EB-2016-0152 2017-2021 OPG Payment Rates 26 January, 2018

Sustainability-Journal.ca submission re. The OEB interim decision and its OPG response

The Government of Ontario created OPG and several other government-controlled agencies as a means of ensuring that residents of Ontario would enjoy safe, reliable, adequate, sustainable, environmentally responsible and affordable electricity. These agencies are organized as for-profit business organizations so the OEB was established to protect the public's various interests in implementing and operating those companies. In the past the Board reviews have dealt with evolutionary variations in the trends for demand, costs, etc. However, the current review covers a period during which revolutionary changes will be occurring in the markets for electricity and for power generation and distribution methods. Much of the evidence for a new driving force requiring radical changes has emerged since the verbal hearings for the OPG Payment Rates were held. From a procedural point of view it may be late in the day to revisit fundamental issues but a failure to bring these changes to the Board's attention could result in OPG being saddled with very large stranded assets and it is likely that OPG may not deliver most of the objectives listed above, and in particular the need to supply affordable electricity. The Board may want to incorporate some cautionary instructions in their final decision to minimize these risks.

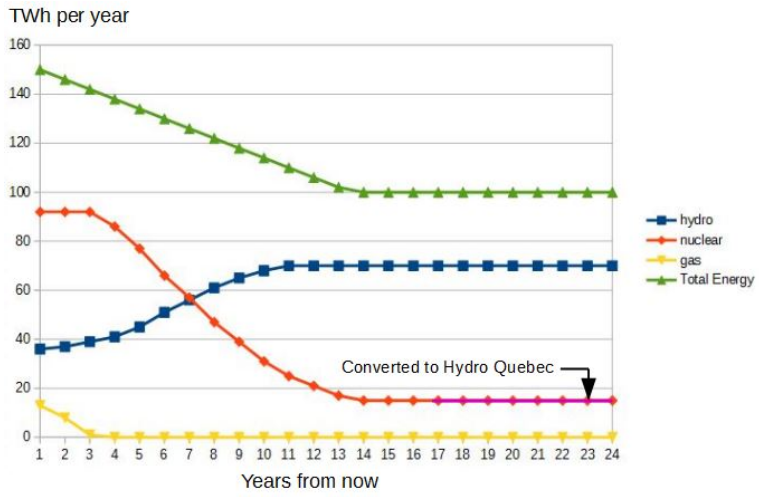
It appears that most of the planning for OPG's power generation, including the anticipated demand and the facilities that will be needed to meet that demand are made by the IESO rather than by OPG. A review of that planning is provided in Appendix 1: "Missing the Mark". As the title implies the plans do not meet any of the objectives expected by the public:

* they will not deliver affordable electricity
* they will result in runaway growth in Ontario's GHG emissions
* they are not sustainable

The core problem is not being considered by either OPG or the IESO, or by any other government agency or via multi-disciplinary reviews like the Long Term Energy Plan. There is a substantial probability that if the current plans are followed the resulting GHG emissions from methane alone would exceed 3000 megatonnes of GHGeq per year within the coming decade. That compares to a total of 30 megatonnes per year in the recent past, and a 2050 objective of about 170 megatonnes/yr from all Ontario GHG sources put together. The environmental consequences of such a high rate of release may not be the responsibility of OPG, or IESO or the Board, but the federal government has imposed a requirement that a rate of $50 per tonne of GHG must be applied to fossil fuels via a suitable mechanism such as a Carbon Tax or a Cap and Trade program. At $50/tonne the tax on 3000 megatonnes will amount to 150 billion dollars per year. A substantial part of that would be charged to OPG, which will be increasing its consumption of natural gas because 8 of its nuclear reactors are about to be taken out of service and all of the remaining reactors will be temporarily withdrawn from service while they are being refurbished. The IESO has not yet estimated the increase in OPG demand for gas but obviously that will have a large effect on OPG's costs. No provision has been made for that cost because the government does not yet include upstream methane in its calculations.

