Sustainable Utilities in Rural Alaska

Effective Management, Maintenance and Operation of Electric, Water, Sewer, Bulk Fuel, Solid Waste

FINAL REPORT

Part A: Overview

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Executive Summary

Project Intent. Reliable and affordable utility services remain out of reach for thousands of Alaskans and between $1.5 and $2 billion of public investment is potentially at risk due to the inadequate operations, maintenance, and management of electric, water, sewer, bulk fuel, and solid waste utilities in many small rural Alaska communities. This report provides a foundation of facts and ideas that can be used to move toward sustainable utilities in these places.

Utility Cost and Consumption in Alaska. Alaskans in PCE communities pay about twice as much as Anchorage residents for electricity and use only 40% as much power. Many users of flush/haul systems have cut back their water consumption to less than 6 gallons per person per day to reduce their bills, despite significant health risks, while Anchorage consumers use about 100 gallons per person per day. Despite consuming less, rural consumers pay between 3.2 and 5.1 percent of their household income for electric, water, and sewer service, while Anchorage residents pay about 1.5 percent.

Economic Context. The demand for utility services is growing faster than the economic base in rural Alaska. The rural economy is tied to the statewide economy, and statewide economic performance during the 1990s was lackluster and dominated by increases in transfer payments. Real personal income in Alaska increased by $1.8 billion between 1990 and 1999, but more than 90 percent of this increase is due to the growth of Permanent Fund dividends, federal transfers, federal grants, and the economic multiplier effects created by these cash infusions. Rural economies are similarly becoming more dependent on grants, transfers and dividends. In parts of Interior Alaska the dollar flows from federal grants and PFDs are now 40% of total regional income whereas in 1990 they were only 20%.

Cultural Context. Rural Alaskans face trade-offs between the need for cash income and the need to participate in subsistence. This trade-off makes it hard for small utilities to keep trained operators on the job and means that sometimes people must choose between raising cash to pay utility bills and getting food for their families. Given this fundamental tension between traditional culture and the forces of modernization, some feel that there is a critical linkage between outside influence, local capacity, and long-run prospects for sustainability. According to this view, sustainability is as much about cultural survival as it is about economics. Therefore, the manner in which services are delivered and by which communities develop their general capacity for self-governance is equally, if not more, important to long run sustainability than the achievement of some predetermined standard of conduct or performance by a utility. The Governor's Council on Rural Sanitation echoed this view when it stated that "Performance targets should be developed as a *collaborative effort* between the community and the funding agency."

Approaches in Other Places. Other countries and regions also struggle to provide rural utility services. In Finland, Canada and other regions of the United States there are no "magic bullets" by which to overcome the problems of high cost, remoteness, and lack of economic base. Subsidies seem to be required to bridge the gap between high costs and affordable rates. Local control, a sense of local ownership, and the passage of time have all been important to progress.

Current Subsidies and Incentives. All of the major utilities are subsidized, to some degree, in both urban and rural Alaska. PCE is highly visible but has an economic present value of less than $7,500 per recipient, compared to more than $10,000 per resident of the Four Dam Pool service territory. More than $1.5 billion has been spent on rural water and sewer capital projects, but Anchorage also benefited from more than $200 million in water project funding during the 1980s. Telecommunications are also highly subsidized. Although service is provided by private firms, rates are held down by the annual inflow of about $120 million from out of state ratepayers and federal sources. There has been little previous cash expenditure on bulk fuel and solid waste subsidies, but current estimates indicate a backlog of several hundred million dollars in needed repairs and replacements.

Current rural utility subsidies and assistance programs have seven major incentive effects:

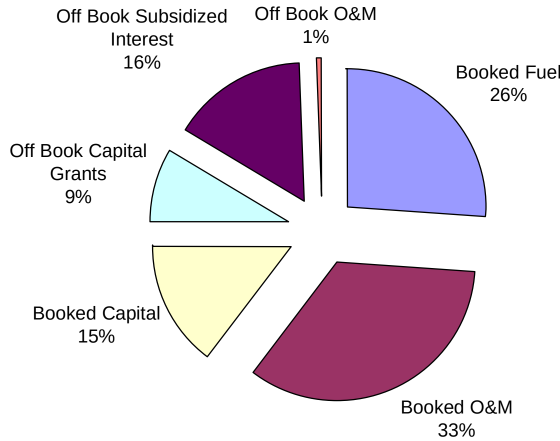
- They are biased toward capital-intensive water and sewer technologies.
- Understaffed agencies are under extreme pressure to move large amounts of money and to measure success by the number of projects completed. In this environment, it is very difficult for agencies to devote resources to the community planning and interaction required for sustainability.
- Current programs tend to respond to perceived "needs," rather than rewarding sustainable performance.
- They provide large amounts of targeted support for capital construction, but little or no targeted support for preventive maintenance.
- PCE rules reward high-cost operations and encourage the loading of general government costs onto the electric utility.
- Cost-saving innovation is discouraged.
- Current subsidies focus on production and can penalize efficiency improvements that reduce consumption.

A major attempt during the early 1990s to tie PCE payments to improved fuel efficiency met with mixed success. Of the 90 utilities not initially in compliance with efficiency standards, only 15 moved into compliance during the following decade.

The True Cost of Rural Utility Services. The true cost of utility service includes operating and maintenance plus the cost of providing, renewing, or replacing capital equipment. All utilities incur these costs, but some of the costs may not be carried on the utility's books. True cost can exceed book cost when the utility uses capital funded by grants or subsidized loans and when it defers or neglects maintenance.

We estimate that it costs between $80 million and $120 million per year to provide each of the major utilities – electricity, water/sewer, and telecommunications – to rural Alaska consumers. In the case of electricity, fuel and booked operation and maintenance together account for 59% of total cost. Capital costs carried on utility books account for 15%. The remaining 26% is "off-book" and consists of government-funded capital construction. Government funded O&M assistance accounts for less than 1% of the total true cost of electricity.

Components of Total True Cost of Electric Service (all PCE Communities)



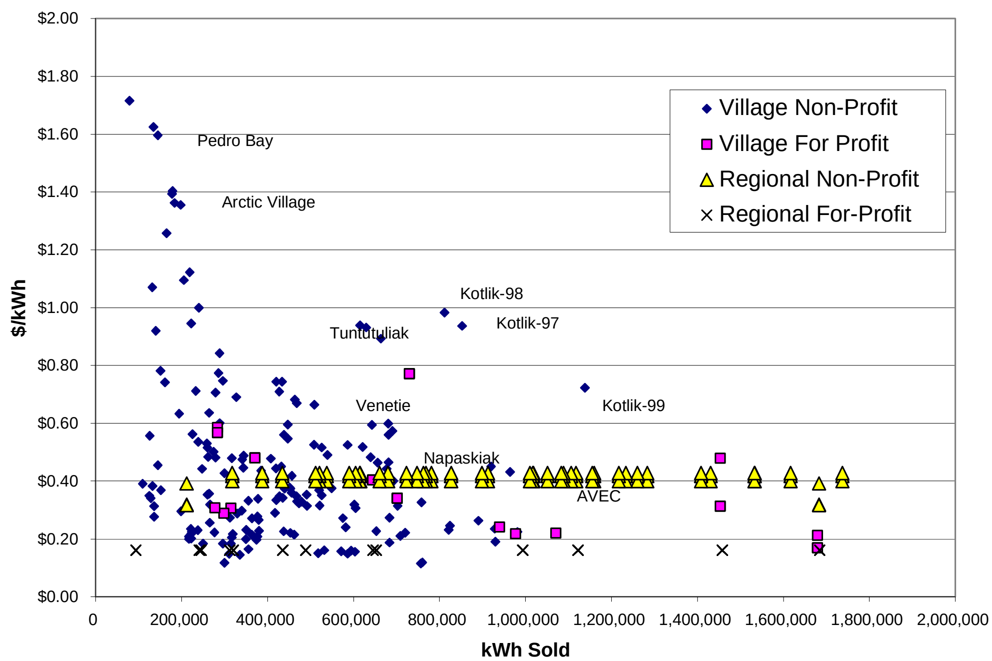
The true cost of rural water and sewer is about $100 million per year, consisting of $75 million to amortize capital investment, $10-15 million in O&M funded through rates, and $5-10 million in O&M funded by other sources, deferred, or avoided. Due to the sporadic nature of system replacements and emergency repairs, we still do not know what the true cost of water and sewer service will turn out to be over longer time scales that encompass capital replacement.

