

Geothermal Energy in Northern Climates

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Northern climates (e.g., Canada and Russia north of 60°) present unique challenges to the provision of energy for a number of reasons: solar and wind are largely absent for many months of the year, hydro power is impractical, natural gas deposits and infrastructure are not available, the scale of communities precludes nuclear power, and so on. Diesel fuel is the energy source for the vast majority of northern communities, and the only other option may be geothermal energy.

Geothermal energy can provide power and heat, both existential issues in the north. Even though geothermal gradients may be low, temperatures of 65-85° are found at depths of several kilometers, and in the cold months of December to March, this is suitable for Organic Rankine Cycle power systems to be used because ambient temperatures are below -15°C. Residual heat also has value and can be used in several ways: direct habitat heating, seasonal heat storage in shallow thermal repositories (not in ice-rich permafrost of course), or it can be returned to the deep geothermal source to avoid waste heat dissipation.

Ground-source heat pumps in the north are usually considered impractical because of the low initial ground temperature (below 0°C) and the continued cooling associated with the extraction of heat. However, if excess low-grade heat from deep geothermal sources (or surface sources such as diesel power generators) can be stored at a seasonal time scale (one year), these shallow systems become highly efficient for habitat heating. It appears feasible to use parabolic solar thermal collectors in the long sunny days to “recharge the thermal battery”, creating a hybrid geothermal energy system (power + heat + storage) in combination with the deep heat source.

These novel concepts may open the way to reductions in the need for diesel fuel in the north.