reforms and infrastructure investments are reshaping Argentina's energy landscape. The government has prioritized oil and gas export growth through updated regulations and large-scale midstream development. These include pipeline expansions, LNG terminal proposals, and offshore natural gas initiatives designed to unlock Argentina's full production potential.

While positive momentum is building, the sector still contends with economic volatility and regulatory complexity—factors that can inhibit long-term investment planning.

Coal and Biofuels: Complementary Energy Segments

Argentina's coal reserves are relatively small, and production is low and declining. Metallurgical coal accounts for 70% of domestic coal demand, and thermal coal comprises the remaining 30%. In 2023, imports accounted for 96% of thermal coal consumption and 100% of metallurgical coal consumption. Metallurgical coal is traditionally used to make metallurgical coke, which is essential in steel production. Argentina's metallurgical coke market is growing because of increasing demand driven by the construction, infrastructure, and automotive sectors. To reduce reliance on coal imports for steel production, Argentina has developed a process that primarily uses petroleum coke and coal tar pitch. Despite this, the industry still faces challenges such as high production costs, aging infrastructure, and competition from imported coke.

Meanwhile, Argentina ranks among the world's top biofuel producers. In 2022, biodiesel made up 65% of national biofuel output, primarily from soybean oil, while sugarcane and corn supported bioethanol production. Though advanced biofuels like hydrotreated vegetable oil (HVO) and sustainable aviation fuel (SAF) are in early stages, supportive policy frameworks are still evolving.

Renewables and Energy Storage Momentum

Argentina's renewable energy story has been gaining traction. Hydropower remains a key contributor to electricity generation (16.5% in 2022), but recent years have seen explosive growth in wind and solar energy. Between 2012 and 2022, installed capacity in these sectors grew by 160% annually, supported by strong natural resources and initiatives like the RenovAr program.

Further bolstering Argentina's energy transition is its lithium potential. As the world's fourth-largest producer, Argentina is positioned to play a central role in global battery supply chains and domestic energy storage solutions.

Outlook: A Market in Transition

For petroleum industry professionals, Argentina offers a blend of challenges and promise. Its world-class shale resources, rising renewable energy sector, and infrastructure development initiatives create a compelling case for long-term investment. Yet success will depend on navigating a complex regulatory

environment and aligning with Argentina's evolving energy ambitions. Those who build strong local partnerships and take a long-term view may find Argentina to be one of the most dynamic energy markets in the region.

ARGENTINA

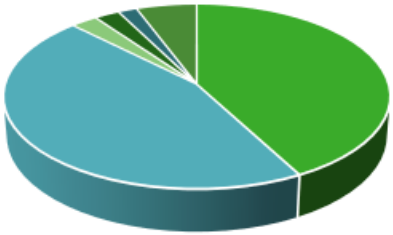
Emissions Reduction and Net Zero Commitments

- Reduce emissions 19% below 2007 **by 2030**
- Net zero emissions **by 2050**
- >50% of power generated from renewable sources **by 2030**

Key Export Opportunities for Canadian Companies

- Methane emissions monitoring and **LDAR** technologies
- Exploration and Production (**E&P**) of unconventional and shale oil and gas
- **Digitalization** and automation
- Enhanced oil recovery (**EOR**) techniques
- Energy infrastructure such as **pipelines**, **energy storage**, and **grid modernization**
- **Drilling** and **fracking** equipment

Domestic Energy Production*



- Crude oil 42.2%
- Natural gas 45.4%
- Nuclear 2.5%
- Hydro 2.4%
- Wind, solar, etc. 1.8%
- Biofuels and waste 5.7%

2023:

$35 MILLION

of Canadian Cleantech Imported^

Crude Oil°

Daily Production: **627,000 BOE**

Proven Reserves: **2.4 billion BOE**

5-Year CAGR: **0.5%**

2 **Active Canadian O&G Companies†**

Natural Gas°

Annual Production: **1.72 trillion ft³**

Proven Reserves: **10.8 trillion ft³**

5-Year CAGR: **0.2%**

* IEA, 2021 ^ Statistics Canada ° EIA, 2021 † CGEF, 2022

Brazil

Energy Abundance Meets Global Ambition

Brazil's energy journey is one of abundance, diversification, and strategic reinvention. With rich reserves of oil, natural gas, and renewable resources, Brazil has transformed itself into a top global energy producer while positioning for leadership in clean energy. Its evolving regulatory environment and rising demand for infrastructure modernization offer compelling opportunities for petroleum industry professionals looking to engage in one of the world's most dynamic energy markets.

Offshore Oil Drives Growth

At the center of Brazil's energy success story is its vast offshore oil sector. The country boasts the largest proven crude reserves in Central and South America and ranks as the world's tenth-largest oil producer. Much of this production comes from the pre-salt basins off Brazil's southeastern coast—deepwater fields that have propelled Brazil's rise on the global energy stage.

Petrobras, Brazil's state-owned energy giant, plays a dominant role in upstream operations, accounting for approximately 63% of national oil output and 65% of natural gas production. Regulatory reforms in recent years have opened new space for private and international operators, particularly in onshore basins. While Petrobras retains control over most offshore assets, onshore oil production is now forecast to grow by 65% by 2032, led by private firms reviving mature fields with enhanced recovery technologies.

Brazil's crude exports are primarily destined for Asia, with China as the top buyer, followed by Europe and the United States. However, the country remains dependent on imported refined petroleum products—mainly from the U.S., India, and the UAE—underscoring the strategic need to expand and modernize domestic refining capacity.

Natural Gas and Infrastructure Challenges

Brazil's natural gas sector remains underdeveloped relative to its oil production. While much of the country's gas is reinjected to enhance oil recovery, domestic supply still falls short of demand. Brazil imports natural gas through pipelines from Bolivia and via LNG shipments from the U.S. and Qatar.

Infrastructure limitations continue to hamper broader commercialization. The lack of pipelines connecting offshore production to inland demand centers restricts the role gas can play in Brazil's energy transition. In response, the government is prioritizing new investments in processing facilities, transmission networks, and regasification capacity to improve energy security and reduce emissions.

A Dual Coal Narrative

Coal plays a more limited role in Brazil's energy mix but remains significant in power generation and metallurgy. The country is the second-largest coal producer in Latin America, yet its domestic reserves are of low quality and insufficient for industrial use. Roughly three-quarters of Brazilian coal is exported, while imports from Australia, the U.S., and Colombia meet the higher-grade demands of the steel sector.

Despite decarbonization goals, Brazil plans to maintain coal-fired power generation through at least 2040, with gradual modernization to improve efficiency and lower emissions.

Renewable Energy: A Global Success Story

Few countries rival Brazil's progress in renewable energy. Hydropower has long been the backbone of the electricity grid, and in 2021 accounted for 9.2% of national energy consumption. In recent years, wind and solar energy have grown rapidly—wind now ranks as Brazil's third-largest energy source, and solar has scaled from virtually zero to 3% in a decade.

Brazil also leads in biofuels, ranking second globally in production. Ethanol derived from sugarcane and corn dominates domestic fuel blends, while soybeans power biodiesel production. In 2022, Brazil exported nearly a quarter of the world's ethanol supply, with South Korea, the Netherlands, and the U.S. among the top markets. While biodiesel exports face cost-related constraints, domestic consumption remains robust.

The Ethanol Cooperation Agreement between Brazil and the United States supports ongoing innovation, trade, and knowledge-sharing in the biofuels sector.

Emissions Commitments and Low-Carbon Investment

Brazil has pledged to reduce emissions by 48.4% by 2025 and by up to 67% by 2030 compared to 2005 levels, with targets of net-zero emissions and zero deforestation by 2050 and 2030, respectively. These ambitions are backed by major investments from Petrobras, which plans to allocate US$11.5 billion toward low-carbon projects as part of a broader US$102 billion capital plan from 2024 to 2028.

Key focus areas include carbon capture and storage (CCS), offshore wind development, and green hydrogen. International and private operators are also aligning their strategies with national goals, incorporating emissions tracking, CCUS technologies, and digital optimization across upstream and midstream assets.

Opportunity Landscape for Energy and Cleantech Firms

Brazil's diversified energy sector offers multiple entry points for foreign companies, especially those equipped with innovative technologies and a long-term outlook. Key areas of opportunity include:

- Offshore oil and gas exploration in pre-salt formations
- Onshore field revitalization using enhanced oil recovery (EOR)
- CCUS and emissions monitoring systems for upstream operations
- Natural gas infrastructure: pipelines, processing plants, regasification units
- Renewable energy technologies for wind, solar, and hydrogen
- Digital energy solutions: remote monitoring, AI-driven maintenance, geotechnical risk modelling, and drone-based inspection

With one of the largest electricity markets in the world and rising demand for clean energy, Brazil offers a scale advantage and strong potential for technology deployment and market growth.

Considerations for Canadian Firms

Canada and Brazil enjoy a longstanding trade relationship within the Mercosur framework, which encourages regional energy cooperation and policy alignment. However, the Brazilian market presents challenges that demand strategic adaptation.

Foreign firms must contend with a complex tax and regulatory landscape, high labour costs, environmental licensing delays, and bureaucratic inefficiencies. Offshore markets remain highly competitive, dominated by players from the U.S., U.K., Norway, and the EU.

Local partnerships are not only advantageous—they are often essential. Building trust, navigating procurement, and aligning with local content rules all require on-the-ground knowledge and collaborative business models.

A Market of Scale, Complexity, and Promise

Brazil represents a high-opportunity but high-complexity market for petroleum and clean technology companies. Its world-class oil reserves, growing biofuels sector, and renewable energy leadership make it a critical part of the global energy transition. Firms that can navigate local conditions, deliver value through innovation, and invest in durable partnerships will find Brazil a rewarding and resilient market for long-term growth.

BRAZIL

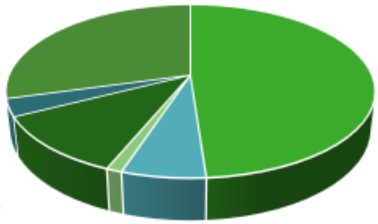
Emissions Reduction and Net Zero Commitments

- Reduce net GHG emissions 59-67% below 2005 levels **by 2035**
- Net zero emissions **by 2050**

Key Export Opportunities for Canadian Companies

- **Emissions reduction** technology
- Carbon Capture and Storage (**CCS**)
- Exploration and Production (**E&P**) of oil and gas in mature and offshore fields
- Natural gas pipeline infrastructure
- Digital energy technologies
- **Renewable** energy

Domestic Energy Production*



- Coal 0.7%
- Crude oil 48.5%
- Natural gas 6.2%
- Nuclear 1.2%
- Hydro 11.1%
- Wind, solar, etc. 3.2%
- Biofuels and waste 29.1%

2023:

$52 MILLION

of Canadian Cleantech Imported^

4 Active Canadian O&G Companies†

Crude Oil°

Daily Production: **2,906,000 BOE**
Proven Reserves: **12.7 billion BOE**
5-Year CAGR: **2.7%**

Natural Gas°

Annual Production: **0.84 trillion ft³**
Proven Reserves: **12.9 trillion ft³**
5-Year CAGR: **0.5%**

* IEA, 2021 ^ Statistics Canada ° EIA, 2021 † CGEF, 2022

Colombia

A Strategic Player Navigating Transition and Uncertainty

Colombia's energy sector has long served as a backbone of its economy, underpinning growth and international trade. With a geostrategic location offering access to both the Pacific Ocean and the Caribbean Sea, Colombia is well-positioned as an energy supplier to global markets. Yet, the country stands at a critical juncture—balancing a legacy of fossil fuel production with growing pressures for environmental sustainability and economic diversification.

Oil and Gas: Mature Assets, Emerging Frontiers

Colombia's crude oil production is entirely onshore, concentrated in the Llanos Orientales Basin, east of Bogotá. While historically the second-largest petroleum producer in South America, Colombia has seen a decline in output due to reduced exploration activity. Despite this, the country is eyeing new offshore opportunities and enhanced recovery technologies to stabilize its production outlook.

Primary export destinations for Colombian crude include the United States, China, Panama, and India. To maintain these relationships, the country must reverse downward trends in production and bolster infrastructure.

Natural gas plays a dual role in Colombia's energy strategy: as a fuel for domestic use and as a technical asset in enhanced oil recovery (EOR). Nearly half of the country's gas output is used to support EOR. Although domestic production remains modest, Colombia supplements its supply with imports from the United States and Trinidad and Tobago.

Colombia holds significant shale gas potential, though commercial development is currently limited to pilot projects. A 2019 partnership between Ecopetrol and Occidental in the U.S. Permian Basin illustrates Colombia's intent to build shale expertise for future domestic application once fracking restrictions are lifted.

Market Liberalization and Investment Framework

Colombia's constitution reserves ownership of subsoil and non-renewable natural resources for the state. However, the energy sector operates under a liberalized framework that allows full foreign ownership and does not impose local content requirements—an advantage for international investors.

Ecopetrol, the national oil company, dominates the sector with control over two-thirds of Colombia's oil and gas production. Nonetheless, the regulatory environment remains open: foreign and domestic firms can operate independently of Ecopetrol. The government has recently introduced tax and fiscal reforms to further encourage foreign direct investment in energy and infrastructure.

Coal and Hydropower: Balancing Export and Reliability

In 2021, Colombia was the leading coal producer in South America. Coal remains a key export commodity, with major shipments to Europe, Latin America, and North America—accounting for 71% of U.S. coal imports in 2020.

Domestically, hydropower is the principal source of electricity, offering low-carbon generation to meet Colombia's energy needs. However, increased drought frequency has exposed the grid's vulnerability, prompting greater reliance on fossil fuels and sparking renewed interest in energy diversification.

Wind and solar are emerging as viable alternatives. Supported by favourable policies and investor interest, non-hydro renewables are expected to grow significantly in the coming decade.

Climate Commitments and Corporate Targets

Colombia has made firm commitments under the Paris Agreement, targeting a 51% reduction in GHG emissions by 2030 and carbon neutrality by 2050. Ecopetrol has pledged to cut its own emissions by 20% by 2030 and to eliminate routine flaring within the same timeframe. These national and corporate-level targets are accelerating demand for emissions-reducing technologies and operational innovation across the oil and gas value chain.

Energy and Cleantech Opportunities

Colombia's dual focus on energy development and decarbonization presents wide-ranging opportunities for Canadian and international companies. Key areas include:

- Emissions monitoring and methane abatement technologies
- Clean technologies for oil and gas decarbonization
- Small-scale carbon capture, utilization, and storage (CCUS)
- Energy and water efficiency systems
- EOR technologies and services
- Low-emission hydrogen and geothermal production
- Environmental management tools and services

Colombia and Canada are connected through a Free Trade Agreement and a Double Taxation Convention, simplifying trade and fiscal processes. Canadian companies bringing innovative, cost-effective clean technologies—particularly in CCUS and hydrogen—are well-positioned to become strategic partners in Colombia's energy transition.

Considerations for Canadian Firms

Despite an open investment climate, success in Colombia requires local presence and market familiarity. Spanish proficiency is highly valuable, and business relationships often depend on trust built through long-term engagement.

Environmental permitting processes can be slow and complex. Projects that affect indigenous or minority communities require "Consulta Previa" consultations—mandatory legal procedures that extend timelines and necessitate community engagement strategies.

High logistics costs, particularly in moving goods from ports to inland cities like Bogotá and Medellín, remain a significant hurdle. These are exacerbated by underdeveloped road infrastructure crossing

mountainous terrain. Although the government has launched major infrastructure investments, benefits will take time to materialize.

A Market in Transition, Open to Innovation

Colombia remains one of Latin America's most accessible energy markets for international partners. Its maturing oil sector, openness to foreign investment, and strong trade ties with Canada create a solid foundation for collaboration. As the country intensifies its transition to a lower-carbon energy system, the need for advanced technologies, services, and strategic partnerships will only grow.

COLOMBIA

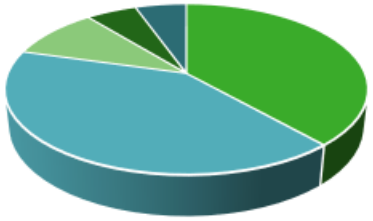
Emissions Reduction and Net Zero Commitments

- Reduce emissions by 51% **by 2030**
- Carbon neutrality **by 2050**

Key Export Opportunities for Canadian Companies

- Emissions reduction technology
- Carbon capture and storage (**CCS**)
- **Environmental** management
- Enhanced oil recovery (**EOR**)
- Energy efficiency and **water optimization**
- Low-emission **hydrogen** production
- **Geothermal** production

Domestic Energy Production*



- Coal 38.5%
- Crude oil 40.9%
- Natural gas 9.8%
- Hydro 5.4%
- Biofuels and waste 5.4%

2023:

$10 MILLION

of Canadian Cleantech Imported^

Crude Oil°

Daily Production: **739,000 BOE**
Proven Reserves: **1.7 billion BOE**
5-Year CAGR: **-3.1%**

9 **Active Canadian O&G Companies†**

Natural Gas°

Annual Production: **0.45 trillion ft³**
Proven Reserves: **4.1 trillion ft³**
5-Year CAGR: **-0.2%**

* IEA, 2021 ^ Statistics Canada ° EIA, 2021 † CGEF, 2022

Guyana

A Small Nation with Outsized Energy Potential

Guyana is one of the most remarkable energy stories of the past decade. Since its first commercial oil production in 2019, this small South American nation has rapidly emerged as one of the world's fastest-growing petroleum producers. With vast offshore reserves, strategic partnerships, and a carbon-negative status rooted in its extensive forests, Guyana is redefining its economic future while striving to manage growth sustainably.

Offshore Oil Boom and Strategic Partnerships

All of Guyana's oil production is offshore, developed through one of the most successful deepwater exploration campaigns in recent history. Since 2019, daily production has surged from 15,000 barrels to over 630,000 barrels in 2024. By 2027, output is expected to more than double to 1.3 million barrels per day, driven by successive discoveries and project expansions.

The Stabroek Block, operated by a consortium including ExxonMobil, Hess, and CNOOC, is the anchor of this transformation. Other players such as Eco Atlantic, Frontera, and Esso are also active in the basin. Despite lacking domestic refining capacity, Guyana has leveraged its resources for export, shipping crude to Europe (mainly the Netherlands and Germany), the U.S., China, and other Latin American markets. Refined products are imported, primarily from the United States.

The Gas-to-Energy Vision: Balancing Growth and Sustainability

Guyana currently reinjects all associated natural gas due to the absence of infrastructure. However, this is set to change. The flagship Gas-to-Energy project—also known as Gas-to-Shore—aims to construct a 140-mile pipeline to transport offshore gas to an integrated power and LNG complex onshore. The facility will support power generation and diversify Guyana's energy mix, which is currently dominated by imported fuel oil.

This project is central to the government's strategy to reduce emissions, lower energy costs, and stimulate industrial development. If realized, it would significantly enhance Guyana's energy security and provide a cleaner bridge fuel as the country builds its renewable energy portfolio.

Energy Mix and Renewable Opportunities

As of 2024, fossil fuels account for over 99% of Guyana's energy production and consumption. However, the country holds strong potential for renewable development—particularly in solar, hydropower, wind, and biomass. Sugarcane waste and wood residues form the base of the country's nascent bioenergy sector, which remains underdeveloped but promising.

