Electric Power and Environmental Health in Alaska Native Villages

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ENVIRONMENTAL HEALTH in the United States has improved hand in hand with the increased availability of electric power. Although a direct causal relationship may be lacking, there is no doubt that power has contributed vastly to the factors considered important to better environmental health. Electric power has become such a part of our lives that even the thought of doing without it would bewilder all but the most avid naturalists.

Large segments of the Alaska community, however, are power starved. The inhabitants of remote Alaska native villages year after year have had few of the environmental health benefits and conveniences that power brings. The present status of power and specific ways in which electric power could benefit environmental health and might be made available in those villages where it is lacking are outlined here.

Two-thirds of the towns in Alaska have fewer than 200 inhabitants; the median-size community is 129 people (*1*). The typical remote village is a collection of residences, a school, a church or two, a small general store, and usually little else.

Unemployment is high, and the incidence of welfare assistance is high. There are often only four or five full-time employees in a village. There is great dependence on fish and game for food. Far from the railroad and highway, the only outside contact for many of these villagers is through radio, the bush plane, and the arrival of a boat once a year.

Even the briefest visit to a remote village reveals that many native homes have no electric power and totally lack the necessities and conveniences that power makes possible. I have attempted in table 1 to quantitate the percentage of Alaska native homes in areas that have public power available. In this report, public power refers to electric power systems available to the public, whether ownership is public or private. The data include 213 cities and villages on which information could be found. The map outlines the areas covered in this table.

The sources (*2*, *3*) from which these data were taken, while reasonably accurate, give an overly optimistic picture in showing that 53 percent of Alaska natives live in areas served with public power. Many native homes in these areas do not use the power because of the cost. The data also do not show how many natives are included as being "in" a village or community even though located on the outskirts far from the limits of the powerlines.

Although no definite data could be found on the number of native residences with full-time electric power inside, it is suspected that the figure more closely approaches the 32 to 35 percent shown for the Tanana and Chain areas rather than the 53 percent average for the State. For comparison, 98.8 percent of residences in the entire United States have electric power inside, and 95.9 percent of U.S. farms have power. The 53 percent mark for power in residences was passed in the United States as a whole in 1925, nearly 40 years ago (*4*).

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Benefits of Power

One of the principal factors in improved environmental health made possible by electric power is running water inside the house. Schliessmann (*5*) has demonstrated the relationship between enteric infections and the accessibility of water. He showed that prevalence of *Ascaris* in a population with water piped into the homes was about 60 percent of that found in a population without the piped-in water. The difference in prevalence of *Shigella* among preschool children was even more striking. Children in homes with piped-in water had less than half the incidence of *Shigella* of children in homes without water.

In a similar study of 6,000 migrant workers in Fresno County, Calif., Hollister (*6*) showed a much lower rate of enteric infection in families with water taps available inside the house than in families without, even though water was available nearby outside these houses. He concluded that "control of *Shigella* infections may be significantly improved through a single practical modification of the environment—provision of easily accessible water for personal hygiene."

These studies make clear that the accessibility of water is a major factor in controlling enteric diseases. The findings appear to have wide application in Alaska villages for two reasons. First, enteric diseases are reported (*2*) to be a major problem in five of the seven Alaska areas cited in table 1. Second, according to the 1960 census, more than 12,000 rural nonfarm Alaska homes do not have running water (*7*).

Electric power then could be the basic means for bringing running water to these homes and a significant factor in improving environmental health in a large population group. This is not to say that power equals running water in homes. However, because of the difficulties in establishing and maintaining a water system in the very cold climate and remote areas, power is a prerequisite since practically the only way of providing running water to these homes is through the use of power.

