BRIEF ON POTENTIAL CONSEQUENCES OF DECARBONIZING ELECTRICITY IN ONTARIO

Introduction

The City of Ottawa and some other municipalities in Ontario have endorsed the goal of attaining "Net-zero" greenhouse gas emissions from electricity generation by 2035. The goal is ill-conceived. This brief will explain why the implementation of measures to "decarbonize" Ottawa's and Ontario's electricity systems are unwarranted.

Global and National Contexts

First, some basic facts. Global GHG emissions from energy use were about 35 billion tonnes per year in 2022. Canada's emissions in that year were about 525 million tonnes, or 1.5% of the global total. Ottawa's GHG emissions were about six million tonnes, or about 1% of Canada's emissions. Global consumption of fossil fuels, including coal, oil and natural gas account for about 81% of global emissions and have risen every year since 1990 except for the years of the global financial crisis and the global pandemic. Global uses of coal, oil and natural gas are now at their highest levels in history and continue to increase every year. (source: Statistical Review of World Energy, 2024)

Electricity generation in Ontario is primarily from nuclear and hydro-electric sources. Those, plus industrial wind turbines, solar plants and biomass-based generation are such that 94% of the generation is GHG emissions-free. Generation by natural gas-fired plants accounts for six percent of electricity generation emissions and only 3% of Ontario's GHG emissions.

Why is there such a focus on eliminating that last 3%? It has nothing to do with the effect of emissions on global temperatures or weather. According to an analysis by the Fraser Institute, if all the of the measures now being pursued by the federal government in its plan for 2030 were implemented, and were not offset by increased emissions by other countries, the result would be a reduction in global temperatures of 0.007 degrees C by 2100. That is seven thousandths of a degree, and it would be the effect of Canada's total measures. The effects of what Ottawa would or could do is too small to measure. One does not pursue goals like this because they offer measurable benefits; one does so for symbolic or ideological reasons alone.

IESO's Assessment

The Independent Electricity Systems Operator (IESO) has already provided to the government of Ontario two reports that should have indicated very clearly the problems associated with pursuit of the "net-zero emissions" or "decarbonization" objective. In the *Decarbonization and Ontario's Electricity System* report of October 2021 and the *Pathways to Decarbonization* report of December, 2022, IESO set out its professional assessment of the costs and risks associated with decarbonization by 2050. The following, in our view, are some of the most compelling observations in those reports:

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- Natural gas generation plays a crucial role in the reliability of the electricity grid. It provides a range of services that no other resource today can provide on its own, including producing large amounts of power to meet high demand and running for extended periods when other resources are not available.
- Phasing out natural gas generation by 2030 would entail a capital investment of more than $27 billion and bring the cost of carbon reduction in the electricity industry to at least $464 per tonne (far above any reasonable estimate of the “social cost of carbon”).
- A “Pathways scenario” to decarbonization by 2050 projects a system designed to meet winter peaks that are almost three times higher than those we experience today, and thus require an additional 69,000 MW of “non-emitting” supply and 5,000 MW in demand reduction from conservation. (Comment: “Conservation” is sometime a euphemism for demand destruction, the process whereby consumers are forced by higher prices to reduce their use.)
- The scenario includes an additional 17,800 MW of nuclear supply, and additional 17,600 MW of wind and 650 MW of new hydroelectric, plus an additional 2,000 MW of long-duration storage added in the late 2030s.
- The cost of building out the bulk 500 kV and 230 kV transmission systems to meet the Pathways scenario is estimated to be between $20 billion and $50 billion. This construction will pose “substantial” siting challenges. (Comment: This is the understatement of the century.)
- The bulk system expansion needed to enable decarbonization, including transmission, in this scenario would require an investment in the range of $375 billion to $425 billion.

The IESO reports did not include an estimate of the rate impact on electricity consumers, which was buried in an appendix.

<u>Costs of “Unreliables” i.e., Industrial Wind Turbines and Solar Generation</u>

The costs of decarbonizing Ontario’s electrical energy system arise both from the higher cost of generation by wind and solar energy and from the requirement, at high levels of dependence on intermittent sources of generation, to substitute grid-scale battery storage (“BESS” systems) for cheaper natural gas fired backup.

The real costs of wind generation are hidden due to the extensive subsidies provided by federal and provincial governments to the wind industry. The subsidies, or market advantages, provided by governments in Canada and elsewhere fall into several different categories: funding of research and development, conducted either in government research facilities or in private research laboratories; funding for technology demonstration projects; grants, contributions and low-interest loans made either to suppliers or purchasers; preferential procurement practices; tax incentives such as credits, deductions, and exemptions that are not provided to other firms and allowing firms to pass these benefits on to outside investors in the form of flow-through shares; preferences granted through regulation; preferential, above-market utility rates, as used in “feed-in-tariffs” regimes, often guaranteed at fixed rates for the life of the contract; and restrictions on local government ability to impose property and other taxes on solar and wind project sites These and other incentives create multiple, often-duplicative, subsidy possibilities. Societal costs are further increased when governments fund these subsidies by borrowing, thus increasing the interest costs imposed on future taxpayers. The costs of the subsidies are rarely reported or accounted for publicly when the costs of wind turbines are discussed.

