ONTARIO SOCIETY OF PROFESSIONAL ENGINEERS

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Subject: Thermal Networks as Critical Energy Infrastructure: Feedback to OEB/IESO Joint Engagement Sessions on DER Integration

Dear Mr. Campbell,

OSPE is the advocacy body and voice of the engineering profession in Ontario. Ontario currently has over 85,000 professional engineers, 250,000 engineering graduates, 6,600 engineering post-graduate students and 37,000 engineering undergraduate students. Through OSPE's non-partisan, evidence-based approach to advocacy, we are recognized as a trusted advisor to government and regularly asked to provide input on policy, planning, and budget decisions.

OSPE wishes to take the opportunity to provide feedback on the OEB/IESO Joint Engagement on Distributed Energy Resources (DER) Integration. This letter contains a detailed proposal regarding the potential impacts of building heating electrification on Ontario's electricity systems and recommends the utilization of Thermal Networks (TNs). With the anticipated increased demand for space heating combined with the increasing electrification of heating systems, it is crucial to address the challenges associated with peak loads and low utilization.

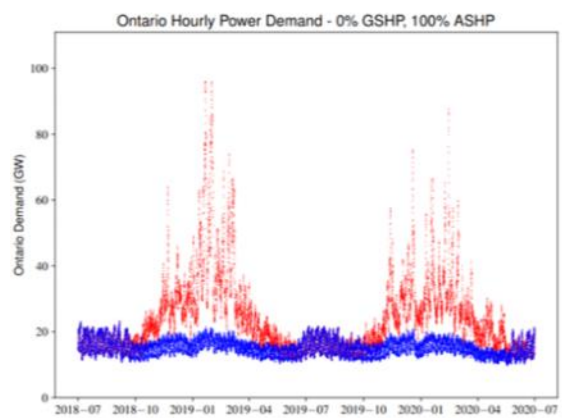
Overview:

The electrification of space heating has the potential to quadruple electricity peak loads, placing a significant strain on the existing infrastructure. Analysis suggests that addressing this challenge will require substantial investments in generation, transmission, and distribution systems, with an estimated cost of approximately $700 billion for the entire province. Additionally, incorporating renewable electricity sources further complicates the task, necessitating expensive electrical storage solutions.

Furthermore, given the seasonal and "peaky" nature of heat loads, incremental capacity required for heating will have very low utilization – about 24% if electric resistance heating were universally adopted and about 13% for air source heat pumps. Accordingly, the OEB and IESO should consider it within their mandate to explore how to minimize peak loads and improve utilization in order to keep electricity service as affordable as possible.

The current peak natural gas load in Ontario is 85 GW, primarily for space and water heating. Adjusting for an 85% efficiency average, the peak heat load served is approximately 73 GW. To meet this demand, there would be a need for both generation and distribution system expansion. Following IESO and Toronto Hydro estimates of $8 billion/GW for generation and transmission and $2 billion/GW for distribution upgrades, the total cost of expanding the electricity system could reach $10 billion/GW, totaling around $700 billion for the entire province. The inclusion of renewable electricity, such as wind and solar PV, would exacerbate the challenge of providing reliable peak power, leading to increased costs for electrical storage.

The graph depicts two years of actual electricity loads and simulated loads for heating, assuming a complete transition to air source heat pumps with efficiency factors (COPs) corresponding to local hourly temperatures. In response to the challenges of extreme peaks and low utilization, it is essential to minimize increases in peak demand and implement measures to flatten the load.



The Case for Thermal Networks:

To mitigate extreme peaks and improve utilization, we propose considering TNs as a viable solution, especially in urban areas representing up to 70% of buildings. TNs offer a modern and versatile form of district energy systems that capture and harvest otherwise wasted thermal energy. The advantages of TNs include:

1. Utilization of Low-Grade Heat: TNs can capture low-grade heat currently rejected into surface waters or the atmosphere by existing electricity systems.
2. Combined Heat and Power (CHP): Converting to CHP and co-locating generation near urban areas could significantly increase efficiency and provide a dual benefit of generating heat and electricity.
3. Industrial Energy Capture: Industry wastes up to 40% of input energy as low-grade heat, which TNs can capture and utilize efficiently.
4. Renewable Energy Integration: TNs can incorporate locally available renewable energy sources, such as solid wastes and biomass residues, supporting both the forestry economy and heat/electricity generation.
5. Cooling System Integration: Heat rejected from cooling systems in communities and data centers can be collected and upgraded for building heating.
6. Thermal Energy Storage (TES): TNs enable cost-effective thermal energy storage, providing load management services over extended periods compared to electrical storage.
7. Integrated Approach: TNs can be integrated with the electricity network to meet heating loads in a decarbonized way, enhancing affordability, adaptability, and resilience.

Recent Developments and Feasibility:

Recent efforts by the Boltzmann Institute, the Canadian Nuclear Association (CNA), and McMaster Institute for Energy Studies (MIES) indicate that TNs, in conjunction with nuclear generation and CHP, present a promising decarbonization option. Comparative cost studies funded by the Net Zero Advisory Board and Environment and Climate Change Canada are underway.

German electricity distribution utilities have acknowledged the challenges posed by the electrification of building heating. They proposed constraints or a ban on air source heat pumps (ASHPs) due to capacity issues in the electricity system. While the EU government rejected an outright ban, they permitted limitations on ASHPs to 4.2 kW. This restriction aims to control peak electrical loads but necessitates the development of a non-electrical and non-emitting supplementary heating source during the coldest days to align with the EU's net-zero emission goal.

Proposed Recommendation

OSPE strongly recommends that the OEB and IESO investigate TNs as a core strategy to address the challenges associated with building heating electrification. OSPE is prepared to collaborate with the Boltzmann Institute, universities, and other partners to conduct further studies and explore potential opportunities. Anticipating the future impacts of widespread electrification will safeguard electricity customers from unacceptable cost increases.

Conclusion

Left to market forces, electrification of building heating will proceed in potentially ineffective ways for the province. Eventually the full cost impact of widespread adoption will become apparent. We may then have to change direction and incur significant stranded investment. If we anticipate and act today, TNs can accelerate decarbonization and protect both electricity and heating customers from future unnecessary costs. OSPE welcomes the opportunity to meet with the appropriate contacts to provide more information and recommendations on TNs and their application to space heating. If this is possible, please reach out to advocacy@ospe.on.ca.

Sincerely,

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