A LIFE CYCLE APPROACH TO ELECTRICITY SUPPLY IN ONTARIO

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Overview

There are a large number of energy technologies that can be used to meet electricity demand in Ontario. Analysis is needed to determine which energy technologies to use, while also lowering emissions and cost. Further, such decisions often need to be made under significant uncertainty, and potentially with a significant lag between when a decision is made and when a generating station is operational. The objective of this paper is to investigate which energy technologies can contribute to a cost-effective ($/MJ) and low life cycle greenhouse gas (GHG) emission (kg CO_2e/MJ) electricity grid mix for Ontario over a 20 year horizon. The results of this study 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.

Methods

This study builds on previous work [1] that used publicly available energy data and published life cycle assessment data to generate a static model of Ontario's energy supply and demand system. That model has been expanded to allow forecasting of future annual life cycle emissions and life cycle costs of the Ontario electricity supply system. The reference scenario is based on forecasted supply and grid mix data from Ontario's Independent Electricity System Operator (IESO) [2], covering the period 2016 to 2035.

Alternative grid mix scenarios are also generated, with objectives such as minimizing cost or GHG emissions. In these scenarios, existing and committed capacities remain unchanged, under the assumption that it would not be economically feasible to shut down a currently operating plant prior to its end of life/contract. Capacity considered "directed" (i.e., included in current plans to meet mandated targets) or subject to expiration (technical or contractual) is available to be allocated to different technologies in various scenarios.

Results

Preliminary results suggest that there are opportunities for Ontario to reduce both GHG emissions and cost of electricity. It is expected that the final results of this analysis will aid decision-makers in identifying technologies that may help meet emission goals and reduce the costs of electricity in Ontario. Further, the results may suggest policy instruments that decision-makers could employ to promote uptake of those attractive technologies.

Conclusions

Electricity supply planning is complex and multi-faceted. Decisions need to be made based on best-available information, often with a long lead-time, to ensure sufficient supply into the future. At the same time, uncertainty around future demand, global commodity prices, evolving technologies and shifting government policies raise the risk of being "locked in" to technologies and/or contracts that become unattractive as conditions change. Low risk options may include technologies that are attractive under various future scenarios, or those with relatively small "sunk costs". The model being developed here is intended to provide insights into which technologies may meet these low risk criteria.

References

[1] Murphy-Snow, R., McKellar, J.M. (2015) Examining the sustainability of Ontario's energy use. 65th Canadian Chemical Engineering Conference; Oct 4-7; Calgary, Alberta.

[2] Independent Electricity System Operator. (2016). Ontario Planning Outlook - IESO. Retrieved May 29, 2017, from http://www.ieso.ca/sector-participants/planning-and-forecasting/ontario-planning-outlook