Seasonal Storage Capacity

The provincial government's brochure "Our Energy, Our Future"distributed to Ontario residents states that "renewable sources alone cannot close the growing gap between electricity supply and demand" (ref OPA). That is not true. Renewable sources are all variants of the basic process of utilizing solar energy to meet our energy needs. The amount of solar energy that is available grossly exceeds all of our energy requirements, and unquestionably has the potential to "close the growing gap". The trick is to find ways to harness that energy.

The OPA report reviewed some of the means of utilizing solar energy: directly via photovoltaic cells and solar collectors, and indirectly via windmills and hydro power. However, the OPA report completely ignored the use of seasonal storage, which has by far the largest capacity to deliver the energy we need, when we need it.

The world's largest hydro power facility, the Three Gorges Dam in China, will deliver up to 18,200 megawatts of electric power when it is completed. The reservoir for that dam occupies a space of 1045 square kilometres. The peak amount of solar energy delivered to such an area is about 1,300,000 megawatts. Obviously the sun does not shine all of the time, and when it does it will strike at an oblique angle, etc., so the average incident power level is much less than 1,300,000 megawatts, but the point is that if we find a more direct way of utilizing solar energy then its potential capacity is enormous.

The solar energy can readily be collected in the form of heat, but we don't want heat in the summer – what we need then is a means to cool our buildings. That need for cooling is in fact what is creating the "growing gap" referred to above, since we currently use electricity to drive the heat pumps that are used for air conditioning. However, if we store the summer heat to heat our homes in the winter and also store winter cold to cool them in the summer then we can meet those particular energy needs with only minimal needs for electricity to operate the heat exchangers, circulation equipment and controls.

If you open a window in the wintertime you will very quickly appreciate the capacity of the outside air to provide immense amounts of cold or heat. What we need is a way to store that cold and heat. There is no problem at all in the capacity of nature to provide the amount of heat or cold that we need (in Canada), the trick is to store it for six months. Such seasonal storage has been employed on a large scale for thousands of years. Until quite recently (in historical terms) massive amounts of ice were stored in warehouses and distributed for cooling throughout the summer. In more recent decades we have turned to the use of the ground for storing heat and cold. Rock is such a good insulator that a moderately large underground storage volume loses very little of the stored heat or cold.

What we have then is an unlimited source of energy and an unlimited capacity to store that energy until such time as it is useful to us if we build enough underground storage modules. The remaining questions are: *Are the costs acceptable and is the energy in a usable form?*

The UOIT has a 384 borehole seasonal heat store that was drilled at the rate of three boreholes per day by a small crew. The heat exchangers that are installed in the holes are made of inexpensive polyethylene tubing that has a useful operating lifetime of many decades. The cost of installing such ground heat exchangers, even under city streets, is extremely modest in comparison to the cost of the facilities of comparable capacity proposed by the OPA, and the operating cost is very nearly zero. Installation of one of the proposed standard ***HEAT networks*** modules would take about a week, and it would be comparable to street paving or sewer repairs in the attendant disruptions.

That leaves one residual question – *is the energy in a usable form?* Certainly the storage of cold is very usable, and that application alone solves the problem of the large and growing summer electricity demand peak. If Canada and a few northern US states employed stored cold then our electricity demand pattern would be the mirror image of that further south so the north-south power grid connections would be mutually advantageous, and could reduce the peak demand in the opposite season, so there is a year round benefit for everyone.

Using stored heat to heat our homes in the winter could eliminate the need to use natural gas and fuel oil (and sometimes electricity) for heating our homes, which would eliminate the resultant pollution and greenhouse gases. It would also put strong downward pressure on the price of natural gas, which would make electricity from that source more affordable. Moreover, since a ***HEAT network*** is inherently a district heating system one of the available options would be to build local power generators in which the waste heat is stored in the underground storage modules and is used for heating the homes in the winter.

A variant of the above could use solar panels to collect solar energy at a higher temperature. That stored heat could then drive Stirling or Coanda turbine generators instead of using natural gas, again using the waste heat for home heating. Such generators will require development effort, but towards the year 2020 they could lead to an era when fossil fuels (and nuclear reactors) could be phased out completely.

Note that it is not the adequacy of the renewable energy source that is the issue, either now or in the future. The limit is our willingness to accept change. The OPA has recommended that we should continue with the status quo. They have recommended that we should build reactors to continue with the current level of nuclear power, and that we should continue to rely heavily on fossil fuels. In fact, the nuclear program that they have proposed would quickly collapse for the lack of fuel for the reactors, and it assumes highly improbable numbers for the construction schedules and cost of the nuclear reactors, so that if there should be construction delays or costs overruns (as has ***always*** happened in the past) then Ontario will be unexpectedly dependent on expensive, dirty energy sources throughout the planning period.

Renewable energy sources *do* have the capacity to "fill the gap". It is the nuclear and fossil fuel sources that *do not*.