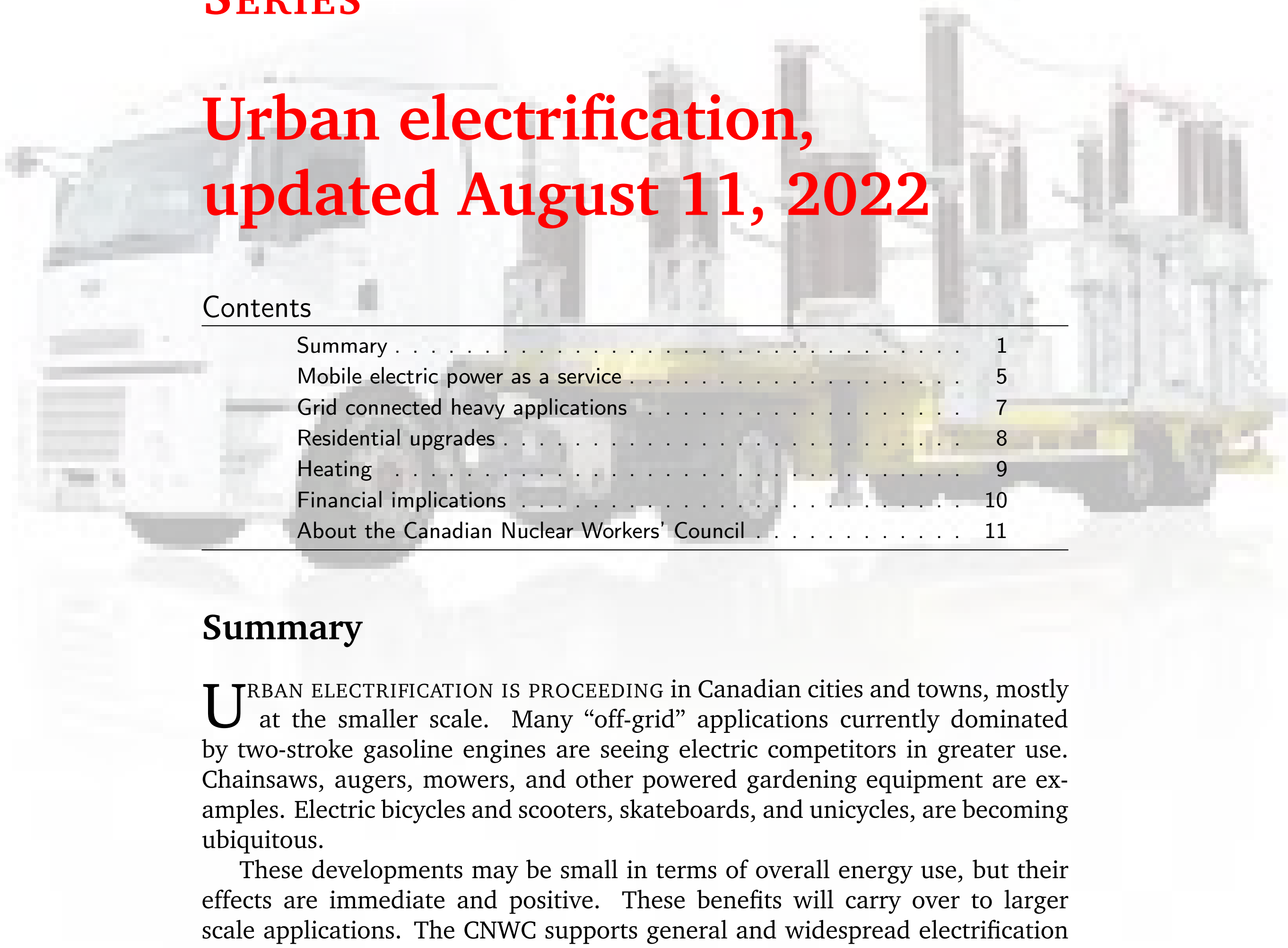
CNWC Electrification Policy Series



Urban electrification, updated August 11, 2022

Contents

Summary

Urban electrification is proceeding in Canadian cities and towns, mostly at the smaller scale. Many "off-grid" applications currently dominated by two-stroke gasoline engines are seeing electric competitors in greater use. Chainsaws, augers, mowers, and other powered gardening equipment are examples. Electric bicycles and scooters, skateboards, and unicycles, are becoming ubiquitous.

These developments may be small in terms of overall energy use, but their effects are immediate and positive. These benefits will carry over to larger scale applications. The CNWC supports general and widespread electrification of fossil-fuelled applications, and recommends governments continue to underpin this development.

However, we are at a critical juncture. Larger-scale applications—EVs mostly, with demands that exceed most residential households' current peak demand—are also seeing significant uptake. There is growing interest in stationary applications based on EV-scale batteries. Applications in the range of 100+ kilowatts have the potential to disrupt utility capital planning. This applies mainly to fleets of commercial electric vehicles, directly connected or battery. This category is growing.