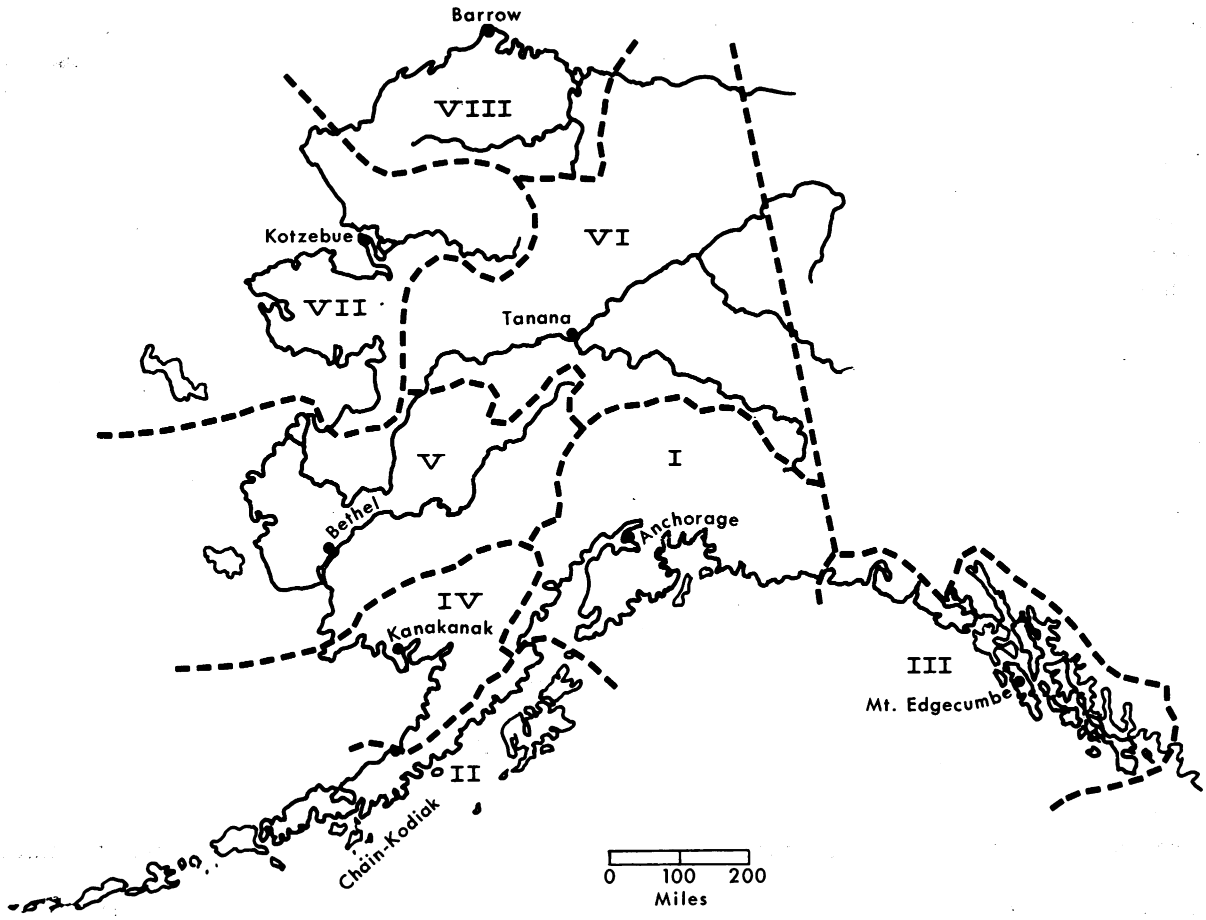
Refrigeration is another important environmental benefit made possible by power. Despite the cold climate, adequate refrigeration is a vital need in rural Alaska in preventing spoilage of food. Summer is an especially critical period, for it is then that the native Alaskan gathers the fish and game that must last through the winter.

In addition to preventing spoilage, refrigeration can destroy parasites found in food fish. Hilliard (*8*) shows that larval cestodes and other helminths, which cause fish tapeworm in humans, are killed if exposed to 0° F. for 24 hours. He cites a 30 percent incidence of tapeworm infection in the Kuskokwim River area, which is not surprising when one considers that the people habitually consume raw or partially cooked fish containing the tapeworm larvae. Since the tapeworms compete with their hosts

Table 1. Percentage of Alaska natives living in areas served with public electric power

District	Natives in district [1]	Communities with full-time public power	Natives in areas served with full-time public power [2]	
			Number	Percent
Anchorage	3, 619	24	3, 036	84
Chain-Kodiak	2, 347	4	753	32
Mount Edgecumbe	7, 327	12	6, 046	82
Kanakanak	2, 338	6	1, 147	49
Bethel	10, 293	15	3, 836	37
Tanana	4, 465	4	1, 562	35
Kotzebue-Barrow	9, 731	6	4, 887	50
Total	40, 120	71	21, 267	53

[1] 1960 census or later estimates where available.
[2] Public power refers to full-time electric power available to the public, whether ownership is private or public.
SOURCE: References 2 and 3.



Survey districts listed in table 1, Alaska

for certain nutrients, a means of destroying the larval cestodes in food fish would be of particular value for native peoples of western Alaska (*8*). Infected persons can receive medical treatment, but since they may be subject to almost immediate reinfection, effective control of this problem depends on preventive measures. Dependable community or private deep-freeze refrigeration, available only through electric power, appears to be a practical solution.

