

GENOMICS FOR ENERGY AND MINING

Enhancing hydrocarbon energy, coal and metal mining operations through genomics can help boost Canada's outputs and advance international leadership in a field already worth \$1.25 trillion.



GENOMICS: The science that aims to decipher and understand the entire genetic information of an organism.

Importance of THE ENERGY AND MINING SECTOR to Canada*

* Figures from *Advancing Canada's Energy and Mining Sector through State-of-the-Art Genomics Applications*, Genome Canada, 2013.



\$880

Billion – value of Canada's energy resources



\$126

Billion in exports



11%

of GDP



#1

Private employer of Aboriginal peoples



\$370

Billion – Canada's mineral assets



1.4

Million – Canadians employed by the sector (5% of Canadian workforce)



40%

Growth of world's oil needs projected over the next 25 years



6TH

Largest oil producer in the world



\$500

Billion in provincial royalties the Canadian government stands to gain as Canada generates nearly 5% of global demand over the next quarter century



GenomeCanada



GenomeBritishColumbia



GenomeAlberta



GenomePrairie



OntarioGenomicsInstitute



GenomeQuébec



GenomeAtlantic

CHALLENGES FACING THE SECTOR, WHICH GENOMICS CAN HELP ADDRESS

PIPELINE CORROSION AND WELL SOURING

Genomics has helped to identify many of the microbes involved in souring and corrosion. However, more research is required to translate these discoveries into commercial biotechnologies.

RESOURCE-INTENSIVE EXTRACTION

Recovery of metals and the conversion of residual (unrecoverable) oil to value added compounds or products (e.g., methane, alcohols, bioplastics) remains a challenge.

ACCELERATING REMEDIATION

Genomic research has identified many microorganisms which can treat toxic compounds. Additional research can optimize the activity of these microbes in contaminated sites.

ASSESSMENT, MONITORING, AND COMPLIANCE

Limited tools to assess toxicology and risk mean that it is difficult to develop regulations that accurately reflect today's complex environments.

AGING ASSETS

Recovery of metals and minerals is declining in older deposits, which may cause extraction operations to close prematurely.

As high-grade reserves are depleted and oil reservoirs are water flooded, using microorganisms to leach valuable metals is becoming increasingly important.

ACID ROCK AND MINE DRAINAGE

Treatments to neutralize the acidic run-off from mines containing heavy metals is expensive.

GREENHOUSE GASES

Both the microbes producing methane in tailing ponds and the microbes capable of consuming methane emissions have been identified. Future genomics research is needed to create biotechnologies that will allow operators to actively manage methane production in their ponds.

OIL/HYDROCARBON SPILLS

Selected microbes have the potential to biodegrade oil and bitumen spills that have occurred in soil, ocean environments, and the Arctic.

Improved knowledge of the microorganisms and pathways involved in the highest biodegradation rates is required to develop effective approaches for each situation.



GENOMICS

Providing technology to meet fundamental challenges

GENOMICS CAN HELP THE SECTOR TO:

- Optimize processes.
- Address environmental issues.
- Meet regulatory requirements.
- Manage and mitigate risk.
- Support responsible and sustainable business practices.

“We are very excited about the prospects for genomic applications in the mining sector, particularly in environmental management and sustainability of operations and in reclamation and closure of mining sites.”

– Chris Hodgson, President, Ontario Mining Association

WHY CANADA CAN LEAD IN ENERGY AND MINING GENOMICS:

- ✓ World-leading expertise in hydrocarbon and petroleum microbiology.
- ✓ Plentiful natural resources and substantial processing and infrastructure capabilities in energy and mining.
- ✓ Most of the largest energy companies have major operations, facilities and offices in Canada.
- ✓ Generous tax incentives for investing in exploration.
- ✓ Internationally-competitive large-scale technology platforms and R&D centres across the country.

“Genomics is an area of great potential for breakthrough technologies in the energy industry.”

– Soheil Asgarpour, President, Petroleum Technology Alliance Canada





BUILDING ON SUCCESS

A wide range of biological tools and technological advancements that benefit the energy and mining sector have resulted from Canadian genomics research investments. Notable promising discoveries include:

- Improved remediation of oil sands tailings.
- Greener production and extraction of hydrocarbon energy, including souring control, tailings pond modeling, corrosion prevention, etc.
- Improved bioremediation of polluted soils.
- Tools for monitoring and improving mine drainage treatment.
- Better understanding of the biological processes involved in breakdown of pollutants at contaminated industrial sites.
- Enhanced 'biomonitoring' – to better describe and understand biological diversity and mitigate environmental threats.
- Exploring how organisms respond at a genetic level to toxic substances in the environment.

Canada's Opportunity

The power of genomic technologies is only beginning to be recognized in the energy and mining sectors. Now is the time to greatly expand the use of these tools to improve operational practices and make Canada a leader and exporter of genomic and life science technologies for the benefit of these sectors and Canadians. How this can be done is detailed in *Advancing Canada's Energy and Mining Sector through State-of-the-Art Genomics Applications*, available on Genome Canada's website at www.genomecanada.ca/en/sectorstrategies.



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