The true cost of bulk fuel storage is roughly $1.50 per gallon delivered from the tank. About half this cost is capital expense, and spill response capability may contribute up to 60 cents. Bulk fuel is expensive because the fuel is stored for an entire year. Hence, the fixed capital cost is spread over relatively few gallons delivered.

The true cost of solid waste disposal is largely unknown because so much remains to be done to replace open dumps with adequate new landfills. The Indian Health Service Sanitation Deficiency System shows that there is a backlog of at least $60 million just to close down open dumps in Alaska. It seems clear that based on this unmet need the true cost of rural solid waste is currently being paid in the form of health and environmental risks rather than dollars.

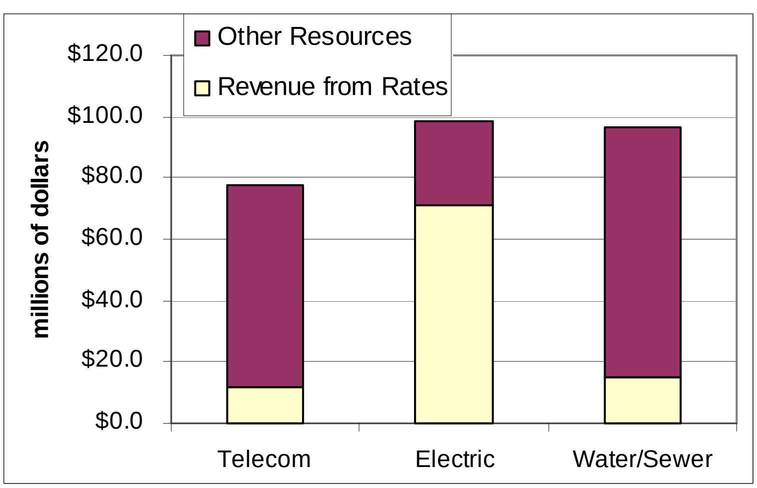
Cost vs. Management Structure. Although one private regional utility has particularly low costs, the true cost of electricity appears to be statistically unrelated to the type of management structure.

True Non-Fuel Cost of Electricity vs. Annual Sales, for Different Management Structures
(Village Level Data for Places with Electric Sales of Less Than 2 million kWh/yr)



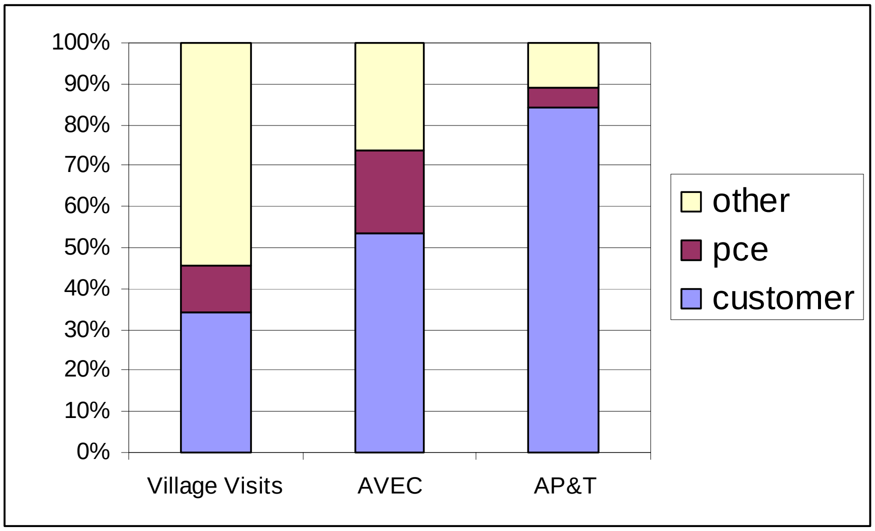
Cost vs. Rates. Utility rates often bear little or no relation to the true cost of service. Consumers in rural Alaska pay only about 15% of the cost of telephone and water/sewer costs through rates, but they pay between 60 and 75% of electric costs.

True Cost of Rural Utilities vs. Revenue from Rates



The portion of total cost paid by customers varies widely. In our case study communities[1] rates and PCE cover only about 45% of true cost. The remaining 55% is paid for by government capital grants (54%) and O&M programs (1%). At AVEC, about 54% of true cost is covered by customer payments, about 20% by PCE, and about 26% by government capital subsidies, mostly in the form of low-interest loans. Alaska Power and Telephone customers cover 84% of total costs, in large part because AP&T operates in relatively large communities.

Sources of Funds to Cover Cost of Electric Service



[1] Tuntutuliak, Napaskiak, Venetie, Deering

Overview

1.1. Project Intent

Adequate utilities are a basic foundation of economic and social well-being in American communities today. However, despite decades of effort and billions of dollars spent, this foundation is still out of reach for many residents of small communities in rural Alaska. From a purely fiscal standpoint, a huge and growing public investment in rural utility infrastructure -- approaching $2 billion of gross value and growing by $60-$100 million per year – is potentially at risk due to inadequate operations and maintenance. The problem is most dramatically illustrated by the catastrophic failure of several rural utility systems during the past two decades.[2] Such failures can mean the instant loss of several million dollars of investment which must be replaced at great cost or abandoned. But the issue goes far beyond fiscal responsibility. Reliable electricity, clean water, effective sanitation, and the removal of solid waste are basic requirements for public health, social well-being, and economic development.

The original purpose of this project as articulated by its sponsors is as follows:

Project Purpose
The following is a listing of goals for a Management, Maintenance and Operation Study (Phase 2a of a comprehensive statewide energy plan).

A. Provide a clear understanding of total life cycle costs, including operation, maintenance and management of water, sanitation, solid waste disposal, electric power and bulk fuel storage utilities in rural Alaska.
B. Identify socially and culturally appropriate and cost efficient public policy incentives associated with rural utilities in Alaska.
C. Examine and develop management, operation and maintenance approaches for core utility services (i.e. electric power, water and sewer, solid waste, and bulk fuel). Identify and define existing management structures that promote the development, maintenance and operation of socially appropriate, reliable, sustainable, and cost efficient rural utilities.
D. Define policy options, improved ordinances, and best practices designed to help improve utility management, operations, maintenance and efficiencies in rural Alaska villages. Present the findings in a list of policy recommendations, utility operational models and best service practices that are understandable to village residents, policy makers and service providers (for example, standardization).
E. Provide a list of service alternatives from minimum service (individual) to community based services.

[2] Catastrophic failures have occurred in Kotzebue, Venetie, Goodnews Bay, and Mekoryuk. Most occurred during the 1980s. Due to advances in technology such as plastic “freeze-friendly” piping, and better maintenance practices such as RMW program, there has been a dramatic reduction in the number of such failures. However, that reduction may be difficult to sustain unless O&M resources keep pace with capital investment.