Meanwhile, there is considerable potential for "on-grid" expansion: applications, such as domestic hot water (DHW), which today are already electrified to some extent but could easily see expanded electrification. CNWC analysis suggests that baseload demand for residential and commercial DHW in Toronto alone could approach 1,500 megawatts.[1] Meeting this baseload energy demand with non-emitting electricity generation would solve the shoulder-season curtailment of Bruce-size nuclear units, and some hydro units. This would increase grid stability while reducing system costs and emissions.

It is important to note that DHW, while important, pales in magnitude to the energy involved in space heating. This is an energy use category that is currently served, in most Canadian provinces, with natural gas. Electrifying this category would require substantial amounts of new energy. DHW in Toronto alone, at 1,500 MW, would require a large power station.

Electrification, in short, requires substantial new generation, which must be non-emitting, reliable, and affordable. Electrification also carries significant new grid management pressures. Grid authorities are only beginning to address these.

Air and noise pollution, from electricity's competitors in the above applications, adversely impact human physical and psychological health, and diminish quality of life. Today's high petroleum prices add a troubling element of economic uncertainty to electricity's competitors.

For these reasons, the CNWC supports electrifying all equipment that can reasonably be electrified, in all residential, commercial, and industrial applications.

For distribution grids to meet the challenges of these major new energy duties will require significant planning.[2] Upgrading is already occurring with the uptake of battery-electric vehicles (BEVs), albeit very slowly. CNWC believes that upgrades will be very significant, and that integrated planning must begin as soon as possible.

Only reliable zero emitting generation can enable decarbonization by electrification Along with new and upgraded distribution infrastructure, meeting the increase in demand will also require new generation. This adds great urgency to planning in this area, all across Canada, including and especially the "fossil provinces" (Alberta, Saskatchewan, Nova Scotia, New Brunswick, and, after 2024, Ontario). In spite of governmental admonitions about the climate change crisis requiring immediate action, no government in the country at present plans to meet new electrical demand with nuclear supply.

1 See "CNWC Statement for COP26: Exploring Climate Actions," at https://cnwc-cctn.ca/cnwc-statement-for-cop26-exploring-climate-actions/

2 See "Overview of electric energy distribution networks expansion planning", *IEEE Access*, 12 February 2020, https://ieeexplore.ieee.org/document/8995556

This is a serious disconnect, and CNWC strongly recommends it be immediately redressed. No significant electrification of the items above, much less transport, can occur without significant investment in new nuclear generation.[3]

This disconnect is due at least in part to the false belief among policymakers and the general public that the costs of non-nuclear zero emitting generation types are falling. Widely-repeated claims to this effect fill the airwaves and social media. However, those making such claims fail to account for the cost of the generation that performs the grid-balancing role that variable renewable energy (VRE, i.e. wind and solar) generation necessitates. Electricity costs have risen in all grids with significant VRE additions.[4]

Removing the barriers to price parity between fossil-fired and zero-emitting energy High electricity prices make it impossible to properly incentivize voluntary consumer transition from fossil fuel to electricity in the case of major energy source categories like heating. The current approach to this problem is to tax CO_2 emissions. However, given that it would require a tax of more than $800 per ton to bring the cost of heating with natural gas into parity with that of heating with electricity at the current Ontario household retail price, the CNWC feels that a much better approach is to reform electricity pricing so that the price to end users more accurately reflects the cost of the dominant supply.[5]

[3] In spite of the fact that demand for space heating is greatest at nighttime, much mainstream discussion on the future grid emphasizes solar photovoltaic as a central player in future supply. Solar PV produces no power at nighttime, and its mode output value is zero, meaning that most of the time it produces no electricity.

[4] The US Bureau of Labor Statistics reports that the cost of electricity in major cities in the US state of Texas was in the range of 13 to 14 US cents per kilowatt-hour in April and May 2021. Those prices are about 6 cents cheaper than in New York. This data, combined with the fact that Texas has by far the most installed wind energy capacity in the US and much more than New York, may appear to rebut the claim that VRE raises prices. However, it must be noted that the eleven-figure economic losses due to blackouts during Winter Storm Uri represent the *ex post facto* cost of VRE in Texas. Because VRE cannot power a grid on its own, grid authorities must ensure that “balancing” sources are always available to provide necessary voltage, frequency, and of course active power. These sources are critical, and unlike VRE they *can* power the grid on their own. They are currently capacitized so as to be able to “stand in” for VRE when the latter is not available, yet under market rules must “stand aside” when it is available. This imposes a cost on the former. If that cost is not acknowledged and compensated for, ultimately through rates, then critical components of system reliability may be compromised. These components certainly were compromised in Texas during Uri. This was due to federal and state mandates and incentives for VRE that not only prioritized massive investment into VRE at the expense of its predominantly gas-fired system symbionts, but also enabled it to underbid the same system symbionts during actual grid market operations. To repeat, VRE’s symbionts are essential for proper grid functioning; VRE itself is not. The cost of the resulting blackouts is therefore properly attributed to directing billions of dollars of investment into VRE. VRE at best is non-essential to system integrity. At worst, it is detrimental.