Guyana's Low Carbon Development Strategy (LCDS) 2030 outlines a national vision to maintain net-zero emissions while growing the economy. The plan prioritizes renewable energy investment, sustainable forestry, energy efficiency, and the responsible management of oil and gas revenues. The strategy

positions Guyana to lead by example among developing economies in aligning resource development with climate goals.

Emissions Commitments and Carbon Market Engagement

Despite being a new oil producer, Guyana maintains one of the lowest per capita emissions rates globally and is one of the few countries to self-declare net-zero emissions. Its forests absorb more carbon than the country emits, a position Guyana intends to preserve through forest conservation and carbon market participation.

Under its LCDS 2030, Guyana has committed to reducing heavy fuel oil use, expanding renewable energy deployment, and using natural gas as a transitional fuel. The strategy includes plans to monetize forest carbon through voluntary carbon markets and international offset agreements—generating revenue while protecting biodiversity and enhancing global climate action.

Energy and Cleantech Opportunities

Guyana's economic and energy transformation creates wide-ranging opportunities for Canadian and international companies. Priority areas include:

- Natural gas infrastructure: pipeline construction, processing, and LNG facilities
- Power generation: combined-cycle plants and grid modernization
- Renewable energy development: solar, hydro, wind, and waste-to-energy projects
- Workforce development: technical and vocational training in energy disciplines
- Environmental management: emissions monitoring, ecosystem services, and sustainability consulting

With limited domestic capacity, Guyana is actively seeking partners with proven expertise, technology, and a long-term commitment to supporting its development goals.

Considerations for Canadian Firms

Despite the rapid growth, doing business in Guyana presents unique challenges. The business culture values personal relationships and verbal communication, often requiring an in-country presence to establish trust. Limited flight connectivity and logistical constraints—such as the absence of a deep-water port—add complexity and cost to operations.

Due diligence is essential in identifying reliable local partners. While Canada has a longstanding footprint in Guyana's mining sector, the energy industry is newer and more competitive. Other international players have established strong relationships, and market entry requires clear value differentiation and sustained engagement.

Infrastructure gaps, a young workforce, and capacity limitations further highlight the need for foreign technical expertise. Canadian firms that can offer practical, scalable solutions—particularly in natural gas, renewables, and training—have a unique window to become trusted partners in Guyana's nation-building journey.

A Transformative Opportunity in a High-Growth Market

Guyana is rapidly evolving from a frontier market into a rising oil and gas power, with ambitions to lead sustainably. For energy companies, service providers, and technology exporters, this represents a rare opportunity to support a country at the beginning of its industrial expansion. With the right approach and long-term vision, Guyana offers fertile ground for strategic partnerships and enduring impact.

GUYANA

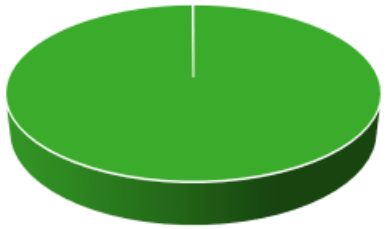
Emissions Reduction and Net Zero Commitments

- Self-declared **net zero since 2021** and aims to maintain this status

Key Export Opportunities for Canadian Companies

- **Natural gas** infrastructure
- Power grid **modernization**
- Environmental monitoring and remediation (particularly for marine ecosystems)
- **Renewable** energy

Domestic Energy Production*



2023:

$9.2 MILLION

of Canadian Cleantech Imported^

Crude Oil°

Daily Production: **102,000 BOE**

Proven Reserves: **4.5 billion BOE**

5-Year CAGR: **0%**

4 Active Canadian O&G Companies†

Natural Gas°

Annual Production: **0 trillion ft³**

Proven Reserves: **0.1 trillion ft³**

5-Year CAGR: **0%**

* IEA, 2021 ^ Statistics Canada ° EIA, 2021 † CGEF, 2022

Insights for South America

Commitments to Emissions Reduction and Net-Zero Targets

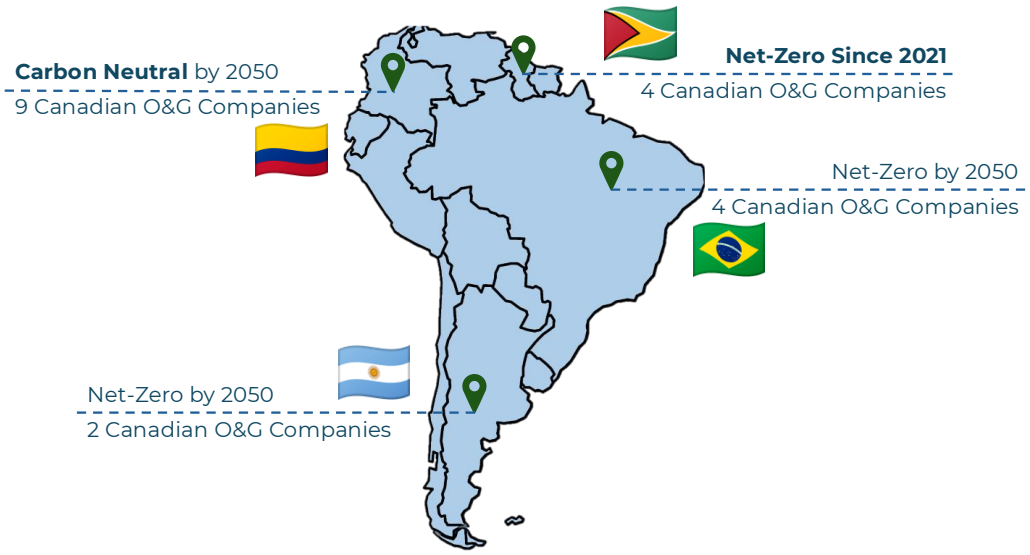
South American countries are increasingly aligning their national development strategies with climate goals, setting ambitious emissions reduction targets and laying the groundwork for net-zero transitions.

Argentina has committed to capping net emissions at 349 $MtCO_2e$ by 2030, representing a 4.2% reduction from 2016 levels and a 21% reduction from 2007. It aims to reach net-zero emissions by 2050, with a focus on decarbonizing the energy sector and achieving 50% renewable electricity generation by 2030. This is supported by investments in wind, solar, hydropower, and biofuels, alongside its emerging lithium and battery storage industries.

Brazil has set one of the most ambitious targets in the region, aiming to reduce emissions by 48.4% by 2025 and 53.1% by 2030 compared to 2005 levels, with a goal of net-zero by 2050 and zero deforestation by 2030. These commitments are underpinned by Petrobras' US$102 billion investment plan (2024–2028), including US$11.5 billion earmarked for low-carbon initiatives such as offshore wind, CCS, and green hydrogen. Brazil's biofuels leadership and deep renewable energy penetration further bolster its decarbonization trajectory.

Colombia has pledged to reduce GHG emissions by 51% by 2030 and to achieve carbon neutrality by 2050. State oil company Ecopetrol has set its own goals of a 20% emissions reduction and zero routine flaring by 2030. The country's dual reliance on oil and hydropower has sparked growing interest in energy diversification, particularly through non-hydro renewables, clean hydrogen, and CCUS pilot initiatives.

Guyana, despite being a new oil producer, **maintains a carbon-negative status**, with forest carbon absorption exceeding national emissions. Through its Low Carbon Development Strategy (LCDS) 2030, Guyana aims to reduce heavy fuel oil use, expand renewable energy, and leverage natural gas as a transitional fuel. It also intends to monetize forest carbon through voluntary carbon markets, positioning itself as a global model for integrating oil wealth with sustainable development.



Energy and Cleantech Opportunities for Canadian Exports

South America presents a diverse opportunity landscape for Canadian cleantech exporters, shaped by evolving energy demands, infrastructure gaps, and climate policy ambitions.

In **Argentina**, opportunities lie in unconventional oil and gas development (especially in Vaca Muerta), gas infrastructure, and refined product substitution. The growth of wind and solar, supported by government programs and Argentina's emerging lithium supply chain, creates strong potential for Canadian companies in renewables, battery storage, and grid integration technologies.

Brazil offers scale and diversification across offshore oil, natural gas infrastructure, and renewable energy. Priority areas include CCUS systems, pipeline construction, refinery modernization, biofuels technology, and green hydrogen. There is also demand for AI-enabled monitoring, remote sensing, and drone-based inspection tools. Canadian firms can leverage experience in energy systems integration and emissions control to support Brazil's decarbonization drive. However, success requires navigating Brazil's complex regulatory and tax environment and establishing local partnerships to meet content rules and build trust.

Colombia presents accessible opportunities, particularly due to its liberalized market, strong Canada–Colombia trade ties, and focus on low-emissions technologies. Canadian firms can provide methane abatement, small-scale CCUS, EOR solutions, and clean hydrogen systems. There is also growing interest in environmental management, energy efficiency, and geothermal. While no local content requirements exist, success hinges on in-country presence, Spanish fluency, and managing consultation processes with local and Indigenous communities.

Guyana stands out as a frontier market with outsized potential. With limited domestic capacity, Guyana seeks partners in natural gas infrastructure, power generation, solar and hydro projects, and environmental consulting. Canadian firms can also play a key role in workforce training, grid modernization, and emissions monitoring. Although logistics and bureaucratic hurdles exist, Canada's historical ties to Guyana and experience in resource sector governance position firms well—provided they demonstrate long-term commitment, technical capability, and local engagement.

Middle East

Iraq

Navigating Growth Amid Complexity in a Hydrocarbon Powerhouse

Iraq holds some of the world's largest oil and gas reserves, positioning it as a major force within global energy markets. Despite political volatility and infrastructure challenges, the country remains one of OPEC's top producers and has ambitious goals to scale both its oil output and renewable energy capacity. For international energy firms, Iraq offers significant upside potential—but requires careful navigation of regulatory, logistical, and geopolitical realities.

Oil Dominance and Expansion Plans

Iraq is the second-largest crude oil producer within OPEC and ranks fifth globally in proven oil reserves, with an estimated 145 billion barrels. Production reached 4.29 million barrels per day in 2021, and the government plans to increase this to 7 million barrels per day by 2030, driven by further exploration and expanded development of southern oil fields.

Most production is concentrated in the south, where new investments are focused on improving output through enhanced oil recovery techniques such as water injection. However, political instability, aging infrastructure, and uncertainty among international oil companies have caused delays in project execution.

Despite these headwinds, Iraq remains heavily dependent on oil. Crude exports account for 95% of government revenues. Key customers include India, China, South Korea, and several European nations. However, recent shifts in Asian markets—particularly the replacement of Iraqi oil with discounted Russian barrels—have impacted export volumes to China and India.

The government is working to modernize and expand domestic refining capacity to reduce dependence on imported refined products and create value-added export opportunities. Refinery upgrades aim to meet cleaner fuel standards and process a wider variety of crudes.

Natural Gas: Underutilized Potential

Iraq possesses significant natural gas reserves—mostly associated with oil fields in the south—but limited infrastructure has constrained its development. As of 2021, the country produced 1.71 trillion cubic feet of gas, yet much of this is flared due to inadequate processing and transport capacity.

Reducing gas flaring is a top priority, both for environmental and economic reasons. Iraq is seeking to invest in new gas capture and processing facilities to utilize this resource for domestic power generation and, potentially, for export in the future. These initiatives are closely tied to the country's climate commitments and long-term energy security.

Domestic Energy Needs and Grid Challenges

Iraq faces chronic power shortages, fueled by a young and growing population, insufficient generation capacity, and heavy reliance on fossil fuel imports to meet peak demand. These issues are compounded by outdated transmission infrastructure and high technical losses across the grid.

To address these gaps, Iraq is pursuing grid modernization and utility-scale energy diversification. Renewables—particularly solar—are expected to contribute to future energy security, although progress has been slow. The country is targeting a 5% share of renewables in total installed capacity by 2030, with foreign investment encouraged in project development and implementation.

Emissions Targets and Climate Strategy

Under its nationally determined contribution (NDC) to the UNFCCC, Iraq aims to reduce greenhouse gas emissions by 2% below its business-as-usual scenario by 2030, with a conditional target of up to 15% reductions depending on international support.

The emissions strategy focuses on:

- Integrating renewables into the power mix
- Reducing flaring in the oil and gas sector
- Improving energy efficiency in production and consumption
- Enhancing environmental protection and sustainable development

Although Iraq's climate commitments are relatively modest, the government has acknowledged the need to diversify its energy mix and improve its resilience to climate-related shocks.

Energy and Cleantech Opportunities

Iraq's expanding production targets and emissions goals create a range of opportunities for Canadian and international firms, particularly those offering practical solutions to maximize output while minimizing environmental impact. Key opportunity areas include:

- Upstream, midstream, and downstream oil and gas technologies
- Enhanced oil recovery and water injection systems
- Natural gas capture, processing, and flaring reduction solutions
- Solar power project development and integration
- Emissions monitoring and GHG abatement technologies
- Environmental protection and waste management systems

While security and political risk are factors, these opportunities are significant, particularly in regions with more stable governance or under the jurisdiction of more investment-friendly frameworks.

Market Considerations for Canadian Firms

Canadian companies seeking to enter Iraq must carefully assess both the potential and the risks. Travel advisories, corruption, and bureaucratic inefficiencies can impede project delivery. Regulatory complexity—especially in licensing and contracting—adds further challenges.

That said, the Kurdistan Region of Iraq (KRI) offers a more liberal and transparent investment climate. Under the 2006 Law on Investment in the Kurdistan Region, foreign businesses enjoy simplified procedures and greater operational freedom. Partnering with a local firm, though not mandatory, is often essential for navigating local procurement and establishing legitimacy.

Canadian companies must also compete with strong international players, including firms from the U.S., U.K., China, and the EU. Differentiation through innovation, cost-effectiveness, and long-term relationship-building is critical for success.

A Complex but High-Reward Frontier

Iraq is a challenging but resource-rich market. For energy and cleantech firms that can align with the country's production and sustainability goals, Iraq offers significant strategic value. Those willing to invest the time, forge reliable partnerships, and adapt to local realities may find Iraq a high-potential frontier for growth and impact.

IRAQ

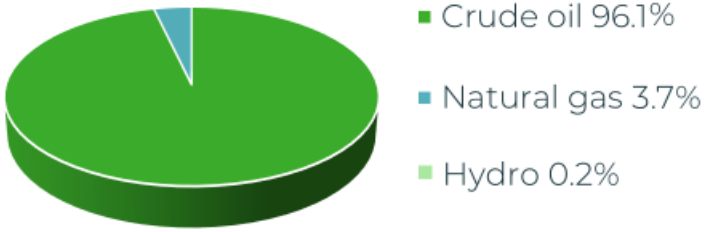
Emissions Reduction and Net Zero Commitments

- Emissions reduction of 2% below BAU **by 2030** (unconditional; 15% conditional)
- 5% renewable capacity **by 2030**

Key Export Opportunities for Canadian Companies

- **Oil & Gas**: Upstream, Midstream, Downstream
- Capturing & eliminating **GHG-emissions**
- Environmental protection & management
- **Solar** & **renewable** power projects

Domestic Energy Production*



2023:

$1.5 MILLION

of Canadian Cleantech Imported^

Crude Oil°

Daily Production: **4,289,000 BOE**

Proven Reserves: **145 billion BOE**

5-Year CAGR: **-1.8%**

3 **Active Canadian O&G Companies†**

Natural Gas°

Annual Production: **1.27 trillion ft³**

Proven Reserves: **3.7 trillion ft³**

5-Year CAGR: **0.4%**

* IEA, 2021 ^ Statistics Canada ° EIA, 2021 † CGEF, 2022

Kuwait

A Legacy Producer Strategizing for a Low-Carbon Future

Kuwait's energy identity is built on scale, stability, and state control. With one of the world's largest proven oil reserves and a longstanding role in OPEC, Kuwait has been a cornerstone of global oil markets for decades. Today, the country is navigating the challenge of sustaining hydrocarbon production while preparing for a more carbon-conscious future. For international firms, Kuwait offers a resource-rich, technically advanced market—but one that requires long-term commitment and strategic alignment with national priorities.

Oil Leadership and Upstream Ambitions

Kuwait ranks among the world's top 10 oil producers, with output reaching 2.71 million barrels per day in 2021. As of 2022, the country's reserves are estimated at 101.5 billion barrels, making it the seventh-largest holder of proven crude oil globally. Oil accounts for roughly half of Kuwait's GDP and 90% of export revenues, with most exports destined for Asia—particularly China, South Korea, Japan, India, Taiwan, and Vietnam.

The Kuwait Petroleum Corporation (KPC), through its network of eight subsidiaries, oversees both domestic operations and international investments. Since 2017, production has declined slightly due to OPEC+ quotas, rising project costs, and bureaucratic delays. Despite these constraints, Kuwait has set a target to increase production to 4 million barrels per day by 2035.

This growth will rely heavily on enhanced oil recovery (EOR) methods and the development of new upstream projects. More than five new oil and gas initiatives are in the pipeline, aimed at unlocking both light and heavy oil reserves and ensuring long-term supply resilience.

Natural Gas: An Evolving Role

Kuwait's natural gas output—estimated at 0.65 trillion cubic feet in 2021—is largely associated with oil production, meaning it is vulnerable to OPEC-related oil cuts. To mitigate this, Kuwait plans to increase production from non-associated gas fields and reduce reliance on imports.

Rising domestic demand is driving plans for US$48 billion in investment over the next five years, aimed at boosting natural gas production to 1.5 billion cubic feet per day by 2040. These investments will support industrial development, power generation, and water desalination, all of which are heavily reliant on gas.

Refining Capacity and Emissions Management

Kuwait has recently completed significant upgrades to its refining infrastructure, expanding capacity to 1.4 million barrels per day. These enhancements allow the country to produce petroleum products with lower sulfur and nitrogen oxide levels, aligning with international clean fuel standards and improving air quality.

Refinery modernization is central to Kuwait's dual goals: increasing the export value of refined products while contributing to its emissions reduction targets. The country is also exploring ways to integrate carbon

management solutions—including carbon capture, utilization, and storage (CCUS)—into its industrial operations.

Energy Transition and Emissions Commitments

Kuwait is gradually embracing the global energy transition. Under its Energy Transition Strategy 2050, the country has committed to reducing greenhouse gas emissions by 7.4% below business-as-usual projections by 2035. KPC has set an internal target to achieve net-zero emissions by 2050.

Key focus areas of Kuwait's decarbonization strategy include:

- Energy efficiency and electrification across industrial sectors
- Installation of renewable energy (primarily photovoltaic and concentrated solar power)
- CCUS deployment in upstream and refining operations
- Reforestation initiatives, including mangrove cultivation
- Methane emissions abatement in the oil and gas sector

While the transition remains gradual, Kuwait is actively pursuing partnerships to bring in proven low-carbon technologies and solutions.

