Missing the Mark

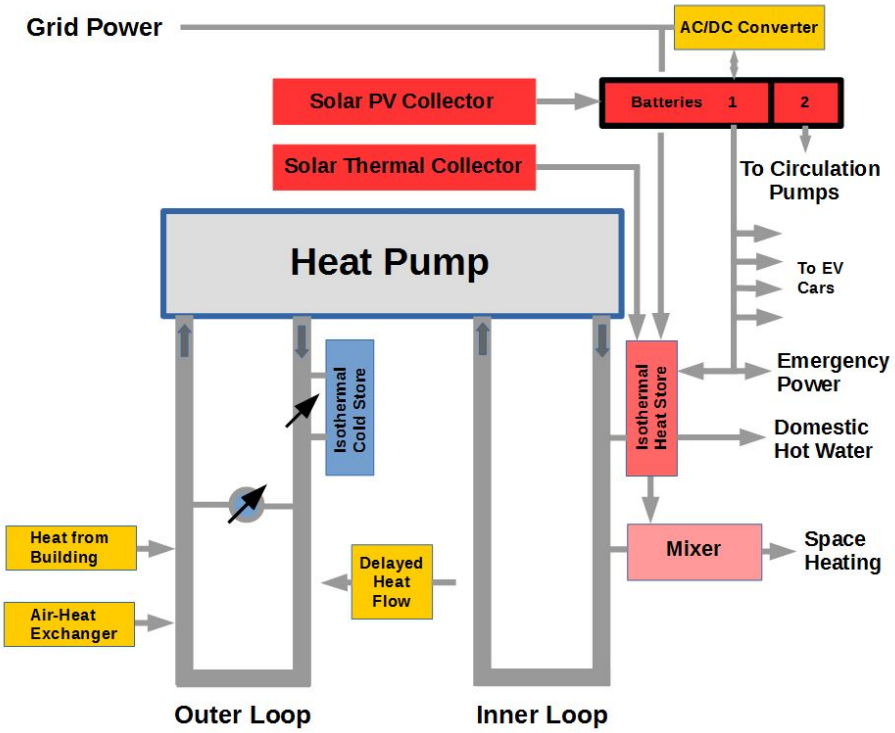
Exergy stores can heat and cool our buildings, provide domestic hot water, provide motive power for our cars, trucks, buses and trains, and can provide cleaner, cheaper, more stable and sustainable power. For all of those applications they could readily be applied on a scale that would in time almost 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 funding 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.

Ron Tolmie
[redacted]