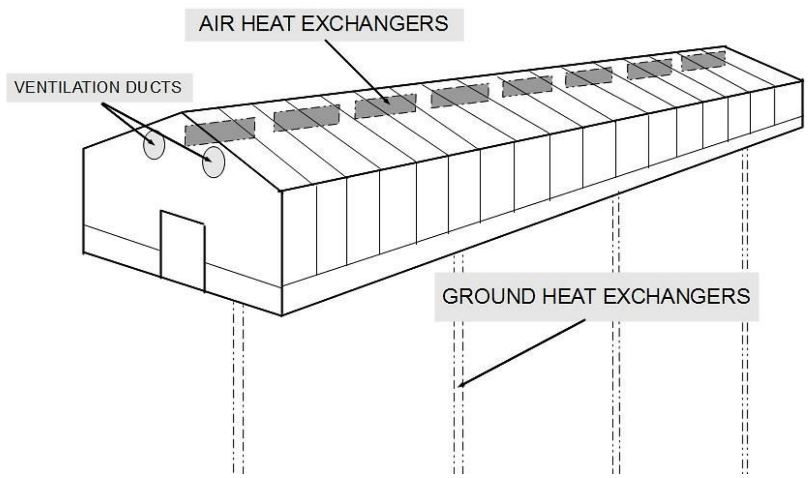

Large buildings – a massive source of energy.

Large buildings, such as “big box” retail stores, could help solve four of Canada's biggest problems:

(1) Such buildings are potentially the source of massive amounts of energy (in the form of heat) that is presently going to waste
(2) The big buildings are the primary cause of the huge summer power peak demand, which could potentially be cut in half
(3) Stored heat from the buildings could be used in the winter for heating buildings of all types, potentially reducing the use of natural gas for that purpose
(4) The heat could also be used for heating greenhouses on the large, flat roofs of typical "big box" stores, making Canada more self sufficient for many agricultural products.

Canadians are accustomed to using a lot of heat in the winter, usually employing natural gas, and a comparatively small amount of electricity in the summer for air conditioning. For big buildings the pattern is the opposite – they consume a very large amount of electricity for AC in the summer, and in the spring and fall, but require relatively little winter heating. On an annual basis they need to get rid of an enormous amount of heat that comes not only from the HVAC systems but also from the computers, lights and other equipment in the buildings and from the people in the buildings. At the present time all of that excess heat is simply wasted by dumping it into the atmosphere. Such heat can be economically stored by transferring it into the ground under the building or under nearby parking lots and it can be put to good use in the winter even though it may not raise the temperature of the ground by more than a few degrees.

The present practice of using electrically driven air conditioners is very inefficient because the AC heat sink (the surrounding air) is at a high temperature in the summer so the heat pumps have poor efficiencies. If the heat is transferred into the ground, which is much cooler, then the amount of power consumed is greatly reduced, resulting in substantial cost savings (even if the stored heat is not used at all). As an alternative it could be simply dumped into the cold winter air to get rid of it at minimum expense, but it is more intriguing to consider how to put that stored heat to good use.

The most obvious use of the stored heat is to heat the large buildings themselves by reversing the heat pumps, but as noted above such buildings have a relatively small winter heating demand so that would still leave a considerable excess. A rational alternative, particularly in Canada, would be to collect the heat from downtown areas in our cities and use it to heat the surrounding residential areas. That would be a component of making our cities virtually self sufficient (and totally clean) for our heating needs and at the same time being much more efficient in their power consumption. However such an approach would be complicated to implement.

Big buildings need to get rid of the heat in some way. In one example the heat is being used to melt snow. A more useful application would be to employ the heat in greenhouses mounted on the roofs of the buildings. Greenhouses need a large amount of heat but the temperature does not have to be tightly regulated like indoor building heat so it is relatively easy to recover the stored heat efficiently. Canada is already a major exporter of greenhouse produce, a consequence of our greater need for using greenhouses, so this could be a source of substantial exports as well as a means of being much more self sufficient for our own foods.

Global warming

This year's drought across most of North America has provided evidence of the consequences of changes in weather patterns. Many factors determine the actual weather, not just the GHG in the atmosphere, so we cannot "blame" this year's weather on GHG, but it does illustrate what the experts tell us will happen. It doesn't much matter whether GHG is the cause of this year's effects or if the effects are merely indicative of how the weather can directly have a big affect our lives, our environment and the economy - the end result is the same. Proving a direct linkage is purely academic.