Energy and Cleantech Opportunities

As Kuwait expands hydrocarbon production and modernizes its energy infrastructure, there are multiple opportunities for Canadian and international companies across the value chain. High-priority areas include:

- Enhanced oil recovery technologies and chemical solutions
- Reservoir pressure management and produced water treatment systems
- Heavy oil development tools and optimization software
- CCUS systems and emissions monitoring platforms
- Methane detection and mitigation technologies
- Renewable energy systems, particularly in solar generation
- Blue and green hydrogen development
- Water conservation and reuse solutions in energy applications

The country's emphasis on energy efficiency and emissions reduction offers a growing entry point for clean technology providers—especially those with a track record in the oil and gas sector.

Market Considerations for Canadian Firms

Canadian companies seeking to do business in Kuwait must undergo a prequalification process with the appropriate KPC subsidiary. This process can be lengthy and bureaucratic, often requiring documentation of technical expertise, financial stability, and prior international performance.

Once prequalified, companies must compete on both price and technical value—cost-efficiency is a critical success factor. Building strong relationships with local stakeholders and maintaining an in-country presence are essential for project visibility and procurement participation.

Kuwait favors suppliers that demonstrate long-term commitment, operational excellence, and alignment with national development goals. Companies with established cleantech solutions for upstream efficiency and emissions control are well-positioned to contribute meaningfully to Kuwait's evolving energy strategy.

A Traditional Market Looking Toward the Future

Kuwait remains a cornerstone of global oil production, but its energy outlook is changing. As the country strengthens its upstream capacity, diversifies its energy mix, and invests in emissions mitigation, the demand for advanced technologies and international partnerships will grow. For firms with the expertise to enhance efficiency, reduce emissions, and build lasting relationships, Kuwait offers a stable and strategically significant market.

KUWAIT

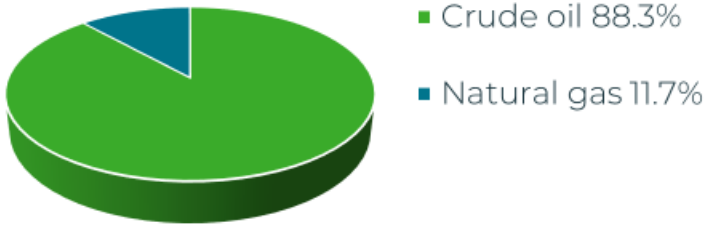
Emissions Reduction and Net Zero Commitments

- Reduce emissions by 7.4% **by 2035**
- Kuwait Petroleum Corporation aims to achieve net zero emissions **by 2050**

Key Export Opportunities for Canadian Companies

- Gas and chemical-enhanced oil recovery (**EOR**)
- Technologies to **reduce the cost of development and production** of heavy oil
- Technologies and solutions to **develop gas reservoirs**
- Treatment of water produced during hydrocarbon production
- Renewables (solar, blue and green hydrogen)

Domestic Energy Production*



2023:

$2.8 MILLION

of Canadian Cleantech Imported^

Crude Oil°

Daily Production: **2,713,000 BOE**
Proven Reserves: **101.5 billion BOE**
5-Year CAGR: **0%**

0 **Active Canadian O&G Companies†**

Natural Gas°

Annual Production: **0.65 trillion ft³**
Proven Reserves: **1.8 trillion ft³**
5-Year CAGR: **0%**

* IEA, 2021 ^ Statistics Canada ° EIA, 2021 † CGEF, 2022

Saudi Arabia

Leading the Global Energy Narrative in an Era of Transition

Saudi Arabia is synonymous with oil. As the world's largest oil exporter and the de facto leader of OPEC+, the Kingdom has long shaped the trajectory of global energy markets. Today, however, Saudi Arabia is writing a new chapter—one that balances energy dominance with diversification, decarbonization, and economic transformation.

With bold ambitions laid out in Vision 2030 and the Saudi Green Initiative, the country is reimagining its energy sector to play a leading role in a lower-carbon global economy. For international companies, Saudi Arabia presents both a legacy hydrocarbon powerhouse and an emerging hub for clean energy innovation.

Oil and Gas: Expansion, Efficiency, and Market Influence

Saudi Arabia holds 267 billion barrels of proven oil reserves and produced 10.95 million barrels per day in 2021. While production has been managed under OPEC+ agreements, the Kingdom maintains capacity to ramp up output quickly, a key lever of its influence in global supply dynamics.

Aramco, the state-owned oil giant, is at the center of upstream development. It continues to invest in maximizing output from mature fields, expanding enhanced oil recovery (EOR) techniques, and developing new reservoirs—including the vast Jafurah unconventional gas field.

Saudi Arabia's natural gas output reached 4.24 trillion cubic feet in 2021. While most gas is consumed domestically to support industrial growth and power generation, the development of new non-associated gas fields could position the Kingdom for future LNG exports.

The downstream sector is also expanding. Saudi Aramco is investing in refinery upgrades, petrochemical integration, and export-oriented production—particularly to Asian and European markets. These projects aim to increase the value of hydrocarbons while lowering the carbon intensity of operations.

Net-Zero Commitments and the Saudi Green Initiative

Saudi Arabia has committed to achieving net-zero emissions by 2060, with interim goals focused on reducing emissions by 278 million tonnes of CO_2e annually by 2030. The government's decarbonization strategy is anchored in three pillars:

- Scaling up renewable energy, particularly solar and wind
- Deploying carbon capture, utilization, and storage (CCUS) at industrial scale
- Improving energy efficiency and emissions management across sectors

Through the Saudi Green Initiative, the Kingdom also aims to plant 10 billion trees and designate 30% of its land for environmental conservation.

In the oil and gas sector, **Aramco** has pledged to reduce upstream emissions intensity by 15% by 2035 and achieve net-zero Scope 1 and 2 emissions by 2050. The company is already piloting CCUS, hydrogen production, and flaring elimination technologies.

Renewable Energy and Diversification Momentum

The Kingdom's National Renewable Energy Program aims to generate 50% of electricity from renewables by 2030, replacing a significant share of oil-fired generation. Utility-scale solar and wind projects—such as Sakaka and Dumat Al Jandal—are gaining momentum, supported by competitive tenders and public-private partnerships.

Hydrogen is another strategic focus. Saudi Arabia is investing heavily in green and blue hydrogen production, including NEOM's flagship green hydrogen project, expected to be one of the largest in the world. These initiatives align with the country's ambitions to become a global hub for hydrogen export and clean fuel innovation.

Energy efficiency and smart grid development are also priorities, particularly in buildings, transport, and water desalination.

Energy and Cleantech Opportunities

Saudi Arabia's dual agenda—hydrocarbon optimization and clean energy leadership—creates expansive opportunities for Canadian and international firms. Priority areas include:

- **Upstream Optimization**: EOR, digital oilfield technologies, and remote sensing
- **Gas Development**: Processing, storage, and unconventional production
- **CCUS**: Large-scale capture systems, monitoring tools, and utilization pathways
- **Hydrogen**: Electrolyzer technologies, storage solutions, and transport systems
- **Renewables**: Solar PV, CSP, wind turbines, and hybrid microgrids
- **Water-Energy Nexus**: Efficient desalination, water reuse, and zero liquid discharge
- **Smart Cities**: Energy efficiency, emissions tracking, and sustainable mobility

Saudi Arabia also offers strong incentives for R&D partnerships, local manufacturing, and workforce development as part of its broader economic transformation goals.

Market Considerations for Canadian Companies

Saudi Arabia is a high-value but highly structured market. Government procurement typically favors companies with established in-country presence, local partners, and alignment with national priorities. The In-Kingdom Total Value Add (IKTVA) program requires foreign firms to contribute to local content, workforce development, and knowledge transfer.

While the market is competitive—with strong players from the U.S., Europe, and increasingly Asia—Canada is well regarded for its energy expertise and innovation capacity. Companies that can demonstrate lifecycle value, local engagement, and environmental performance will be best positioned to succeed.

The Saudi–Canada trade relationship is gradually recovering from past diplomatic tensions, with renewed potential for collaboration in energy, technology, and sustainable infrastructure.

A Global Energy Leader Embracing the Future

Saudi Arabia is not turning away from oil—it is redefining its role in the global energy transition. For firms equipped with the technology, expertise, and vision to support this transformation, the Kingdom offers unrivalled scale, investment potential, and strategic relevance in both conventional and low-carbon energy.

SAUDI ARABIA

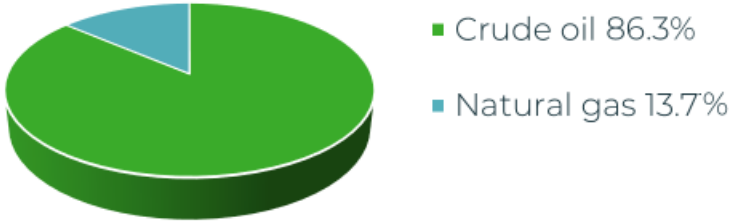
Emissions Reduction and Net Zero Commitments

- Reduce emissions below 2019 level by more than 278 million tonnes annually **by 2030**
- Net zero **by 2060**

Key Export Opportunities for Canadian Companies

- Advanced **drilling, exploration, and production** technologies
- Engineering and maintenance services
- **Downstream** industries
- Environmental technologies: carbon capture, utilization, and storage (**CCUS**), **waste management**, **recycling**, and **water treatment**
- Carbon markets

Domestic Energy Production*



2023:

$16 MILLION

of Canadian Cleantech Imported^

0 **Active Canadian O&G Companies†**

Crude Oil°

Daily Production: **10,123,000 BOE**
Proven Reserves: **297.6 billion BOE**
5-Year CAGR: **-2.8%**

Natural Gas°

Annual Production: **11.25 trillion ft³**
Proven Reserves: **196.3 trillion ft³**
5-Year CAGR: **2.1%**

* IEA, 2021 ^ Statistics Canada ° EIA, 2021 † CGEF, 2022

United Arab Emirates

Bridging Energy Traditions and Climate Ambitions

The United Arab Emirates (UAE) has established itself as a regional energy powerhouse and a global leader in the low-carbon transition. As one of the top oil producers in OPEC, the UAE has long leveraged its hydrocarbon wealth to drive economic development. Today, the country is actively using that foundation to pursue a bold vision of diversification, emissions reduction, and sustainable innovation.

With an advanced energy sector, investor-friendly policies, and world-leading decarbonization initiatives, the UAE offers a unique blend of tradition and transformation—making it a key destination for companies seeking to contribute to and benefit from the future of energy.

Oil and Gas: Optimizing for Value and Sustainability

As of 2022, the UAE held approximately 111 billion barrels of proven oil reserves, ranking sixth globally. In 2021, the country produced 3.78 million barrels per day, with output led by the Abu Dhabi National Oil Company (ADNOC). Under current expansion plans, the UAE aims to increase capacity to 5 million barrels per day by 2027.

ADNOC continues to invest heavily in upstream development, advanced recovery techniques, and digital oilfield technologies. The company is also among the most progressive national oil companies (NOCs) in terms of sustainability, having committed to net-zero Scope 1 and 2 emissions by 2045—the most ambitious target of any major NOC to date.

Natural gas plays a growing role in the UAE's domestic and export strategy. The country produced 2.33 trillion cubic feet in 2021 and is working to expand production through unconventional reserves and sour gas projects. The Jebel Ali field and Hail and Ghasha developments are key to this strategy, aimed at reducing import dependence and strengthening regional supply security.

ADNOC's efforts are underpinned by an integrated approach that prioritizes low-carbon intensity, operational efficiency, and long-term value creation.

Climate Commitments and Energy Transition Leadership

As host of COP28 in 2023, the UAE has positioned itself as a bridge between fossil fuel producers and climate action advocates. The country has committed to net-zero emissions by 2050—the first in the MENA region to do so—and has developed a comprehensive strategy to decarbonize its energy system and broader economy.

Key pillars of the UAE's energy transition include:

- Scaling renewables to 44% of the electricity mix by 2050
- Deploying CCUS to abate industrial emissions
- Expanding hydrogen production for export and domestic use

- Electrifying transport and enhancing energy efficiency
- Investing in clean energy research, innovation, and localization

Through the UAE Net Zero 2050 Strategic Initiative and the National Hydrogen Strategy, the government is creating one of the world's most ambitious frameworks for emissions reduction and green growth.

Renewable Energy and Clean Technology Expansion

The UAE has already achieved notable progress in clean energy deployment. Masdar City, the country's flagship sustainable development zone, serves as a global showcase for renewable energy, urban efficiency, and innovation. Masdar, the UAE's renewable energy company, has invested in over 40 countries and plans to expand its portfolio to 100 GW of clean energy capacity by 2030.

Domestically, the UAE has commissioned several landmark projects, including:

- **Mohammed bin Rashid Al Maktoum Solar Park**: One of the largest solar parks in the world
- **Barakah Nuclear Energy Plant**: The Arab world's first nuclear power plant
- **Al Dhafra Solar Project**: Among the most cost-competitive utility-scale solar installations globally

The country is also investing in green and blue hydrogen production, with multiple pilot and commercial-scale projects underway.

Energy and Cleantech Opportunities

The UAE's integrated energy strategy and openness to foreign partnerships create diverse opportunities for Canadian and international companies, including:

- **Upstream Optimization**: EOR, subsurface analytics, and automation tools
- **Gas Development**: Sour gas treatment, carbon capture, and unconventional resources
- **CCUS and Emissions Management**: Monitoring, verification, and storage solutions
- **Hydrogen Technologies**: Electrolyzers, transport infrastructure, and fuel cell applications
- **Renewables**: PV, CSP, and wind systems; grid integration and storage
- **Smart Infrastructure**: Digital energy systems, green buildings, and urban mobility
- **Water-Energy Nexus**: Efficient desalination, brine management, and reuse

The UAE also offers co-investment platforms, R&D funding, and free zone benefits to support technology localization and commercialization.

Market Considerations for Canadian Companies

The UAE is an open, business-friendly market with modern infrastructure, clear regulations, and strong protection for foreign investors. Government initiatives such as the Abu Dhabi Industrial Strategy and Dubai Clean Energy Strategy support private-sector participation and public-private partnerships.

Canadian companies are well regarded for their engineering quality, technology expertise, and more sustainable solutions. To succeed, firms should build strong local partnerships, consider regional representation, and align offerings with national priorities.

The Canadian Trade Commissioner Service in the UAE and organizations like the Canada–UAE Business Council can provide critical support for market entry, networking, and opportunity development.

A Model for Energy Transition in the Gulf

The UAE is proving that fossil fuel leadership and climate ambition are not mutually exclusive. By investing in both low-carbon technologies and sustainable hydrocarbons, the country is shaping the future of energy from a position of strength. For companies with solutions to enhance performance, cut emissions, and drive innovation, the UAE is an essential partner in a decarbonizing world.

UNITED ARAB EMIRATES

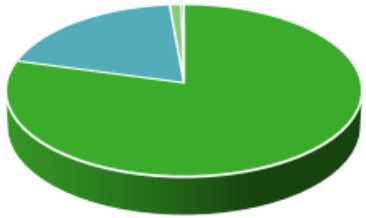
Emissions Reduction and Net Zero Commitments

- Reduce emissions 47% below 2019 levels **by 2035**
- Net zero **by 2050**

Key Export Opportunities for Canadian Companies

- **Upstream** and **downstream** oil and gas
- Enhanced oil recovery (**EOR**) technologies
- **Offshore**
- **LNG** and **Pipelines**
- **Decarbonization** – CCUS and methane emissions reduction technologies
- Unconventional oil and gas expertise: **hydraulic fracturing, drilling,** and **resource management**
- Waste-to-Energy and Environmental Technologies: **waste management, recycling**, and environmental monitoring and remediation
- **Renewable** energy technologies

Domestic Energy Production



- Crude oil 79.2%
- Natural gas 19.4%
- Nuclear 1.2%
- Wind, solar, etc. 0.3%

2023:

$44 MILLION

of Canadian Cleantech Imported

Crude Oil°

Daily Production: **3,203,000 BOE**
Proven Reserves: **107 billion BOE**
5-Year CAGR: **-1.5%**

0 **Active Canadian O&G Companies†**

Natural Gas°

Annual Production: **2.72 trillion ft³**
Proven Reserves: **215.1 trillion ft³**
5-Year CAGR: **-2.5%**

* IEA, 2021 ^ Statistics Canada ° EIA, 2021 † CGEF, 2022

Insights for the Middle East

Commitments to Emissions Reduction and Net-Zero Targets

Middle Eastern producers are increasingly committing to emissions reductions and net-zero targets while continuing to expand oil and gas operations. This dual track of hydrocarbon development and energy transition is shaping long-term policy and investment direction across the region.

Saudi Arabia aims to cut carbon emissions by 278 million tonnes annually by 2030 and reach net-zero by 2060. Through the Saudi Green Initiative, the country is investing heavily in renewable energy, CCUS technologies, and afforestation, with a target to generate 50% of its electricity from renewables by 2030. Aramco is committed to reducing upstream emissions intensity by 15% by 2035 and achieving net-zero Scope 1 and 2 emissions by 2050.

The **United Arab Emirates** was the first country in the region to commit to net-zero by 2050, with a clean energy target of 44% of its electricity mix by mid-century. Its strategy includes major investments in solar power, nuclear energy, and hydrogen, alongside CCUS and energy efficiency measures. ADNOC has pledged net-zero Scope 1 and 2 emissions by 2045—one of the most ambitious targets among national oil companies globally.

Kuwait is gradually aligning with the global energy transition, aiming for a 7.4% reduction in GHG emissions by 2035 (relative to business-as-usual) and net-zero by 2050 through Kuwait Petroleum Corporation (KPC). Focus areas include energy efficiency, renewable energy development, and CCUS integration into upstream and refining operations.

Iraq, while still early in its transition, has committed to a 2% GHG reduction below business-as-usual by 2030, with a conditional target of 15% pending international support. Its climate strategy emphasizes reducing gas flaring, integrating renewables into power generation, and improving energy efficiency.

Energy and Cleantech Opportunities for Canadian Exports

The Middle East presents a high-value but nuanced environment for Canadian clean technology and energy service exporters. While oil and gas will remain dominant in the near term, governments are investing in emissions reduction, energy diversification, and industrial innovation—opening the door to targeted international collaboration.

In **Saudi Arabia**, opportunities span both the conventional and low-carbon energy value chain. These include enhanced oil recovery (EOR), unconventional gas development, large-scale CCUS, and renewable energy deployment—especially in solar and wind. There is also growing demand for hydrogen technologies, desalination efficiency, emissions tracking, and smart city solutions. Companies that align with national initiatives such as Vision 2030 and meet local content requirements (e.g., IKTVA) are best positioned for success.

The **UAE** offers a broad, innovation-driven landscape. Canadian firms can support ADNOC's sustainability goals through subsurface analytics, emissions monitoring, and automation technologies, while also contributing to hydrogen production, CCUS, and clean energy integration. The country's openness to foreign investment, co-investment platforms, and free-zone incentives make it one of the most accessible markets in the region.

In **Kuwait**, investment in upstream oil production and refining modernization creates opportunities in reservoir management, produced water treatment, and refinery emissions reduction. The government is also pursuing solar energy development, hydrogen projects, and methane abatement technologies. Long-term supplier relationships and prequalification with KPC subsidiaries are essential for market entry.

Iraq presents a high-risk but high-reward opportunity landscape. Canadian companies can offer practical solutions for gas flaring reduction, natural gas processing, solar project development, and GHG abatement. While challenges remain around governance and infrastructure, more stable regions—such as the Kurdistan Region of Iraq (KRI)—offer a more favorable business environment. Strategic partnerships and in-country presence are critical for success.

