Net-Zero Microgrids to Advance TransformTO Energy Goals

Angelica Chow | Supervisor: Dr. John Robinson
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Introduction

- TransformTO: City of Toronto's climate action plan to reach net-zero by 2040.
- 54% of Toronto's GHG emissions derive from natural gas usage in buildings, pushing the need for the electrification of buildings [9].
- Increasing electrical demand combined with the provincial grid capacity decreasing, due to Pickering nuclear's decommissioning and other nuclear plant refurbishments, leads to energy gap issues [5].
- Can Toronto leverage distributed energy resources (DER) to produce more local energy and help mitigate the energy gap while reducing GHG emissions?
- **Net-zero microgrids (NZMs) are a way to aggregate multiple renewable energy and low-carbon energy sources while reducing GHG emissions and providing community resiliency benefits** [8].

Research Objectives

- **How can community-scale NZMs be feasibly implemented in Toronto?**
- Comprehensive analysis of NZMs: available technologies, sustainability (environmental, economic, and social) analysis.
- Evaluate energy policies within Canada affecting NZMs.
- Assess challenges and barriers to NZM deployment within Toronto.

Methodology

- Interdisciplinary literature review of academic and grey literature on NZMs.
- Interviews with industry professionals from the following organizations to discover challenges and barriers to NZM deployment within Toronto:

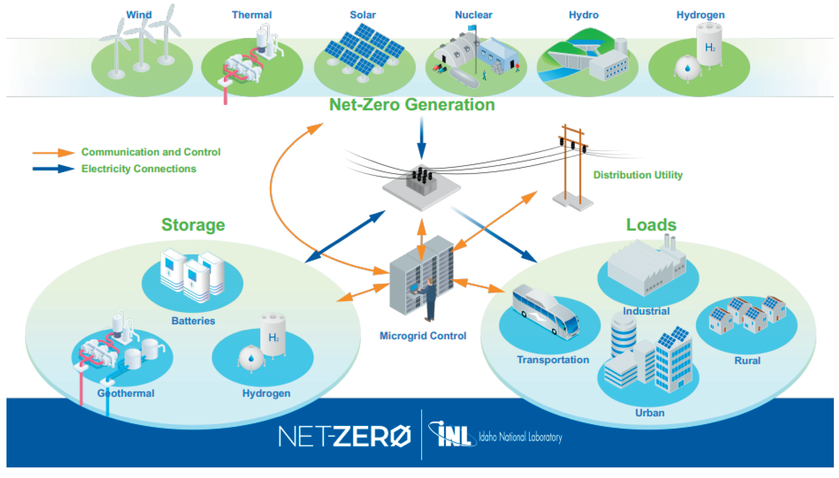
Natural Resources Canada
Ministry of Energy, Northern Development & Trade
ONTARIO ENERGY BOARD
ONTARIO POWER GENERATION
TORONTO HYDRO
TORONTO

Results and Discussion

- Technologies for NZMs include generation sources (solar, micro-wind, micro-hydro, hydrogen fuel cells, geothermal, microturbines with renewable fuel sources, e.g., biogas and carbon capture turned into hydrogen or methane); energy storage systems (batteries, flywheels, hydrogen fuel cells, SuperCapacitors, thermal); microgrid controllers; voltage inverters; and smart meters [2, 4, 6, 7, 13]. Flexibility of NZMs allow consumers to evaluate and select technology most suitable for geographic location, financial means, and energy needs.
- When accounting for sustainability factors e.g., utility bill savings, community resilience, social cost of carbon, public health costs, job creation, and lower operating costs, NZMs provide more net present value than diesel-only and hybrid microgrids [1]. Although NZMs currently come at a higher capital cost than traditional microgrids, technology improvement and increased competition will help lower costs [11]. Energy-as-a-Service (EaaS) business model is a popular financing method rather than owner financed microgrids [12].
- Few government funding programs for innovative smart grid projects: NRCan Smart Grid Program (federal), IESO Grid Innovation Fund (Ontario), retrofits and Development Charge Refund Program (Toronto) [3]. Toronto Green Standard mandates buildings after 2030 must be net-zero, and Net-Zero Existing Buildings Strategy requires existing buildings to be net-zero by 2040 [10]. This pushes for more sustainable design requirements for buildings in future standard revisions, including increased procurement of renewable energy [10].
- Key challenges and barriers: lack of a business case for most consumers to install an NZM; need to figure out which generation and storage sources are suitable for Toronto, technical difficulties connecting NZMs to main grid; community net metering (CNM) and utility rate policies are not designed to support NZMs.

Key Takeways

- NZMs help increase renewable energy deployment, reduce GHG emissions, and provide resiliency.
- Opportunities to integrate NZMs with thermal energy networks and shallow geothermal systems within Toronto.
- High capital costs and lack of financial incentives create a lack of business case. Target critical institutions, campus-sized institutions, and real estate developers and provide business case planning and NZM configuration optimization tools for feasible costs and targeted GHG reductions.
- For consumers ready to install an NZM, Toronto can help facilitate planning sessions to work through technical grid connection challenges and negotiate CNM and utility rates with Toronto Hydro and OEB.



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