The True Cost of Diesel in Remote Communities of Nunavut: A Triple Bottom Line Cost-Benefit Analysis

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Abstract

Nunavut is Canada's largest territory, encompassing 25 remote communities that primarily rely on diesel-fueled electricity and heat generators and boilers. Diesel-based generation has been considered a reliable and cost-effective energy source due to the lack of dispatchable alternatives. Geographical limitations, infrastructure, and policies have also favoured diesel reliance; however, these systems do not fully account for the socioenvironmental impacts of diesel use. This research analyses the true cost of diesel to understand the implications of its continued use until 2050, reflecting on the effects of externalities, policies, and infrastructure, along with a comparison to the energy transition costs. The results show that this dependence could reach CAD 27 billion by 2050, factoring in electricity and heating expenses. Additionally, a triple-bottom-line cost-benefit analysis was conducted to compare the capital investment required to transition to renewable energy, indicating that this investment could be lower when the true cost of diesel is considered.

Challenges of Bringing Diesel to Nunavut

- Large territory with low population density.
- The twenty-five communities, each powered by its own grid, rely nearly 100% on diesel for electricity and heating generation.
- Extreme climate with average daily temperature of −35 to 10 °C. and low annual precipitation (>200mm).
- Limited access with shipment mainly by air or water during summer. Door-to-door diesel delivery for heating to supply the oil furnaces, as houses and buildings require external oil tanks.

The True Cost

The true cost is derived from the idea of adding economic externalities in the final cost analysis. This method requires the integration of health-related, environmental, and societal expenses that are not always easily quantifiable.

Marginal Cost		Avoided Cost	True Cost
Extraction	Distribution	Operation	Environmental
Refining	Handling	Maintenance	Social
Storage	Taxes	Capital	Health
Transport	Generation Efficiency	Amortization	Subsidies

Figure 1. Elements composing the true cost of diesel.

The hidden burden of diesel reliance and the entrenched subsidy structures and infrastructure make renewable energy projects appear less attractive. Accounting for the true cost of diesel presents the full extent of the impacts of diesel-based energy generation and can provide a fair comparison for the energy transition process.

Methodology

Data was collected using quantitative and qualitative data from government reports, databases, financial records, and studies from relevant organizations, academic papers, statutes, and regulations.

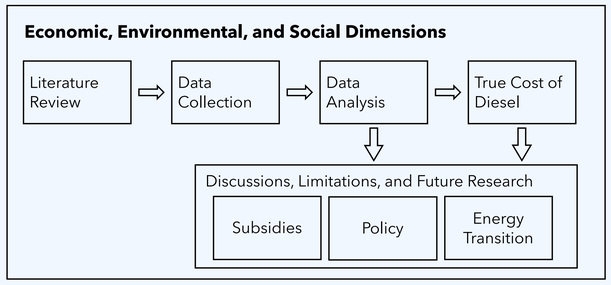


Figure 2. Methodology used to model and analyze the true cost.

System Boundaries

The research encompassed the diesel life cycle from extraction and production to consumption, as illustrated by Figure 3.