The intent of this project is to focus on the long term sustainability and efficient operation of utility infrastructure in rural Alaska. To protect and best use these assets requires sustainable utility management and governance, backed up by community support and community capacity. Thus, we pay primary attention to institutions, incentives, and other components of the "human system." Purely technical issues, while important, are not the central concern of this report.[3]

Scope of Study

This study considers electricity, water and sewer, bulk fuel, and solid waste. It focuses on small communities not connected to the road system. These are sometimes referred to as "bush" communities (Thomas 1998).

It is not possible to draw clear geographic or demographic boundaries around the study area. For statistical analysis of electric utilities, we use the Power Cost Equalization (PCE) database. There are about 190 communities currently eligible for PCE and contained in this database, and we include them all when calculating the statewide total cost of rural electric service. Some of these communities are relatively large and/or connected to the road system, such as Cordova, Bethel, Nome, Kotzebue, Haines/Skagway,[4] or Tok. These communities generally have annual electricity sales of more than 10 million kilowatt hours (kWh), and their electric utilities are generally considered sustainable, given current levels of PCE support.

A second group of about 30 communities has annual electricity sales of between 2 million and 10 million kWh. The remaining group consists of about 120 communities with annual sales of less than 2 million kWh. We focus our analysis on this group of communities because they typically face the greatest challenges to sustainable utility operations.

For analysis of water and sewer utilities, we generally consider communities places with population under 1,000 people. Most of these places are eligible to participate in the Village Safe Water Program.[5] A 1998 survey by the Rural Utility Business Advisor (RUBA) program created a database of 168 of these communities. We use this database for statistical analysis.

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[3] The recently updated *Cold Regions Utilities Monograph* (ASCE 1996) provides an excellent overview of technical problems and approaches from an engineering standpoint.

[4] The PCE database is based on data reported by utilities. Some utilities report data for more than one community as a single piece of information.

[5] Colt & Hill (2000) estimated that there are more than 250 entities potentially eligible for the VSW program. Tribal governments, school districts, and isolated unserved areas within larger communities can apply for VSW assistance, in addition to small communities.

The Denali Commission (2001) has identified 168 communities with current or imminent bulk fuel needs.

In summary, although there is some lack of overlap among these groups of communities, this study is focused on between 150 and 200 places, almost all of which have fewer than 1,000 people and are not connected to the road system or to each other. It is easiest to think of these communities as being the group of small PCE and VSW communities.

Major Data and Information Sources

Because the issues related to sustainable rural utilities are so complex, we have drawn upon a wide range of previous research and information sources. In addition, some of the key findings in this report are based on original research and data development.

We developed and/or analyzed the following major data and information sources:

- Community visits: site visits to Deering, Venetie, Napaskiak, Tuntutuliak
- Database covering 150 communities on true cost of electric service developed from annual and monthly PCE filings during 1997-99
- Division of Energy / AIDEA grants records for 1995-2000
- Denali Commission project files
- Individual utility rate filings
- Data on true cost of water and sewer systems developed from previous ISER studies and actual project experience
- Key informants: extensive interviews with utility professionals from public and private sectors, from Alaska, Canada, Finland, Virginia, Texas, New Mexico
- PCE annual statistical reports
- AIDEA bulk fuel database
- AIDEA / AEA electric system condition assessment
- ISER / ANHB O&M Demonstration Project including in-depth interviews with 33 communities
- 1999 RUBA Survey of 168 community water and sewer utilities
- Literature review: more than 100 technical and management documents from other places, technical, trade, and professional associations, and government agencies.

1.2. The Setting and the Problem

It is a tremendous challenge to build, operate and maintain basic utility systems in rural Alaska today. Most rural villages are small (under 1,000 population), remote (not connected by roads or utility grids), have very low per capita cash income (less than $15,000[6]), and face

[6] Colt and Hill (2000) estimated that the average per capita income in VSW communities was $13,000 in 1999.

formidable environmental challenges, including Arctic winters, permafrost, poor soils, and seasonal flooding.

Electricity is generated by isolated diesel generators that are not tied into regional grids. Water and sewer systems must move fluids to and from buildings under some of the harshest environmental conditions on the planet. Fuel and construction materials cannot be delivered by truck; they must be barged in during short summers or delivered by air. Remote local economies generate little cash to support utility operations.

Arctic utility systems are very expensive. Many of the electric systems and almost all of the struggling sanitation utilities are run by local governments. With a small customer base and limited income, many--if not most--systems are not self supporting. The difference between customer payments and the actual cost of day to day operations is made up by the power cost equalization program (PCE), by general city revenues, by several state and federal assistance programs, and by the deferral or avoidance of maintenance, with public agencies often picking up the bill for major repairs or premature replacement.[7]

While the lights are generally on in rural Alaska, inadequate sanitation and water supply remains a serious problem.[8,9,10] Thousands of Alaskans in small rural villages lack flush toilets and running water. Bulk fuel facilities are in serious disrepair. The Denali Commission (2001) has identified the need to immediately replace more than 45 million gallons of fuel storage capacity.

This situation is not necessarily due to an overall lack of funding -- more than $1.5 billion has been spent on capital construction projects and valuable lessons have been learned from engineering research and development. Instead, there is widespread agreement[11] that inadequate

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[7] Colt, Stephen, 1994. *Operation and Maintenance Issues in Rural Alaska Sanitation*. Prepared for US EPA / Region 10 and Federal Field Work Group on Rural Alaska Sanitation. Anchorage: Institute of Social and Economic Research.

[8] Miller, Nina, and Joe Sarcone, 1999. *Rural Sanitation Facilities Operation and Maintenance Demonstration Project: Interim Project Report.* Prepared for Alaska Native Health Board, Anchorage AK, and U.S. E.P.A. Region 10. April.

[9] Governor's Council on Rural Sanitation, 1998. *Rural Sanitation 2005 Action Plan.* Available from the Council, c/o Department of Environmental Conservation, FC&O, 410 Willoughby Avenue Suite 102, Juneau AK. February.

[10] U.S. Environmental Protection Agency, 1995. *Federal Field Work Group Report to Congress on Alaska Rural Sanitation.* Seattle WA: U.S. GPO, EPA 910/R-95-002.

[11] At least one Steering Committee Member disagrees with this contention, stating: “We don't agree that the reason that rural Alaskans lack sanitation infrastructure is due to inadequate operations and maintenance. They lack toilets and sinks because the infrastructure hasn't been built, not because of inadequate operations.”

operations, maintenance, and management is at the heart of the problem. After a year of careful review, the Federal Field Work Group (1994) wrote:

> "It will not be possible to attain a satisfactory level of sanitation service in a significant number of rural Alaska communities unless the O&M issue is addressed effectively. The FFWG regards this issue as one of its key priorities..."[12]

In this report we examine the maintenance, management, and operation of rural Alaska utilities. We ask five fundamental questions:

- What does it really cost to operate these utility systems?
- Who currently pays these costs?
- How can we reduce these overall costs through more efficient operating practices?
- How can rural utilities be made more sustainable? Who should operate them?
- What actions can policymakers, agencies, utility organizations, communities, tribes, and individuals take to make sustainable utilities a lasting reality in rural Alaska?

These questions are important to everyone. Alaskans depend on sustainable utilities for their long-term health, safety, and well-being. State and federal agencies have a multibillion dollar investment in utility facilities at risk due to improper operation, maintenance, and management.