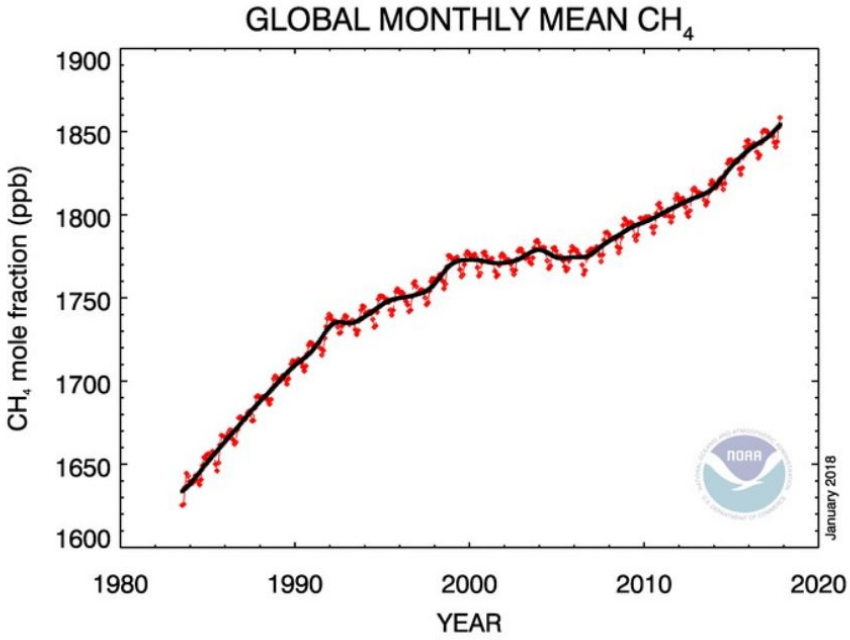
The present OPG Payment Rates review covers only the period 2017 to 2021 but over that period a substantial portion of the capital cost of the Darlington refurbishments will be spent and more will be committed for contracts for the balance (and indirectly for Bruce refurbishments) and a comparable amount will be spent on operating the reactors so if the costs are in danger of going that much higher

OPG might want to reconsider the available alternatives such as the one described in Sustainability-Journal's submission for the hearing (graph below). That submission showed how the nuclear stations could if necessary be phased out completely as their CNSC licences expire.



About two thirds of the natural gas that is used in Ontario is produced by fracking, and that contribution will soon rise to nearly 100% when the Rover pipeline (under construction) and the NEXUS pipeline (under FERC review) are completed. When the shale is fractured some of the gas it contains is released but only about half of it is captured for commercial use. Until recently the balance was believed to be fixed in place underground because it was argued that the high pressure at the 2 km depth of the Marcellus deposit reduced the permeability to almost zero. However, recent research has shown that the permeability does not in fact decrease with depth and surface tests show that the methane is indeed reaching the atmosphere. The tests have been carried out by ground and airborne surveys, by satellite measurements and by ground water measurement made at sufficient depth to prevent contamination from biological methane from the air and soil. The ethane content of the water measurements has shown that the methane is indeed coming from the shale because ethane is not produced by the biological processes.

NASA has just published its results for the atmospheric methane releases in areas surrounding shale gas recovery operations (below) and in 2050 NASA will be launching a stationary satellite that will constantly monitor most of North America. The current NASA graph shows an accelerating release pattern since 2008, when fracking became big business, but it is expected that this rise will continue for many years because most of the methane is still in transit. If 50% of the released gas eventually reaches the surface then it will create the predicted 3000 megatonnes of GHGeq, causing both delayed and environmental and economic crises.



From Osborn et al. Methane measured in water wells near shale gas workings

Scope

It can be argued that from a procedural point of view this information has arrived too late for consideration. However, Hearing EB-2016-0152 is likely to define Ontario's power generation commitment for 40 years to come, and it involves the expenditure of 26 billion dollars in capital costs, a comparable sum in operating costs, and potentially much more in environmental and "Carbon Tax" costs so the directions to OPG should require that they consider this late-arriving issue.

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Appendix 1 Submission to IESO re. their *Market Renewal Program*