[5] Current Ontario electricity household prices reflect both the system costs—transmission/distribution corridors and connections—associated with the significant amounts of VRE added to the provincial electricity system since 2010 and shifting the bulk of the month-by-month user payments for VRE generation from large users to households. The latter payments include “make whole” arrangements or other remuneration mechanisms that cover

The latter will require a change in the predominant ethos around electricity, an ethos best summarized in the slogan "conservation first." While conservation is always a good policy, too often it focuses exclusively on electricity while ignoring transport and heating, which are predominantly fossil fueled. In fact, electrification of transport is the most spectacular example of the environmental benefit of conservation: electric transport uses far less energy than fossil transport. If the electricity is clean, then the environmental benefit is further amplified.

For this reason, the new slogan should be "live better electrically," since electricity will become the main energy source anyway and it perfectly incorporates conservation.[6]

Most important, it is recommended that all Canadian jurisdictions seeking to decarbonize energy by electrifying fossil-fueled equipment (which absolutely requires zero emitting electricity), make use of proven economies of scale and decarbonize electricity on the basis of low-cost bulk generation in nuclear reactors. Nuclear decarbonized Ontario electricity in a 20-year period in 1970–1990, with high reliability and low cost, and it can do the same wherever else it is given the chance.

the curtailment costs incurred by both VRE and the non-VRE generators that must "stand aside" during periods of high VRE output and low demand.

[6] "Live better electrically" was coined by General Electric in the 1950s, and repurposed by Ontario Hydro in the late 1970s. It fell out of favour in the late-1980s–early 1990s.

Mobile electric power as a service

Direct from grid

The most widespread use of urban off grid power is construction. Often major construction sites using diesel generators are literally meters away from the local distribution grid wires. In almost all applications, grid electricity would be a cheaper option than diesel-generated. In all instances it would be cleaner and quieter, and its use would thereby be far better for the health and safety of workers, passers by, and nearby residents.

Decisions to electrify construction sites with diesel instead of a grid connection are often due to real or perceived bureaucratic issues related to the necessary interfaces between construction planners, municipal permitting authorities, and utilities. The issue is time-to-permit. For municipalities, and construction contractors, to see the benefits of direct-from-grid site power, this red tape must be minimized. CNWC recommends striking a task force with a mandate to reduce time-to-permit without compromising safety. Together with municipal campaigns to sell contractors on the value of living better electrically, more construction sites would use grid power.

The CNWC recommends that local utilities more proactively market site power to developers. Federal, provincial, and municipal government support for this should be made explicit. In the case of municipalities seeking to decarbonize, bylaws that explicitly encourage grid-based (or discourage fossil-fired) site power should be promulgated, with federal and provincial encouragement.

Mobile transformers and substations In some cases, the size, location, and expected energy use of a site warrants higher voltage service. With general electrification, this could become more common. Mobile transformers and even substations could enable electrification of the largest, most complex and energy intensive construction operations.

As electrification of currently fossil-powered applications expands and society's dependence on electricity increases, more utilities will require mobile transformers/substations not only to handle demand for temporary grid power in bulk for construction sites but also to handle the increased demand to upgrade and maintain existing substations, and other planned and unplanned outages, and emergency restoration. The City of Ottawa has in the past five years seen two major storm related outages directly affecting transmission infrastructure. The CNWC recommends the above-mentioned task force study the advantages of making available large mobile transformers and substations.

From battery

The sudden proliferation of heavier battery-electric applications, chiefly commercial trucks and transit buses, presents an opportunity for equally rapid inward grid expansion. Private firms have already emerged offering to electrify specialized power-intensive applications, such as outdoor film industry sets, using battery-electric mobile power[7].

It is conceivable that such services could become widespread, and quickly. This would increase urban electrical demand, likely substantially. Major urban charge centres requiring ten- to hundred-megawatt scale charge capacity would necessitate increasing the number and capacity of distribution transformers and substations.[8]

CNWC believes the public would support rapid uptake of clean quiet urban power if they were presented with interesting and memorable examples. Toward this end, CNWC recommends visible public-facing pilot projects. The Toronto film industry would be a natural candidate for an MBS UPS or something similar.[9]

As mentioned above, the infrastructure implications of this dovetail with those of electric transport. Integrated planning that takes this into account is necessary. Specialist engineering firms estimate that medium-capacity charge stations would require transformers in the 5 to 15 kV range. This may significantly underestimate real demand.

