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Comment re. Hydro Ottawa's request for distribution fee increases

The OEB should reject Hydro Ottawa's request for distribution fee increases on the grounds that their current distribution procedures are excessively expensive.

Hydro Ottawa and its subsidiary Energy Ottawa could deliver energy to its customers at a much lower price and at the same time realize a greater profit in their operations if they collected and distributed energy from local sources, using the electricity that is presently going to waste to drive the collection process. Such local sources would be capable of progressively expanding to eventually supply nearly all of the energy needed for buildings in Ottawa, utilizing sources that are presently being almost totally ignored, including the capacity to utilize the available electricity much more efficiently.

From an engineering point of view the problem is that the rate of power distribution swings widely because of large variations in both the electricity supply and demand. The consequence is that the IESO price of electricity drops essentially to zero every night (and is frequently negative) and then jumps to very high values during the day, especially during the heating and cooling seasons. If Hydro Ottawa employed exergy stores (see the appendix) then the surplus nighttime power could be used to store energy that would be recovered during the peak demand periods. Exergy stores draw most of their energy from local thermal sources: the ground, the air and the buildings' cooling systems, and they use electricity and solar heat to boost the exergy of the stored heat, providing thermal outputs of 60 degrees for heating and 4 degrees for cooling, thus obviating the need for consuming more power at the time that the energy is recovered. The amount of energy that is delivered is several times larger than the amount of electricity consumed, and even that electricity would be drawn only at night, and at a rate that would be under the direct control of Hydro Ottawa. The outcome would be a very large expansion in Hydro Ottawa's delivery capacity with no need for any expansion at all in the generation facilities. The need for peak power would be greatly reduced so most of the currently planned capital expenditures on new or refurbished generation capacity would also be eliminated.

From an economic point of view all five of the energy sources that are used by exergy stores are free or are very inexpensive but the cost of the nighttime electricity component is artificially inflated. The IESO price is a good indication of the actual value of the electricity, which is close to zero at night but by applying a tax (in the form of the "Global Adjustment") the OEB has been approving the inflation of the nighttime power to a value that makes it non-competitive with other energy sources like natural gas. If the IESO price (plus a reasonable markup) applied as the retail price then building owners would build the exergy stores themselves and both the consumers and the power producers would save many billions of dollars per year. An even simpler option would be for Hydro Ottawa or Energy Ottawa to build and operate the exergy stores themselves. Moreover, continuing the current obstructionist practice would be putting the environment in serious danger. The OEB should seriously reconsider its practices. The government's strategy of leaving the power industry as a bureaucratically controlled monopoly but breaking it up into many pieces and the OEB's practice of examining the costs and pricing on a piecemeal basis have made it nearly impossible to introduce urgently needed basic reforms.

