An application of GCAM to assess the Mid-Century Strategy for Canada’s Deep Decarbonization

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Background

Canadian GHG emissions trajectory following the Paris Agreement:
- Nationally Determined Contributions (NDC) target is to reduce 30% below 2005 levels by 2030
- Mid-Century Strategy (MCS) proposes reductions of as much as 80% by 2050

Objectives

The main objective of this work is modeling, through different scenarios, how Canadian implementation of its GHG emissions targets could affect domestic energy and emissions profiles through mid-century. Therefore, this research aims to describe:
- How decarbonization patterns differ depending on the cost and adoption levels of technologies in the power, end-use, and energy production sectors.
- How Canada’s choice of emissions pathway affects their energy and emissions profiles through mid-century.

Scenarios

<table>
<thead>
<tr>
<th>Name</th>
<th>Descriptions</th>
</tr>
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<tbody>
<tr>
<td>Current Policy</td>
<td>Policy implementations consistent with currently situation:</td>
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<tr>
<td></td>
<td>Implemented no new coal power plant</td>
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<td></td>
<td>Implemented carbon tax 10 $CAD rising to $50 CAD in 2020</td>
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<td></td>
<td>High wind production in early years</td>
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<td>Mid Century Strategy</td>
<td>Various technology pathways simulated:</td>
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<td></td>
<td>Regular CCS and no CCS</td>
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<td></td>
<td>Low, regular and high nuclear</td>
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<td>Regular and high electrification</td>
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<td>Regular and high renewables</td>
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<td>Regular and low biomass</td>
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Results

GHG Emissions by Type

Current Policy has the energy consumption over 14 EJ by 2050 and almost total elimination of coal. In the MCS scenario, consumption is below 13 EJ by 2050 and renewable energy technologies with and without carbon capture and storage play important roles.

Energy Consumption by Fuel

One of the most striking results is from the high electrification scenario in the transportation sector where a high electric car penetration scenario combined with deep decarbonization resulted in a rapid phase-out of conventional fossil-fuel-based vehicles. At same time, it reduces the demand for bioenergy and land elsewhere. The overall final energy consumption is significantly reduced, due to higher efficiency of electric vehicles.

Electrification Scenarios

GCAM Model

GCAM (Global Change Assessment Model) links socioeconomic, energy, agriculture and land-use, climate and water systems to explore human and earth system dynamics.

For this work, the Canada region was calibrated to current Canadian energy and emissions inventories and refined to improve the behavior and resolution of key sectors, including unconventional oil and the off-road recreational vehicles.

Future Development

- GCAM-Canada, a regional model level with all 10 provinces and 3 territories which will provide a tool to model their heterogeneous sector characteristics. (Under development)
- Dynamic hydropower estimates and further improvements to water use for energy;
- Breakout of oil sands technology into distinct extraction and upgrading types, including surface mining and in situ extraction. (Under development)
- More detailed Canadian Industry sector – manufacturing, paper, oil and metals, for example
- USA-Canada trade-offs and differential decarbonization patterns
- Additional policy analysis

Poster Session

2018 IAMC Meeting. November 13, 6:00 pm to 9:00 pm.

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