The small population base (often with fewer than 200 customers) of rural communities means that most small utilities cannot afford a full-time utility manager. Many cannot afford inventories of critical spare parts or basic business insurance.[13] Others lack a personal computer or software to keep track of customer accounts; partly as a result, the delinquency rate on customer payments in many villages exceeds 25%.[14] Furthermore, the volunteer tasks required for basic community governance often exhaust the available human resources. As a result, in many cases there are simply not enough human resources to meet the multiple tasks of governance, operation, and maintenance on a volunteer basis. In this environment, breakdowns lead to shutdowns and routine component failure can lead to complete system collapse.

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[12] U.S. EPA 1995, *op. cit.*, p. 13.

[13] Colt, Stephen, 1996. *Yukon -Kuskokwim Region Sanitation Utility Management Options Type I Market Feasibility Study*. Prepared for U.S. Army Corps of Engineers, Partners in Environmental Progress Program, Alaska District. January.

[14] Alaska Department of Community and Regional Affairs, Rural Utility Business Advisor Program (RUBA), *1999 Utility Management Survey*.

1.3. Utility Cost and Consumption in Alaska

At the outset, it is important to understand a few basic facts about the cost and use of utilities in both rural and urban Alaska.

Some people feel that because of the Power Cost Equalization program (PCE), electricity is cheap in rural villages and heavily consumed. There is no evidence to support this view. Even *after* deducting the amounts that PCE covers,[15] rural consumers pay between 15 and 35 cents per kilowatt-hour (kWh) for the first 500 kWh per month. Residents who consume more than this level and all commercial customers pay significantly more. Overall, customers in PCE communities pay about twice the average rate of about 10-12 cents per kWh paid by Anchorage or Fairbanks residents. As a result, rural Alaskans consume only about 4,000 kWh per year, less than 40% of the average consumption of Anchorage or U.S. residents (10,000 kWh/year) (Colt 1993, Energy Information Administration 2001).

The situation is no different for water and sewer. Rural Alaskans lucky enough to have piped water and sewer are generally charged between $50 and $120 per month –sometimes more -- for this service, compared to $49 per month in Anchorage. Many users of flush/haul systems, who pay by the gallon, have cut back their water consumption to less than 6 gallons per person per day in an effort to reduce their bills (Colt 2000). Anchorage consumers use about 100 gallons per person per day (AWWU 1994). Since medical data show a significant increase in the prevalence of infectious diseases when water use drops below 8 gallons per person per day (ASCE 1996, p. 2-3), the low consumption levels currently associated with some flush haul systems could have serious health consequences.

Table 1 summarizes these comparisons and shows that when the low level of per capita income in rural Alaska is taken into account, rural consumers pay between 3.2 and 5.1 percent of their pre-tax household income for electric, water, and sewer, while Anchorage residents pay about 1.5 percent. The water/sewer component of this total burden ranges up to 3 percent of household income. Our review of several studies of affordability suggests that when water and

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[15] The PCE program reimburses utilities for a fixed amount per kWh for the first 500 kWh of residential consumption and for community facility use of up to 70 kWh per person. The reimbursement per kWh is equal to between 75-95% of the eligible costs that exceed the “floor” amount (set at 12 cents for FY2000) and the “ceiling amount” (set at 52.5 cents). The reimbursement percentage cannot exceed 95% by statute, but often falls short of this level due to limited overall funding.

sewer costs rise above 2 percent of household income, ability to pay is compromised (EPA 1996, EPA 1993).

Table 1
Income and Utility Consumption Comparisons

	Rural AK	Anchorage	US
Per Capita Income 1999	13,000	30,000	28,500
Residential Electric Consumption (kWh/yr)	4,000	10,500	10,100
Percent of Household Income Spent on electric/water/sewer	3.2 - 5.1%	1.6%	N/A

Sources: Author calculations based on PCE data, BEA Local Area Personal Income, Energy Information Administration
Notes: Rural Alaska per capita income based on VSW-eligible communities (Colt & Hill 2000).

1.4. Social, Economic and Cultural Context

A realistic approach to sustainable utility services must start with an honest appraisal of the social, economic, and cultural context. We consider this in three steps. First, the statewide economic outlook strongly affects the rural economy. Second, we consider how the outlook for the rural Alaska economy differs from the statewide picture. Third, we discuss the importance of traditional culture, subsistence values and the non-cash economy.

Statewide Economic Outlook

Alaska's statewide economic performance during the 1990s was lackluster compared both to earlier decades and to the rest of the U.S. Most of the job growth was in trade and services while basic sector jobs actually declined. Consequently the average real wage fell and personal income growth was slow. Per capita income, adjusted for inflation, remained flat and by the end of the decade had fallen below the US average for the first time since statehood. All of the increase in population during the decade was in the 40+ age category, as the baby boomers continued to age and the slow economy failed to attract young workers into the state.

There are three key factors that are likely to influence the economy during the coming decade. First, the income flowing into both the private and public sectors from Prudhoe Bay oil production will continue to fall as production declines, and other petroleum activity on the North Slope, as well as growth in other basic sectors, will be hard pressed to fill the resulting gap.

Second, there are a number of basic sectors with growth potential to offset this trend. Other petroleum activity, including the commercialization of natural gas, is the most obvious. Growth in tourism and mining are also likely to bring new money into the state and add jobs.

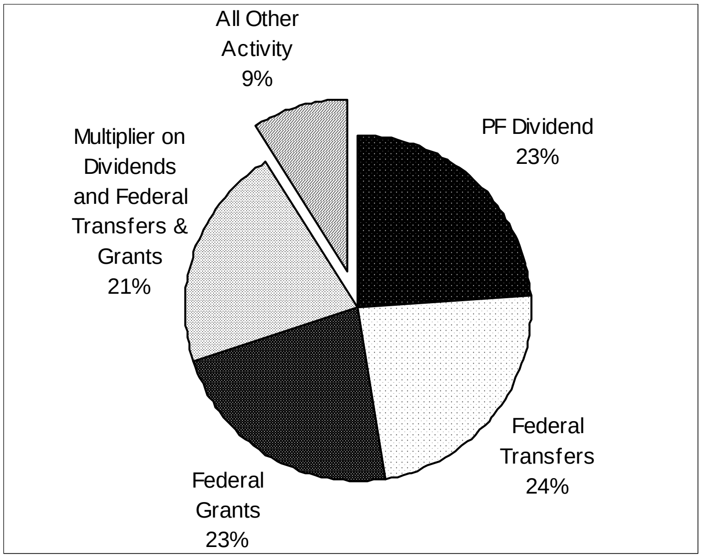
The military presence, which has been declining for several years, could easily rebound. International air cargo activity will continue to expand. Finally Alaska may be able to attract some footloose activities—which do not need to be close to either their suppliers or markets.

Third, the economy is in the midst of a small economic boom, created by a rapid but unsustainable increase in federal and state expenditures in the form of federal grants, federal transfers to persons, and high Permanent Fund dividends. These sources of new money flowing into the economy have enhanced the purchasing power of households and accounted for a large share of the growth in trade and service jobs since 1990 and most of the growth in total income. Growth in these non-wage sources of household income has largely compensated for the fall in the average wage, without which average household income would have fallen.

Statewide Importance of Transfer Payments

Real personal income in Alaska increased by $1.8 billion between 1990 and 1999. More than 90 percent of this increase is due to the growth of Permanent Fund dividends, federal transfers, federal grants, and the economic multiplier effects created by these cash infusions. The remaining 10 percent, amounting to $158 million over the decade, represents the net growth in personal income from *all other sources* within the economy. -- the net result of growth in tourism, mining, seafood, and air cargo, offset by declines in wood products, military, federal civilian, and petroleum.