The expected service lives of wind turbines are a third to a half of the service lives of fossil-fueled generators, resulting in depreciation expenses that are two to three times higher.

Transmission costs are higher than for conventional electricity generators. A nuclear plant or a coal or natural gas-fired plant typically will have one transmission line and the distance from the generation plant to the population centre served will be relatively short. A rough equivalent of wind energy will have many transmission lines and will be located at a considerable distance from the population centres served. The transmission cost difference can be substantial, but none of it is attributed to the cause – wind energy.

The situation for the electricity consumers is also worsened when, due to limits on the ability of conventional generators to reduce generation, wind turbine output is too high, forcing the IESO to market the surplus in export markets in the United States at a significant loss. The losses are then passed on to Ontario electricity consumers in the form of higher rates. In 2024, Ontario exported 19,069,719 MWh of electricity, more than the total 13,388,307 MWh of electricity generated by wind. The difference between what Ontario paid for the wind production and what it received in export markets was almost $1.4 billion, which just got added to Ontario consumers’ bills. Wind turbines in the Ottawa valley would just add to these losses.

The wind power supply chain has high costs. These include their use of rare earth metals and minerals in construction. Some 2 to 4 thousand pounds of rare earth metals are in every turbine. The environmental and health impacts of this are staggering, even if they are being felt mostly in other countries. The largest share of the tonnage of materials in wind and solar farms is found in conventional materials like concrete, steel and glass. Compared with a natural gas plant, wind and solar require at least 10 times as many tonnes mined, moved and converted into machines to deliver the same quantity of energy. For example, building a single 100-MW wind farm requires some 30,000 tons of iron ore and 50,000 tons of concrete, as well as 900 tons of nonrecyclable plastics for the huge blades.

A non-costed but important disadvantage of increased reliance on wind turbines relates to the security consequences of increasing reliance on imports from insecure sources for the materials needed for wind turbines and batteries. The Global Wind Blade Supply Chain Update for 2020 ranks China as the largest producing country for wind turbines. China is also the leading supplier of many minerals critical to the manufacture of wind turbines: 56% of global supply of aluminum; 97% of Gallium; 63% of rare earths; 64% of silicon; 62% of Tellurium; 82% of tungsten; and 55% of vanadium.

The Need for Backup Capacity

Much higher reliance on intermittent and unreliable sources of electricity generation, especially when use of fossil fuel generation as a backup source of supply is banned, would leave Ontario dependent on the use of much higher amounts of grid-scale battery storage. If adequate backup generation or storage is not available, the result could be much increased frequency of brownouts and blackouts, and the subsequent problems for residential and commercial consumers and the loss of industry that needs reliable supply.

The storage capacity required to avoid brownouts and blackouts requires an assessment of the projected peak demand for power at all times of the year compared to the power that can be reliably assured over the period of time when the supply inadequacy might persist.

Projections of electricity demand in Ontario have been notoriously wrong, usually almost far above what has actually happened. These over-estimates of demand growth have been used to justify the over-building of capacity at great cost to consumers. It has, however, been assured that supply shortfalls would be avoided.

Lithium-ion batteries are usable for about four hours of discharge at full power and are typically used during the day and then recharged overnight. However, the intermittency patterns of wind and solar electricity generation have not only hourly and daily wings, but also a broad annual pattern of seasonal peaks and troughs. Batteries to back up such a grid must have the capability of storing energy from the windy and sunny parts of the year to be drawn down during the autumn and winter. None of the battery technologies currently available have anything like the capabilities to meet these requirements. Research on possible technologies that might have these capabilities is at the earliest stages and nobody has any real idea what, if any, technology might work or how much it might cost.

The lithium-ion batteries used in today's BESS installations thus can only provide backup for short periods of time and cannot cope with multi-day or seasonal variations in demand. Building these will not attain "net-zero", simply short-term back up.

Costs of Grid-Scale Battery Storage

The costs of battery storage are extremely high. It costs less an $1 per barrel to store oil or natural gas (in energy equivalent terms) for a couple of months. With batteries, it costs roughly $200 to store the energy equivalent to one barrel of oil. Grid-scale battery costs would have to drop at least 20-fold to match the reliability economics of conventional dispatchable power. That will take decades, if ever, to occur.

The US Government's National Renewable Energy Laboratory produces periodic reports on the present and projected costs of utility-scale lithium-ion batteries. The most recent edition, in 2021, gives the current average cost as approximately USD 350 per kWh.

In May 2024, the Ontario government issued a press release stating that it had concluded the largest battery procurement in Canadian history, which secured about 3,000 MW of new battery energy storage, enough to power three million homes! It neglected to say that this would be only for four hours.