[7] See e.g. the so-called Urban Power Source (UPS) developed by Vancouver-based lighting and grip equipment supplier Sim International, recently transferred to MBS Equipment Company. The UPS is a 225-kWh truck mounted battery pack designed for outdoor movie sets; https://125bbw2tod1m1t79e53b6kxq-wpengine.netdna-ssl.com/wp-content/uploads/2021/05/TheMBSE-Canada-UPS.pdf

[8] The Ontario city of Brampton in early 2021 deployed an innovative pantograph-based charging system for battery-electric city buses that charges at 450 kilowatts (see https://www.ebmag.com/interoperable-battery-electric-buses-brampton-now-has-the-worlds-largest-fleet/). This is another example of battery-based energy that could apply as much to stationary power as to transport.

[9] Such applications are typically "Bullfrog powered," complete with the usual claims about "100 percent renewable power." In light of Bullfrog's years of success in putting the "100 percent RE" stamp on its clients' events and facilities, it may seem a tall order to persuade a prospective client who is anxious to present a progressive climate-friendly face to proclaim that the clean power running the event is nuclear and not RE. Such a move would inevitably attract protesters from green NGOs trotting out the usual antinuclear hobbyhorses. Nonetheless, if these shenanigans were effectively countered, then a a public-facing campaign promoting viable, provably clean power could be a spectacular showcase for urban electrification. Other venue opportunities could include fairgrounds, outdoor events such as the GWN Dragonboat Festival at Marilyn Bell Park every September (which in previous years has been gasoline powered), and of course any and all events that Bullfrog is currently involved with.

Grid connected heavy applications

ELECTRIFYING HEAVY INDUSTRIAL APPLICATIONS that are currently fossil powered would continue a trend that has existed in Canada since the interwar period. Aluminum and nickel smelting have long been heavily electrified. The CNWC welcomed the recent announcement that Dofasco will deploy electric arc technology at its Hamilton steel operation.

Institutions Other applications include fossil powered large institutions such as hospitals and universities. One major complex, the Ottawa Hospital General Campus, has since mid-2013 drastically reduced its use of a 70 megawatt gas-fired generation plant.[10] As with all fossil-powered urban applications, noise during operation is very significant. While the reported emissions from this facility have declined significantly since 2013, the emissions rate of CO_2 alone has tripled.[11]

An adequately supplied grid is easily capable of completely electrifying such operations. The benefits, in terms of noise and air quality, would be immediate. The CNWC believes that these kinds of locations constitute “low hanging fruit” when it comes to electrification, and that the policy objective of local, provincial, and national governments should be to work with the ICI sector to ensure that facilities are supplied with grid electricity. CNWC is pleased to see transmission upgrades planned and recently completed by Hydro One and local distribution companies, and hopes this work continues.

At present, the Ottawa Hospital gas turbine provides valuable voltage support and energy inside the Hydro Ottawa service territory. Should that facility transition to grid-supplied electric DHW, such ancillary services would expand to include energy storage and fast-frequency response, while serving the larger decarbonization goal.

Shore power CNWC applauds the Canadian federal government’s Shore Power program, as electrification of currently diesel powered shore power immediately reduces local air pollution emissions. The Council would like to see efforts to reduce the emissions rate of the grids that provide the power. In most of the currently funded federal shore power projects, the grids are already clean. However, in the case of Nova Scotia, emissions reduced at the port will increase at the fossil-fired power plants that provide most of that province’s electricity.

As will all electrification, there is no substitute for zero-emission baseload power. In provinces that have tapped out available hydro, the only alternative is nuclear.

[10] This campus of the Ottawa Hospital is located directly adjacent to the 115-kV transmission corridor connecting the Riverdale transformer station.

[11] This facility may see greater use when the Pickering nuclear station goes out of service after 2025. If it resumes pre-2014 output levels, which is conceivable, CO_2 emissions will increase nearly tenfold.

Residential upgrades

An immediate implication of the expected high uptake of battery-electric personal vehicles is that residential electrical service will be generally increased to at least 200 amps.

This could enable very rapid full electrification of household energy, including heating, hot water, and cooking.[12] The latter two alone represent average minimum power demand in August—the month of lowest heating demand—of about 8,000 megawatts just in Ontario.[13] Serving such a demand would consume all the output of a Bruce size nuclear plant, plus 4 Pickering size reactors.

While most new residential homes in Canada have 200 amp service, the overwhelming bulk of existing homes do not. For them to achieve fully electric energy, they would have to be upgraded. Affordable electricity is key to making that an attractive prospect for homeowners. The energy cost of electricity cannot be much higher than that of electricity's main competitor, natural gas.