Africa

Ghana

Emerging Potential in a Shifting Energy Landscape

Ghana's energy sector is at a pivotal moment. Since entering the oil and gas arena in 2007, the West African nation has steadily expanded its production capacity and infrastructure. Though challenges remain—particularly related to financing and power reliability—Ghana is positioning itself to be a regional hub for petroleum processing and an early adopter of clean energy in sub-Saharan Africa.

Offshore Oil and Gas Development: A Foundation for Growth

Oil and gas production in Ghana is entirely offshore, with output led by international oil companies including Tullow Oil, ENI, and Kosmos Energy. The Ghana National Petroleum Corporation (GNPC) holds a minimum 15% equity stake in all petroleum agreements, maintaining state involvement in resource development while allowing significant space for private investment.

Crude oil production has declined slightly since peaking in 2019, but recent commitments by Tullow and others are expected to stabilize output in the near term. The government has ambitions to double oil production by 2025, supported by deepwater exploration and prospective onshore development in the Voltaian Basin.

To supplement crude production, Ghana is scaling up natural gas utilization. **Ghana Gas**, the state-owned company overseeing processing and marketing, has seen gas production triple since 2018. Most of this gas is used domestically for power generation. A second gas processing plant, valued at US$700 million, is under development to increase capacity and extract additional value through gas liquids and by-products.

Downstream Vision: A Petroleum Hub in the Making

In a bid to move up the value chain, Ghana has launched the Petroleum Hub Development Project—a US$60 billion initiative to attract private capital into downstream infrastructure. Plans include new refineries, petrochemical facilities, storage terminals, and port developments, all designed to serve both domestic demand and regional export markets.

This long-term strategy signals Ghana's desire to evolve from a primary resource exporter into a regional energy services and processing center. With growing domestic consumption and regional demand, the hub could be a transformative asset—if financial, regulatory, and logistical challenges are addressed.

Power Generation and Energy Security

Ghana has one of the highest electricity access rates in sub-Saharan Africa, with over 90% of its population connected to the grid. However, reliability remains an issue, with power outages averaging around 60 hours annually.

As of 2021, 68% of electricity came from thermal sources—mostly natural gas—while hydropower accounted for 29%. Renewables contributed less than 3%, although future expansion is anticipated through solar and wind initiatives.

Gas will continue to play a central role in power generation as Ghana scales back reliance on more carbon-intensive fuels. However, aging infrastructure, market constraints, and legacy debt in the electricity sector remain obstacles to reliable and efficient service delivery.

Climate Commitments and Energy Transition Planning

Ghana has pledged to cut greenhouse gas emissions by 20% unconditionally by 2030, and by up to 64% with international support. The country's National Energy Transition Framework (2022–2070) and Natural Gas Utilization Plan provide a clear roadmap toward decarbonization.

Key initiatives include:

- Increasing renewable energy's share in the energy mix to 10% by 2030
- Scaling adoption of compressed natural gas vehicles
- Deploying CCUS in power generation and oil and gas sectors by 2040
- Phasing down heavy fuel oil in favour of natural gas and renewables

These efforts are supported by an emerging voluntary carbon market and exploration of civil nuclear energy as a long-term, low-carbon option.

Energy and Cleantech Opportunities

Ghana's evolving energy sector presents several strategic opportunities for Canadian and international companies, including:

- Offshore exploration and production support services
- Specialized upstream and engineering consulting through local partnerships
- Technical assistance for clean technology policies and frameworks
- Emissions tracking, carbon offset development, and CCUS deployment
- Smart grid and metering technologies for power reliability
- Energy efficiency solutions for industrial and commercial applications
- Solar panel manufacturing and project development
- Hydropower modernization and infrastructure expansion

Ghana's efforts to attract green investment, improve transparency, and scale voluntary carbon markets provide additional entry points for climate-aligned technologies and services.

Considerations for Canadian Firms

Canadian firms entering Ghana must contend with a few critical challenges. International competition is strong, and awareness of Canadian capabilities in the market is limited. Financial constraints on public spending and a moratorium on new Power Purchase Agreements further restrict renewable energy project development.

The exit of major international oil companies like ExxonMobil and Anadarko has reduced exploration momentum. Regulatory uncertainties and opaque procurement processes may add further complexity.

Nonetheless, Ghana's political stability, open trade environment, and strategic ambitions create a favourable backdrop for long-term engagement. Local partnerships, strong value propositions, and support from the Canadian Trade Commissioner Service will be key to unlocking opportunities.

A Promising Market for Long-Term Partnerships

Ghana represents one of West Africa's most promising energy markets. With a clear decarbonization roadmap, expanding infrastructure, and a commitment to becoming a regional energy hub, the country offers meaningful opportunities for foreign firms willing to navigate complexity and invest in durable partnerships.

GHANA

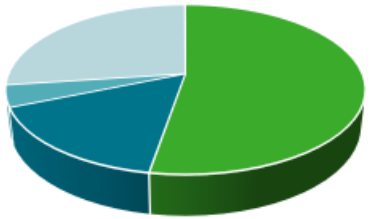
Emissions Reduction and Net Zero Commitments

- Reduce emissions by 20% **by 2030**
- Carbon neutrality **by 2070**

Key Export Opportunities for Canadian Companies

- **Emissions reduction** technology
- Carbon capture and storage (**CCS**)
- Exploration and production (**E&P**) of oil and gas
- Energy infrastructure
- Energy **efficiency**
- **Renewable** Energy

Domestic Energy Production*



- Crude oil 52.7%
- Natural gas 16.1%
- Hydro 4.1%
- Biofuels and waste 27.0%
- Wind, solar, etc. 0.1%

2023:

$7.3 MILLION

of Canadian Cleantech Imported^

Crude Oil°

Daily Production: **179,000 BOE**

Proven Reserves: **0.7 billion BOE**

5-Year CAGR: **12.2%**

1 **Active Canadian O&G Companies†**

Natural Gas°

Annual Production: **0.1 trillion ft³**

Proven Reserves: **0.8 trillion ft³**

5-Year CAGR: **0.2%**

* IEA, 2021 ^ Statistics Canada ° EIA, 2021 † CGEF, 2022

Nigeria

Africa's Energy Giant Seeking Reform and Diversification

Nigeria is Africa's largest oil producer and a major player in global energy markets, but its energy story is one of paradox: vast reserves alongside underperformance, high emissions alongside under-electrification, and tremendous opportunity tempered by systemic challenges. The government is pursuing long-overdue reforms to unlock investment, improve governance, and diversify the energy mix—creating space for international partners equipped to navigate complexity and drive sustainable growth.

Oil and Gas: Dominance Amid Disruption

Nigeria holds an estimated 36.9 billion barrels of proven oil reserves and produced 1.59 million barrels per day in 2021. Oil accounts for over 80% of export earnings and more than half of government revenues. Yet, Nigeria consistently underperforms its OPEC quota due to insecurity in the Niger Delta, aging infrastructure, and limited upstream investment.

In 2021, the landmark Petroleum Industry Act (PIA) was enacted to modernize the sector's legal and fiscal framework. It established the Nigerian National Petroleum Company Limited (NNPCL) as a commercial entity, created new regulatory bodies, and introduced more competitive terms for investors. This reform has spurred cautious optimism for a more transparent and investor-friendly upstream environment.

Most of Nigeria's production is exported, with India, the Netherlands, and Spain as major buyers. However, pipeline vandalism and oil theft continue to impair supply. Refining capacity remains limited, forcing Nigeria to import most of its refined products—though the long-awaited Dangote Refinery may alter this dynamic once fully operational.

Gas Ambitions: Domestic Use and Export Expansion

Nigeria also holds vast natural gas reserves—over 200 trillion cubic feet—yet less than 25% is currently produced or monetized. Historically, much of Nigeria's gas has been flared or underutilized. The government's "Decade of Gas" strategy aims to shift this trajectory by promoting gas as both a transition fuel and a driver of industrialization.

Nigeria is already a major LNG exporter, primarily through the Nigeria LNG (NLNG) facility, with cargoes shipped to Europe, Asia, and Latin America. New LNG terminals and gas pipeline projects, including links to North Africa and Europe, are planned to expand market access.

Domestically, gas is central to Nigeria's ambitions for electrification, industrial development, and cleaner cooking fuels. Incentives are in place to spur investment in gas processing, transmission, and distribution infrastructure.

Power and Energy Access: A Persistent Challenge

Despite its resource wealth, Nigeria suffers from chronic power shortages. Only 55% of the population has access to electricity, and grid reliability is among the worst globally. The power sector is characterized by underinvestment, high technical losses, non-cost-reflective tariffs, and a legacy of state control.

Thermal generation—largely gas-fired—accounts for over 70% of installed capacity. However, capacity utilization is low due to fuel supply constraints and infrastructure gaps. Hydropower and renewables remain underdeveloped but are recognized as part of the long-term solution.

Privatization of distribution companies has yielded mixed results. The government is now focused on stabilizing the sector through grid investments, mini-grid development, and improved governance.

Climate Commitments and Decarbonization Strategy

Nigeria has committed to achieving carbon-neutrality by 2060. Its updated nationally determined contribution (NDC) targets a 20% emissions reduction by 2030 (unconditionally), and 47% with international support.

The Energy Transition Plan (ETP), launched in 2022, lays out a roadmap for deep decarbonization through:

- Ending gas flaring by 2030
- Scaling renewable energy, including solar and hydropower
- Deploying clean cooking solutions for 30 million households
- Expanding electrification using decentralized solutions
- Promoting green jobs and local manufacturing of clean energy components

The ETP anticipates over US$400 billion in investment needs through 2060, underscoring Nigeria's appetite for international capital, technology, and expertise.

Energy and Cleantech Opportunities

Nigeria's reform momentum and infrastructure gaps create high-impact opportunities for Canadian and international firms, including:

- **Upstream Services**: EOR, subsea engineering, flow assurance, and leak detection
- **Gas Development**: Processing plants, CNG infrastructure, and LNG logistics
- **Power Solutions**: Gas turbines, hybrid mini-grids, and smart metering
- **Renewables**: Utility-scale solar, solar irrigation, and battery storage
- **Emissions Management**: Flaring reduction, methane tracking, and CCUS pilots
- **Clean Cooking**: Biofuels, LPG distribution, and appliance deployment
- **Local Content**: Skills development, fabrication, and technology transfer

Growing carbon market activity and voluntary offset initiatives further open the door for cleantech partnerships with environmental co-benefits.

Market Considerations for Canadian Firms

While opportunity is abundant, Nigeria's business environment remains challenging. Corruption, foreign exchange volatility, and regulatory unpredictability can delay or derail projects. The Local Content Act requires foreign firms to partner with local entities for many upstream and engineering services.

Canadian OEMs face strong competition from U.S., U.K., and increasingly Asian suppliers—often preferred due to legacy relationships. However, Canadian firms offering cost-effective, reliable, and impact-driven solutions are gaining traction, especially in off-grid power, emissions control, and capacity building.

Engaging with the Canadian Trade Commissioner Service in Lagos and working through local industry associations can enhance visibility and reduce market entry risks.

A High-Reward Market Demanding Local Engagement

Nigeria is one of Africa's most important energy markets, with vast needs and a clear vision for reform. Companies that can navigate the regulatory landscape, build trust with local partners, and deliver measurable value—particularly in gas, power, and cleantech—stand to gain a strong foothold in a market poised for transformation.

NIGERIA

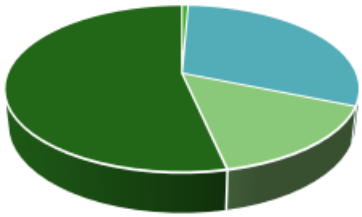
Emissions Reduction and Net Zero Commitments

- Reduce emissions by 20% unconditionally (47% conditionally) **by 2030**
- Net zero **by 2060**

Key Export Opportunities for Canadian Companies

- Oil and gas exploration and production (**E&P**)
- **LNG** infrastructure
- **Renewable energy** infrastructure

Domestic Energy Production*



2023:

$24 MILLION

of Canadian Cleantech Imported^

Crude Oil°

Daily Production: **1,348,000 BOE**
Proven Reserves: **37 billion BOE**
5-Year CAGR: **-5.6%**

5 **Active Canadian O&G Companies†**

Natural Gas°

Annual Production: **4.54 trillion ft³**
Proven Reserves: **127.2 trillion ft³**
5-Year CAGR: **12.2%**

* IEA, 2021 ^ Statistics Canada ° EIA, 2021 † CGEF, 2022

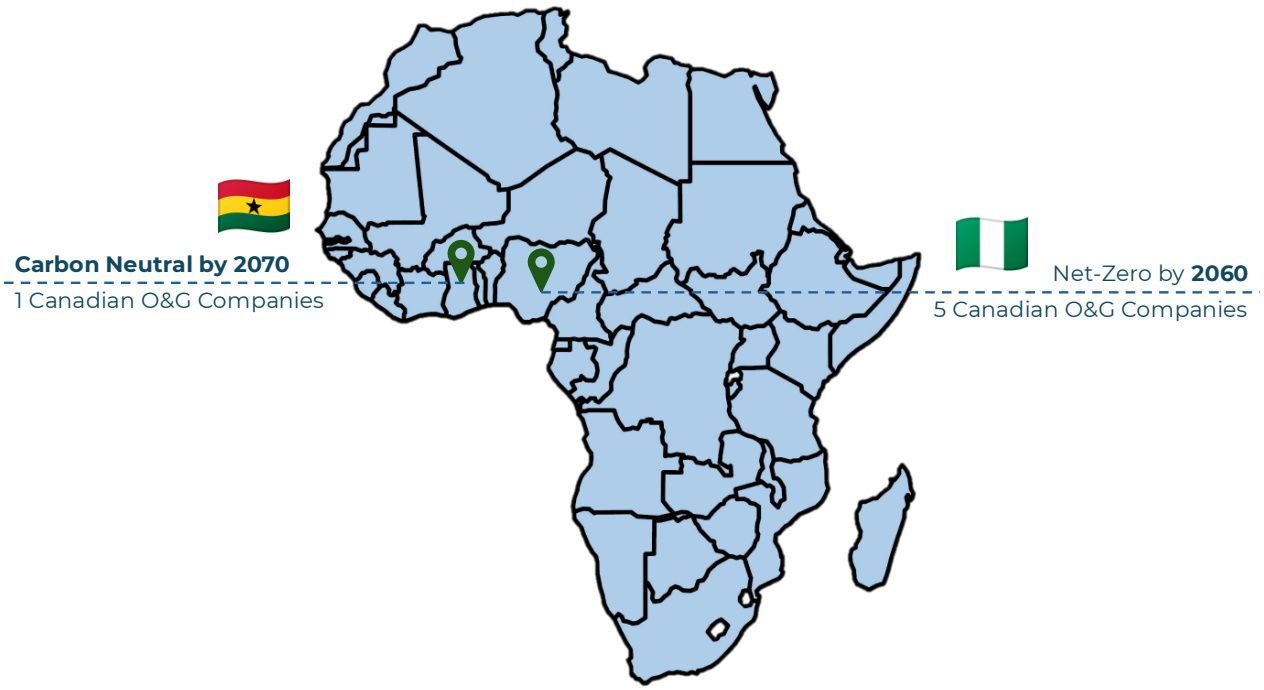
Insights for Africa

Commitments to Emissions Reduction and Net-Zero Targets

African energy leaders are advancing climate strategies that reflect their development priorities, balancing economic growth with international climate goals.

Ghana has committed to reducing emissions by 20% by 2030, with an additional 64% reduction conditional on international support. Its National Energy Transition Framework (2022–2070) outlines a phased decarbonization strategy focused on renewables, CCUS, and compressed natural gas vehicles. The country also plans to phase out heavy fuel oil and scale up its voluntary carbon market. By 2030, Ghana aims for 10% of its electricity mix from renewables, with long-term exploration into civil nuclear energy as a zero-carbon alternative.

Nigeria, Africa's largest oil producer, aims to reduce emissions by up to 47% by 2050 and reach carbon neutrality by 2060. Under its Climate Change Act and Energy Transition Plan (ETP), Nigeria targets major reductions in emissions across the power, transport, oil and gas, cooking, and industrial sectors. The government is investing in solar energy, electric vehicles, and clean cooking solutions, with a goal to eliminate routine gas flaring by 2030 and electrify underserved communities through decentralized systems. Its NDC sets an unconditional target of 20% emissions reduction by 2030, and 47% with external financing.



Energy and Cleantech Opportunities for Canadian Exports

Ghana and Nigeria offer high-potential entry points for Canadian clean technology and energy solutions, driven by infrastructure gaps, sector reforms, and climate ambitions.

In **Ghana**, Canadian companies can support offshore oil and gas operations, gas processing, and upstream services through local partnerships. Opportunities are emerging in smart grid systems, power metering, solar manufacturing, and hydropower modernization. The country's push for emissions tracking, CCUS deployment, and carbon offset development creates space for firms specializing in environmental consulting and low-carbon project design. Ghana's ambitions to become a regional petroleum processing hub through its US$60 billion Petroleum Hub Development Project further highlight prospects in refining, petrochemicals, and logistics infrastructure.

Nigeria presents a large, complex, but dynamic market. Canadian firms can engage across a broad range of sectors, including EOR, gas processing, LNG logistics, and CNG distribution. The government's "Decade of Gas" strategy supports investment in infrastructure for industrial fuel switching, power generation, and clean cooking fuels. There are also opportunities in solar irrigation, hybrid mini-grids, methane tracking, and CCUS pilots. Nigeria's scale and energy needs demand solutions that are both technically robust and cost-effective. However, local content requirements, regulatory fragmentation, and project risks mean firms must approach the market with strong local partnerships, in-country capacity, and flexible financing models.

Asia-Pacific & Oceania

China

A Global Energy Powerhouse in Transition

China's energy story is one of immense scale, rapid transformation, and strategic ambition. As the world's largest energy producer, consumer, and emitter, China occupies a central role in global energy markets. Yet even as coal and oil remain pillars of its domestic energy system, the country is fast becoming a clean technology superpower—driven by climate commitments, economic priorities, and the pursuit of energy security.

Fossil Fuels and Strategic Supply

China's energy mix remains anchored in fossil fuels. In 2021, coal accounted for 60.6% of total consumption, followed by oil (18.1%) and natural gas (8%). Despite strong decarbonization rhetoric, coal continues to provide base-load energy for industrial and residential needs, and China remains the largest producer and consumer of coal worldwide.

In oil and gas, the state-owned trio of **PetroChina, Sinopec, and CNOOC** dominate domestic production and infrastructure. However, output remains insufficient to meet China's growing energy demands, making the country one of the world's largest importers of crude oil and natural gas. Key crude suppliers include Russia, Saudi Arabia, Iran, Venezuela, and the UAE, while natural gas imports—via pipeline and LNG—come primarily from Turkmenistan, Russia, and Australia.

China has invested heavily in strategic petroleum reserves, refinery integration, and LNG terminals to improve resilience and reduce dependence on foreign markets. The country is also actively pursuing domestic upstream development, including shale and ultra-deep reservoirs, although technical challenges and water scarcity limit scalability.