However, the evidence is mounting that the predicted changes are already happening:
http://www.nasa.gov/topics/earth/features/warming-links.html

The greenhouse idea not only provides a way of significantly reducing GHG emissions but also of alleviating the consequences of the drought, particularly in Canada. There is already a flourishing Canadian industry that produces vegetables and flowers but presently Canadian greenhouses require a very large amount of energy to heat them in the winter, usually provided by natural gas heaters. Stored heat provides a clean, economical way of providing that energy, and at the same time solves the problem of how to cool the large buildings underneath. As a side benefit it also makes productive use of roof space that is otherwise going to waste.

Transportation GHG

The practice of importing vegetables from distant places like California and Mexico imposes a substantial penalty in the form of the GHG that is emitted by the fleets of trucks that transport the produce. There is also an infrastructure cost associated with supporting that traffic that could be eliminated.

Water

Crops grown outdoors frequently require irrigation and that is becoming an increasingly difficult need for all nations to meet, especially during periods of drought. Most of the water is lost to evaporation so irrigation is a very inefficient practice. Using greenhouses makes much more efficient use of this increasingly scarce resource.

Design considerations

An existing "big box" store provides a starting point for explaining what a roof-mounted greenhouse could do. The store in question has a floor area of 415,000 square feet and it incorporates a ground heat store that captures the heat from the air conditioning system and stores it until the weather turns cold enough to dissipate the heat. In this case the heat is not used to heat a greenhouse. Instead, a large asphalt pad with a serpentine pipe buried in it dissipates the heat, much of which is carried away by melting snow that falls on the pad during the winter.

The store collects 5,100,000 kBTU annually from its air conditioning system. Part of the heat (530,000 kBTU) is used to heat the building in the winter by reversing the heat pumps. Part of it could be used to meet the needs for hot water (DHW) in the building (not covered in the available reports). Part of it is used to melt snow in the winter. However, most of it is simply dissipated into the atmosphere via the pad. That represents a waste of roughly 4,000,000 kBTU (1,172,000 kWh) that should be put to good use. To put that number in perspective, it is the same amount of energy as would be delivered by 1465 microFIT solar systems that have the full 10 kW rating. At a unit price of $60,000 that number of solar systems would cost $88 million vs. a net cost of almost zero for the "big box" systems, yet they both deliver the same amount of useful energy.

Although the heat storage system does not generate electricity it does conserve electricity, which is even more useful because there are no transmission costs or losses. The estimated savings in the existing building as compared to the cost of a conventional HVAC system are $410,000 per year, primarily because of reduced electricity consumption. At 10 cents per kWh that corresponds to 4,100,000 kWh. Although that is less than half as much electricity as would be generated by 1465 solar systems it is much more useful because the storage permits the energy to be delivered exactly when it is needed. The solar systems on the other hand deliver most of their output in the spring and fall when there is very little need for extra power, and they need an expensive backup capacity because they are only useful when the sun is shining. That backup system spews out so much GHG that the upshot is that the electricity conservation from the seasonal storage system is much more useful than the power generated by the solar systems, leaving the 4,000,000 kBTU (1,172,000 kWh) available as an additional energy source that can be used to heat the greenhouse.

City-wide application

Cities like Ottawa have hundreds of buildings that could utilize this approach to conserving both heat and electricity and if they did so there would be a drastic reduction in the GHG emissions, in comparison with both the existing use of peaking power stations and the use of solar power generation.

Since such systems save the building owners substantial amounts of money and have a quick payback period (estimated at 4 years for the existing building) they do not require subsidies. The greenhouse operations should be highly profitable because the largest expense (the cost of winter heat) is eliminated so any revenue from that source would be in addition to the savings in the building operation.

Moreover, such systems:
** could make Canada much more self sufficient in supplying its own fruit and vegetables
** make it much easier to protect large buildings from power failures
** provide a significant help in dealing with drought, as we are encountering in 2012
** greatly reduce the consumption of water

** reduce the fuel consumption of trucks that currently deliver produce from California or Mexico
** provide flexibility - the heat can be used for greenhouses, smaller buildings, or can be dumped
** do not waste any space or interfere with the environment or impose visual or audio problems
** achieve large energy demand and GHG reductions with a small number of installations
** can be implemented quickly employing existing technologies
** would make northern cities much more competitive

Owners of large northern buildings also have the option of storing winter cold, as is done with Toronto's Enwave system, eliminating the need for using heat pumps in the buildings and thus further reducing the power demand at the expense of losing the heat for greenhouse applications. In this case the reduction in power consumption would amount to about 2,000,000 kWh, which is comparable to the annual output of about 250 microFIT systems, but the building would need heat in the winter.

Seasonal storage can be used for buildings of all sizes (including homes) and thus provides a general means of eventually eradicating the use of fossil fuels in all buildings.

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