Current (July 2022) gasoline prices in Ontario have made electricity as a personal motor vehicle transport "fuel" more affordable by comparison. Should these prices persist at the level that existed immediately prior to the Russian invasion of Ukraine—a level which was unprecedented in the past 10 years—it is reasonable to expect there will be significant consumer interest in EVs, and therefore in upgrading residential service to be able to accommodate level 2 charging. This applies all the more in Canadian provinces with electricity prices lower than Ontario.

Two hundred amp residential service allows portable electric heaters rated at 4 kilowatts and above. It also allows electric barbecues and other cooking appliances. It is plausible that consumers would utilize appliances of this wattage if they were physically able to. Local utilities would soon be hard pressed to handle this level of demand. The CNWC urges all electricity authorities to consider this demand growth scenario.

[12] The province of Quebec leads the North American continent in residential electrification. Most Quebec homes heat with electricity, and the existing service at most homes makes adding at least a level 2 EV charger easily viable.

[13] This is based on sales of natural gas, reported by Statistics Canada.

Heating

SPACE AND WATER HEATING represent a major use category for fossil fuels, mostly natural gas. On cold days in Canada, heating represents the single largest energy demand category, often outstripping road transport. Electrifying heat is easily possible, using existing commercially available technology. Most residential heating in Quebec is with plain old electric baseboard heaters. Quebec today actively encourages heat-pump uptake, and that is something CNWC supports across the country and especially Ontario.

The national "heating market" is ripe for heat pump–based electrification, and heat pumps should be standard for space heating in all new homes. Because in winter a DHW heat pump would simply add load to the space heating system, DHW electrification in existing homes should be based on resistance. This carries energy conservation and grid stability benefits, in addition to the potential of total GHG elimination from a single use category, depending on the CIPK of the electrical grid in question. The CNWC supports government incentives, in the form of rebates or waived carbon tax, for heat pumps.

The source of electricity is critical. Because Quebec electricity is virtually zero-emitting, heating in that province is exceptionally clean. Heating can only be clean if it is electric. Electricity can only be clean if it is hydro or nuclear, and all Canadian provinces already utilize economically available hydro. This leaves nuclear as the only viable option for decarbonizing heat.

With the right incentives, commercial buildings could also become good candidates for electric heat. An office complex with say 40 MW of gas-fired boiler capacity converted to electric on a grid with an Ontario-level CIPK (50 grams per kWh) would emit 500 tons less CO_2 over 24 hours at full power compared with gas. An electric load this size could provide fast frequency response, a grid ancillary service that may be required more in a system in which electric heating is prominent, and could even provide "embedded" ancillary services to mitigate the effects of residential resistance heating.

Large scale heat pumps are another promising approach to electrifying heat, in residential and commercial applications.[14] Given the potential for decarbonizing through electrification of Canada's largest GHG-emitting energy use category, the CNWC recommends that all levels of government actively encourage all greenfield and brownfield redevelopment multi-unit residential developments to pursue, wherever possible, heat pumps for space and DHW heating.

The CNWC also supports measures currently underway at the Cliff heating plant that serves federal buildings in the Ottawa Parliamentary Precinct. CNWC is pleased to see the federal government revisit the Sacré Cœur heating plant electrification, which was abandoned in the 1990s. The CNWC hopes the federal department of Public Works will publish a well-promoted before–after report on these projects, showing reduced energy costs, and factoring in the carbon tax.

[14] The Beaver Barracks residential geothermal system in Ottawa is an excellent example of the use of central and individual heat pumps for a large residential complex. See https://www.canadianconsultingengineer.com/features/beaver-barracks-geoexchange/

Financial implications

FULL URBAN ELECTRIFICATION WOULD EXPAND the importance of municipal electric utilities. Their duties would increase to include those of filling stations and gas utilities. Their capital additions would greatly increase, but so would revenue. Mobile power as a service, described above beginning page 5, would account for a significant portion of both capital additions and revenues.

It must be stressed again that municipal governments would experience significant increase in demand for services. Their duties would now include those currrently performed by fuel retailers and gas utilities. All energy the latter provide today would come from generating plants via the transmission system and then through the distribution grid.

Of course, the revenue to pay for the energy would come from ratepayers. But it is unlikely this transition would occur as the result of mandates. It could only occur if current consumers of combustible fuel found an economic benefit in electrification—that is, if electricity were priced so that it were less expensive to use it than its combustible alternatives.

In this area, governments have great latitude, much more so than they do with combustible fuels. Economies of scale were the basis for the electrification that occurred in the mid Twentieth Century, in practically all jurisdictions that electrified. Government policy at the Canadian federal level therefore should focus on enabling capital acquisition at the provincial generation fleet level, to guarantee a reliable and abundant supply of low cost bulk power to effect the electrification of combustible fueled equipment. Acquisition of transmission and distribution equipment should be similarly enabled.