Laying the Groundwork for a Clean Energy Future

Over the past decade, China has emerged as a global leader in renewable energy development. From 2019 to 2024, it is projected to account for 40% of global growth in renewable capacity. Massive investments in wind, solar, hydro, and nuclear are reshaping the grid and reducing the carbon intensity of electricity generation.

Wind and solar lead the expansion. China is home to the largest installed capacities of both, with a national goal of reaching 1,200 GW by 2030. Large-scale transmission upgrades and grid flexibility investments are enabling these intermittent sources to play a greater role in the energy mix.

China is also the world's largest producer and consumer of hydrogen, with aggressive plans to expand green hydrogen through electrolysis powered by renewables. Its hydrogen fuel cell vehicle market is the most developed globally, supported by national industrial policy and regional pilot zones.

In the bioenergy space, ethanol production is rising, driven by government blending mandates and financial incentives for advanced biofuels.

Policy Leadership and Emissions Strategy

China's commitment to peak carbon emissions by 2030 and achieve carbon neutrality by 2060 has reshaped national energy and industrial planning. Rather than impose absolute limits, China's strategy centers on reducing emissions intensity—emissions per unit of GDP—while maintaining economic growth.

Key mechanisms driving this transition include:

- Investment in carbon capture, utilization, and storage (CCUS)
- Expansion of electric vehicle infrastructure and green urbanization
- Deployment of smart grids and digital energy platforms
- Carbon market reforms and regional pilot programs
- Integration of climate risk into financial and regulatory frameworks

These policies reflect China's preference for a state-led, innovation-driven pathway to decarbonization, with a heavy emphasis on technology and industrial upgrading.

Opportunities for Foreign Firms

As China accelerates its energy transformation, demand for advanced technologies—especially from international firms—is growing. Canadian and foreign companies offering innovative, cost-effective solutions aligned with China's policy priorities may find substantial market opportunities. These include:

- Advanced upstream technologies for shale and deep reservoirs (e.g., smart fracking fluids, corrosion-resistant alloys)
- Emissions monitoring and leak detection systems
- CCUS technologies and carbon accounting tools
- Smart grid integration and long-duration energy storage
- Digital platforms for predictive maintenance and energy optimization
- Hydrogen production, storage, and transportation systems
- Water, air, soil, and waste treatment for industrial decarbonization

China's scale and commitment to green development make it a valuable market for firms with specialized technologies and long-term vision.

Market Access: High Rewards, High Complexity

Despite the potential, doing business in China requires strategic preparation. Foreign firms must navigate:

- A complex and evolving regulatory system
- Intellectual property concerns

- Local content preferences and standards compliance
- Cultural and communication barriers
- Logistics constraints, including limited direct connectivity with Canada

Success in China depends on strong local partnerships, early intellectual property protection, and a commitment to understanding local policy dynamics. Engagement with Chinese regulators, research institutes, and industrial parks can provide essential insight and access.

Canadian companies should leverage the support of the Canadian Trade Commissioner Service, explore regional pilot programs aligned with national priorities, and consider co-development models with Chinese counterparts.

Conclusion: China's Energy Transformation Is a Global Story

China's energy transition is not just a domestic priority—it's a global event with wide-ranging implications for energy markets, emissions trajectories, and clean technology deployment. For firms prepared to navigate its complexities, China offers unmatched scale, opportunity, and momentum. Its dual identity—as both the world's largest fossil fuel consumer and its leading clean energy investor—makes it a critical partner and a market of consequence for the global energy industry.

CHINA

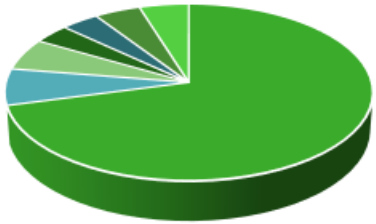
Emissions Reduction and Net Zero Commitments

- Peak CO2 emissions **by 2030**
- Reduce emissions per unit of GDP by over 65% below 2005 levels **by 2030**
- Carbon neutral **by 2050**

Key Export Opportunities for Canadian Companies

- Exploration and production (**E&P**) of shale and unconventional oil and gas
- Emissions reduction technology
- Carbon Capture and Storage (**CCS**)
- **Environmental** management

Domestic Energy Production*



- Coal 70.9%
- Crude oil 6.7%
- Natural gas 5.8%
- Nuclear 3.6%
- Hydro 3.7%
- Wind, solar, etc. 4.5%
- Biofuels and waste 4.8%

2023:

$432 MILLION

of Canadian Cleantech Imported^

Crude Oil°

Daily Production: **3,897,000 BOE**
Proven Reserves: **25.2 billion BOE**
5-Year CAGR: **-0.1%**

2 **Active Canadian O&G Companies†**

Natural Gas°

Annual Production: **6.58 trillion ft³**
Proven Reserves: **8.4 trillion ft³**
5-Year CAGR: **8.7%**

* IEA, 2021 ^ Statistics Canada ° EIA, 2021 † CGEF, 2022

Indonesia

Balancing Resource Wealth with Decarbonization Goals

As Southeast Asia's largest economy and a global energy player, Indonesia sits at the crossroads of fossil fuel legacy and clean energy ambition. Rich in oil, gas, coal, and biofuels, the country has historically powered its growth through hydrocarbons. Yet mounting environmental pressures and bold emissions targets are now accelerating Indonesia's pivot toward a more diversified, lower-carbon energy future.

Oil and Gas: Production Under Pressure, Demand Rising

Indonesia remains one of the region's most influential oil and gas producers. However, its upstream sector faces mounting challenges. Crude oil production—at 0.69 million barrels per day in 2021—has been steadily declining due to aging fields, technical limitations, and underinvestment. Many reserves require enhanced oil recovery (EOR) technologies beyond the capabilities of domestic firms, and access to remote regions is constrained by limited infrastructure.

Pertamina, the national oil company, accounts for nearly half of current oil production. The government aims to boost output to 1 million barrels per day and increase gas production to 12 billion cubic feet per day by 2030. Realizing these goals will depend on unlocking mature and unconventional reserves and addressing investment bottlenecks.

Natural gas plays an increasingly strategic role. Indonesia is Southeast Asia's primary gas supplier, with proven reserves of nearly 50 trillion cubic feet. The country is a long-established LNG exporter, serving major markets in China, Japan, South Korea, and Taiwan. Domestically, demand for gas is growing, especially in the power and industrial sectors. To support this shift, the government is prioritizing the expansion of national gas infrastructure, including pipelines, terminals, and processing capacity.

Refining and Trade Dynamics

Indonesia's refining system covers only about half of its domestic fuel demand. As a result, the country imports crude oil from suppliers including Saudi Arabia, Malaysia, Nigeria, and Australia. After refining, some product is re-exported, but most is consumed locally. Imports are also used directly in power generation.

To reduce dependence on foreign refined products, Indonesia is advancing a major refinery development and upgrade program, including new capacity and sulphur-reducing technologies. The goal is to increase energy security while improving environmental performance in line with emerging clean fuel standards.

Biofuels and Coal: Managing Transition in Key Sectors

Indonesia is the world's largest producer of biofuels, primarily biodiesel from palm oil. The country has aggressively expanded biofuel blending mandates to curb oil imports and reduce emissions in the transport sector. While biofuels are seen as a strategic asset, sustainability concerns and trade restrictions remain ongoing issues.

Coal still dominates Indonesia's energy mix, contributing over 30% of total consumption. The country is the world's fourth-largest coal producer and a leading exporter. However, the government has committed to phasing out unabated coal-fired power by 2040. This shift marks a significant policy pivot that will require a careful balance between energy security, employment, and emissions goals.

Climate Commitments and Energy Transition Plans

Indonesia has pledged to cut greenhouse gas emissions by at least 32% by 2030, and up to 43% with international support. The country's net-zero target is set for 2060. The transition plan centers on increasing energy efficiency, expanding electrification, and accelerating renewable energy adoption.

The power sector is expected to deliver half of the country's emissions reductions, with 60% of that coming from new renewable energy sources. Indonesia's long-term energy plan calls for 60% of electricity capacity to come from renewables by 2060, with solar playing a dominant role.

To support this, the government is implementing reforms to encourage investment in solar, geothermal, and biomass, while also exploring carbon capture, utilization, and storage (CCUS) in high-emitting industries.

Energy and Cleantech Opportunities

Indonesia's scale, industrial growth, and ambitious energy transition targets create broad opportunities for Canadian and international companies. Key areas include:

- Unconventional hydrocarbon development and EOR technologies
- Natural gas infrastructure, storage, and transportation
- Refining upgrades and sulphur management technologies
- Renewable energy deployment: rooftop solar, geothermal, biomass
- CCUS project development and emissions tracking systems
- Industrial water and wastewater treatment solutions
- Energy efficiency and smart metering systems for commercial and public infrastructure
- Non-revenue water management and municipal services

As clean energy targets become binding, the demand for international expertise in project development, financing, and technology integration will continue to grow.

Market Access and Challenges for Canadian Firms

Indonesia's regulatory environment can be complex and often requires strong local partnerships. Local content rules mandate prioritization of domestic suppliers and service providers, complicating entry for foreign firms. Bureaucratic delays and non-transparent approval processes can slow projects and add compliance risks.

Price sensitivity and limited incentives for innovation can challenge technology adoption, particularly in early-stage sectors like CCUS or advanced efficiency systems. Long-term success depends on localization strategies, relationship-building, and patient capital.

Most foreign direct investment remains concentrated in Java. Canadian companies may need to target underserved or infrastructure-limited regions, where energy development and environmental services are more urgently needed.

A Market in Transition, Open to Innovation

Indonesia is at the forefront of Southeast Asia's energy evolution. Its resource base, industrial demand, and climate commitments form a powerful platform for long-term investment in both fossil and clean energy systems. For companies offering adaptable, proven solutions—particularly in natural gas, renewables, and emissions management—Indonesia represents a high-potential market navigating a critical phase of transition.

INDONESIA

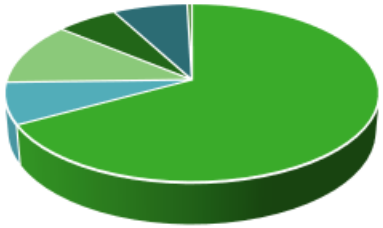
Emissions Reduction and Net Zero Commitments

- Reduce emissions by 32% (unconditionally, 43% conditionally) **by 2030**
- Net zero emissions **by 2060**

Key Export Opportunities for Canadian Companies

- Exploration and production (**E&P**) of unconventional oil and gas
- Enhanced oil recovery (**EOR**)
- Gas infrastructure
- Emissions reduction technologies
- **Renewable Energy**, especially in Rooftop Solar PV, Geothermal Power, and Biomass
- Carbon capture, utilization, and storage (**CCUS**)
- Wastewater treatment and management

Domestic Energy Production*



- Coal 67.0%
- Crude oil 7.5%
- Natural gas 11.4%
- Wind, solar, etc. 6.1%
- Biofuels and waste 7.4%
- Hydro 0.5%

2023:

$8.2 MILLION

of Canadian Cleantech Imported^

Crude Oil°

Daily Production: **692,000 BOE**

Proven Reserves: **3.6 billion BOE**

5-Year CAGR: **-4.6%**

6 **Active Canadian O&G Companies†**

Natural Gas°

Annual Production: **2.89 trillion ft³**

Proven Reserves: **49.7 trillion ft³**

5-Year CAGR: **-4.6%**

* IEA, 2021 ^ Statistics Canada ° EIA, 2021 † CGEF, 2022

Malaysia

A Regional Energy Leader Adapting to a Low-Carbon Future

Malaysia stands as Southeast Asia's second-largest oil and gas producer and a global LNG powerhouse, long recognized for its robust infrastructure, strategic geographic position, and regional influence. While hydrocarbons continue to underpin the nation's energy economy, Malaysia is now advancing a more sustainable path. With declining gas production and mounting pressure to reduce emissions, the country is investing in cleaner technologies and diversifying its energy mix.

For international players in oil, gas, and cleantech, Malaysia offers a well-regulated and competitive environment—one that is increasingly open to innovation in energy efficiency, carbon management, and renewable power.

Oil and Gas: A Mature Sector in Transition

Malaysia's oil and gas sector remains central to its economic strength, though production has declined due to maturing fields. As of 2021, the country produced 0.51 million barrels of crude oil per day and held 3.6 billion barrels of proven oil reserves. Most production occurs offshore and is overseen by **Petroliam Nasional Berhad (Petronas)**, Malaysia's state-owned oil and gas company.

Malaysia exports crude oil and refined products mainly to Asian neighbours, including Singapore, Thailand, and China. Despite being a producer, it also imports light crude—primarily from Saudi Arabia—to meet refinery specifications. In response to production declines, Malaysia is prioritizing enhanced recovery techniques and the development of new reserves.

Natural gas continues to play a vital role in Malaysia's domestic and export strategies. The country produced 2.54 trillion cubic feet in 2021, with most output derived offshore. Malaysia is the world's fifth-largest LNG exporter, shipping to Japan, South Korea, China, and Taiwan. Yet, infrastructure constraints have led to regional imbalances in domestic supply, necessitating selective natural gas imports. As gas fields age and output falls, investment is shifting toward improving efficiency and unlocking new non-associated gas reserves.

Advancing Toward Net-Zero: Commitments and Roadmaps

Malaysia has committed to achieving carbon neutrality by 2050 and is aligning its policies with the Paris Agreement. The National Energy Transition Roadmap outlines the country's strategies to build a low-carbon economy. This includes expanding renewable energy deployment, promoting energy efficiency, and advancing carbon capture and storage (CCS) technologies.

Emissions reduction will depend heavily on sector-wide reforms and new investment. While fossil fuels remain dominant, Malaysia aims to gradually reduce its reliance on coal and optimize its natural gas use in power generation and industrial processes.

Key focus areas of the roadmap include:

- Increasing the share of renewables, especially solar and hydro

- Improving energy efficiency across power and industrial sectors
- Deploying CCS and methane abatement technologies
- Electrifying transport and expanding public transit systems

This shift is supported by fiscal incentives, regulatory reforms, and public-private partnerships, creating clear entry points for international collaboration.

Energy and Cleantech Opportunities

Malaysia's energy transition opens new avenues for foreign companies, particularly those offering solutions that improve efficiency, cut emissions, and support decarbonization. Key opportunities include:

- **Renewable Energy**: Solar, wind, and hydropower projects are actively encouraged, with government incentives for green energy developers.
- **Carbon Capture and Storage (CCS)**: Petronas is advancing CCS pilot projects, and the government is welcoming technical and financial collaboration.
- **Methane Emissions Reduction**: Technologies that detect, quantify, and mitigate methane emissions are in demand, particularly in oil and gas operations.
- **Energy Efficiency**: Industrial retrofitting, digitalization, and smart grid technologies present growing markets.
- **Oil and Gas Services**: There is continued demand for advanced upstream services, including deepwater exploration, enhanced oil recovery, and refining innovations.

Malaysia's openness to foreign partnerships, coupled with strong industrial fundamentals, makes it a strategic market for Canadian and international cleantech providers with expertise in the oil and gas value chain.

Market Considerations for Canadian Companies

Entering Malaysia's energy market often requires a local partner—an important signal of long-term commitment and a vital bridge to navigating regulatory and business networks. Competition is intense in subsectors like energy efficiency and renewables, and success typically hinges on persistence, relationship-building, and value demonstration over time.

There is also a perception that Canadian technologies are expensive. As such, Canadian firms may need to offer financing solutions or secure third-party funding to improve competitiveness and market uptake.

Despite these barriers, Malaysia offers a relatively stable and transparent environment. The country's strong regional trade links and energy expertise make it a promising destination for firms that can align with Malaysia's dual priorities: sustaining energy security while enabling decarbonization.

MALAYSIA

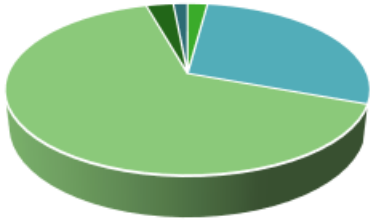
Emissions Reduction and Net Zero Commitments

- Reduce emissions by 43% **by 2030**
- Net zero emissions **by 2050**

Key Export Opportunities for Canadian Companies

- Enhanced oil recovery (**EOR**)
- Deepwater exploration
- Refining technologies
- Carbon capture and storage (**CCS**)
- Energy **Efficiency**
- **Renewable** Energy

Domestic Energy Production*



- Coal 2.1%
- Crude oil 28.5%
- Natural gas 64.9%
- Hydro 2.9%
- Biofuels and waste 1.5%

2023:

$73 MILLION

of Canadian Cleantech Imported^

Crude Oil°

Daily Production: **495,000 BOE**
Proven Reserves: **3.6 billion BOE**
5-Year CAGR: **-5.5%**

2 **Active Canadian O&G Companies†**

Natural Gas°

Annual Production: **2.54 trillion ft³**
Proven Reserves: **30 trillion ft³**
5-Year CAGR: **1.1%**

* IEA, 2021 ^ Statistics Canada ° EIA, 2021

Pakistan

Energy Security at the Heart of Economic Stability

Pakistan's energy landscape is defined by a persistent need for stability. The country faces a complex mix of challenges—ranging from fuel import dependency and chronic power shortages to mounting circular debt and rising emissions. Yet, amid these hurdles, Pakistan is pursuing reforms to diversify its energy mix, expand access, and embrace lower-carbon pathways.

As demand grows and legacy systems strain under pressure, Pakistan is actively seeking international expertise, investment, and technology to help meet its dual goals of energy security and sustainability.

Fossil Fuels and the Energy Mix: A Heavy Dependence

Pakistan relies heavily on fossil fuels, which make up nearly two-thirds of its electricity generation. In 2021, the country produced 0.09 million barrels of oil per day—well below domestic demand—and imported crude primarily from the UAE and Saudi Arabia. Refining capacity remains limited and in need of modernization, leading to further reliance on imported refined products.

Natural gas is a critical energy source for Pakistan, serving both the power and industrial sectors. However, local production has declined in recent years, and the country has turned to LNG imports to bridge the gap. Qatar and Oman are key suppliers, with additional spot market purchases contributing to energy cost volatility.

Coal has also re-entered the energy mix, driven by large-scale infrastructure projects under the China–Pakistan Economic Corridor (CPEC). These coal plants, while improving supply, have raised emissions and exacerbated Pakistan's climate vulnerability.

Power Sector: Reforms and Reliability

Pakistan's power sector has long struggled with inefficiencies, including outdated infrastructure, technical losses, and tariff distortions. Circular debt—caused by unpaid subsidies and bill collection gaps—remains a significant fiscal burden. As a result, blackouts and load shedding are common, especially during summer peaks.

The government is working to improve the sector's financial and operational performance through tariff adjustments, privatization initiatives, and transmission upgrades. There is also a growing focus on distributed energy and grid decentralization to reach underserved rural communities.

With a growing population and industrial base, Pakistan's electricity demand is expected to rise substantially over the next two decades. Ensuring reliable, affordable, and sustainable power is a top national priority—and one that requires external support and innovation.