However, if Ontario were without natural gas plants for just two days, Parker Gallant estimates, Ontario would need 60,000 MW of BESS storage capacity, which is more than 25 times what IESO has contracted for so far. Using IESO's recent agreement to contract for 2,034 MW of BESS storage at a cost of $672.34 per MW times 250 annual business days, the cost would be close to $10 billion annually or over $200 billion for 20-year contracts. Incidentally, the IESO contracts are for capacity, not energy. In other words, the owners of the storage batteries would be obligated to make the power available during certain times (7am to 11 pm during business days) to provide energy. In other words, these contracted BESS units will be paid per MW of capacity even if they dispersed NO ELECTRICITY into the grid, and they would still receive that payment of $672.32/MW based on 2050 annual business days, and Ontario electricity consumers would still have to pay it.

Just the existing contracted BESS units (2,024 MW capacity) that will be guaranteed $673.32/MW over 20-year contracts would cost Ontario ratepayers $341,884,890 annually for 20 years or $6.838 billion - for potentially delivering nothing.

Its gets worse. In two days of May, 2024, Ontario's natural gas-fired generators produced 145,394 MWH. The 145,304 MWh divided by four indicates how much BESS would have been needed to replace the natural gas-fired generators, which is 36,349 MW of capacity. Ontario would need 18 times the existing IESO-contracted BESS capacity. Should IESO decide to contract for that, the annual cost added would be $6.1 billion annually. This would increase total Ontario electricity bills by 33%, and that does not include the additional transmission costs. Over 20 years, the costs would amount to $123 billion – again, just to cover the potential loss of two days of current natural gas-fired generation!

Once those BESS units had disbursed their four hours of storage, how would we recharge them if the doldrums lasted more than two days? The answer is probably rolling blackouts, which would be bad news for this with all-electric vehicles or house heated by heat pumps.

Blackout Risks

The North American Electric Reliability Corporation (NERC) is a not-for-profit international regulatory authority whose mission is to assure the effective and efficient reduction of risks to the reliability and security of the grid. NERC develops and enforces Reliability Standards; annually assesses seasonal and long-term reliability; monitors the bulk power system through system awareness; and educates, trains, and certifies industry personnel. NERC's area of responsibility spans the continental United States, Canada, and the northern portion of Baja California, Mexico. NERC is the Electric Reliability Organization (ERO) for North America, subject to oversight by the Federal Energy Regulatory Commission (FERC) and governmental authorities in Canada. NERC's jurisdiction includes users, owners, and operators of the bulk power system, which serves nearly 400 million people.

NERC issued its latest long-term reliability assessment in December, 2024. In that report, it assessed the threats to electricity reliability across North America. It noted that in many areas the power grid is becoming dangerously unreliable. It suggested that rolling blackouts and power shortages may become the norm due to the closure of coal-fired powered plants and natural gas-fired power plants that produce electricity when it is needed.

One can get a general idea of the risk of blackouts in Ontario from the province's experience on February 20 of 2025. The 4,900 MW of industrial wind turbines available generated only 6,826 MWh or 11.6% of their rated capacity over the first 12 hours of the day. The peak power demand over the 12 hours occurred at 9:00 am when it reached total net demand of 21,450 MW. At that point, wind turbines, solar and biomass together generated 693 MWh or only 3.2% of that hour's demand! Nuclear and hydro produced 13,361 MWh or 62.3% of that hour's total demand. Natural gas plants came to the rescue by generating 7,100 MWH or 33% of the peak period demand. Without natural gas-fired generation, there almost certainly would have been a large shortfall in electricity to meet consumers' needs.

Community Concerns

The pushback from Ontario communities against BESS plants to date has been based upon a number of concerns. These include the impact of the BESS plant operations on local farming, the environment, light and noise, decreased property values, insurance risks and associated costs, lack of physical management presence (the units in Ontario will be monitored from Gatineau), and increased electricity rates. The biggest concern however, relates to fire risk and mitigation. Many rural areas do not have fire stations that are manned on a "24/7" basis, and of the ones that do, most do not have personnel trained to deal with battery fires. Battery fires run fast and hot, with toxic by-products. The possibility of an incident may be low, but the potential impact of a fire could be catastrophic.

Conclusion

The environmental benefits of pursuing net-zero electricity policies in Ottawa, as in Ontario, are essentially nil.

The net-zero by 2050 goal is an arbitrary target set by ideology, not science or economics. Further, net-zero rests upon the rapid commercialization of many technologies that are either immature or simply not proven, such as hydrogen, carbon dioxide capture and storage, second generation biofuels, and small nuclear reactors. The continued pursuit of present policy will not only raise prices to unheard of levels but it will lead to a future of rationing, oppressive regulations and economic decline.

The costs of decarbonizing electricity at the provincial level will be at least $400 billion. The costs of building enough BESS plants to replace natural gas generators as four-hour backup supply for unreliable wind and solar plants would be many times the cost of the natural gas generations, even if the storage produces nothing at all. Barring some sort of miracle, there is no possibility that any suitable storage technology will be available, let alone at affordable cost, to provide long-term backup supply in any foreseeable time frame.

The governments of Ontario and its major municipalities should abandon the foolish goal of “decarbonizing” (i.e., completely eliminating the use of natural gas-fired generation).

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