Figure 1
Sources of Growth in Alaskans' Real Income from 1990 to 1999
(Total income Growth = $1.8 billion)



Statewide Economic Projections

Federal grants are likely to fall in future years since Alaska now receives three times the national average per person, up from twice the national average only a few years ago. Federal transfers to individuals will continue to increase as the population ages. Because of a return to normal stock market behavior, the PF dividend will not grow as it has in the recent past.

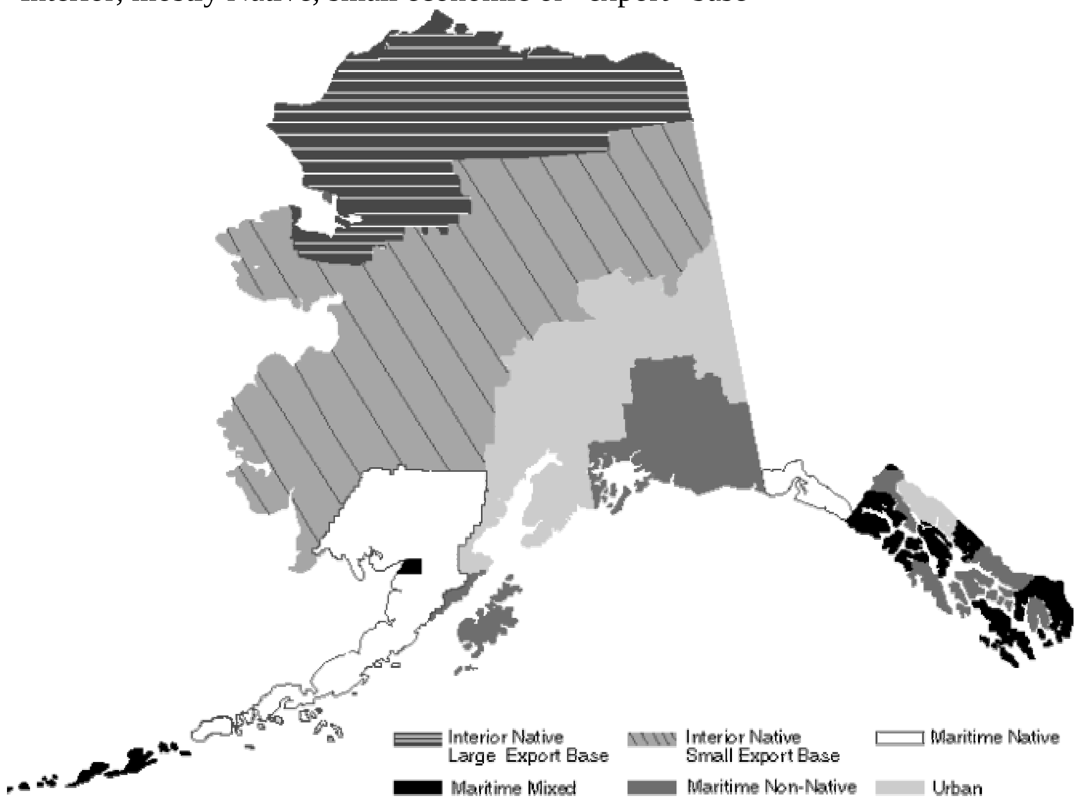
Based on these broad assumptions, ISER's latest statewide economic projections suggest a continuation of modest growth during the next 10 years, with jobs increasing about 1-1.5% per year. Growth in the support sectors—primarily trade and services—will be slower than in the 1990s, but the basic sectors should experience some net increase.

Rural Alaska Economic Outlook

Statewide projections mask significant differences among regions, particularly between urban and rural Alaska, but also among the different rural areas. To get a more accurate snapshot of the regions we aggregated the urban Railbelt with Juneau and divided the remaining rural census areas into the following five regions:[16]

[16] The regions are defined to contain the following boroughs or census areas. URBAN: Denali Borough, Matanuska-Susitna Borough, Fairbanks North Star Borough, Kenai Peninsula Borough, Anchorage Borough, Juneau Borough, Southeast Fairbanks Census Area. MARITIME, Mostly Non-Native: Ketchikan Borough, Valdez-Cordova

- Maritime, mostly non-Native
- Maritime, mixed
- Maritime, mostly Native
- Interior, mostly Native, large economic or “export” base
- Interior, mostly Native, small economic or “export” base



Dividing the state into these regions highlights the poor economic performance of those parts of Maritime Alaska most dependent on the timber and fishing industries. In these areas employment, total personal income, and per capita personal income all fell during the 1990s. One key reason for this decline is the cyclical peak in salmon prices, which occurred at the end of the previous decade.

Although most of the job growth was in Urban Alaska during the 1990s, there was job growth in the regions of Alaska where Natives predominate. Job growth was particularly strong in health, social, and membership services—funded largely by government grants—and in trade—driven by growth in the Permanent Fund dividend and purchasing power derived from

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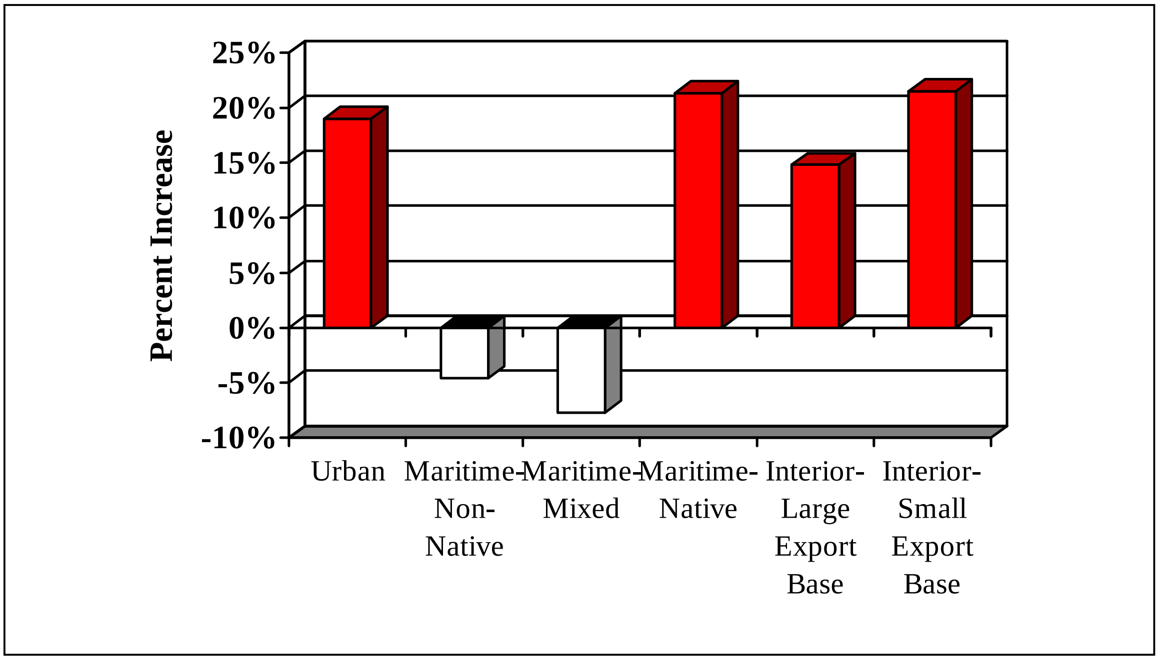
Census Area, Haines Borough, Kodiak Island Borough, Wrangell-Petersburg Census Area, Sitka Borough. MARITIME, Mixed: Aleutians West Census Area, Skagway-Hoonah-Angoon Census Area, Bristol Bay Borough, Prince of Wales-Outer Ketchikan Census Area. MARITIME, Mostly Native: Aleutians East Borough, Yakutat Borough, Dillingham Census Area, Lake and Peninsula Borough. INTERIOR, Mostly Native, Large Export Base:

service job payrolls. There were also increases in infrastructure jobs (transportation, communications, and utilities) and in other sectors. Consequently real income growth in Interior Alaska was comparable to that of Urban Alaska and per capita income actually increased, albeit quite modestly. The largest contributor to this growth was government transfers -- income from wages fell as it did in other parts of the state.

