Net Plus Homes

A ***Net Plus*** home meets all of its own energy requirements and in addition makes a substantial amount of additional electricity available. Any home can be a ***Net Plus*** home – a detached suburban home, an apartment, a row house or a cottage – but the greatest community and personal benefits will be realized with homes that are connected to a city-run heat supply system as described in the articles of AE-Street systems.

An AE system can be of any size but the energy gains can best be explained by examining the global numbers for the residential totals for all of Canada. Currently we use about 794 petajoules (PJ) of energy for space heating, 31 PJ for cooling and 247 PJ for hot water (data from NRCan OEE for 2006), for a total of 1072 PJ. That accounts for 79.6% of all of the energy used by the residential sector.

Most of that energy is currently supplied by natural gas, heating oil and wood, all of which generate CO_2 and other pollutants that will be eliminated if we use the summer air as our source of energy. Many homes are heated by electricity, which accounts for 266 PJ of the energy supply. The AE systems require electricity to drive their heat pumps. If their average COP is 5 the electric energy consumption will amount to 204 PJ, leaving a net surplus of 62 PJ (subject to various small corrections for circulation pump power, etc.)

Each storage site of an AE-Street network can store up to 80 MWh of heat. One way of using that is to store the waste heat of buildings that house power hungry information and communications equipment. That means that the electric energy is used for two sequential purposes, first to run the equipment and then to heat the neighbouring homes. One estimate puts the total at about 400 PJ but whether this should be considered to be a reduction in power demand or an increase in the thermal energy supply is subject to interpretation. Much of that energy will meet a demand that cannot be met by heat from the air, particularly at sites that are cannot support long term storage because of poor ground conductivity or heat leakage caused by groundwater movement.

The 63 PJ of demand reduction is one of many conservation measures that are (or could be) implemented, but in Ontario such measures have created a problem. The power demand sometimes falls below the minimum delivery of the nuclear power generators, and it routinely results in poor financial returns at night. Such surpluses can be stored by AE-Street systems, providing up to 160 MWh per station of extra supply capability during the day. Storage makes it possible to make use of large amounts of energy that would otherwise be unusable.

There is a need to deal with both this supply limitation and the need to handle diurnal and seasonal demand peaks. However, alternatives like wind turbines require backup from an energy source that can react to their sudden supply variations. In such a combination over 80% of the energy comes from the backup source, which in Ontario is primarily natural gas generators. The consequence is that without storage this combination actually increases the production of CO_2, which is of course the opposite of the nominal intent.

Traditionally it has been assumed that load and energy source variations must be met by building systems that are capable of meeting the daily and seasonal load variations. That is an expensive approach that is difficult to control considering that the power demand can often change very abruptly, for example from the loss of a distribution link in the grid. Substituting demand control for the traditional supply control is a fundamental change that has some important advantages.

The procedure is simple and inexpensive, requiring only that the electric heat injection be turned ON as required at the AE storage sites that are managed by the cities. They permit almost instantaneous matching of the demand and supply. They enable the loads to be adjusted at the physical locations where the demand control is most needed. The potential storage capacity is inherently larger that the capacity needed to achieve this control.

There are advantages for the AE systems as well. The injected heat makes it possible to use ground that would otherwise be unsuitable, creating the ability of AE-Street systems to be installed almost anywhere. The injected heat can be directed to long term storage sites in the summer and then redirected to the short term storage sites in the winter. At both types of sites the heat delivery capacity is improved and the storage at each site can be dynamically controlled to match changes in the community building mix.

22% of the residential heating in Canada is provided by electricity. Nearly all of the demand occurs during a three month winter period, creating a large winter demand peak. AE systems flatten both this winter demand peak and the summer demand peak, making it practical for the stored heat to replace the use of combustible fuels for peaking power generation.

There are comparable benefits in other sectors, like Commercial and Institutional, Industrial, etc., that are not covered in this review.