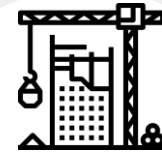




**Agriculture, Agri-food
and Aquaculture**
73 Mt CO₂e
10% Canada's
Emission



**Building, Real Estate,
and Infrastructure**
92.5 Mt CO₂e
13% Canada's
Emission



**Waste, Plastics,
and Others**
42 Mt CO₂e
6% Canada's
Emission



Electricity
64 Mt CO₂e
9% Canada's
Emission



Transportation
186 Mt CO₂e
25% Canada's
Emission



Oil and Gas
193 Mt CO₂e
26% Canada's
Emission

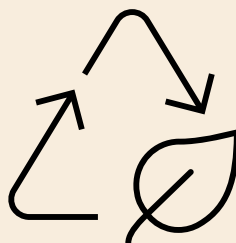


Heavy Industry
78 Mt CO₂e
11% Canada's
Emission

Canadian Target Sector Demand



This project is funded by
the European Union





Heavy Industry

Overview

Includes extraction and conversion of raw materials into commodities including metal, non-metal mining, smelting and refining activities such as lime, cement, chemicals, fertilizers, pulp and paper, glass production, etc.

Sector priority:

Low-carbon cement/alternatives; chemical/plastic end of life recycling; hydrogen for steel production; forestry invasive species monitoring/reduction; low emission machinery; low carbon feedstock manufacturing; low-grade waste recovery; Artificial Intelligence and Machine Learning.

78 Mt CO₂e

GHG Emission



**11% of Canada's
GHG Emissions**

Challenges

Mineral Mining & Cement Production

Consists of extraction products such as gold, coal, potash, iron ore, copper and nickel



8.8 Mt CO₂e
GHG Emission

Steel & Other Metal Production

Creation of steel, iron, aluminum, and other

15 Mt CO₂e



Excessive amount of electricity usage in metal production

Forestry

Solid wood manufacturing, pulp, logging and paper manufacturing

13.7 Mt CO₂e



Growing number of invasive insects

Chemical Industry, halocarbons & solvents



Ensuring proper disposal/ use of products at end-of-life cycle

35 Mt CO₂e

No innovative technologies to reduce emission



Opportunities

- Canadian companies are expected to increase research/ development and investments to reduce cost or emissions of their production;
- Technology that helps steel manufacturers transition their processes e.g. hydrogen steel production;
- Innovation into using plastics, oils, and solvents at the end of the designed life.



**R&D
BIOECONOMY**

Forest Management

Hydrogen Steel Production





Oil and Gas, including Oil Sands Mining

Overview

The sector includes up-stream extraction, production, pipeline transportation, refining and distribution of oil and gas products.

Sector Priority Areas:

Water reduction & increased recyclability; pipeline leak detection; operation automation; Unmanned Aerial Vehicles for remote methane detection; carbon capture, utilization & storage; flare gas recovery and utilization; biofuels.

73 Mt CO₂e

GHG Emission



5% of Canadian GDP

**26% Canada's
GHG Emission**

**The Largest
Emitter &
Contributor of
GHGs**



Challenges

**FUEL REDUCTION & REPLACEMENT FOR MACHINERY USED
IN ESCAVATION AND TRANSPORTATION OF PRODUCTS
(UPSTREAM)**

**SOLUTIONS TO BETTER UNDERSTAND SOURCE & VOLUME
OF FUGITIVE METHANE EMISSION AND MITIGATE THEM**

Opportunities

- Demand for emission reduction solutions in upstream (extraction, production) operations; technologies to reduce fuel emissions, such as biocrude and biofuel production; technologies to reduce GHG emissions from the processing, refining and transportation of crude
- Methane emissions reduction technologies that replace gas-driven chemical injection pumps with a non-natural gas driven variety;
- Carbon Capture Utilization and Storage (CCUS) solutions that can efficiently utilize gas for flaring, particularly for small-scale operations

LEAK DETECTION AND REPAIR

RENEWABLE BIOFUELS



Transportation

Overview

The sector includes emissions associated with the transportation of passenger, freight, residential and commercial transport (on-road and off-road).

The four main subsectors in Canada are *road*, *rail*, *aviation*, and *marine* transport.

Road vehicles make up **76%** of all transportation related GHG emissions in Canada.

186 Mt CO₂e
GHG Emission



4.2%
Percentage of
Canada's GDP

2nd Largest Emitter

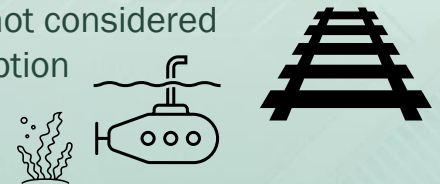


High service cost and uneven/limited access to transportation infrastructure as a result of vast geographical area

Struggle to find affordable and sustainable public transit solutions

Limited rail transport access; electrification technologies are not considered logistically or economically feasible to enable widespread adoption

Complex process of maritime infrastructure replacement



Opportunities

- **Solutions to adopt lower carbon fuels.**
- **Electrification of marine vessels and railways.**
- **Advanced logistics technologies, big data platforms and shared services to improve transit corridors e.g., Remotely Piloted Aircraft Systems (RPAS), drones and artificial intelligence.**
- **Solution to decarbonize long haul rail.**

**BIOETHANOL
HYDROGEN**

**NATURAL GAS
BIODIESEL**





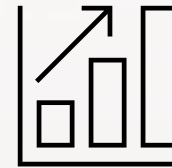
Buildings, Real Estate, and Infrastructure

Overview

Expected to reduce emissions to 62 Mt CO₂e by 2030

Sector Priority Areas:

Wood-based structures; low emitting energy sources (e.g., electric ground source heat pumps); renewable building materials; water leak detection and repair; surface water management (e.g., green walls/roofs); efficiency technologies; district energy systems.



