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DIRECT UTILIZATION OF GEOTHERMAL ENERGY IN SIX ALASKAN TOWNS

Ramon Grijalva, Patricia Kirkwood and John Farquhar

Pacific Sierra Research Corporation
Santa Monica, California

This report summarizes the potential for direct (non-electrical) utilization of local-gradient geothermal energy in six Alaskan towns. A major objective of this study was to stimulate development and use of the geothermal resource provided by the earth's average thermal gradient, as opposed to the few anomalies that are typically chosen for geothermal development. Hence, six towns for study were selected as being representative of remote Alaskan conditions, rather than for their proximity to known geothermal resources. The moderate-temperature heat available almost everywhere at depths of two to four kilometers into the earth's mantle could satisfy a major portion of the nation's heating requirements--but the cost must be reduced. We conclude that a geothermal demonstration in Nome would probably be successful and would promote this objective.

HEATING

It was hypothesized that the high fuel costs in most of Alaska (due to transportation) and high heating duty-cycle (due to climate) would show geothermal energy to be economically competitive. Based on space heating alone, it was found that

a. In Nome and Wrangell, the geothermal costs are close enough to fossil costs to warrant consideration on economic criteria alone;
b. Huslia, Nikolski, and Kiana are too small for economic development of the geothermal resources, due to the high well costs--development must rely on social advantages;
c. In Barrow, geothermal energy cannot compete economically with a natural-gas well located near the town.

The table below compares annual costs of geothermal space heating and present conventional heating. The geothermal estimates are highly conservative, including the capital, interest, and maintenance costs associated with a totally new space-heating system, whereas the conventional estimates include only fuel costs. The geothermal costs are highly sensitive to our estimated cost of drilling in these areas. Uncertainty in the geology and the drilling costs have a major influence on the validity of cost comparisons determined in this study. Advances in drilling technology would significantly lower the costs.

	Projected 30-Year Average Annual Cost	
	Geothermal	Conventional
Barrow	$6,147,000	$2,137,000
Huslia	2,779,000	178,000
Kiana	2,350,000	422,000
Nikolski	2,410,000	105,000
Nome	5,313,000	3,194,000
Wrangell	2,674,000	2,579,000

OTHER APPLICATIONS

The costs of geothermal heat would be reduced by developing additional applications for hot water. Potential applications for utilization of moderate-temperature geothermal energy in the six towns studied are numerous and varied.

In villages where subsistence patterns dominate the economy, such services as community bath and wash houses, refrigeration facilities, and individual greenhouses can make major contributions to the quality of life but are difficult to equate with cash benefits in a non-cash economy. Similarly, moderate-temperature geothermal heat can enhance rates of biodegradation for sewage treatment and soil improvement, particularly crucial applications in the Arctic. Special precautions in programs involving ground or soil heating are required in permafrost regions of Alaska including the study towns of Barrow, Nome, and Kiana.

DEMONSTRATION SITES

The decision to construct a geothermal system will be based on several criteria. The table below summarizes the ratings of each town for a demonstrated site as a function of alternative economic and social criteria.

We recommend Nome as a candidate for a demonstration of moderate-temperature applications from a hot, dry-rock reservoir. Nome's status as a regional population center and its relatively large population would make such development highly visible and dramatic, as well as potentially cost-effective. Development of significant new geothermal uses or a 50-percent reduction in drilling costs would ensure economic viability of this demonstration.

Criterion for Demonstration	Sites					
	Nome	Wrangell	Kiana	Nikolski	Huslia	Barrow
To determine relative costs, geothermal vs. alternate	excellent	excellent	fair	poor	poor	poor
To create high visibility, low-cost installation	good	fair	excellent	good	fair	poor
To enhance regional development	good	poor	excellent	good	poor	poor
To foster social stability	poor	poor	good	excellent	poor	poor

Kiana's central location among other villages in the Kobuk-Selewik region, and its highly favorable social climate, make this village a promising site for a total energy system based on geothermal energy (hot, dry-rock resource) and multiple applications. New industry is badly needed in this part of Alaska and would be readily catalyzed by such development.

Nearby geothermal resources make Nikolski a very attractive candidate for geothermal development. The local-gradient resource is expected to be relatively inexpensive to develop, though not cost-competitive for the present small population of Nikolski. An important cultural benefit that would occur with geothermal development at Nikolski is the stabilization of the Aleut culture, which is in danger of disappearing entirely in future years. This stabilization would also mean continued occupation and growth of Umnak--the oldest continuous settlement in the Western Hemisphere. In time, geothermal energy might generate a cultural and economic oasis.

The cost of geothermal development for space heating in Wrangell appears to be competitive with fuel costs over the next 30 years. Development of hydroelectric resources near Wrangell is likely and might prove to be complementary (or possibly competitive) to geothermal energy.

ALASKA VERSUS "LOWER 48"

Legal and institutional factors are expected to make geothermal development in Alaska easier than in the lower 48 states. Fewer regulations and permits currently pertain in Alaska, since much of the land with potential for geothermal development is subject to state and federal regulations but few, if any, local regulations. Most land in the areas studied is owned by the state, federal government, or native corporations. The native corporations are generally eager to cooperate in endeavors that promote development in their regions and may invest in such development when geothermal implementation becomes less speculative. Local politics and interactions between regional and local native corporations will require a judicious approach at such a time.

For further geothermal development in Alaska, improved drilling technology and concomitant reduction in the cost of drilling will be of primary importance.

Though information from this study may be extrapolated to other Alaskan towns, it is not valid to assign similar weights to the individual costs of local-gradient geothermal implementation in towns of the "lower 48." For example, whereas labor and material costs for Alaska run 1.4 to 3 times the base rate in the rest of the nation, Alaskan deep-drilling costs are around 10 times those in the contiguous United States. Reduction of these drilling costs could make utilization of normal gradient geothermal resources in Alaska economical in the near future. The relatively low cost of drilling in the "lower 48" and the dominance of these costs in the final cost-benefit analysis suggest further consideration of local-gradient geothermal energy in the contiguous United States.