The CNWC recommends establishing a standard for measuring the ability of financed equipment to meet the twin goals of providing reliable clean power in bulk and at a cost to the end user that represents a viable alternative to combustible fuel. The "clean" portion of the standard should aim for zero emissions. The "affordable" portion should aim for at least parity with current per-kilowatt-hour prices of combustible fuels in the targeted applications (transport and heating).

CANADIAN
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About the Canadian Nuclear Workers' Council

"The collective voice of organized labour in the nuclear industries"

The CNWC has been the collective voice of Unionized Workers across Canada's Nuclear Industry for more than 27 years. Our Member Unions represent Workers in uranium mines and mills, nuclear fuel fabrication, nuclear power plant (NPP) operation and maintenance, NPP construction and refurbishment, medical isotope production, nuclear research and development, nuclear waste management and decommissioning.

The CNWC believes that nuclear power is a proven, reliable and non-GHG emitting source of electricity that will continue to support our clean energy future.

All CNWC policy positions can be found at https://cnwc-cctn.ca/policy-positions/.

Bob Walker,

National Director

Content in this document was prepared for CNWC by S.E. Aplin.

Appendix A

Forecasting

Heating and electricity

This study on electric heating in France shows the impact of electric heating on winter demand. Demand spikes in winter, showing sharper daily rises/falls, and this is in a jurisdiction with nothing like the winter that happens in Ontario. Ontario winter heating demand makes the fuel that meets most of it—natural gas—the province's biggest energy provider by far, in annual terms. Below –2°C, each 1°C decrease in temperature in Toronto adds roughly 250 MW of space heating demand. As you can see from fig 2, Toronto temperature correlates strongly with overall demand for Ontario. In an electric heat scenario, those roughly 250 MW per one-degree temperature decrease in Toronto are now part of Ontario electrical demand. The boomerang-shaped scatter in fig would tilt down and to the right—i.e., much higher cold-temperature provincial demand, and Ontario is now a winter peak jurisdiction (as is every jurisdiction that pursues this strategy).

The load curve changes shape, in some cases drastically. Fig **??**, showing an Ontario week with fairly steady outside temperatures and little variation between highs and lows, simply pushes the electricity-plus-heat curve upward, by roughly 15,000 MW. It is easy to see this additional demand will not be met with wind and solar, even if a future government decides to expand combined wind/solar capacity fivefold.

The IESO will have to become proficient in dealing with this kind of shape in an "electrify everything" scenario.

But that proficiency can be developed over time. In the immediate near term, hot water heating—a component of baseload demand—can be electrified in Ontario without drastically affecting today's load shapes.

Meanwhile, how does nuclear-heavy France handle the large and fast load swings related to space heating? Simply by accepting lower fleet capacity factors than the U.S. and Canadian nuclear operators, whose duties today consist almost solely of steady baseload supply. The French approach allows load to be spread more evenly across the fleet, with individual plant output increases/decreases well within plant ramping range. In lieu of the adoption of fast-ramping nuclear plants (which necessitates using high enriched uranium fuel, a non-starter in today's policy environment), this is likely Canada's future when it comes to electric heating.