6%

Percentage of Canada GDP



92.5 Mt CO₂e

GHG Emission in 2018

INFRASTRUCTURE

3rd Largest Emitter

16.4% (146,255 km) of roads
12.4%(9,661) bridge/tunnel structures
older than 20 years and in very poor condition

>30% of all plastic waste comes from the construction industry – many plastics used in construction are difficult to recycle

Challenges



ROADS

RUNWAYS

COASTAL INFRASTRUCTURE

Opportunities

- Use of new climate-resilient infrastructure
- Improvements to the recovery, reuse and recycling of plastic construction wastes generated by residential/commercial construction activities
- More effective leak detection and repair of water pipes and use of new and more efficient technologies
- Urban drainage systems improvements to reduce stormwater runoff volume
- Better surface water management with green walls and roofs
- Better structural stormwater controls



SMART CITY TECHNOLOGY

RENEWABLE BUILDING



Agriculture, Agri-food and Aquaculture

Overview

Source of Emissions:

Biological processes in animal, fish, crop production, and energy use of farms; biological emissions from methane, nitrous oxide and CO₂ from energy use.

Sector Priority Areas:

Innovative irrigation technologies; sensory & digital surveillance technologies; alternative protein production; nutrient management; methane emission capture & utilization (e.g., anaerobic digestion); farm equipment electrification, vertical agriculture.



73 Mt CO₂e
GHG Emission



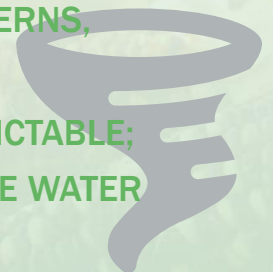
7% of Canadian GDP



**10% Canada's
GHG Emission**

- CLIMATE CHANGE IS ALTERING HYDROMETEOROLOGICAL PATTERNS, MAKING AGRICULTURE SEEDING, PEST MANAGEMENT, AND HARVESTING PRACTICES MORE COMPLEX AND YIELDS UNPREDICTABLE;
- INCREASING GROUND WATER RECHARGE ISSUES AND SURFACE WATER SHORTAGES IN CERTAIN GEOGRAPHIES

Challenges



Opportunities

- Anaerobic digestion solutions to address nutrient runoff and fugitive methane emissions from waste;
- Biofuel technologies to generate renewable fuel for on-farm energy production;
- Innovative irrigation technologies to reduce or conserve water consumption;
- Diversification product lines with alternative protein sources, animal-free products, gluten-free products and organic/free range products;
- Electrification and automation of agricultural equipment;
- Increasing adoption/scale-up of vertical agriculture;



ANAEROBIC DIGESTION

BIOFUEL

INNOVATIVE IRRIGATION

Electricity



Overview

81% of Canada's electricity is generated from non-emitting sources, hence, Canada's low carbon electricity will play an important and expanding role in decarbonizing the economy.

Sector Priority Areas:

Decentralized grid development & integration; accelerating renewable energy capacity; energy storage solutions (e.g., battery); resilient grid infrastructure (e.g., extreme weather); biomass combined heat & power for off-grid communities; automation technologies.



64 Mt CO_{2e}
GHG Emission



10% of Canadian GDP

Challenges

NATURAL GAS



- Continued phase-out of coal fired power production by 2030
- All energy generators must reach an efficiency of **420t CO₂/GWh** by 2030



- **>280 communities** are not connected to the main electrical grid or gas distribution pipeline systems

CCUS

- Most remote communities rely on diesel-fired generation as their primary power source

Opportunities

- Replacement of fossil fuels and increased adoption of cleaner/alternative energy sources, including emerging renewable sources of clean energy such as instream tidal, solar, and geothermal energy technologies
- Solutions to reduce reliance on diesel in remote and off-grid communities including biomass combined heat and power projects
- Decentralized generation technologies with solutions including solar PV, micro hydro, renewable natural gas, cogeneration and enabling technologies such as battery storage systems

RESILIENT GRID INFRASTRUCTURE

SMART GRID DEPLOYMENT



Waste and Plastics

Overview

Sector deals with general solid and liquid waste, methane emissions from municipal landfill operations, fugitive methane associated with waste-water treatment.

Sector Priority Areas:

Landfill & wastewater treatment facility methane capture and utilization; e-waste management and recycling; biodegradable and renewable packaging; microplastic monitoring (especially in aquatic environments) and filtration; digital sorting.

← **3%**
Percentage of
Canada GDP

42 Mt CO₂e
GHG Emission



Challenges

- COVID-19 CONSUMPTION PATTERNS LED TO INCREASED PRODUCTION
- SEPARATING COMPONENTS OF E-WASTE (PLASTICS AND METALS) IS DIFFICULT
- LACK OF TECHNOLOGIES TO DECONTAMINATE PLASTICS REMOVED FROM E-WASTE
- CANADIANS GENERATE SIGNIFICANT AMOUNTS OF GARBAGE PER CAPITA ONLY **30%** OF THAT CONTENT IS RECYCLED



Opportunities

- Solutions to increase the percentage of methane recovered from landfills
- Circular economy solutions that cover plastics, metals, batteries, minerals, etc.
- Cost-saving waste management solutions
- Digital sorting technologies for public facilities & infrastructure
- Solutions for recycling & biodegradable solutions for packaging
- Ocean plastics:
 - Microplastic filtration from marine vessel grey water
 - Measurement tools to detect microplastics in aquatic environments



WASTEWATER TREATMENT FACILITIES
ANAEROBIC DIGESTION