A major benefit of power is light. Particularly in the arctic environment, with extended periods of darkness during which the family spends most of the time inside the home, good lighting cannot help but enhance health in several ways: in cleanliness, by enabling one to see the dirt; in education, by providing light to read by and power for radios and phonographs; and in mental well-being, by making the surroundings more comfortable and pleasant. While recognizing this particular statement as subjective, one can find in the literature any number of references to the importance of these three factors in health. Incidentally, although the transistor radio has made receiving sets independent of a power source, 26 percent of homes in the predominantly native areas of Alaska in 1960 had no radio (*7*).

Power appliances and tools such as saws, sewing machines, and washing machines provide the family with the means to improve themselves and their housing and surroundings and may also give the aspiring family an opportunity for economic improvement through more efficient manufacture of goods for home use or sale.

The residents of remote villages recognize the need for power and want it. This is clear from the fact that of 142 villages reported to have no public power available, in only 18 was there complete lack of electricity (*2, 3*). For the remainder, in almost every case the village survey cards (*3*) reported "several private plants," "church and store have plant," "eight private plants—some sell to neighbors," or similar expressions. The sizes of the private plants are 1.5 to 3.5 kw. for the most part, indicating that they are intended for use by single families or small groups.

Although these plants cannot be considered as comparable to public power in adequacy and reliability, their existence demonstrates the residents' awareness of the importance of power and their willingness to pay for it. The questions therefore arise as to why public power is not available now and how it can be provided.

Cost of Power

Cost is one reason why electric power is not more widely available in rural Alaska. The small villages represent widely dispersed small markets (median size, 129) so that the charge per customer is high for a public lightplant. The high cost keeps many potential customers from subscribing for service, thus reducing the market still further and increasing the charge per customer. The relatively high cost of power and the relatively low amount of cash available in villages makes power a luxury item for the typical remote village dweller.

Kotzebue has its own powerplant. With 976 natives and 200 whites, Kotzebue is one of the larger communities inhabited predominantly by Alaska natives. It is relatively well developed, having two schools, five churches, three general stores, and a restaurant.

The Public Health Service native hospital serving the area is in Kotzebue, and two commercial airlines serve the community. There are a few private wells and septic tanks; however, the natives generally obtain water by hauling it in summer and melting ice in winter and dispose of sewage by dumping "honey buckets" outside. There is daily delivery of mail, a telephone system, and a municipal powerplant.

Kotzebue's electric rates are compared in table 2 with those in Anchorage and Washington, D.C., on a kilowatt-hour basis. These rates are converted into typical monthly electric bills in table 3. Compared with the other communities

Table 2. Comparison of Kotzebue's current residential electric power rates with current rates in Anchorage and Washington, D.C.

Kilowatt-hours used	Kotzebue village (population, 1,176)	Urban Anchorage	Rural Anchorage	Washington, D.C.
First 50	$0.20	$0.055	$0.064	$0.024–.042
Next 200	.085–.11	.031	.037	.024
All over 250	.08–.085	.024	.032	.018–.024
Deposit required	40.00	20.00	30.00	(1)
Minimum charge for month	9.00	2.00	2.00	1.50

[1] None.

Table 3. Comparison of typical residential monthly electric bills in Kotzebue, Anchorage, and Washington, D.C., and the national average

Kilowatt-hour used per month	Kotzebue village	Urban Anchorage	Rural Anchorage	Washington, D.C.	National average, 1957 [1]
250 national average	$28.25	$8.95	$10.60	$6.68	$7.08
580 for a 4-bedroom, 2-bath house with usual appliances but excluding heat	54.90	16.86	21.17	12.91	(2)

[1] Reference 9, latest year available.
[2] Not available.

Table 4. Comparison of lighting costs; private plants or gasoline lanterns versus electricity, Kotzebue rates

Light source	Initial cost	Operating cost (kw.-hr.)
Kotzebue lightplant:		
Meter charge, deposit, etc.	$40	$0. 20–. 08
Wiring, fuse box, fixtures (approximate minimum)	20	----------
Gasoline lantern and extra mantles (equivalent to 300-watt bulb)	18	[1].075
Individual powerplant (3,500 watts)	400–600	[2].20 [3].50

[1] For equivalent light and assuming $0.75 per gallon for gasoline.
[2] Full load.
[3] ¼ load and assuming $0.75 per gallon for gasoline.

and with the national average, the rates in Kotzebue are very high, yet the village plant is a success and is being supported by people with much lower incomes than the national average (*2*).