Missing the Mark

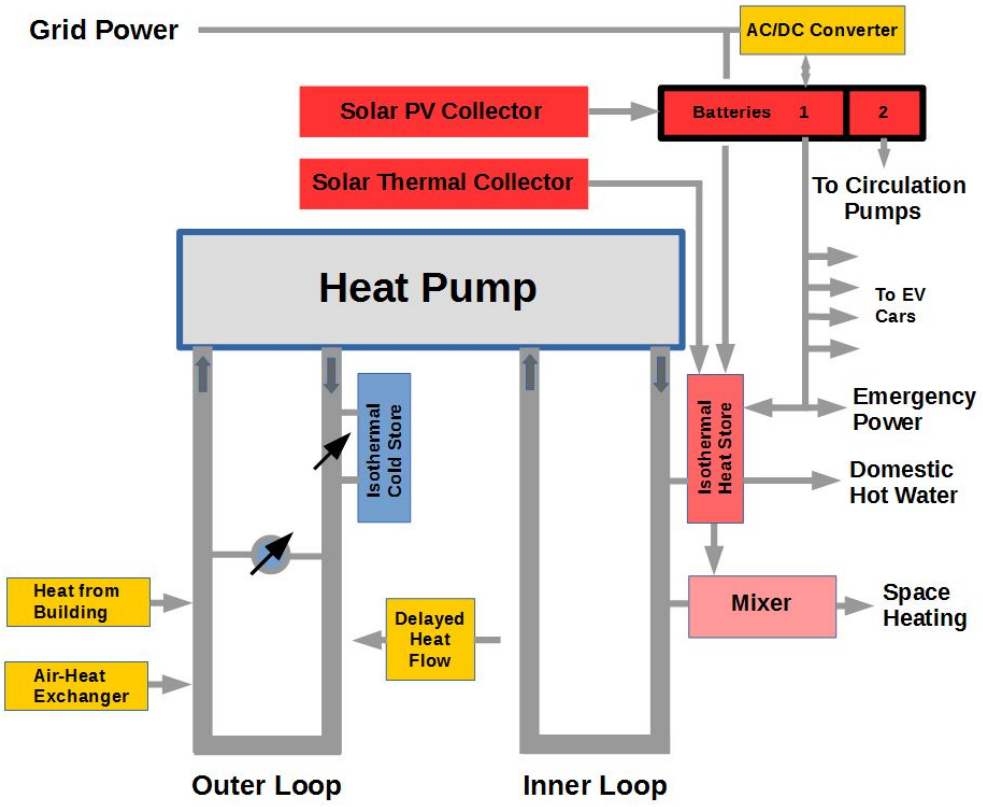
Exergy stores can heat and cool our buildings, provide domestic hot water, provide motive power for our cars, trucks, buses and trains, and can provide cleaner, cheaper, more stable and sustainable power. For all of those applications they could readily be applied on a scale that would in time almost completely eliminate Ontario's need to use fossil fuels. Exergy storage could reduce the global costs of those energy needs by many billions of dollars but under current policies almost the entire cost of building exergy stores is put on the shoulders of the building owners. The theoretical result may be huge global cost savings but they are shared by the entire province, with only a tiny fraction of the electrical benefits going to the building owners, so there is really no incentive in place for them to build the exergy stores.

One of the consequences of building exergy stores would be large reductions in Ontario's average and peak power demands, leading to big revenue reductions for Ontario's government-run power monopolies. Not surprisingly those agencies have for years refused to even listen to explanations of how such stores function and how they could save billions of dollars, reduce GHG's, and provide a more sustainable energy supply system. **The IESO has been the worst offender of all.** For example, the IESO is currently considering the funding of a pilot project at the Saunders Power Station that will use batteries to regulate the grid. Such batteries are much more expensive than an exergy store and they need to be replaced every 13 years, a cost that is eliminated in the exergy store alternative. On a much larger scale, ANY alternative that eliminates the peak demands for power for heating and cooling applications could reduce Ontario's peak power demand by more than a factor of two, reducing the capital and operating costs in proportion. Exergy stores have the capacity to provide the heating and cooling with ZERO power demand during the grid's peak demand periods so they would do the job.

The principles of exergy storage have been extensively covered in the science literature[(1)] so they will not be repeated here. The diagram below illustrates one implementation of the concept. The heat is extracted from the summer air and from the building's AC system and is initially stored in the outer ring of ground heat exchangers. At times when excess power is available (primarily at night) a heat pump transfers the heat into the inner ring of ground heat exchangers and the electricity used to drive the heat pump is thus stored, boosting the exergy of the storage core. The electricity is effectively recovered in the winter because heat can then be extracted from the core without the need for any grid power. In the summer the ground around the outer ring is chilled because heat is being withdrawn from it and from the cold isothermal tank, so building cooling is a freebie.