Climate Commitments and Energy Transition

Pakistan has committed to reducing its projected greenhouse gas emissions by 50% by 2030 (15% unconditionally and 35% conditional on international support), with an aspiration to achieve net-zero

emissions by 2050. However, given the country's limited fiscal space and energy poverty, climate targets are closely tied to access to international finance and technology.

The updated Nationally Determined Contribution (NDC) and Alternative and Renewable Energy Policy 2019 outline Pakistan's roadmap for transitioning to a more sustainable energy mix. These plans include:

- Achieving 60% clean energy in the power mix by 2030
- Ending imported coal use while expanding local coal with emission controls
- Promoting solar, wind, hydropower, and biomass
- Supporting electric vehicle uptake and cleaner transport fuels
- Exploring carbon market mechanisms and voluntary offset projects

Pakistan is also actively engaging in climate adaptation programs and disaster risk mitigation, given its vulnerability to extreme weather events and water stress.

Energy and Cleantech Opportunities

Pakistan's evolving energy needs create diverse opportunities for Canadian and international firms, particularly in areas that address reliability, affordability, and emissions reduction. Priority sectors include:

- **Upstream Development**: Enhanced recovery, pipeline rehabilitation, and field services
- **LNG Infrastructure**: Regasification, floating terminals, and supply chain optimization
- **Refinery Modernization**: Desulfurization, emissions controls, and throughput upgrades
- **Renewables**: Utility-scale solar, wind farms, mini-grids, and net metering systems
- **Grid Solutions**: Smart meters, control systems, and energy storage
- **Energy Efficiency**: Industrial retrofits and demand-side management
- **Water-Energy Nexus**: Efficient desalination, wastewater treatment, and reuse

Given the country's emissions targets, opportunities are also emerging in clean fuel deployment, green hydrogen pilots, and carbon capture feasibility studies.

Market Considerations for Canadian Companies

Pakistan offers market entry through joint ventures, technical partnerships, or direct exports—but local presence and relationship-building are essential. Public procurement is often opaque, and regulatory delays can challenge foreign bidders.

While Canadian technologies are respected, affordability is key. Companies that can demonstrate life-cycle value, offer flexible financing, or link to concessional funding will be more competitive. Additionally, firms that align with government priorities—such as rural electrification or grid efficiency—may access preferential treatment or donor-backed projects.

Working with multilateral development banks, export agencies, or the Canada Trade Commissioner Service in Islamabad can help mitigate risk and build credibility.

A Complex Market Ready for Practical Innovation

Pakistan's energy sector requires pragmatic solutions and trusted partners. For firms with the technical depth and patience to navigate regulatory and economic constraints, Pakistan presents an important emerging market with real potential to make an impact. Whether in natural gas, renewables, or emissions reduction, the country's energy future will be shaped by those who can deliver reliable, cost-effective, and resilient technologies.

PAKISTAN

Emissions Reduction and Net Zero Commitments

- Reduce emissions by 15% unconditionally (conditionally 50%) **by 2030**
- Net Zero **by 2050**

Key Export Opportunities for Canadian Companies

- Oil and gas exploration and production (**E&P**) (onshore and offshore)
- Carbon capture, utilization, and storage (**CCUS**)
- Energy infrastructure and efficiency
- **Renewable energy** expertise

Domestic Energy Production*

- Coal 4.5%
- Crude oil 5.4%
- Natural gas 31.7%
- Nuclear 5.1%
- Hydro 3.7%
- Wind, solar, etc. 0.4%
- Biofuels and waste 49.2%

2023:

$20 MILLION

of Canadian Cleantech Imported^

Crude Oil°

Daily Production: **83,000 BOE**

Proven Reserves: **0.3 billion BOE**

5-Year CAGR: **-2.9%**

2 **Active Canadian O&G Companies†**

Natural Gas°

Annual Production: **1.04 trillion ft³**

Proven Reserves: **20.5 trillion ft³**

5-Year CAGR: **1.9%**

* IEA, 2021 ^ Statistics Canada ° EIA, 2021 † CGEF, 2022

Australia

Energy Leadership at a Crossroads: Tradition Meets Transition

Australia stands at the intersection of legacy energy dominance and clean technology transformation. Long recognized as a major fossil fuel exporter—particularly of LNG, coal, and crude oil—the country is now executing a deliberate shift toward low-emissions energy. This dual identity defines Australia's current energy narrative: a stable supplier to global markets actively reinventing itself for the energy systems of tomorrow.

Fossil Fuel Exports and Domestic Dynamics

Australia's upstream oil and gas production is centred in offshore and onshore fields across the North West Shelf, generating mostly light, sweet crude. Despite its vast hydrocarbon output, the country imports refined products—primarily from Malaysia and Brunei—due to limited refining capacity near consumption centers on the east coast.

A sophisticated network of more than 39,000 km of natural gas transmission pipelines connects Australia's production basins with export terminals, power generation hubs, and domestic markets. LNG remains a cornerstone of the export economy, with Australia ranking among the world's largest exporters. China and Japan are its top customers, while crude oil flows primarily to regional markets including Singapore, South Korea, Indonesia, and Thailand. Coal exports also remain vital, supporting energy and industrial demand across Asia.

While coal and oil production have held steady, natural gas output has surged over the past decade. However, capacity constraints and supply bottlenecks are expected to temper future growth, prompting increased attention to infrastructure resilience and diversification.

Navigating the Energy Transition

Australia has taken significant steps toward decarbonizing its economy, driven by national emissions reduction targets and global climate obligations. Solar, wind, and hydropower currently dominate the renewable mix, while bioenergy plays a modest but expanding role.

Under the federal Technology Investment Roadmap, Australia is prioritizing the commercialization of next-generation clean technologies. This includes long-duration energy storage, carbon capture and storage (CCS), and green hydrogen—all of which are seen as critical to achieving the government's target of 82% renewable electricity by 2030.

Hydrogen development is advancing rapidly, with both green (electrolysis-based) and blue (gas-based with CCS) projects in progress. Australia's ambition to become a global hydrogen leader is backed by strong public-private partnerships and export-oriented infrastructure planning.

Interestingly, while Australia holds the largest uranium reserves globally, it does not utilize nuclear power. This remains a point of political and policy debate as the country balances energy security, public opinion, and decarbonization imperatives.

Emissions Strategy and Climate Commitments

Australia has pledged to reduce greenhouse gas emissions by 43% from 2005 levels by 2030 and to reach net-zero emissions by 2050. Its climate strategy is anchored in technology adoption and sectoral decarbonization, rather than carbon pricing or regulatory mandates alone.

This approach supports clean energy innovation across industrial, transportation, and mining sectors—each representing significant opportunities for international collaboration. Australia's focus on building new clean-tech industries is intended to both cut emissions and create long-term competitive advantages in global energy markets.

Cleantech Opportunities and Sector Growth

Australia's clean energy transition opens broad opportunities for Canadian and international technology providers, particularly in:

- Hydrogen production, transport, and storage
- CCS and CCUS systems for industrial and energy use
- Energy efficiency improvements for heavy industry
- Smart grid and long-duration energy storage solutions
- Green mining and sustainable resource extraction technologies

Additionally, Australia's critical minerals sector—particularly in lithium, rare earths, and battery metals—offers prospects for integrated clean-tech partnerships. As demand for green metals and sustainable extraction rises, Australia's mining capabilities become central to global supply chains.

Market Access and Business Considerations

The Canada-Australia economic relationship is underpinned by the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP), which provides preferential tariff access and legal protections for Canadian firms. Bilateral merchandise trade reached CAD 6.4 billion in 2023, with high collaboration in cleantech, aerospace, and advanced manufacturing.

However, Canadian exporters must navigate a competitive landscape shaped by complex procurement processes, distance-related logistics, and nuanced regulatory frameworks. Business norms differ across states and territories, and localization is essential for market traction.

To mitigate risks and accelerate entry, Canadian firms are encouraged to engage the Canadian Trade Commissioner Service and establish strategic partnerships with local firms that understand regional policy and infrastructure development environments.

A Strategic Partner in a Changing Energy World

Australia's evolving energy profile—anchored in fossil fuel strength but guided by climate ambition—makes it a compelling partner for energy professionals. Its continued relevance as an LNG and coal exporter is balanced by a national commitment to clean energy innovation. For firms focused on energy

resilience, low-carbon technologies, and international market growth, Australia presents a rare combination of stability and transformation.

AUSTRALIA

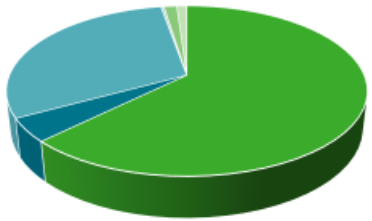
Emissions Reduction and Net Zero Commitments

- Reduce emissions 43% below 2005 levels **by 2030**
- Net zero emissions **by 2050**
- 82% of power generated from renewable sources **by 2030**

Key Export Opportunities for Canadian Companies

- Carbon Capture and Storage (**CCS**)
- Technologies that **improve energy efficiency**
- Energy Storage
- Clean **Hydrogen**
- Low Carbon Materials
- Soil Carbon

Domestic Energy Production*



- Coal 62.6%
- Crude oil 4.4%
- Natural gas 30.2%
- Hydro 0.3%
- Wind, solar, etc. 1.4%
- Biofuels and waste 1.1%

2023:

$62 MILLION

of Canadian Cleantech Imported^

Crude Oil°

Daily Production: **389,000 BOE**
Proven Reserves: **3.9 billion BOE**
5-Year CAGR: **1.3%**

4 Active Canadian O&G Companies†

Natural Gas°

Annual Production: **4.54 trillion ft³**
Proven Reserves: **127.2 trillion ft³**
5-Year CAGR: **12.2%**

* IEA, 2021 ^ Statistics Canada ° EIA, 2021 † CGEF, 2022

Insights for Asia-Pacific and Oceania

Commitments to Emissions Reduction and Net-Zero Targets

Asia-Pacific and Oceanic countries are accelerating their climate commitments while balancing development goals and energy security.

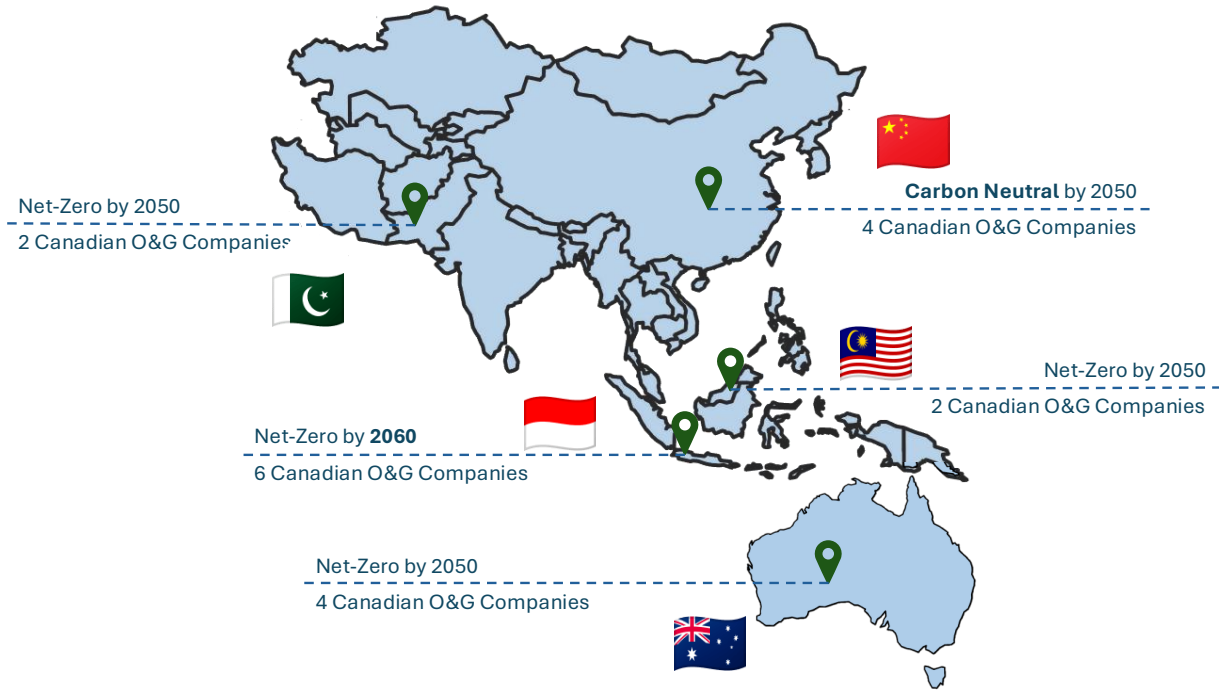
China has pledged to peak carbon emissions by 2030 and achieve carbon neutrality by 2060, aiming to reduce CO_2 emissions per unit of GDP by 65% from 2005 levels. Its strategy emphasizes large-scale renewable deployment, with a target of 1,200 GW of wind and solar capacity by 2030, alongside the expansion of hydrogen, CCUS, and digital energy systems.

Indonesia targets a 29% reduction in GHG emissions by 2030, rising to 43% with international support. It plans to phase out coal-fired power by 2040 and reach net-zero by 2060, supported by renewables, electrification, and emerging CCUS projects.

Malaysia has committed to carbon neutrality by 2050. Its National Energy Transition Roadmap outlines emissions reduction pathways through renewable energy, energy efficiency, and carbon capture and storage, supported by sectoral reforms and private-sector investment.

Pakistan has set a 50% emissions reduction goal by 2030, conditional on international financing, and is targeting net-zero by 2050. It is shifting toward renewables and natural gas, while phasing out imported coal and expanding cleaner transport and power infrastructure.

Australia is aiming for a 43% emissions reduction by 2030 (from 2005 levels) and net-zero by 2050. The country's Technology Investment Roadmap prioritizes hydrogen, carbon capture, and long-duration energy storage, with a goal of reaching 82% renewable electricity by 2030.



Energy and Cleantech Opportunities for Canadian Exports

The region presents a dynamic and diverse market for Canadian energy and cleantech firms, spanning legacy infrastructure upgrades and new low-carbon investments.

In **China**, opportunities include emissions monitoring, CCUS, smart grid integration, hydrogen storage and transport, and predictive maintenance software. While the market is complex and regulatory-heavy, Canadian companies offering innovative, scalable solutions aligned with state policy priorities may gain traction through local partnerships, co-development models, and engagement with industrial parks and green zones.

Indonesia is transitioning from coal and oil dependence to a cleaner mix, opening opportunities in unconventional oil and gas technologies, gas infrastructure, renewable deployment, and CCUS project development. Canadian firms can also support refining upgrades, smart grid systems, and wastewater management, particularly in underserved regions. Success requires local content compliance, regulatory navigation, and strategic partnerships.

Malaysia offers a stable, well-regulated market for clean technology exports. Key areas include solar and hydro projects, methane emissions reduction, energy efficiency retrofits, and CCS collaboration with Petronas. Canadian companies are well-positioned to deliver solutions across the upstream, refining, and digital energy segments, especially when bundled with financing or localization strategies.

In **Pakistan**, energy security challenges and climate goals are creating demand for solutions in LNG infrastructure, renewable energy, grid decentralization, refinery modernization, and desalination systems. Companies offering cost-effective, resilient, and scalable technologies will find traction, particularly when supported by concessional finance or multilateral partnerships. Local presence and long-term relationship building are essential for navigating procurement risks and ensuring project delivery.

Australia combines global fossil fuel exports with aggressive clean energy targets. Key opportunities include hydrogen production and export infrastructure, CCUS systems, smart grids, sustainable mining, and battery storage. Canadian firms can also engage in the critical minerals and green metals supply chain. Australia's openness to international trade under the CPTPP and its strong bilateral ties with Canada make it a strategic market, though success depends on local market knowledge, regulatory alignment, and state-level engagement.

Global Trends and Key Takeaways

Across global energy markets, countries are aligning their climate ambitions with national development goals, presenting a mix of long-term targets, near-term emissions reduction milestones, and energy system reforms. While fossil fuels continue to dominate in many regions, there is growing momentum toward low-carbon solutions—driven by climate policy, energy security needs, and economic diversification strategies.

Climate commitments are widespread but varied in ambition and approach. Most countries profiled have committed to net-zero emissions between 2050 and 2060, with intermediate targets for 2030 reductions ranging from 20% to over 50%. Leading economies reviewed in this report, such as the United States, China, and Brazil, have paired these targets with substantial domestic legislation or investment plans, notwithstanding recent changes in the United States. Others—such as Ghana, Pakistan, and Indonesia—have conditional targets dependent on international finance and technology support. Energy transition planning increasingly includes carbon markets, adaptation finance, and voluntary offset mechanisms.

Renewable energy is a central pillar of decarbonization. Nearly all regions are scaling up wind, solar, and hydro to reduce emissions and meet growing energy demand. Targets range from 50% renewable electricity by 2030 (Saudi Arabia, Argentina, Australia) to specific capacity goals like China's 1,200 GW of wind and solar. Countries with large hydropower potential—such as Brazil, Colombia, and Ghana—are also integrating solar and wind to diversify their renewable mix.

Natural gas and LNG are being used as transitional fuels. In developing countries with rich fossil-fuel resources, natural gas plays a key role in displacing coal and supporting grid reliability. This is evident in Pakistan, Nigeria, Malaysia, and Ghana, where LNG infrastructure and domestic gas expansion are prioritized alongside decarbonization.

Carbon Capture, hydrogen, and energy storage are emerging priorities. Countries like the U.S., China, Australia, Saudi Arabia, and Malaysia are investing in carbon capture, green/blue hydrogen, and energy storage to enable deeper decarbonization. These technologies are also being piloted in middle-income markets such as **Indonesia, the UAE**, and **Brazil**, often with international collaboration.

Electric mobility, energy efficiency, and grid modernization are gaining traction. Many countries—particularly **Mexico, Nigeria, the UAE, and China**—are advancing electric vehicle (EV) adoption, smart grid systems, and industrial energy efficiency as part of broader transition strategies. These areas are attracting private sector interest due to their scalability and climate co-benefits.

Cleantech market opportunities for Canadian firms are expanding across regions. Common areas of demand include:

- **Methane mitigation and emissions monitoring** in oil and gas
- **CCUS project development**, including MRV systems
- **Hydrogen production, transport, and storage technologies**
- **Renewables**, including off-grid solar, wind, and hydropower modernization

- **Energy storage**, smart grids, and industrial retrofits
- **Water-energy nexus** technologies (e.g., desalination, reuse, and efficiency)
- **Environmental consulting, ESG advisory**, and **carbon offset services**

While entry conditions vary, success across all markets increasingly depends on local partnerships, project financing, compliance with local content rules, and long-term engagement. Canadian companies offering cost-effective, scalable, and impact-driven solutions—particularly those aligned with national strategies—are well-positioned to compete globally.

Global energy markets are rapidly evolving, creating opportunities for Canadian cleantech companies to export their expertise and innovative technologies. From decarbonizing oil and gas to expanding renewable energy and grid modernization, Canadian firms are well-positioned to support energy transitions worldwide. By leveraging trade agreements, strategic partnerships, and advanced cleantech solutions, Canada can expand its international presence and contribute to the global push toward a sustainable energy future.