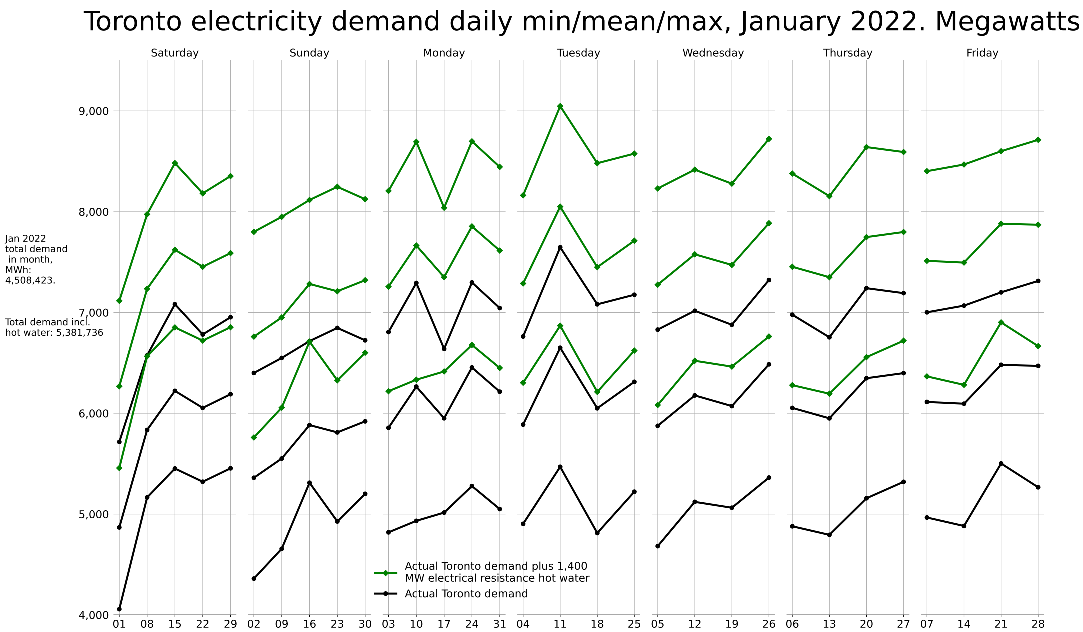

Figure 1: Data sources: IESO "Hourly Zonal Demand Report"; SE Aplin EmissionTrak™"Residential/commercial hot water demand, Ontario."

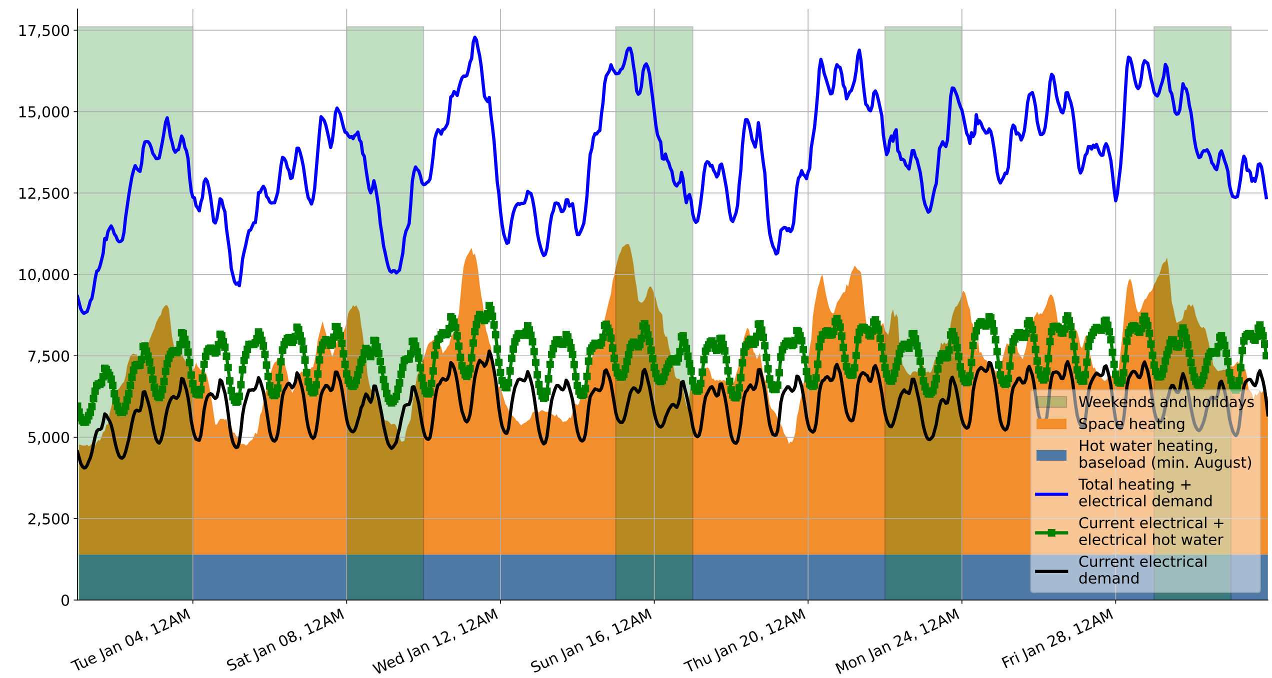

Figure 2: Toronto heat and power demand, January 2022. Heating demand (orange area) is a function of outdoor temperature and wind, and is on a different cycle than electrical demand. Data sources: Environment and Climate Change Canada "Hourly Data Report for January 2022"; IESO "Hourly Zonal Demand Report"; Statistics Canada "Census Profile, 2016 Census, Ontario"; SE Aplin EmissionTrak™"Residential space heating demand, Ontario."

Appendix B

Regulatory and financing

Marketing, promotion, and advocacy

PUBLIC APPRECIATION OF THE BENEFITS OF ELECTRIFICATION could be fostered with small scale but spectacular public-facing efforts

1. A concerted public effort to show the benefits of electrification.
2. Targeted lobbying to standardize residential electrical service to 200 amps minimum.
3. Targeted lobbying to establish heat pump requirements for large greenfield and redeveloped brownfield residential developments.
4. Electrification project CO_2 disclosure and reporting

Demonstrate benefits of electrification to public Public-facing demonstrations of newly electrified applications will, if well conceived and executed, help to foster a favourable attitude toward this general course of action in the public mind. The best examples are those that involve situations many members of the public encounter every day. Construction site power is one of the most common. Other examples include recreational areas inside city limits. Still others could involve heavier but no less common applications like garbage trucks.