Figure 2
Percent Increase in Jobs: 1990 to 1998



Population growth occurred throughout the state in the 1990s except for a drop in the Non-Native population in timber and seafood dependent Maritime Alaska. The Native population growth rate exceeded that of Non-Natives and was most rapid in urban Alaska, reflecting a continuing out migration from rural to urban areas. The slowest Native population growth rate occurred in the North Slope and Northwest Arctic Boroughs, which are the two areas with significant basic industry. There is some anecdotal evidence that workers holding jobs in or related to these industries are choosing to live in Anchorage in greater numbers (Colt 1999).

North Slope Borough, Northwest Arctic Borough. INTERIOR, Mostly Native, Small Export Base: Yukon-Koyukuk Census Area, Nome Census Area, Bethel Census Area, Wade Hampton Census Area.

Local Resources to Support Utility Services

The ability of rural Alaskans to pay for infrastructure and services depends upon all the financial and other resources they have available. These resources come from market activities—the production and sale of natural resources, inflows associated with the delivery of government services, inflows from grants and transfers, and inflows from residents working outside the community—as well as subsistence activities which produce economic value even though it is unmeasured using conventional methods of economic analysis. Conventional personal income statistics show that much of rural Alaska has a continuing dependence on government through the direct provision of services and transfers.

Real purchasing power of local government revenues has grown very little during the 1990s due to cutbacks in state government assistance. Some of this reduction has been replaced by expansion of local revenues from local sources, but the tax and revenue base in most of rural Alaska is quite limited. In contrast federal grants have increased dramatically—more than doubling in per capita amounts between 1990 and 1999. For Interior Alaska, per capita federal grants now range from $5,000 to $8,000 per person, up from $2,000 to $3,000 per person as recently as 1990.

Dependence on Transfers and Capital Projects

Rural economies are becoming more dependent on federal grants and transfers as well as the Permanent Fund Dividend. This is underscored by comparing the size of these flows to total regional income. In parts of Interior Alaska the dollar flows from federal grants and PFDs are now 40% of total regional income whereas in 1990 they were only 20%.

This continuing dependence, which means jobs added to the rural economy are largely in services and trade, as well as the slow rate of job creation relative to the growth in the labor force looking for market employment, leads to a continuous out migration from rural into urban Alaska, even as the population of rural Alaska continues to grow.

Compounding this dependence is a serious structural problem that most rural communities face as they try to develop their economies. *Their small size precludes their ability to hold on to dollars that come into the community*. Local businesses are simply not economic in very small places, so both business purchases to support capital projects and household income from those projects gets spent outside the community, in urban Alaska. This is reflected in very small economic multipliers in rural Alaska. In one detailed study of this problem, Colt (1989) found that at least 80% of the total income from a grant-funded energy program quickly ended up in the pockets of *urban* residents.

Subsistence Values and the Non-Cash Economy

More than 54 million pounds per year of fish, wildlife, and plants were harvested statewide for subsistence during the 1990s. On average, rural residents consumed 375 pounds of subsistence foods per person per year and obtained 35% of their calories and 100% of their protein needs from this source (ADF&G 1998).

According to the Alaska Rural Governance Commission (1999),

> Protecting subsistence is the top priority of rural Alaskans. Harvesting and consuming fish, game and other natural foods and resources for subsistence is the cornerstone of life in rural Alaska. These resources have great nutritional, economic, cultural and spiritual importance. (p. 12)

Rural Alaskans often face difficult trade-offs between the need for cash income and the need to participate in subsistence. This trade-off makes it harder for small rural utilities to keep trained operators on the job during all of the times when they are needed.[17] It also means that rural villages may not wish to generate as much *cash* income as they could, because their scarce time is better spent on subsistence. With less cash income, customers have a harder time paying utility bills.

The Importance of Cultural Integrity and Self-Determination

Several recent efforts to document the challenges facing Alaska Natives in a time of rapid social change have noted the importance of both cultural integrity and effective self-governance. Drawing on the extensive empirical research by the Harvard Project on American Indian Economic Development, Sociologist Stephen Cornell *et al* (1998) noted that

> Native self-governance is not the whole answer to Native problems, but it is a necessary component in achieving sustained economic development, in overcoming virulent social problems, in reducing financial burdens of social welfare programs, and in restoring health and dignity to Native communities.

[17] A Trade-off with subsistence is not the only reason why some utilities have difficulty retaining trained operators. Other reasons include low wages, poor benefits, competition from other local employers (such as the school), and competition from larger utilities in larger communities.

The Alaska Commission on Rural Governance and Empowerment (1999) echoed this general principle while making a critical distinction between the services delivered by external agencies and the *manner in which* the services are delivered:

> The recent impact of (federal) government on Native villages, while often beneficial in content, has been destructive in process. Laws, regulations, appropriations, and service agencies….intent on helping people…reach right through community networks of obligation to deal directly with each individual. Little time or money was spent on supporting the village's innate capacity to take care of itself. Accordingly, local authority and responsibility for decisions had been usurped; Native people had lost control of their own communities and of their children's lives. The assumption that people cannot do for themselves, if continued long enough, becomes a self-fulfilling prophecy (p. 22).

These general observations are relevant to the challenge of establishing and nurturing sustainable utilities in rural Alaska because of the central role that community capacity plays in determining the success of a utility operation. This fact has been endorsed by several authors and work groups, most recently the Governor's Council on Rural Sanitation (1998) when it stressed that "Improved local capacity to manage and maintain completed sanitation facilities is key to eliminating the honeybucket by the year 2005" (p. 3).

The following statement, by a rural development specialist with international experience, eloquently summarizes the view that there is a critical linkage between outside influence, local capacity, and long-run prospects for sustainability:

> Nearly every action of an outside agency [interacting] with a Tribal government has the potential to either augment or diminish the governance and leadership of the tribe (Sarcone 2001).

According to this view, sustainability is as much about cultural survival as it is about economics. Therefore, manner in which services are delivered and by which communities develop their general capacity for self-governance is equally, if not more, important to long run sustainability than the achievement of some predetermined standard of conduct or performance by a utility entity. A corollary viewpoint, adopted by the Governor's Council on Rural Sanitation, is that "Performance targets should be developed as a *collaborative effort* between the community and the funding agency" (p. 21, emphasis added).

Policymakers, funding agencies, and utility managers need to be aware of the possible differences between community or tribal values and modern western business practices. These differences can be managed and harnessed for the good of all concerned, but only if they are acknowledged. For example, in one village the utility operator appealed directly to a community meeting for people to pay their bills so that he in turn could be paid. The community responded to the appeal and the operator was paid.[18] This communication channel is obviously very different than the standard utility business practice of management sending individual reminders to customers or imposing late payment fees or threats of disconnection.

1.5. How Other Places Address the Challenges

The challenges of providing reliable utility services to remote villages with limited economies are not unique to Alaska. Countries throughout the world are struggling to provide, operate and maintain these services in both urban and rural areas. Our review of the experiences in advanced industrial northern nations such as Finland, Canada and other regions of the United States clearly shows that there are no “magic bullets” by which to overcome the problems of high cost, remoteness, and lack of economic base. Remote places with low populations consistently struggle to provide services that depend on economies of scale for affordability

Subsidies, including infusions of volunteer labor, seem to be required to make up persistent differences between the total cost of water and sewer services and affordable rates in all places. A second persistent finding is the importance of local control and a sense of local ownership to progress. Finally, time itself has been an important ingredient of success in places such as Finland, where today’s systems are the result of more than a century of slow but steady progress.