Canadian Expertise

Canada's unique environmental factors significantly influence the development of cleaner technologies for its oil and gas industry. The country's vast and diverse landscape necessitates a wide range of solutions to address various environmental and regulatory conditions.

Key environmental factors driving this development include:

- **Immense Land Area and Diverse Ecosystems**: Canada is the world's second-largest country, covering almost 10,000,000 km2. Within this area, it features a wide range of ecosystems, including prairies, peatlands, boreal forests, mountains, the Canadian Shield, arctic tundra, and offshore areas.
- **Vast Freshwater Resources**: Canada possesses more lake area than any other country globally, containing approximately **20% of the world's fresh surface water and 7% of the world's renewable water flow**.
- **Extreme Temperature Variations**: The country experiences a wide range of temperatures, from **+40 to -40 degrees Celsius**.

These diverse environmental conditions, coupled with regulations primarily developed by provinces to protect their resources, other industries (like agriculture, minerals, and forestry), and the interests of their populations, demand an **extremely wide range of practical, cleaner technology solutions**. This imperative has driven the development of Canadian technologies specifically tailored for the Canadian Oil and Gas industry.

Key Canadian Industry Metrics – Driving Innovation

Canada's unique environmental landscape is a powerful driver for innovation in cleaner technology within its oil and gas sector. The sheer scale and diversity of the country necessitate a tailored approach to environmental protection, fostering the development of specialized solutions.

Here's how Canada's distinct environmental factors shape cleaner technology development:

- **Vast and Diverse Geography:** Canada is the **world's second-largest country**, encompassing a wide array of ecosystems, from **prairies, peatlands, and boreal forests to mountains, the Canadian Shield, arctic tundra, and extensive offshore regions**. The country also boasts the **longest shoreline in the world**, with 70,000 km of mainland coast and approximately 170,000 km of offshore island coast, alongside a **5,000,000 km2 marine exclusive economic zone**. This geographic diversity means that clean technologies must be adaptable to vastly different operational and ecological conditions.
- **Abundant Freshwater Resources:** Protecting critical freshwater resources is a major priority, driving demand for technologies that minimize water usage, treat wastewater effectively, and prevent contamination in areas ranging from lakes and rivers to the Great Lakes international border.
- **Complex Regulatory Environment and Other Industries:** The presence of other vital Canadian industries, such as **agriculture, fisheries, forestry, mineral extraction, chemical processing, and tourism**, alongside the interests of the population, leads to regulations primarily developed by provinces to protect their resources. This complex web of provincial regulations and shared resource interests demands an **extremely wide range of practical, cleaner, and more efficient technology solutions** for the oil and gas industry.

These factors have spurred the development and implementation of various clean technologies, including:

- **Methane Emission Reductions:** Alberta, a key oil and gas producing province, has seen significant success, with **oil and gas methane emissions dropping approximately 52% below 2014 levels** (as of 2023, reported by the Alberta Energy Regulator), often through methods that are cost-effective or even yield positive economics.
- **Sour Gas Treatment:** Since the 1930s, as much as **30% of natural gas produced was "sour,"** containing high concentrations of CO2/H2S. This has led to the operation of over **60-80 acid gas injection projects** to sweeten the gas, demonstrating long-standing expertise in handling complex gas compositions.
- **Carbon Capture, Utilization, and Storage (CCUS):** Canada has injected over **50 MtCO2** (megatonnes of CO2) as of 2024, primarily for enhanced oil recovery (EOR). Notable projects include the **Whitecap Weyburn CO2 EOR project, which has sequestered ~36 MtCO2**, and the **Shell Quest Project, which injected ~8.2 MtCO2 into a deep aquifer** as of mid-2024. These projects highlight a strong focus on reducing atmospheric carbon emissions.
- **Hydrogen-Rich Fuels:** Canada is a **top ten global hydrogen producer**, generating approximately 3 MtH2/yr for purposes like heavy oil upgrading and ammonia fertilizer. This indicates a move towards cleaner energy carriers and a shift from coal or petroleum to natural gas for reduced GHG emissions.

- **Repurposing Wells:** With approximately **700,000 wells drilled since the 1880s** and about 200,000 still active, there's an ongoing assessment of inactive wells for new clean technology applications, such as **geothermal energy, CO2 disposal, critical minerals production, and storage opportunities**.

In essence, Canada's vast, diverse, and resource-rich environment, combined with its commitment to protecting these resources, directly fuels the need for and development of innovative and adaptable, cleaner technologies within its oil and gas industry.

Carbon Capture, Utilization and Storage

Canada has been at the forefront of carbon capture processes since the 1930s, initially for natural gas sweetening, demonstrating a **long-standing commitment to managing gas streams** containing CO2 and H2S. Today, Canadian expertise extends to **world-scale Carbon Capture, Utilization and Storage (CCUS) projects**. For example, the Weyburn CO2 EOR project, operational since 2000, has sequestered approximately 36 MtCO2 from coal power and gasification sites. Another significant achievement is the Shell Quest Project, which has injected about 7.7 MtCO2 into a deep aquifer, avoiding approximately 6.1 MtCO2 emissions as of 2022. This rich history has led to the development of **cutting-edge Canadian technologies** for acid gas separation, handling, compression, pipelining, injection, and **comprehensive monitoring systems** that track CO2 from its source to underground injection zones. These advancements showcase Canada's **pivotal role in developing scalable solutions** for industrial decarbonization.

Carbon Capture, Utilization, and Storage

- Carbon capture processes based on amines
- Acid gas handling and disposal technologies
- Geophysical technologies for plume tracking and seismic modelling
- Monitoring, measurement and net avoidance reporting technologies for CCS and CCUS
- Research, development and demonstration

Environmental Management

As one of the world's leading oil and gas producers, Canada has a **deep-rooted commitment to sustainable resource development**. With oil and gas production dating back to the 1850s, the country has continuously innovated to transform extensive oil sands and shale resources into viable reserves. This drive for innovation includes **pioneering research and development in cleaner environmental management technologies**. From open-pit mines to artificial islands in the Arctic, Canada has developed solutions that protect vital agricultural, fisheries, forestry, mineral extraction, and tourism industries that often overlap with resource development areas. The result is some of the **most rigorous and transparent environmental approval, management, and monitoring processes globally**. These robust regulations have spurred the creation of **effective, low-cost technologies** that ensure environmental protection while maintaining global competitiveness.

Environmental Management

- Air emissions control – combustors, incinerators, catalytic oxidizers for VOCs
- Water resource management and treating for reuse or disposal
- Remediation and reclamation to return sites to original biological productivity or agriculture
- Ecological impact mitigation for flora, fauna and nearby residents
- Waste management through reuse of materials
- Monitoring and reporting
- New technologies and retrofitting existing sites

Methane Emissions Reduction

Canada is making **rapid and significant strides in reducing methane emissions**, recognizing this as a highly impactful and **cost-effective opportunity** to lower greenhouse gases (GHGs) from oil and gas operations. Through **widespread monitoring and transparent public reporting** by individual facilities and companies, the accuracy of emission tracking has dramatically improved. This includes the use of advanced technologies such as **satellites, manned and unmanned aerial craft, and ground-based mobile and stationary monitoring systems**. In Alberta alone, methane emissions have seen an **impressive drop of 52%** as reported by the Alberta Energy Regulator, thanks to tested, low-cost clean technology solutions. Collaborative initiatives, like those through the Clean Resource Innovation Network (CRIN) and PTAC, backed by Federal and Provincial funding, have facilitated **successful field testing and rapid deployment of mitigation methods** across hundreds of remote sites.

Methane Emissions Reduction

- Technologies for estimating and reporting methane emissions
- Detection, measurement, quantification and monitoring
- Vapour recovery systems for atmospheric tanks
- Enclosed combustors and flare systems
- Catalytic converters
- Alternate power for chemical pumps
- No or low vent pneumatic devices
- Instrument air and air/power hybrid units in remote operations

Hydrogen Enrichment and Utilization

Canada is a **major global player in hydrogen production**, ranking among the top ten countries with approximately 3 million tonnes H2/yr. Innovators are currently leveraging existing surplus hydrogen capacity to **pioneer diverse applications**. This includes **demonstrating hydrogen as a fuel** for trucks, trains, and other mobile energy users, as well as **blending it with natural gas to create "hythane"** for space heating and domestic uses. In the upstream oil and gas sector, hydrogen is viewed as a **valuable potential by-product** of in-situ heavy oil thermal processes.

The core focus of clean technology in this area is on **increasing the hydrogen-to-carbon ratio in fuel streams**, either for downstream processing or upstream use, often **integrating with carbon capture facilities**. These processes involve both in-situ and ex-situ partial upgrading, aiming to reduce emissions from mid-stream and downstream operations. A secondary but equally important focus is the **economic conversion of upstream equipment** (like drilling rigs and vehicle fleets) from refined liquid fuels to natural gas, significantly reducing GHG emissions for the same energy input.

Hydrogen Enrichment and Utilization

- Ex-situ thermal upgrading/partial upgrading of heavy oils sources
- In-situ thermal upgrading/hydrogen generation sources
- Ammonia production sources
- End-user devices for high hydrogen content gases
- Hythane (hydrogen-methane mixtures) from upstream sources where pure H_2 is unsuitable
- Fuel substitution technologies – Compressed or liquified natural gas
- Hydrogen content monitoring
- Fuel cell technologies – hydrogen or methanol

Offshore Technologies

Canada boasts the **world's longest marine shoreline**, controlling over 5,000,000 km2 of marine waters. While offshore developments currently feature four production installations, these are located in the North Atlantic, facing **some of the most extreme weather conditions and iceberg hazards**. Despite these challenges, this region produced approximately 70-75 million barrels of oil in 2022. The industry's sensitivity to other vital offshore sectors, such as fisheries and sea mammal populations, has driven the development of an **extensive array of advanced technologies**. This includes sophisticated **satellite, aerial, and subsea sensing technologies**, alongside **continuously improved safety and environmental protection systems**. These innovations highlight Canada's capability to operate sustainably in some of the harshest marine environments.

Offshore Technologies

- Marine Environmental Management
- Operating in severe ocean environments – storms and ice bergs
- Oil spill equipment, services and training
- Marine mammals/biology/fisheries science, policy
- Health, Safety and Training specific to offshore
- Biomonitoring
- Offshore Power Generation
- Facility decommissioning, reuse and abandonment
- Post-abandonment monitoring
- Digital and remote sensors and satellite monitoring

End of Well Producing Life

With approximately 700,000 wells drilled since the 1880s, and about 200,000 still active, Canada faces a significant opportunity at the end of a well's productive life. Growing regulatory pressure is pushing for shut-in wells to be moved to abandoned status, with ultimate abandonment costs estimated between CDN$30 to 90 billion. From a clean technology perspective, this presents an **innovative focus on reviewing and repurposing wells before abandonment**. Many active wells could be converted for other useful purposes, demonstrating a **commitment to a more circular approach** for infrastructure. Potential uses include:

End of Well Producing Life

- Alternate uses for wells: Recompletion to new zones, Water Disposal, Waste Storage, Production of Minerals or Thermal Energy, CCUS
- Producing zone plugging
- Up-hole capping for abandonment
- Surface reclamation
- Maintenance of Records

- Recompletion to other hydrocarbon formations
- Conversion for water or waste disposal
- Use for storage of natural gas or other hydrocarbons
- Production of minerals (like lithium) or thermal energy
- Integration with Carbon Capture, Utilization and Storage (CCUS) initiatives These methods are already being implemented in Canada, and the developed technologies and methodologies are highly transferable to international applications.

An inventory of Canadian oil and gas clean technology skills and technologies ready for export

The Canadian oil and gas industry has cultivated **world-class skills and technologies** aimed at enhancing the sustainability of oil sands, oil, and gas operations. This progress has occurred within a context of increasing public interest in environmental improvement, while simultaneously ensuring the **reliable and cost-effective supply of energy** demanded by modern society. Canada's **demonstrated strength in cleaner technology development** positions its expertise and solutions for global impact.

For those seeking to explore these capabilities further, PTAC, in collaboration with industry and supported by the Government of Canada's Trade Commissioner Service, has developed comprehensive **directories** outlining Canadian Capabilities in Clean Technologies. These resources offer detailed insights into the general categories and specific capabilities mentioned.

Energy-Related Clean Technology Case Studies

Carbon Capture, Utilisation, and Storage

Background

CCUS (Carbon Capture, Utilization, and Storage) involves advanced methods for capturing, utilizing, or permanently storing carbon dioxide (CO2). This CO2 can originate from natural gas streams or combustion processes.

Globally, the primary approaches for CO2 disposal, prioritized by current practice, are:

- **CO2 Enhanced Oil Recovery (EOR)**: This method currently sequesters over **50 million tonnes (MT) of CO2 annually**. It has a long track record, demonstrating **positive economic returns** when utilizing CO2 from cost-effective, concentrated sources.
- **Direct Carbon Capture and Storage (CCS) into Aquifers**: While currently implemented in a limited number of facilities worldwide, this sector is poised for substantial growth as global efforts intensify to achieve ambitious emissions reduction targets.

Canadian Experience in the Area

Canada stands out for its extensive and distinctive experience in CCUS, having hosted numerous world-leading projects.

- **CO2 Capture Expertise**:

  Historically, approximately **one-third of Canada's natural gas production contains hydrogen sulfide (H2S) and CO2**, which must be removed to meet sales gas specifications.

  Canada also boasts a significant industrial sector that produces hydrogen (H2) from natural gas steam methane reforming. This process is crucial for heavy oil upgrading and ammonia (NH3) production for fertilizer, both of which necessitate the separation of CO2 from H2.

  Consequently, **hundreds of Canadian gas plants capture CO2**, though historically most of this captured gas has been vented.

  This deep-rooted experience has fostered strong capabilities in **Western Canada's engineering and fabrication companies**, which now apply their carbon capture expertise globally. Notable examples include:

  - **Equinox Engineering Ltd** (with operations in the USA, Australia, India)
  - **Thermo Design Engineering** (active in South America, the Middle East, Australia)
  - **Propak Systems** (operating in China, North Africa, the USA, New Zealand)

Furthermore, up to **80 gas plant sites in Canada have facilities and wells for small-scale underground disposal of acid gas (H2S/CO2)**, providing **decades of operational experience** in these specialized activities.

- **Petroleum Technology Research Centre (PTRC)**:

  The **Petroleum Technology Research Centre (PTRC)** has been at the forefront of global CCUS efforts, having managed **one of the world's largest CCUS test programs**: the **IEAGHG Weyburn-Midale CO2 Monitoring and Storage Project (2000-2012)**.

  This international initiative has yielded **invaluable data on the subsurface movement and monitoring of CO2** within an Enhanced Oil Recovery (EOR) operation, now managed by Whitecap Energy.

  The **Weyburn-Midale project boasts the highest cumulative CO2 injection globally**, capturing nearly **40 million tonnes (Mt)** and continuing to grow at approximately **2.8 Mt per year**.

  PTRC's work continues through the **SaskCO2User project** and its **Aquistore project**. Aquistore specifically demonstrates **deep saline geological formation storage** by periodically injecting and storing CO2 from SaskPower's Boundary Dam Carbon Capture Facility.

  Aquistore is also a hub for **unique and extensive data collection**, collaborating with industry and government partners from **Japan, Korea, Australia, the United States, South Africa, and the United Kingdom** to support their own CO2 storage project development. PTRC also actively engages with industry on heavy oil EOR projects.

- **Shell Quest and Alberta Carbon Trunk Line**:

  Shell Quest: This is a pioneering **Direct Carbon Capture and Storage (CCS) injection project** that has been successfully operating since **2015**. It injects approximately **1.2 Mt of CO2 annually**, captured from a hydrogen plant, into an underground aquifer. Operated by Shell, it serves as a **global demonstration of this critical technology**, with the Provincial Government requiring public annual reports on its performance.

  Alberta Carbon Trunk Line (ACTL): Operated by Wolf Midstream, ACTL is recognized as the **world's largest capacity CO2 pipeline system**, capable of transporting approximately **14.3 Mt per year**. Currently, it transports around **1.6 Mt of CO2 annually** from hydrogen production facilities at the NWR Sturgeon Refinery and the Nutrien Redwater Fertilizer Plant, both of which actively capture CO2 from their hydrogen production processes.

Assumed Specific Interests by Country

- **CO_2 EOR** – Brazil, Colombia, Indonesia, Kuwait, Malaysia, Saudi Arabia, USA
- **Heavy Oil CO_2 EOR** – China, Mexico
- **Enhanced Coal Bed Methane** – Australia, China, Pakistan
- **Direct CCS** – United Arab Emirates, USA

Environmental Protection and Management

Background

Environmental challenges not directly related to air emissions often revolve around water. The two primary areas requiring significant attention are:

1. **Water Supply**: This is particularly critical for **fracturing operations in arid regions** or for **heavy oil and oil sands developments**, where the required volumes of fresh water for both supply and subsequent disposal can be substantial.

2. **Water Quality**: In wetter regions, the focus shifts to **managing the quality of discharged water** into the environment, whether on land or into marine ecosystems.

Canadian Experience in the Area

Canada has accumulated extensive experience in water management within the oil and gas sector, particularly since the mid-1970s for oil sands and since 2009 for shale gas and oil fracturing.

- **Water Usage Statistics**: In 2022, the oil and gas sector in Alberta utilized over 260 million m^3 of fresh water. The majority, approximately 81%, was allocated to oil sands mining, followed by 10% for hydraulic fracturing, 6% for in-situ thermal oil sands, and 3% for enhanced oil recovery.
- **Emphasis on Recycling**: Notably, fresh water constitutes only about 17% of the total water consumed. The remaining 83%—approximately 1,500 million m^3/year—is comprised of recycled produced water.
- **Regulatory Influence**: Strict provincial regulations actively limit freshwater consumption by prioritizing maximum water reuse and prohibiting surface water disposal in both land-based and marine operations. This regulatory environment has been a catalyst for Canadian industry to develop extensive technologies and capabilities in designing and manufacturing advanced water treatment systems.
- **Key Water Management Practices**:
    - **Tracking Fresh Water Use**: This critical regulatory function involves provinces collecting and publicly sharing data on water use and sources. Organizations like the Alberta Energy Regulator and the B.C. Energy Regulator lead reporting for unconventional fracturing, supported by numerous service companies. Available information includes:
    - **Daily reporting** of volumes and chemicals by well in most provinces via www.fracfocus.ca.

- **Monthly public reports** on Hydraulic Fracturing Chemical Use, Water Use Data, and Water Source Data.
- **Annual reporting by oil sands operations** detailing water uses from licensed sources and recycled produced water.

- **De-oiling and Solids Removal**: Often, produced water requires only de-oiling and filtration to be suitable for reuse or underground disposal. Companies like Saltworks offer comprehensive water processing packages, integrating innovative core products such as clarifiers, filter presses, and lime systems with digitized modular systems for a complete solution.

Assumed Specific Interests by country

- **Fresh Water Reduction** – Argentina, Australia, China, Colombia, Iraq, Kuwait, Pakistan, Saudi Arabia, United Arab Emirates
- **Water Discharge Quality** – Colombia, Indonesia.