Standardize 200-amp residential electrical service, and heat pumps for large residential developments Numerous recent projects in North America have shown it is possible to electrify residential space and DHW heating at small and large scale. Numerous North American municipalities have called or are calling to phase out the use of natural gas as a heating fuel; this leaves only electricity as a viable replacement energy. While it is generally understood that meeting all this demand with electrical resistance is impractical and that heat pumps ought to provide the bulk of the replacement energy, there will still be a major role for electrical resistance.

Electrification project CO_2 disclosure and reporting Dislclosing CO_2 and other emissions is a sensitive topic for organizations that are heavy Scope 1 emitters. However, the large CIPK variances among electricity grids—which all make, transport, and distribute the exact same product—raise disclosure issues that appear to have been unflagged in the documentation surrounding the extensive consultations on climate disclosure guidelines.

Electric utilities with significant zero-emitting generation output have a unique position in the determination of Scope 1, 2, and 3 emissions. Those that would be Scope 1 emitters if not for hydro and/or nuclear should be permitted to claim avoided emissions. Their sales of electricity to users would, if the electricity generation entailed combustion, result in Scope 2 emission disclosures on the part of those users.

Utilities' Scope 3 emissions overlap with Scope 2, in the category "Use of sold products."[1] An electric utility that sells power to a residential high-rise for the purpose of producing domestic hot water (DHW) may, if it generates with combustible fuel, be obliged to declare Scope 1 and Scope 3 emissions. Its customer would have to declare the emissions from electricity purchases as Scope 2. For electric utilities with a low enterprise CIPK (CO_2 intensity per kilowatt hour, or emission rate), reporting Scope 3 emissions *avoidance* could open the door to more meaningful disclosures, and a cross-sector integrated approach to economy-wide GHG reductions. Enterprise generation CIPK should be a Scope 3 metric for such utilities. Disclosures could then include a metric that relates Enterprise Total Generating Cost [2] (ETGC) per kWh with CIPK: CIPK grams per ETGC cents. The former would be a measure of the risk of a carbon tax to ETGC, hence to enterprise revenue. Comparing carbon tax exposure risk per unit of generation cost across utilities would give investors a fuller picture of carbon risk. Figure 3 shows that risk with ETGCs ranging 4–6 cents.

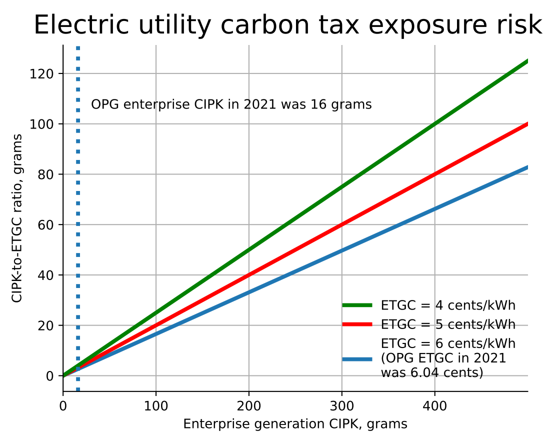

Figure 3: *Multiply C-tax rate per gram by CIPK-ETGC ratio to determine C-tax impact on ETGC. OPG data from OPG MD&A, Dec 2021.*

Such a disclosure would be invaluable for prospective PPA partners and utility investors, allowing them to make more informed choices about electrification. These distinctions were absent in the Canadian Securities Administrators

[1] see Yale University's description of Scope 3 categories at https://sustainability.yale.edu/priorities-progress/climate-action/greenhouse-gas-emissions/scope-3-emissions

[2] Enterprise Total Generating Cost (ETGC) is a non-GAAP metric used by Ontario Power Gneration. It is defined in OPG's "MD&A for the year ended December 31, 2021," p. 92.

Consultations on Climate Related Disclosure, despite electrification being a well-understood pathway to decarbonization.

Electrification as a general solution to climate change is currently downplayed. This must reverse. The notion that the electricity system must at all costs avoid meeting the demand swings inherent in, for example, space heating, has simply preserved natural gas incumbency in meeting overall energy demand. The IESO still considers only electricity to be "energy" and appears unwilling to consider heat to be energy. System planners appear reluctant to consider meeting even the flat (DHW) portion of that demand with electricity in spite of the fact that electrifying gas-fired DHW would result in an overall energy saving at end use. Beyond heat pumps—which could despite limitations below 15°C significantly change the heating market in Ontario—IESO sees little further potential for electrification of heating. CNWC recommends electrical planning authorities take a holistic approach that looks at the entire energy picture—electricity, transport, and heating—to better understand the potential for electrification.