Subsidies and Technology in Greater Northwest Territories of Canada[19],[20]

In the GNWTs, piped water systems are considered uneconomic and/or unworkable and truck haul systems predominate. The GNWT government subsidizes water and sewer costs above 1% of household income, often paying 90% of the full cost of service. The full cost of service is called the “economic rate” and ranges between 4 cents and 40 cents per gallon of water delivered. The actual rate paid is called the “residential” or “commercial” rate and ranges

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[18] Michael Black, Rural Utility Business Advisor Program, personal communication, 4/16/2001.

[19] Our review of the Canadian situation focused on the Greater Northwest Territories (GNWT) because of its many similarities with rural Alaska.

[20] This section based on telephone conversation with and information from Terry Brookes, Professional Engineer, Greater Northwest Territories, Canadian Municipal and Community Affairs.

between 1.1 and 2.3 cents per gallon. The difference, amounting to about 90% of the true cost of service, is subsidized.

Table 2
Northwest Territories Water/Sewer Subsidy Levels

(all values in dollars per litre)

Place	True Cost	Residential Rate	Subsidy	Subsidy %
Fort Liard	0.0316	0.0027	0.0289	91%
Deninoo	0.0149	0.0034	0.0116	77%
Rae Edzo	0.0250	0.0027	0.0223	89%
Deline	0.0309	0.0056	0.0253	82%
Aklavik	0.0230	0.0027	0.0203	88%

Note: there are 3.785 litres per U.S. gallon

Management Structures in Finland

Finland uses a wide variety of cooperative and municipal utility management structures that have evolved over more than100 years. By 1980 only about 70 percent of the rural population of Finland was connected to a common water supply system (Katko, 1992a).

The Finns have used public/private partnerships to provide water and sanitation (Katko 2000). Government has often provided critical resources, but local water associations, small cooperatives, and private firms are the typical service providers (Kulo and Santala 1998). For example, since the mid 1970s an increasing number of small cooperatives have been established in small rural communities with considerable municipal support. Piped water and sewer services have recently been constructed to serve tourist resort areas in Lapland with initial construction support from the central and municipal governments (Katko 2001).

Southwest United States – the "Colonias"[21], [22]

The word "Colonia" is a Spanish term for neighborhood or community. In Texas it refers to an unincorporated settlement that may lack basic water and sewer systems, paved roads and safe and sanitary housing. Colonias exist in Texas, New Mexico, Arizona and California along the United States-Mexican border. The majority of the colonias are found in Texas.

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[21] Information for this section from Federal Reserve Bank of Texas, no date; Texas Natural Resources Conservation Commission (TNRCC), 1999; Texas Low Income Housing Information Service, 1998.

[22] Phone conversations with Manny Casada, Desert Air Water Association, New Mexico, Sandra Alarcon, Loan Specialist, USDA Rural Utility Service, New Mexico Field Office, Martha Torrez, USDA Rural Utility Service, New Mexico Field Office and Adrian Widmere, Professional Engineer, Molzen-Corbin and Associates.

Colonias in Texas have high unemployment (20-60 percent) and residents cannot afford to install piped water and sewer systems. They use septic tanks (which are often installed improperly or are too small), cesspools, outhouses or other means to dispose of wastewater and sewage. In response to this deficiency, programs such as the Texas Department of Natural Resources Conservation Commission's Texas Small Town Environment Program (STEP) are being used to form partnerships among local residents and agencies. The STEP program is a self-help program that helps communities willing to use local volunteers, materials and financial resources to solve local water and sewer problems.

The Colonias in New Mexico currently depend on hauled water. They are hoping to provide piped water systems during the next decade, using from USDA Rural Development. The agency typically requires funding recipients to form "mutual domestic water consumption associations" or cooperatives to own and run the water systems. These associations and cooperatives are run by a volunteer board and they accept responsibility for the repayment of any loans associated with the projects. USDA funding is only available for community water projects, not private individual water services.

Appalachia and Volunteers[23]

Rural Southwestern Virginia is encouraging innovative rural water and sewer projects through the Self Help Virginia program, which is based on large amounts of volunteer labor and community coordination. Dealing with volunteers is itself labor intensive and difficult, but people's desire for water provides the motivation to complete the projects. The Self Help Virginia projects started approximately three years ago and are modeled on the STEP program from Texas.

1.6. Current Subsidies and Incentives in Rural Alaska

All of the major utilities – electricity, water, sewer, and telecommunications – are subsidized, to some degree, in all regions of Alaska. Subsidies involve transfers of resources, but they can also create powerful incentives that can distort choices away from the most cost-

[23] Phone conversation with Jimmy Wallace, Community Representative, Virginia Department of Housing and Community Development and Jim Spencer, Public Service Administration Administrator, Tazwell County, Virginia, 2000 and Self Help Virginia Program information packet.

effective or sustainable technologies and management structures. Therefore, the important issue is not whether subsidies exist, but how they are structured.

In a nutshell, current subsidies to rural Alaska utilities are poorly structured because they encourage the choice of expensive, capital-intensive systems and they discourage prudent or efficient maintenance. They tend to reward the failure to maintain capital by replacing that capital when -- but only when -- it fails, while offering little or no incentives in the form of resources for prudent maintenance or cost cutting.

Electricity

Power Cost Equalization (PCE) is an ongoing, visible state support program that provides about $15 million per year to partly defray the cost of electricity to about 80,000 rural Alaskans. For the first 500 kWh per month purchased by each residential customer of an eligible utility, PCE reimburses the utility for up to 95 percent of the eligible costs that fall between a "floor" amount and a "ceiling" amount. For FY2000, the floor was set at 12 cents per kWh and the ceiling at 52.5 cents per kWh. Community facilities as a group can also receive the monthly credit applied to up to 70 kWh per person. PCE operates using a maximum total funding amount. In recent years, this amount has not been sufficient to allow 95% reimbursement, despite increasing restrictions on program eligibility. In FY99, for example only 85% of the difference between actual costs and the floor amount was reimbursed for most of the year.

Example of how PCE Works

Assume that total allowable cost of power = $.40
and customer uses 400 kWh in a given month. Then,

PCE Credit per kWh:	.95 x (.40 - .12) = .95 x .28 =	$ 0.266	per kWh
Electricity Charges:	400 kWh @ $.40 per kWh =	$ 160.00	
less Total PCE Credit:	400 kWh @ $.266 per kWh =	(106.40)	
Equals customer's electric bill:		$ 53.60	

Currently the PCE subsidy amounts to $437 per household, which amounts to about $225 per *person* per year. If the program is assumed to continue forever, it has a maximum possible net present value of $7,500 per person (assuming a 3% discount rate). Railbelt intertie projects, with a present value cost amounting to about $1,000 per person served, are also a significant source of subsidy to urban consumers. At the end of the spectrum, the Four Dam Pool hydroelectric projects had a total one-time grant-funded cost of $300 million, or about $10,000 of net present value per person served.

Within the sphere of rural electricity, stand-alone village utilities are not the only recipients of capital subsidies. Our analysis (see the following section) shows that regional coops and communities served by private sector firms are also recipients of these subsidies.

