A LIFE CYCLE APPROACH TO ELECTRICITY SUPPLY IN ONTARIO

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Outline

• Ontario’s Electricity System
• Objective
• Modelling Approach
• Preliminary Forecasts of Ontario’s Electricity Future
• Preliminary Conclusions
Electricity Supply in Ontario

- Ontario’s grid mix fairly diverse
- Projected GHG emissions intensity (2017): 3.8 - 4.1 Mt CO₂E/y
- Most IESO forecasts expect demand growth toward 2035
- Some generators nearing end-of-life

Data from: Independent Electricity Systems Operator, Ontario Planning Outlook 2016
Decision-Making Challenges

• Goals:
  – Meet the current and future demand
  – Electricity supply budget friendly
  – Compliant with provincial environmental regulations and emission goals

• Variables and uncertainty:
  – Demand
  – Market conditions
  – Environmental policy
  – Technology development

• Plus
  – Many technologies have long lead times
Examples of Ontario Electricity Generation LCAs

  - Ontario’s average GHG intensity 201 t CO$_2$e/GWh for 2008
- Zhang et al. compared the life cycle operational costs of coal, wood pellets and natural gas
  - Good example of a combined LCA/LCC which determined the cost of GHG emission reduction ($/t CO_2$e) for varying fuel types
Objective

• To investigate which energy technologies can contribute to a cost-effective ($/MJ) and low life cycle greenhouse gas (GHG) emission (kg CO2e/MJ) electricity grid mix for Ontario over a 20 year horizon

• Results are expected to aid government and industry decision-makers by identifying which technologies can be implemented advantageously now to meet future emission goals and energy demand
Modelling

Data/Model References include: Murphy-Snow & McKellar (2015), IESO (2016)
Modelling

• Reference case:
  – Utilizes the projected installed capacity from IESO’s Ontario Planning Outlook [2016]

• Low cost:
  – Directed and Expiring capacity replaced by available energy technology with lowest cost

• Low emissions:
  – Directed and Expiring capacity replaced by available energy technology with lowest emissions

• Variable:
  – Directed and Expiring capacity replaced by energy technology based on user input

• Variable without nuclear:
  – Directed and Expiring capacity replaced by energy technology based on user input while excluding nuclear
Preliminary Results – GHG Emissions

Life Cycle Emissions (Mt CO₂ e/y)

- Reference Case
- Low Cost
- Low Emission
- Variable
- Variable w/o Nuclear

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USAEE/IAEE 2018
Preliminary Results – Life Cycle Costs

Yearly Life Cycle Costs (B$)

- Reference Case
- Low Cost
- Low Emission
- Variable
- Variable w/o Nuclear

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Preliminary Conclusions

• Preliminary results suggest that emissions and costs can be reduced below the reference case

• Pending adjustments to the model

• The model being developed here is intended to provide insights into which technologies may meet low risk criteria
Acknowledgements

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References


References


Murphy-Snow, R., McKellar, J. (2015). Examining the Sustainability of Ontario’s Energy Use. 65th Canadian Chemical Engineering Conference; Oct 4-7; Calgary, Alberta.