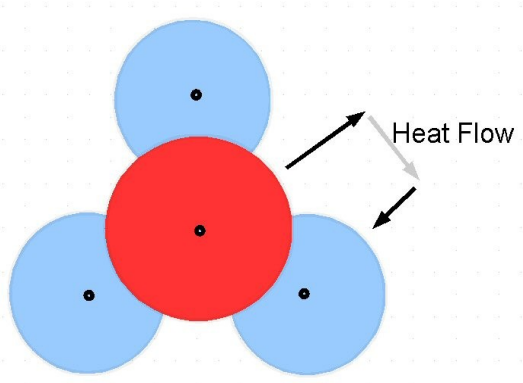
Home Heating with Atmospheric Energy

In most other countries air-source heat pumps are much more common than ground source heat pumps but Canadian winters are too cold to employ standard air-source systems. However, the design of such systems can be modified to incorporate sufficient heat storage in the ground to permit them to operate throughout the winter. Compared to ground source heat pumps these modified systems reduce the borehole length by a factor of 2 to 5, and because they are more efficient and can cope with extreme mid-winter demands they also reduce the electricity demand, typically by 20 to 40%. The reductions in capital and operating costs amount to tens of thousands of dollars.

In air-source systems 100% of the heat comes from the air and from the heat pump drive power. Because there is no net flow of heat into or out of the ground storage volume it is possible to use such systems in congested cities. Unlike the ground, the air is virtually a limitless source of energy.

How it works:



The system has four boreholes containing heat exchangers similar to those used for conventional ground source heat pumps (GSHP's). From April to September heat is extracted from the air and is transferred into the heat exchange fluid and that heat is then injected into the ground in three stages, first to restore the heat that had been extracted from the three outer boreholes, then to heat up the central area during the hot part of the summer, and finally to add extra heat to the three outer boreholes. Air conditioner heat can optionally be added to the central area.

During the winter the heat is normally extracted from the three outer boreholes. The ground around those boreholes will initially be warm but as heat is extracted the ground will cool to below the ambient ground temperature. Through most of the winter heat will therefore flow into their thermal wells (the blue circles) so to compensate for that input some of the heat from the central area is deliberately allowed to escape. The temperature of the core is controlled to balance these two flows. The outer boreholes deliver more heat than their GSHP equivalents because they cycle through a wider temperature range and because heat is fed to them from the warm central area. During very cold periods extra heat is extracted directly from the central borehole.

Components The components are standard. The heat pump is identical to what would be used for a GSHP of the same capacity. The air heat exchanger is the same as those used for conventional air-source heat pumps (or home air conditioners), and the ground heat exchanger is similar to a quad-tube GSHP exchanger, but much shorter.

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