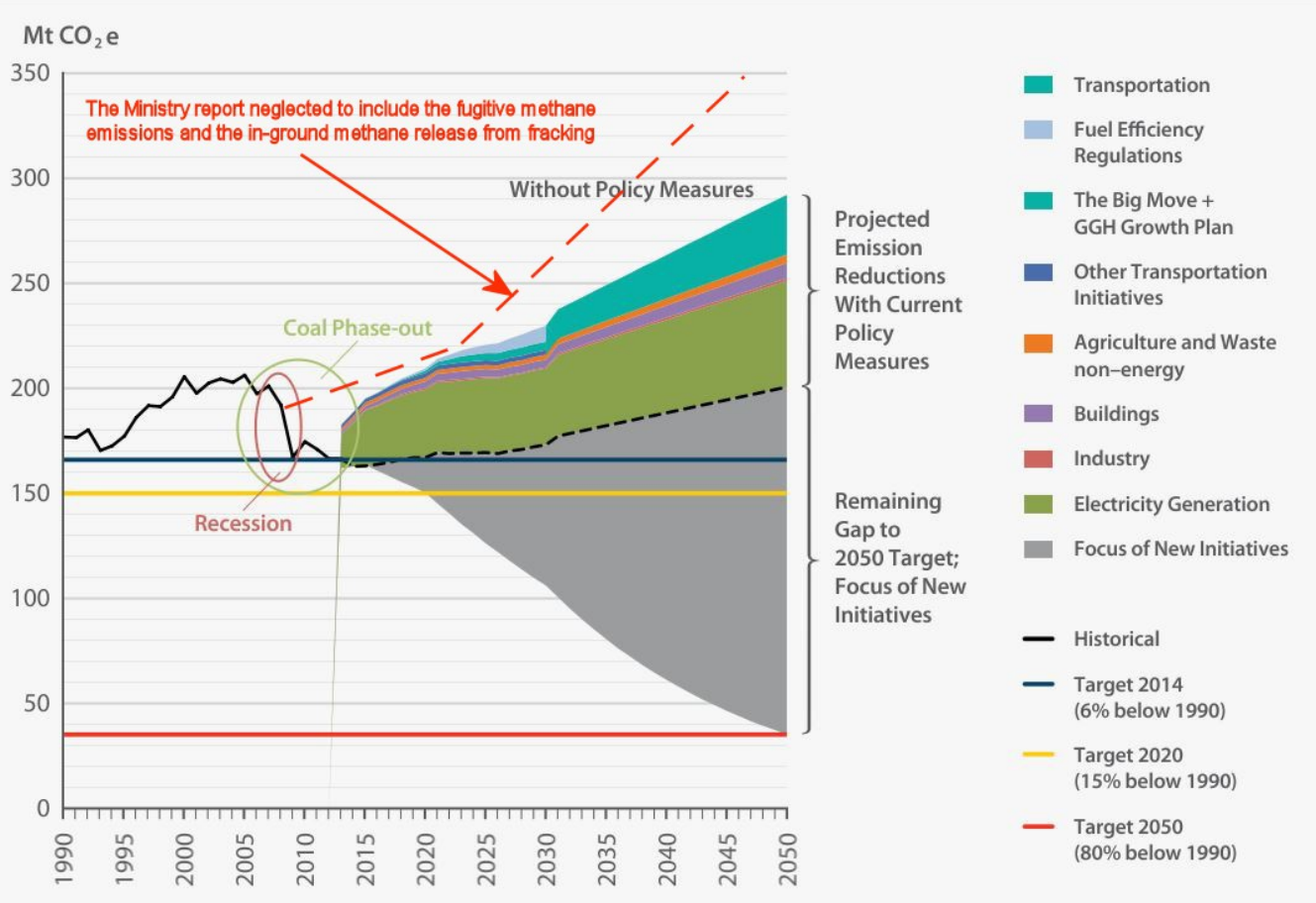
Ottawa is surrounded by hydro generation stations that operate at low power at night because of the weak demand, so the hydro energy output could be expanded by merely putting the nighttime power to good use. Ontario typically exports about 3400 MW of power at night for which it recovers little remuneration so that adds to the available nighttime power. The power stations (and also the province's wind turbines) could produce more power during peak flow periods. Hydro Quebec generates up to 35,000 MW of hydro power (including substantial amounts from the Ottawa River) that has the same problem of large diurnal and seasonal fluctuations. If you add all of these underutilized sources together they would be capable of supplying all of the cheap nighttime power that would be needed for decades to come. The overall result would be a large increase in the energy delivery with a correspondingly large reduction in the cost of the energy, coupled with a very large reduction in the future capital costs for generation and distribution facilities.

Exergy storage (explained in more detail in the appendix) stores energy in two forms: electricity and heat. Exergy stores collect heat from relatively low temperature sources – the summer air, the heat extracted from the buildings, and heat extracted from the ground. Electricity is used during the night to drive heat pumps that raise the temperature of the stored heat, concentrating the energy into a smaller volume. The purpose of the heat pumps is not to increase the energy content but rather to raise its exergy so that the stored thermal capacity can provide space heating and space cooling and domestic hot water (DHW) at the times when they are required without the need for consuming more electricity. The causes of the two major power demand peaks in Ontario are the demand for electricity for cooling in the summer and the demand for heating in the winter. Any buildings that use exergy storage will not draw any power for those applications, or for DHW, so the stores are providing very large decreases in the peak power demands, a capability that is equivalent to collecting electricity via batteries and returning it to the grid during the peak demand periods.

The exergy stores can be designed so that their outer rings are held below the ambient ground temperature throughout the year, with the result that the direction of heat flow is always into the store so there is no possibility of losing heat via the periphery (although a small amount will be lost via the top and bottom of the store). Such stores can thus hold their energy for a very long time with minimal losses and they can store both electricity (in the form of exergy) and heat from summer to winter. They can deliver both heating and cooling at high rates without consuming power and they can utilize electricity at whatever rate is convenient for the power grid.

GHG emissions

GHG emissions result in extra costs for Ontario residents. That may come in the form of "carbon taxes" or cap-and-trade regulations, or in the form of the damages that are caused by climate change, or in the form of the costs of programs designed to mitigate the consequences. Together, such costs are likely to amount to more than $50 per tonne so if the emissions rise to several hundred megatonnes per year as shown in the chart below then the OEB should take that cost ($20B/year) into account in approving all relevant rates. It should be noted that the emission projections from the Ontario Energy and Environment ministries are misleading. They do not include the upstream emissions on the questionable grounds that since Ontario imports the natural gas it should not be held accountable for those emissions. As Ontario moves to fracked gas there will be large scale delayed emissions from the shale plays caused by the build-up of uncaptured methane in the ground, a factor that is commoly ignored by the gas industry and by governments.