In the process there are other freebies that are natural advantages of the concept. If you put an electric heater into the hot isothermal tank then that can be used to regulate the voltage of the grid by modulating the power load. An exergy store can store up to 1,000,000 kWh or more so it has adequate capacity to handle the local grid overvoltage. Severe undervoltage is handled by the batteries of the plug-in EV's, just as the fixed battery of the Saunders system does, but the batteries can be five times smaller and their replacement cost is zero for the grid operators. In another freebie example, the hot and cold isothermal tanks flatten the daily load fluctuations and in doing so they can free up thousands of megawatts of ponding storage that is presently being used to match the fixed output of the nuclear power stations to the widely fluctuating daily load pattern. The electricity storage capacity that has thus been freed can be used for irregular renewable power sources like wind turbines, solar panels, weather-related hydro surges, etc.

(1) Compact Exergy Storage Systems



Exergy
stores provide thermal storage in two ways: via the heat stored in the core and via the wave of heat that flows out of the core and that reaches the outer ring by the winter, at which time the heat pump returns the heat to the core, stabilizing its temperature. The electricity storage takes many forms:

1) storage used for grid regulation as explained above

2) seasonal storage that flattens the summer and winter demand peaks

3) year round storage that matches supply and demand for applications like hot water and EV power

4) diurnal storage that flattens the daily grid load pattern

5) virtual storage via freeing of the hydro ponding storage for RE applications

6) controllable demand shift storage that can minimize demand peaking

Some of the features are not self-evident. For example, the heat pump in an exergy store works throughout the year and at a relatively low power level. That makes it easy to drive it with a small solar collector and also to use much shorter ground heat exchangers than are needed for conventional GSHP systems (the ground heat exchangers are the most expensive component). The system can use solar thermal panels to inject heat directly into the hot isothermal tank, boosting its temperature for DHW and reducing the use of electricity for driving the heat pump. Because of its higher efficiency such a

solar thermal panel will make a bigger net contribution to the electricity supply than a solar PV panel of similar size.

Between them these six storage capabilities provide the means of dealing with the primary energy issues in Ontario: how to heat and cool our homes, how to power our cars, and how to generate electricity without using fossil fuels. The six storage methods can be used concurrently with very little interaction so their productivity is very high and the cost is low. **However, none of the six methods can be employed, or even demonstrated, without the active participation of the IESO and the other supply monopolies.**

To date the IESO has refused a great many requests to discuss the technology, to hear presentations at the local Ottawa advisory meetings, to include exergy storage in their RFP's, or to even mention the topic in their reports. No one from IESO has advanced any technical or economic reasons for their opposition to the concept. The IESO has simply buried the topic in their plans and publications. The obvious observation is that building exergy stores would radically reduce the revenues of the IESO, OPG, Hydro One, etc., which raises the question of whether this obstruction is intended to protect those revenues at the public's expense. Or, to put it more bluntly, is the present *"Market renewal and non-emitting resources"* purely an exercise in hypocrisy?

In the near future Ontario will be permanently closing eight of the province's nuclear power reactors and temporarily shutting down all of the remaining reactors for lengthy (and very expensive) refurbishments. The substantial reduction in baseload baseload power capacity, the need for extra power in the summer and winter, and the need for diurnal peaking generation will primarily have to be met by fossil-fuelled generation, leading to much greater GHG emissions. That problem is greatly aggravated by Ontario's ongoing switch to the use of shale gas. The methane that is released by the fracking process but that is not captured will eventually reach the surface, in time bringing the GHG levels to values that are orders of magnitude greater than the GHG that is produced by burning the gas. Unfortunately, Ontario is turning a blind eye to those upstream emissions, which exacerbates the problem.

Ontario has withdrawn its support for the development of the ACR1000 power reactor and the federal government has virtually closed down AECL so Canada has no native successor to the CANDU reactors, which are nearing the end of their lives. Any replacements will certainly be extremely expensive and are likely to go through construction pains similar to those being encountered with the Areva reactors in Europe. It is questionable whether the nuclear option is sustainable, especially considering that Ontario's future power needs could readily be met by making more efficient use of Canada's hydro power combined with exergy storage systems. Fossil-fuelled generation is intended to be phased out ASAP, leaving Ontario with no long term plan for future sustainability so long as it continues to obstruct exergy storage systems.

Nominally, Ontario power policies are intended to achieve three primary objectives:

1) to provide adequate, stable and affordable electricity
2) to contribute to the planned 80% reductions in GHG by 2050, and
3) to ensure that the electricity supply system is sustainable.

The existing IESO plans completely fail to meet all three of those objectives.

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