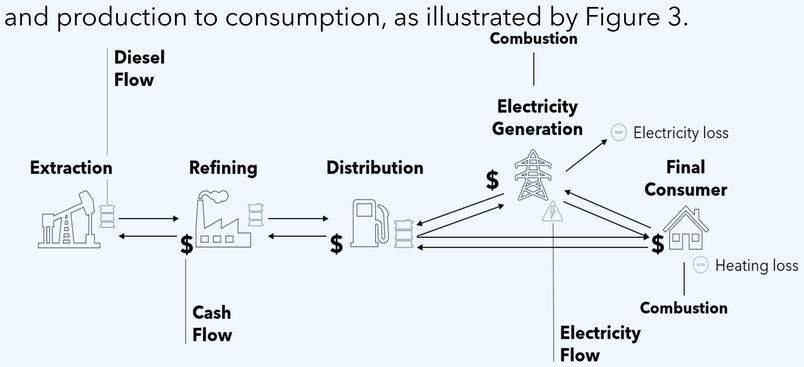
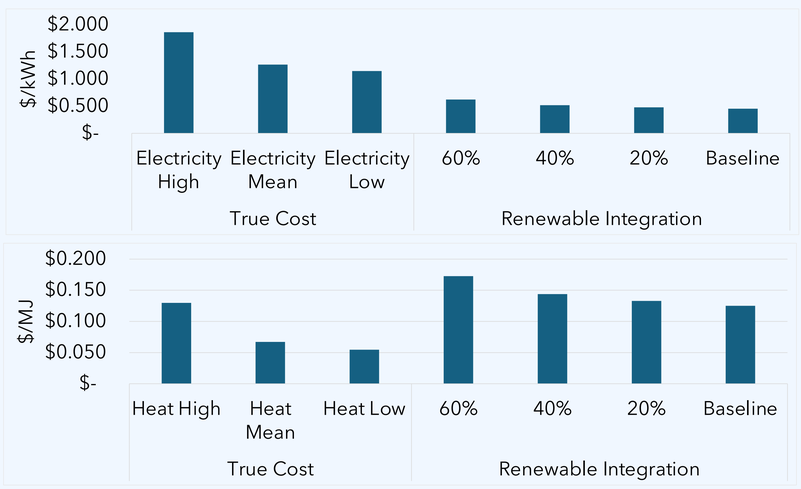


Figure 3. Well-to-wake life cycle of diesel-based electricity and heat generation.

Results

The baseline parameters were taken from reports and previous studies and analyzed in 2023's context for the 25 communities of Nunavut. The true energy cost encompasses the sum of the marginal and avoided costs combined with the quantified externalities and subsidies. The analysis indicated that the financial burden of diesel-based electricity generation and heating in Nunavut could be substantially higher than the current prices set by the energy utility companies PPD and QEC.



Figures 4 and 5. Comparison between the true cost of diesel and Hazelton et al. model of renewables integration cost for electricity and heat generation.

The values presented demonstrate that the true cost of diesel-based electricity is 1.7 to 2.77 times higher than what is currently purchased by non-government residential customers in Nunavut. Heating costs present similar variances, 1.35 to 3.2 times higher than the purchase price of heating fuel.

Limitations

Federal subsidies, the long-term impacts of climate change, fuel stabilization rates, and temporary infrastructure replacement costs were not included in the true cost analysis due to limitations in the publicly available data. These factors would likely contribute to an even higher final cost of diesel.

Sensitivity Analysis

Two main factors were analyzed: the range of externalities and different diesel price adjustment rates over time. As demonstrated in Figure 6, different diesel adjustment rates will play a critical role in determining the overall long-term cost.

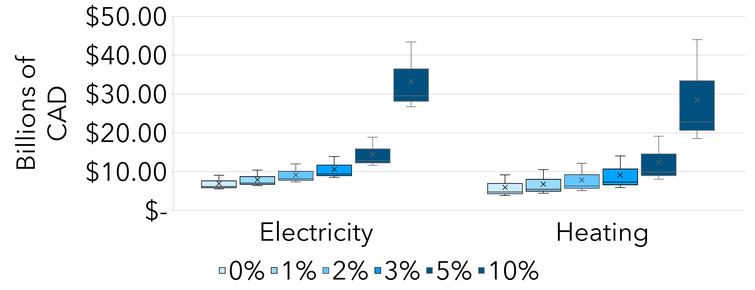


Figure 6. Comparison between different diesel adjustment rates and externalities cost estimated for electricity and heat generation.

Conclusion

The reliance on diesel poses significant economic, environmental, and social risks. The annual cost is approximately $998 million, potentially rising to $27 billion by 2050 if diesel use continues. Electricity costs are 1.7 to 2.77 times higher than non-government residential rates, and heating costs are 1.35 to 3.2 than the current price of diesel. Renewable energy sources show economic advantages for electrification but present challenges for heating. Limited data and assumptions may restrict comparisons; however, future research must provide a deeper understanding of the challenges and costs of renewable energy deployment.

References

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Acknowledgement

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