Is Nuclear Power Inevitable?

The world lives with many limitations that are essentially permanent. We have a finite surface area to live on, a limited amount of air to breathe and water to drink, and so on. In most cases we just learn to live with those limitations, but in the case of energy we have no less than three alternatives that all have substantial potential for future growth – solar energy, for which HEAT networks is one example of the large growth potential, geothermal energy, which is hardly used at all, and nuclear energy. As the world belatedly realizes that we cannot continue to depend on fossil fuels we must consider what mix of these three sources will replace the oil and natural gas.

Nuclear

In Canada the nuclear option is represented by the ACR-1000 power station and its very closely related siblings. Although its fuel is slightly enriched (1.5-2%) those reactors are basically fueled by natural uranium, and are designed for high burn-up. The amount of uranium that can be economically mined is very limited, and might not last past the first generation of ACR-1000 power stations, particularly if there is a resurgence of nuclear power on a world wide basis.

Nuclear reactors can breed some of their own fuel if highly enriched uranium or other nuclear fuels are used. However, Canada does not currently have uranium enrichment facilities, or the fuel processing facilities that are needed to support a breeder reactor program, or indeed the breeder reactors themselves. While we might in time develop such facilities, there in no provision for such expensive developments in the currently proposed nuclear power program. As it stands, the proposed nuclear program appears to have the least growth potential of the three options. It could be argued that a different nuclear program, based on on breeder reactors, would have a significantly longer lifetime, but that is not what is being proposed.

There is a widespread misconception that if we adopt an expanded nuclear power program then our electricity supply problems are solved forever. That is not the case at all. In fact, the reserves of uranium (50 years at the current consumption rate according to the CNA) are much more limited than Canada's reserves of fossil fuels. The proposed nuclear program “burns” uranium in much the same way as power stations burn coal, and as with fossil fuels such a program is not sustainable.

In trading one energy source for another we would also be trading one waste product for another – green house gases vs. nuclear waste. There is currently no approved means of disposal for the nuclear waste. We would also be incurring the security risks inherent in the use of nuclear power, plus the risks of unreliable power that has plagued the nuclear industry, plus a huge economic risk.

Geothermal

Canada has relatively few examples of geothermal heat sources that come close to the surface, where they can be easily exploited. In principle, we could drill a very deep hole anywhere in Canada and eventually reach a high temperature zone. A single “energy mine” might employ multiple power stations that use the geothermal heat as the source of energy and use the upper levels of rock as the heat sink, so that the generated power could be transmitted to the surface via wires in the common mine shaft. However, very little consideration is currently being given to such systems, although in principle they could deliver an essentially unlimited amount of power.

Solar

The solar option falls in between the other two options. The rate of insolation is fixed so we would have to learn to live with that limitation. However, the amount of solar power that is available is much larger than what could be provided by the proposed nuclear option, and it is sustainable.

The prospects for utilizing solar energy are dependent primarily on the HEAT networks concept. Except in the polar and equatorial regions HEAT networks can meet all of the thermal energy demands irrespective of how densely populated the Earth may become, and can sustain that energy supply indefinitely. In the temperate zones of the Earth these thermal needs (including air conditioning) represent the bulk of our stationary energy requirements, so to a very large extent HEAT networks provide a large part of the solution for both energy supply and the need to reduce sources of pollution. Note that unlike all of the other options HEAT networks do not produce any thermal pollution.

However, HEAT networks do not produce any electricity or any mechanical power for transportation or industrial purposes. As noted in other articles they would greatly reduce summer peak electrical demand, open an opportunity to handle year-round loads by load levelling, and they would result in a large surplus of natural gas, part of which could be used for power generation. Since natural gas is usually a by product of the oil industry, and LNG distribution offers a method of preventing its waste in countries where it is being flared off , it makes sense to continue to use natural gas in applications like power generation.

For the next several decades this combination meets our objectives, but what will we do in the coming centuries? Will we eventually have to turn to a breeder or fusion reactor program? Will the geothermal option be developed by that time? Will photovoltaic cells and batteries and less power hungry equipment fill the gaps? Will ground storage be extended to store high temperature solar heat, suitable for power generation, or to flatten windmill output?

The prudent answer to these questions is that we don't know, but if we adopt the HEAT networks concept then we will have a considerable amount of time in which to find the answers.