Development of GHG mitigation potential through energy efficiency improvement in Canada

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Outline

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- Research questions
- Objectives of research
- Methods and importance of integrated assessment models
- Results so far
- Summary
Background

2015 Emissions Projections - Canada’s 2nd Biennial Report to the UNFCCC: 815 Mt

December 2016 Emissions Projections: 742 Mt

Canada’s target of 30% below 2005 levels

Background

How to get there????

2015 Emissions
Projections
Canada’s 2nd
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the UNFCCC:
815 Mt

December 2016
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Canada’s target of
30% below 2005
levels

Background

- Emissions are tied to energy - energy is tied to quality of life

How do we mitigate emissions without sacrificing our energy use?

**Options:**

- Capture/sequester/utilize CO2 – $$$
- Fuel switching and renewables – constrained by geographical location and environment to an extent, $$$
- **Energy efficiency** – using less fuel for the same result – can save money and reduce GHG emissions – Key area for worldwide GHG mitigation
Research questions

1. What is the ultimate potential?
2. What is the cost?
3. How do we make decisions?

- These are important questions to society as a whole
Objectives of study

1. Develop a model capable of simulating Canada’s energy systems

2. Evaluate energy efficiency measures for GHG mitigation potential and cost

3. Present results via GHG emission abatement cost curves for decision making
Approach –
Energy modelling using LEAP

- A data-intensive numerical model used to represent the workings of an energy system
- A platform to analyze and test outcomes in an energy system
- Transparent accounting framework
- A forecasting tool – can be used to forecast future energy demand and supply over a planning horizon.
- Has been used extensively in studying energy and environment problems (IPCC, NREL, UNEP, UNDP, many countries etc.)
Importance of integrated model analysis

- Takes into account interactions within a system and with other independent systems (regional interactions)
- Changes in demand create responses from supply systems
- Supply systems are always changing
- These make it possible to evaluate system-wide economic and environmental impacts (holistic approach)
- Technology-focused (ideal for energy efficiency studies)
LEAP-Canada model – Overall framework

Transmission & distribution

Electricity generation

Petroleum refining

Bitumen upgrading

Bitumen extraction

Conventional crude oil extraction

NGL production

Natural gas production

Coal mining

Uranium production

To out of area

Inter-provincial transfer

Exports

Demand

Transformation

Resources

Imports

Domestic reserves

Inter-provincial transfer

From out of area

Residential

Commercial & institutional

Industrial

Transportation

Agriculture

LEAP-Canada model – Example of demand tree

What is the improvement potential via energy efficiency?

How does this impact GHG emissions? How much does it cost?
LEAP-Canada model – Example of energy supply

Takes into account system load curves
Scenario analysis of energy efficiency options

1. Develop base year
2. Develop business-as-usual (BAU) scenario
3. Develop energy efficiency scenarios
4. Calculate cost of saved energies (CSE)
5. Program model
6. Estimate energy and GHG saving potential and costs
7. Develop cost curves
Business-as-usual scenario

2030 Canada GHG Sankey Diagram (MT CO2e)

Total In-Canada Emissions = 780

Energy efficiency scenarios

- **Examples:**
  - **Residential sector** – efficiency improvement in space heating, lighting, appliances, insulation and windows
  - **Commercial sector** – efficiency improvements in space heating, lighting, auxiliary equipment, water heating, insulation and windows
  - **Industrial sector** – in progress (iron and steel, petroleum refining, cement, mining, oil and gas extraction)
  - **Transport sector** – HE vehicles, bio-fuel/hybrid vehicles, CNG
  - **Agriculture sector** – efficient equipment, lighting, vehicles, and tractors
Alberta chemical industry energy efficiency options

Alberta combined cost curve

Over 250 GHG mitigation scenarios analyzed for Alberta

* NPV of costs discounted to 2010
Current/future work

- Region specific and Canada-wide cost curves for energy efficiency in all sectors
- A decarbonization road map for Canada
- Provide policy makers, industry, investors, and consumers with insights into the environmental and economic performance of energy efficiency pathways
Key takeaways

- Untapped energy efficiency potential exists
- Our research is attempting to quantify this potential
- Our results can provide insight as to where to invest and create policy
  - Homeowners, business owners, building owners, government, industry
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Thank you! Questions?...

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