ENVIRONMENTAL INNOVATION IN THE OIL SANDS
ECONOMIC CONCEPTS AND CASE STUDIES

1. OPPOSING ECONOMY AND ENVIRONMENT: A FALSE DEBATE

The economy is neither good nor bad for the environment; it is an integral part of it. These two realities are pervasive and interrelated, not adversarial.

Source: AppEco 2019

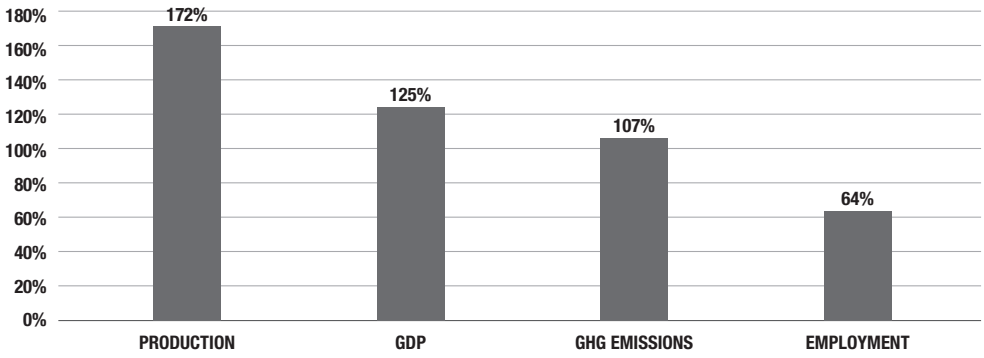
2. INNOVATION AND ENVIRONMENTAL MANAGEMENT IN THE OIL SANDS

- Significant activities, because they are directly related to the scale of production
- An integral part of a company's value chains, both for performance and cost reduction

3. COSIA: AN OPEN SOURCE COLLABORATIVE APPROACH

- 981 distinct shared technologies and innovations
- Total development cost: $1.4B
- 308 active projects in 2017 only—total project value: $545M

4. GROWTH IN OIL SANDS OVER A DECADE



5. WEEKLY PAY

Average weekly earnings: approximately $2,700, almost 3 times the Quebec average and 2.4 times the Alberta average.

6. A SIGNIFICANT IMPROVEMENT IN ENVIRONMENTAL PERFORMANCE

- From 2010 to 2016, GHG emissions per barrel produced: -17%.
- In Canada, the environmental performance of facilities varies widely, with the highest performers generating fewer GHGs per barrel than the U.S. average.
- By 2030, GHG emission intensity could fall by another 16-23%.

7. SIGNIFICANT ECONOMIC BENEFITS FOR QUEBEC INCLUDE:

- $1.2B in contracts to 371 suppliers
- 16,200 jobs, including 8,600 direct jobs
- $288 million in taxes, including $215 million for the Government of Quebec

Source : AppEco

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CANADA'S OIL & NATURAL GAS PRODUCERS

1. FIVE CASES OF ENVIRONMENTAL INNOVATION

1 : LiDea—Caribou Habitat Restoration

2: GHGSat—Measuring Greenhouse Gases

3: Virtual Sensors—Once-Through Steam Generators, or OTSGs

4: Tailings Management by CO_2 Addition and Capture

5: OTSG Natural Gas Turbine

2. ENVIRONMENTAL INNOVATION CASE STUDIES

Environmental Sector	1	2	3	4	5	Description
Greenhouse gases	✓	✓	✓	✓	✓	(Case 1) Conversion of source sites to CO_2 sinks (Case 2) Increased accuracy and frequency of measurements (Case 3) More accurate and effective OTSG operation (Case 4) Capture of CO_2 and injection into tailings (Case 5) Decreased consumption of Alberta produced electricity
Territory	✓					(Case 1) Restoration of forests and caribou habitat
Tailings management				✓		(Case 4) Fine particle capture and reduction of the tailing pond area required
Water			✓	✓		(Case 3) Vapour quality improvement, less water required for production (Case 4) Increases clarity and decreases water requirements for ponds
Monitoring	✓	✓				(Case 1) Data on growth of vegetation and wildlife (Case 2) Satellite measurement of GHG emissions from tailing ponds and mines

3. ENVIRONMENTAL IMPACT

Most of the projects addressed several environmental areas, all of which focused on GHG reduction

4. ECONOMIC IMPACT

- Increased revenues: greater production efficiency
- Decrease in production costs: $45M minimum total savings
- Creating or sustaining jobs: 20 to 25 net

5. APPLICATION TO OTHER SECTORS

- Caribou habitat restoration: in any boreal forest context
- Measuring GHG emissions: various business sectors, e.g., mines, landfills and agriculture
- Virtual Sensors: any sector generating steam by using OTSGs
- CO_2 capture in non-segregated tailings: any mining industry where tailings are stored in oil sands-like ponds

6. APPLICABILITY TO THE QUEBEC ECONOMY

Many of these innovations could be adopted in Quebec, in sectors totalling 1.1 million jobs:

- Manufacturing
- Construction
- Transportation
- Professional and technical services
- Waste management
- Etc.

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