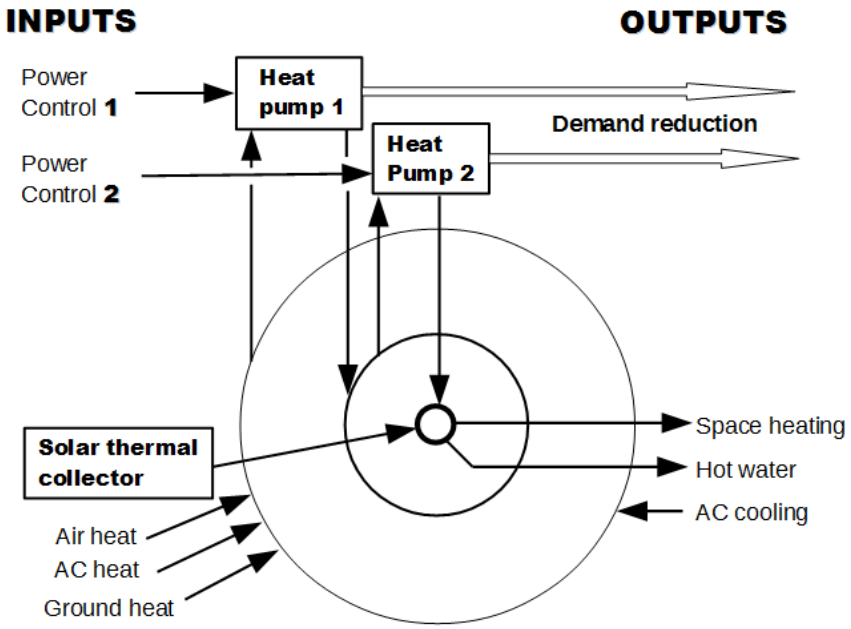
Appendix

If you follow the daily IESO reports on power generation you will observe that at night Ontario is exporting about 3400 MW of power, much of it at a loss. Moreover, while Ontario generates up to 4800 MW of hydro power during the daytime, at night that commonly drops to half as much because there is insufficient demand for the power. That brings the losses related to fluctuating demand to something like 5800 MW. There is a much larger (but hidden) loss that is the consequence of the hydro dams' inability to utilize the higher water flow in the spring or after a rainfall. We are wasting very large amounts of both energy and money by not adapting our systems to handle such demand and supply fluctuations.

Such losses could be progressively reduced and eventually eliminated if the local power distribution companies like Hydro Ottawa built what are called exergy stores. Exergy stores use surplus nighttime electricity to drive heat pumps that move heat from the periphery of the exergy store to its center. Concentrating the heat into a smaller volume raises its temperature but does not require the addition of more energy so a relatively small amount of electricity can be used to accumulate and deliver a much larger amount of thermal energy that will be raised to a useful temperature. That heat can be stored until it is needed, which in effect is storing the electricity as well. The heat that was extracted from the periphery can be replaced by ground heat, heat extracted from buildings, or heat extracted from the air, which are massive energy resources that are presently just going to waste. If the periphery is permanently maintained at a slightly lower temperature than the ambient ground temperature then heat can only flow into the store, never out of it, so such stores do not lose energy and they also provide a

heat sink for air conditioning.

Ontario has two large power demand peaks. One occurs in the summer and is caused by the demand of air conditioners and the other occurs in the winter and is caused primarily by the use of electricity for space heating. Since the exergy stores can deliver both space cooling and space heating (and DHW) without needing any more power during the peak demand periods they could reduce both demand peaks by about 10,000 MW by just utilizing some of the hydro power that is presently going to waste plus some of the local thermal energy that is also going to waste.



The diagram shows how it works. Heat pump 1 holds the peripheral temperature steady while Heat pump 2 holds the core temperature at a constant 60 degrees. If you add a solar thermal collector the amount of power consumed by the heat pumps is reduced so the solar thermal collector is in effect supplying additional power to the grid. Reducing the grid's electricity demand has the same result as temporarily increasing the supply via a storage battery but exergy storage is less expensive than batteries by orders of magnitude and would be easier to implement. The savings would amount to many billions of dollars per year.

The concept is explained in considerably more detail in papers that have been published in the science literature. There are many examples of seasonal storage systems in use in Canada: Enwave, UOIT, Drake Landing, GSHP's, etc. A paper from the journal Sustainability entitled "A Dual Function Energy Store" by Marc Rosen and myself shows how Ontario could completely eliminate the need for using natural gas for both space heating and power generation.