Fuel Switching – Hydrogen Enrichment

Background

The energy sector is currently facing significant pressure to reduce GHG emissions, enhance cost-efficiency, and improve operational reliability. For oil and gas operations, which are inherently energy-intensive, the challenge often lies in the mismatch between energy production from internal streams and the immediate demand for power. This frequently necessitates reliance on external energy sources, such as diesel, for critical equipment like drilling and workover rigs.

However, **rising fuel costs are driving a strategic shift towards more sustainable and economically viable alternative energy sources**. The focus is now on fuels with lower carbon content or those rich in hydrogen to power rig operations and meet the smaller power demands for production monitoring and overall operations.

Canadian Experience in the Area

Canada, endowed with some of the world's largest oil and gas reserves, often accesses these resources from **remote and isolated sites, far from major commercial centers**. Operations in these challenging environments contend with extreme seasonal temperatures, ranging from **-40 to +40 degrees Celsius**, and reduced daylight hours in winter, which can make standalone solar systems unreliable. Consequently, Canadian operations have extensively leveraged **locally produced natural gas to power a wide array of equipment and instruments**.

When oil prices are high and gas prices are low, three key economic applications have emerged:

- **Conversion of Rigs to Natural Gas**: Canadian oilfield drillers have proactively converted drilling and workover rigs, as well as hydraulic fracturing pump equipment, to operate on natural gas. This strategy significantly **reduces fuel costs** and can leverage low-cost natural gas readily available from nearby gas plants. Crucially, this conversion also **reduces GHG emissions by nearly half compared to diesel**. The Canadian Association of Energy Contractors (CAEC) members have collaborated to evaluate various power and lighting options for rigs, assessing both cost and GHG savings. Options include **Compressed Natural Gas (CNG)** from suppliers like Certarus (primarily North America) or **Liquefied Natural Gas (LNG)** from Ferus. In 2014, Ferus established and began operating Canada's first merchant LNG facility, supplying LNG to oil and gas rigs, mines, and other industrial users. The selection of the most cost-effective natural gas solution for a given location depends heavily on supply and transportation logistics. Additionally, companies like Enerflex provide **portable natural gas power generators** in a wide range of sizes, from 20 kW to 50 MW, which can also reliably power local communities at a low cost.
- **Solar/Natural Gas Hybrid Generators**: Many remote natural gas sites require modest amounts of power without incurring substantial operating costs, expensive permanent installations, or the need for extensive power lines. Equipping these sites with appropriately sized remote power systems helps **reduce reliance on more expensive refined fuels** and provides essential power for automation, communications, and enhancing operational efficiency. The most successful of these systems are **solar/natural gas hybrids, which incorporate battery packs** to ensure seamless transitions between

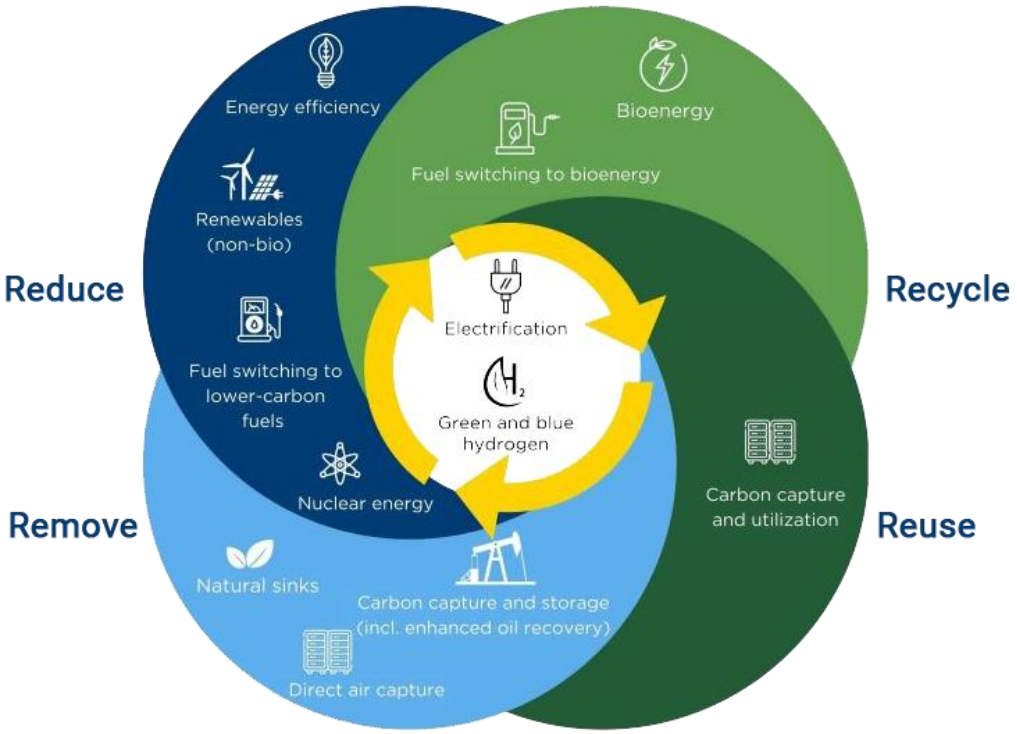
power sources based on prevailing conditions. Available technologies cater to diverse power demands; for instance, Global Power Technologies offers **Thermoelectric Generators (TEG)** ranging from 8-550W, while CNVRG Innovations provides larger units, including their award-winning EPOD system, which can generate up to 35kW.

- **Conversion of Vehicle Fleets to CNG**: Enbridge Inc., a prominent Canadian-based leader in energy transportation and distribution, operates four natural gas utilities. These utilities provide CNG fueling services across two Canadian provinces and four U.S. states, serving approximately 6.3 million customers. Converting vehicle fleets from gasoline and diesel to **CNG can reduce fuel costs by up to 50%**, in addition to significantly **lowering transportation emissions**.

Assumed Specific Interests by country

Global interest in these energy solutions includes:

- **Rig and Site Power** – Australia, Indonesia, Iraq, Mexico, Pakistan, UAE, USA
- **Local Community Power** – Ghana, Guyana, Nigeria



Methane Emissions Reduction

Background

Methane emissions present a compelling opportunity for both economic advantage and significant GHG reduction. This valuable gas, often co-produced on oil and gas sites, contains energy that can effectively **offset the use of more expensive, externally supplied fuels** such as gasoline, diesel, and propane. Essentially, once the necessary equipment is installed, methane can become a virtually free, alternative energy source. Simultaneously, converting methane to CO2 dramatically **reduces its greenhouse gas impact by a factor of seven or more**, depending on its assigned global warming potential, with the added benefit that the methane itself supplies the energy needed for its capture or destruction.

Canadian Experience in the Area

Driven by **aggressive carbon taxes and a strong imperative to reduce GHG emissions**, the Canadian upstream oil and gas industry has proactively collaborated with vendors to develop and demonstrate a wide array of methods for **economically mitigating methane emissions**. Key targets have been facilities where small volumes of methane, either co-produced with oil or venting from natural gas sites, were traditionally used to power instrumentation or pumps. As a result, Canadian upstream producers have achieved **significant strides, reducing methane emissions by 30-40% while simultaneously lowering operating costs**. These innovative mitigation methods include:

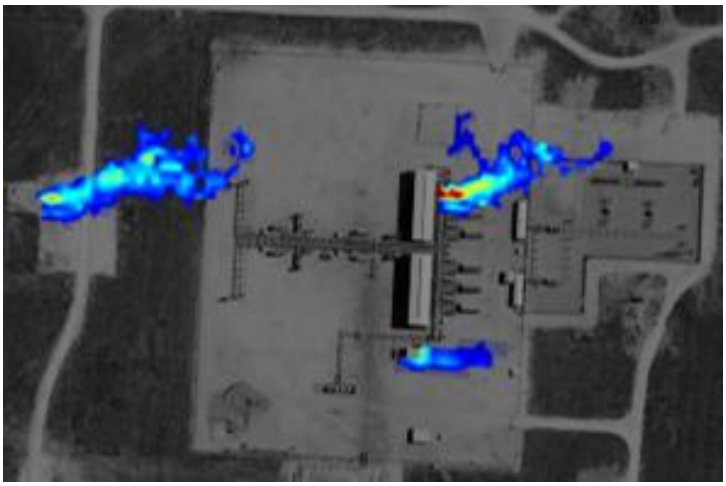
- **Installation of Solar or Hybrid Powered Air Compressors**: Methane venting from chemical pumps and instrumentation/controls can be effectively **eliminated through retrofits** that switch the power gas from methane to air, using on-site compressors powered by various means. These systems often offer **additional benefits, such as the co-generation of both heat and power**, which are typically essential at these sites. Cream Energy Group, for example, supplies a range of solutions, from hybrid solar-powered air compressor packages (1.2-4.8kW 1.2 CFM) to natural gas generation units (5-125 kW 6-150 CFM) for markets in Canada and the USA.
- **Installation of Low or No-Vent Chemical Pumps, Instruments, and Controls**: Optimizing the use of oilfield chemicals and minimizing methane consumption for pumping can be achieved with **electrically powered digital pumping systems**, such as those offered by Sirius Controls. These packaged systems can be supplied with their own power generation and are capable of **remote control via SCADA or other advanced systems** widely used in Canada and the USA.
- **Vent Methane to Fuel Engines**: Spartan Controls markets REM Technology Inc.'s SlipStream® system, which **captures vented hydrocarbons and repurposes them as a supplementary fuel source**, thereby reducing engine fuel consumption across various applications. This patented technology can even **eliminate vent sources that are otherwise difficult to reduce, such as gas from compressor seals**, ultimately increasing the volume of natural gas available for sale.
- **Methane Enclosed Combustors**: Once all on-site energy demands are met, any remaining methane vents can be **efficiently destroyed in enclosed combustors**, which avoid the environmental and operational issues associated with traditional flare stacks. Companies like Total Combustion Inc., Clear Rush Co., and Tornado Combustion Technologies specialize in developing **low-cost, reliable combustion equipment for waste gas destruction**. The resulting **GHG reductions can be monetized**

through the trading of carbon credits, as this represents one of the most cost-effective methods for reducing emissions. All three companies serve both Canada and the USA.

Assumed Specific Interests by Country

Global interest in methane emission reduction strategies and their associated benefits varies, with specific areas of focus identified by country:

- **Fuel in Remote Areas** – China, Ghana, Guyana, Kuwait, Nigeria
- **Low-Cost Emissions Reduction / Credits** – Australia, Iraq, Mexico, Saudi Arabia, UAE, USA



Offshore

Background

Canada's offshore regions present some of the **most challenging operational environments globally**, characterized by a formidable combination of North Atlantic hurricanes, icebergs, and pack ice. Crucially, operations must also prioritize the **protection of sensitive fisheries and marine mammals**. Navigating these extreme conditions effectively hinges on the strategic deployment of **satellite sensing systems combined with continuous monitoring of shipping and production operations to proactively prevent incidents**. Should incidents occur, robust systems are essential for **examining and repairing damage to subsea infrastructure and equipment**, while always safeguarding personnel on offshore rigs, platforms, and ships, as well as the local fisheries and environment.

Canadian Experience in the Area

Canada's robust offshore oil and gas industry, alongside other marine sectors, has fostered the growth of numerous companies specializing in offshore activities, each bringing **decades of invaluable experience**.

- **Satellite-Based Sensing and Monitoring**: **C-CORE** excels in applied research and operational services, leveraging the latest advancements in satellite technology to monitor oceans. Their capabilities include **iceberg and sea ice monitoring, oil slick/seep identification, vessel detection, and emissions monitoring** for an international client base. For more specialized needs, companies like **Whale Seekers** have developed sophisticated **Artificial Intelligence tools and deep knowledge of mammal behavior**. This allows them to provide highly efficient and timely data on whale locations and movements, utilizing platforms ranging from drones to satellites across global oceans.
- **Unmanned Submersibles**: Canadian companies such as **Deep Trekker** offer a diverse range of subsea equipment for **maintenance and monitoring below the waterline**, aiming to minimize and mitigate the potential for underwater failures. Deep Trekker maintains an international presence with an office in Chile and has undertaken projects globally across the USA, Europe, and Asia. For more specialized and unique applications, **International Submarine Engineering Ltd. (ISE)** stands as a leader in the design of **autonomous and remotely operated robotic vehicles**, including submersibles capable of covering the extensive distances required for challenging under-ice surveys.

Assumed Specific Interests by Country

Global interest in these advanced offshore solutions includes:

- **Offshore Operations** – Australia, Brazil, Ghana, Guyana, Indonesia, Malaysia, Mexico, Nigeria, UAE, USA

Well Related (End of Well Life Conversions)

Background

As the global energy landscape rapidly evolves towards **diversification and sustainability**, there's a growing strategic interest in leveraging the subsurface for novel purposes. This includes accessing new resources and pioneering applications such as **geothermal energy, carbon capture and storage (CCS), energy storage, and the extraction of critical minerals like lithium**. This paradigm shift significantly increases the potential for **repurposing existing oil and gas wells** at the culmination of their productive lives. Consequently, traditional well abandonment practices may face new constraints as industries seek to facilitate innovative, cleaner technology solutions.

Canadian Experience in the Area

Canada is renowned for its **rigorous regulatory and environmental protection standards** governing the entire lifecycle of oil and gas development, from initial exploration through to abandonment and long-term post-abandonment monitoring. With a vast national onshore well population exceeding **700,000 wells**, approximately 30% of which are still active, Canada possesses a significant inventory of subsurface assets. These wells, drilled to various depths and into diverse resource types, represent a **unique opportunity for strategic repurposing**.

- **Recompletion to Access Other Oil and Gas Zones**: Leveraging existing well infrastructure for new resource opportunities is a smart strategy. **VZFOXCanada Engineering** offers expert reservoir engineering services that integrate assessments for **Cleaner Tech, CCUS, Safety, Policy, and Power Generation**, recognizing their increasing linkage to subsurface operations. This holistic approach can effectively utilize end-of-life wells to access new resources or facilitate other innovative uses. VZFOXCanada Engineering operates globally from offices in Calgary and Houston.
- **Geothermal Power and Heating**: Canada is actively pursuing geothermal energy, with several operations demonstrating the potential to **harvest geothermal energy for heating or power generation** by utilizing existing wells. **FutEra Energy** exemplifies this success with an **economic 21 MW hybrid geothermal and natural gas power and heat generation facility**. Their operations champion

the principles of **Reduce (emissions), Reuse (facilities for a smaller footprint), and Recycling/Repurposing (legacy assets for enhanced economics)**.

- **Mineral Extraction**: Oil and gas wells frequently access **mineral-rich waters containing valuable resources like lithium**. **E3 Lithium** is at the forefront of this innovation, operating a **Direct Lithium Extraction (DLE) pilot plant**. This technology extracts lithium from aquifer water, which is then reinjected, eliminating the need for external water sources, large evaporation ponds, or traditional mines. With plans for commercial production by 2027, E3 Lithium is collaborating with Imperial Oil Limited to develop lithium extraction from Imperial's Leduc oil field leases.
- **Acid Gas Injection and Monitoring**: Canada has extensive experience with the safe injection of smaller volumes of acid gas (CO2/H2S) from sour gas plants, effectively **preventing acid gas flaring**. These projects often strategically **repurpose existing wells** within a field, offering a more cost-effective alternative to drilling new wells, as is typical for major CCS projects. **Gas Liquids Engineering Ltd. (GLE)** is a leader in designing acid gas injection facilities, having developed over 40 CO2/H2S sequestration systems worldwide since 1995. Beyond EPCM services, GLE has also innovated unique software for designing acid gas water systems.
- **Enhanced Well Abandonment Support**: Optimizing the end-of-life management for oil and gas wells is crucial for environmental stewardship and regulatory compliance. **Volant Products** is a specialized engineering firm providing solutions for a wide array of downhole tubular and equipment challenges throughout a well's lifecycle, offering international service across Australia, Kuwait, Latin America, Nigeria, the UAE, and the US. Similarly, **WSP** has decades of experience in surface reclaiming inactive oil and gas wells, currently managing the reclamation of hundreds of sites nationwide. With a global presence of 70,000 employees across all continents, WSP provides comprehensive expertise.

Assumed Specific Interests by country

Global interest in these well-related solutions includes:

- **Recompletions to alternative zones** – All countries
- **Geothermal Power and Heating** – Colombia, Indonesia, Malaysia, USA
- **Lithium** – Argentina, Australia, China, Brazil, USA
- **Acid Gas Injection** – Argentina, Brazil, China, Colombia, Saudi Arabia, UAE, USA

Closing Words and Next Steps

Canadian cleantech companies are strategically positioned to thrive in the current global climate, as nations worldwide intensify their commitments to emissions reduction and net-zero targets. The global push for decarbonization is fueling strong demand for innovative Canadian cleaner-tech solutions, especially across the **oil and gas, energy infrastructure, and renewable energy sectors**.

Here's a breakdown of the global regions and specific countries actively seeking Canadian cleantech expertise:

North America

United States (U.S.): As Canada's **largest cleantech export market**, the U.S. is particularly interested in technologies for **pipeline infrastructure, Carbon Capture, Utilization, and Storage (CCUS), and methane leak detection**.

Latin America

This region offers significant opportunities as countries pursue diverse decarbonization strategies:

- **Argentina**: Seeks Canadian expertise in **shale resource extraction, methane emissions monitoring, and enhanced oil recovery (EOR)**.
- **Brazil**: Presents opportunities in **offshore oil and gas, CCUS, and natural gas pipeline infrastructure**.
- **Colombia**: Its ambitious decarbonization strategy highlights a need for **Greenhouse Gas (GHG) tracking, CCUS, and low-emission hydrogen production**.
- **Mexico**: With expanding investments in renewable energy, Mexico is looking for advanced **water technologies and offshore energy solutions**.

Africa

African nations are focusing on sustainable energy transitions and emissions management:

- **Ghana**: Is actively investing in **clean technology, carbon capture, and energy efficiency**, creating strong opportunities in **emissions management and renewable energy**.
- **Nigeria**: Its energy transition strategy prioritizes **solar infrastructure and Liquefied Natural Gas (LNG) development**, alongside a need for **methane emissions reduction technologies**.

Asia-Pacific

This dynamic region, home to some of the world's largest energy consumers, is aggressively pursuing clean energy:

- **China**: As the **world's largest energy consumer**, China is making substantial investments in **CCUS, renewable energy, and advanced energy efficiency solutions**.

- **Indonesia, Malaysia, and Pakistan**: These countries are prioritizing **low-carbon energy solutions**, working towards **phasing out coal**, and focusing on comprehensive **industrial decarbonization**.

Middle East

The Middle East is diversifying its energy portfolios with major investments in renewables and carbon management:

- **Saudi Arabia and the UAE (United Arab Emirates)**: Are heavily investing in **renewable energy, carbon capture, and hydrogen production**, presenting significant opportunities for Canadian cleantech firms in **decarbonization, enhanced oil recovery, and waste-to-energy projects**.
- **Iraq and Kuwait**: These nations offer opportunities for **emissions reduction, water treatment, and improvements in energy infrastructure**.

Next Steps

By strategically leveraging existing trade agreements and fostering new partnerships, **Canada is poised to play a pivotal role in accelerating global sustainability and energy transition efforts** amidst evolving global energy markets.

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