

## Greenhouse Gas Emission Assessments for the Canadian Nuclear Fuel Cycle

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### Greenhouse gases and climate change

A greenhouse gas (GHG) is a gas that can trap heat in the atmosphere. The main greenhouse gases include carbon dioxide, methane and nitrous oxide. Increases in GHG concentrations in the atmosphere have resulted in an enhancement of the natural greenhouse effect by causing the global average surface temperature to rise. Global warming refers to the increase in this surface temperature.

Global warming represents one aspect of climate change. Climate change refers to the long-term change in temperature, precipitation or other aspects of measuring climate. Climate change may be due to natural causes or human activities.

[Read more about climate change and the Government of Canada's actions on climate change.](#)

### Government of Canada's proposed methodology for estimating greenhouse gas emissions

On March 19, 2016, Environment and Climate Change Canada (ECCC) published a proposed methodology for estimating the upstream GHG emissions associated with major oil and gas projects undergoing federal environmental assessments. [Read more about ECCC's proposed methodology.](#)

ECCC's proposed methodology is for estimating upstream GHG emissions, and it only applies to major oil and gas projects undergoing federal environmental assessments. The proposed methodology has not yet been finalized. At this time, ECCC has not indicated whether the proposed methodology could be applied to other types of projects.

### Highlights

- A greenhouse gas is any gaseous compound in the atmosphere that is capable of trapping and holding heat in the atmosphere. By increasing the heat in the atmosphere, greenhouse gases are responsible for the greenhouse effect, which ultimately leads to global warming.
- The Canadian Nuclear Safety Commission (CNSC) licenses nuclear facilities in Canada including uranium mines and mills, nuclear power plants, processing facilities and waste management facilities.
- GHG emissions from CNSC-regulated facilities are low and represent a small fraction of Canada's total GHG emissions.
- Environment and Climate Change Canada has published a proposed methodology for estimating the upstream greenhouse gas emissions.
- The CNSC's interim strategy is that proponents assess total GHG production using a lifecycle analysis which is a recognized approach that considers all stages of the electricity generating technology.

## CNSC's interim strategy for environmental assessments

In order to align with ECCC's proposed methodology, the CNSC has proposed that proponents assess the total GHG production as part of CNSC-led environmental assessments. This assessment will be achieved through the use of a lifecycle analysis approach that includes estimation of upstream and downstream GHG emissions.

Lifecycle analysis is a recognized approach for characterizing GHG emissions from various electricity generating technologies. A lifecycle analysis on the core elements within the Canadian nuclear generation lifecycle may include the following stages:

- mining and milling
- refining
- fuel fabrication
- nuclear power plant
- waste disposal (low-, intermediate-, and high-level radioactive waste disposal)

## CNSC's existing approach for assessing GHG emissions from licensed Canadian nuclear facilities and projects

CNSC staff also review information submitted by licensees to verify compliance with federal and provincial GHG emission reporting requirements. Staff's review of the proponent's assessment of GHG emissions includes verifying that:

- the assumptions used include the type and source of emissions
- the methodologies and data used are consistent with industry best practices as well as appropriate standards and guidance
- uncertainties have been documented
- estimates have been compared to estimates from similar types of facilities to determine if the results are reasonable

## Upstream and downstream emissions at a glance

According to ECCC's proposed methodology for the oil and gas industry, upstream emissions include the GHG emissions from all the industrial activities or processes from the point of extraction to the project under assessment.

As shown in the equation below, upstream emissions are calculated as the sum of the emissions from the different industrial processes such as extraction, processing, handling and transportation.

$$Total\ emissions = \sum_i^n (GHG)_i$$

where  $i$  is the different industrial process and  $n$  is the number of component processes or activities

(Adapted from [ECCC's proposed methodology for estimating upstream GHG emissions](#))

## **Greenhouse gases and Canada's nuclear power plants**

The lifecycle analysis for Canada's nuclear power sector includes upstream GHG emissions associated with the extraction, production and transportation of fuel, and downstream GHG emissions arising from activities related to waste management and nuclear fuel disposal.

The Canadian nuclear fleet is made up exclusively of CANDU reactors. CANDU reactors use heavy water as both a moderator and coolant. The following three parameters have implications on the amount of GHGs emitted that are specific to CANDU reactors.

- **Ore grade:** Currently, the highest ore grades, which supply the CANDU fleet operating in Canada, are found in the Athabasca Basin of Saskatchewan, Canada. Emissions from mining and milling higher grade ore are less than mining lower grade ore.
- **Enrichment:** CANDU reactors operate on natural uranium with (0.7 percent uranium-235) and therefore avoid emissions from this stage of the nuclear fuel cycle.
- **Heavy water production:** CANDU reactors use heavy water as both a coolant and a moderator. The production of heavy water is energy intensive. The GHG emissions that are avoided by the absence of the enrichment process may be offset by GHG emissions associated with heavy water production.

GHGs from waste management and final disposal may account for approximately 15 percent of the total lifecycle GHG intensity for a nuclear power plant.

## **Summary**

The CNSC will continue to use its interim strategy for CNSC-led environmental assessments.

The CNSC will also continue to engage with ECCC and other federal partners regarding methodologies for estimating GHG emissions from nuclear facilities to ensure that our requirements for environmental assessments comply with the latest accepted approaches.

### **For more information:**

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