That the Kotzebue plant can succeed with such rates is ample demonstration of the need and desire for electricity. However, if Kotzebue, with more than 1,000 people, must charge such high rates, there appears to be slim hope that small villages can succeed in establishing and maintaining an adequate village powerplant without outside help.

Table 4 compares the cost of gasoline powerplants or lanterns for light with the electric power costs at Kotzebue and shows that people using portable plants are now paying the equivalent of Kotzebue rates or more for power. The table also shows that the use of gasoline lanterns for light, while somewhat cheaper than power, is still quite high. This emphasizes still further how much people want electric light and power and brings us to the question of how power can be provided economically to small villages.

Power Requirements

In considering how to provide electric power to remote villages, the amount required should be explored. This can be estimated for residential services, needed public works such as community freezer plant, water plant, meeting hall, street lights, and other public uses, and for large consumers such as schools and stores.

In calculating power requirements, it is necessary to distinguish between average use and generating capacity. The latest available figure for national average use of residential power is 0.35 kw.-hr. per dwelling unit, while the generating capacity is close to 3 kw.-hr. per dwelling unit (*4*). The generating capacity must meet the peak use and therefore must be several times the average use. This is necessary because power is not used continuously. A household may be using five times the average in the early evening and close to zero at 3 a.m.

If a central power system were made available in a village for the first time, the initial use would be much lower than the national average since the inhabitants would own few appliances requiring power. They probably would install radios and light bulbs first because of low cost and easy accessibility. An initial peak load of 0.2 kw.-hr. per dwelling could easily be reached any evening if every dwelling had a radio and two 50-watt lights turned on.

As the villagers became accustomed to using electric power, appliances such as freezers, sewing machines, record players, and hotplates would likely be added, increasing both average and peak use. With this in mind, an initial generating capacity of 0.5 kw.-hr. per dwelling unit would not be unreasonable. This would cover the basic needs of light, freezer, radio, washing and sewing machines, and some other appliances.

Allowances for needed public works and a school would vary with the size of the village and for convenience might be consolidated and expressed as kilowatts per residence. These combined users would not likely exceed the residential use and might need only half as much. A villagewide power-generating-capacity design requirement could reasonably be set at 0.75 kw.-hr. per residence.

Fortunately, the choice of an initial design figure is not critical, as it is possible to add generating capacity as use grows. The critical factor is to realize that use of power will grow as it becomes available and as the villagers get accustomed to it. Therefore, it is important to allow for a large growth factor in the design of the transmission lines and other permanent installations even though initial use is low.

Ways of Obtaining Power

With the potential waterpower in Alaska, long-distance transmission and penetration of powerlines into isolated areas, such as the Rural Electrification Administration has accomplished in other parts of the United States, is bound to come eventually. However, the only practical source of power now open to remote villages is the local generating plant, and only this source is considered here.

The greatest needs are to provide outside help to the villages in getting started and to devise ways of lowering power costs. The first need is principally financial and will not be discussed here. However, there are Federal and State agencies with authority and responsibility in the field of community facilities improvement. It is to be hoped that a village powerplant will be included in each such project where there is no public power.

Assuming that a village obtains a plant with outside help, the problem then focuses on ways to reduce the cost per kilowatt-hour. Two methods to reduce unit power costs are to increase the use of power and to operate the generators at as close to optimum load as is possible. There are many ways to help in doing this. Almost every village has a school. In areas not served with power, these schools, of necessity, generate their own power from small plants. They would probably be more than willing to purchase power from a village powerplant if a reliable one existed and would benefit thereby from lower costs and more convenience.

In villages with Federal Aviation Agency sites, National Guard armories, hospitals, canneries, or other commercial enterprises, similar arrangements might be mutually beneficial to all. Costs could also be reduced by smoothing out peak loads so that generators could run closer to optimum speed. This might be accomplished by operating public works such as a community waterplant or freezer or even a cannery at off-peak hours. It would not be necessary to reduce costs to match other U.S. rates; maintaining them below the cost of operating private plants or gasoline lanterns would be a significant gain.

If the REA or other outside source of power eventually arrived, the villagers would have the choice of maintaining their own plant or connecting their existing powerline network to the new source.

Many problems remain to be solved before full-time power becomes available in remote Alaskan villages. I feel that the widespread availability of adequate electric power is second only to good housing as a means of improving environmental health in these villages. Although power itself will not automatically improve health in these areas, it may be the only means through which better housing and the other factors important in environmental health can become a reality.

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