Water and Sewer

While more than $1.5 billion has been spent on rural water and sewer capital projects during the past 30 years, urban areas have also received substantial capital subsidies for major water and sanitation projects. For example, Anchorage received more than $200 million state and federal dollars for water and sewer infrastructure between 1979 and 1985. This subsidy covered 90% of total capital additions during this period.[24] In addition, an exemption from Clean Water Act requirements allows Anchorage to discharge its sewage into Cook Inlet after primary treatment, without incurring the significant cost of secondary treatment.

Very little is spent on rural operations and maintenance support, in contrast to the large sums spent on capital construction. The Remote Maintenance Worker (RMW) program now costs about $1.2[25] million and serves about 170 villages,[26] while the Rural Utility Business Advisor Program (RUBA) also costs about $1.2 million and serves about 50 villages.

Both the RMW and RUBA programs have demonstrated their ability to make measurable improvements in management and maintenance practices. In a recent survey,[27] 52 communities served by the RUBA program reported the following improvements due to RUBA assistance:

- 20 out of 52 water/sewer utilities became completely self-supporting (excluding capital replacements). More than 20 others demonstrated an ability to become self-supporting with limited subsidies from local sources.
- 41 of 42 utilities reported a significant decline in service interruptions and improvement in service reliability.
- 29 of 34 utilities owing back payroll taxes became current with the IRS.
- 46 of 52 utilities implemented or improved an accounting system.
- 17 of 23 utilities retired significant amounts of debts owed to vendors.

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[24] Municipality of Anchorage, Comprehensive Annual Financial Report, Annual Audited Financial Statements, Enterprise Funds, Anchorage Water & Wastewater Utility, years 1979-1985.

[25] About 75% of this amount was federal funding in FY2000.

[26] According to the RMW Program 2000 Annual report. Some observers have suggested that fewer than 170 villages are actually served in a substantial way.

[27] Results from a 10-question, closed ended survey administered to 52 communities served by the RUBA program during year 2000, provided by Michael Black, Alaska DCED, April 2001.

- 44 of 47 utilities collected payments owed to them.

Telecommunications

Telecommunications are often thought of as a good example of a utility service efficiently provided by the private sector. However, it is important to note that telecommunications are among the most highly subsidized of all major utilities. Based on a review of rate filings and other cost data, we estimate that more than $120 million flows into Alaska from lower 48 ratepayers and federal taxpayers to support our telecommunications infrastructure. These inflows are the result of two factors. The first is a set of regulatory mechanisms (such as the universal service fund and "geographic averaging") that basically seek to equalize rates across state lines. The second factor is the direct provision of capital equipment such as satellites. In rural Alaska we estimate that more than 85% of the total cost of residential telephone service is subsidized, thereby reducing the cost of telephone service by about $1,000 per year for a typical rural household. The substantial subsidy pool makes it attractive for private firms to enter and serve this market.

Bulk Fuel and Solid Waste

Between 1992 and 1999, at least $23 million of mostly federal funds was spent on piping and tank farm replacements and upgrades (Division of Energy 1999). Beginning in FY1999, the Denali Commission identified bulk fuel as a priority funding area. The commission estimates that more than 45 million gallons of bulk fuel storage capacity need repair or replacement, while the Division of Energy estimated the cost of these repairs at approximately $4 per gallon of capacity, *not counting* associated environmental remediation. These figures imply a total required subsidy to bulk fuel storage of at least $200 million if the systems are to be brought into compliance with current safety and environmental codes. Originally, Denali Commission bulk fuel projects were selected based on a state-generated list based on health and safety. This original list did not address long-term strategies for O&M. The Denali Commission has recently required that new bulk fuel project recipients develop a business plan as part of their project implementation. The Commission intends to refine and strengthen their commitment to O&M strategies based on information and potential policy changes associated with this study.

The situation is much the same for solid waste: While little cash subsidy has been provided in the past, the identified future cost of converting open dumps to satisfactory alternatives is likely to exceed $60 million, according to the Indian Health Service Sanitation Deficiency System.

Incentive Effects of the Current System

Current utility subsidies and assistance programs have at least seven major incentive effects:

- They are biased toward capital-intensive water and sewer technologies.
- Understaffed agencies are under extreme pressure to move large amounts of money and to measure success by the number of projects completed. In this environment, it is very difficult for agencies to devote resources to the community planning and interaction required for sustainability.
- Current programs tend to respond to perceived "needs," rather than rewarding sustainable performance.
- They provide large amounts of targeted support for capital construction, but little or no targeted support for preventive maintenance.
- PCE rules reward high-cost operations and encourage cost shifting and discourage cost cutting.
- Cost-saving innovation is discouraged.
- Current subsidies focus on the supply side and can penalize efficiency improvements.

We now describe each of these effects in more detail. It is critical to remember that these effects are generally the unintended outcomes of complex political and administrative systems. They are *not* the result of ill will or incompetence.

First, current subsidies are heavily if not totally weighted toward capital projects. This is especially true for water and sewer systems, for which ratepayers pay none of the capital costs but essentially all of the operating and maintenance costs. In addition, capital projects provide jobs and income to ratepayers -- as well as engineers and consultants -- during construction. It is easy to see that under these incentives it is rational for users to choose piped systems, which provide high levels of service, deliver more construction jobs, and tend to have lower day-to-day operating costs than flush haul systems. Unfortunately, the higher capital cost of piped systems means that that fewer can be built for a given amount of government funding.

Second, current agency structures reward direct accountability to the external agencies rather than to the communities they serve. Because their mission is construction-driven, the primary agencies do not have the focused resources to provide a distinct community planning function, which requires a different professional skill set than project-oriented scoping and design. In addition, most existing engineering staff are spread so thin that they simply do not have the time for meaningful interaction with communities. The project-based program structure and the extreme pressures to move large amounts of money through the system mean that success is measured largely by dollars spent and the number of projects completed. A broader definition of success that placed more weight on long-term sustainability would likely lead to more attention to community planning, participation, buy-in, and up-front capacity development.

Third, current subsidies to rural Alaska utilities are generally designed to address some form of “need.” In some situations, need reflects the total lack of utility infrastructure, and the current funding criteria are both ethically sound and responsive to the goal of providing basic services. However, current need may also reflect system failure due to past neglect of prudent maintenance. In extreme cases, current programs can reward the failure to maintain capital by replacing that capital when it fails, while offering little or no incentive for preventive maintenance prior to failure.

Fourth, there is little or no external support for proactive preventive maintenance of water and sewer facilities. In spite of this lack of support, many communities make heroic efforts to maintain their systems despite the high relative cost of doing so, knowing that if they fail, it could be many years – for water and sewer – before the system is replaced. In theory, the system further discourages preventive maintenance because it requires ratepayer money up front while “emergency” repairs are often provided by external agencies at no cost to the user. However, we find little direct evidence that this incentive is significant.

Fifth, for electricity the PCE reimbursement formula sends mixed messages to utility managers because PCE reimburses a portion of all types of costs. Those who view utility operations as a source of jobs and local income have a positive incentive to incur additional costs, but little incentive to incur those costs in a way that improves service or better preserves capital infrastructure. In theory, PCE reimburses 95% of allowable incremental cost, but in practice payments only cover about 75% of costs due to overall budget caps. This means that ratepayers or local sources must cover 25% of additional O&M costs, which probably acts as a significant brake on spending for purely utility purposes. However, the program structure encourages utility managers and municipal officials to “load” the cost of shared human resources such as clerical support onto the electric utility function. To the extent they are successful, public resources are diverted away from utility O&M and toward the support of rural employment.

The fifth major effect of current subsidy and assistance programs is that they discourage cost-saving innovation. Electric utility managers stand to lose up to 75 cents of PCE support for every dollar of costs that they manage to cut.[28] Water and sewer planners and designers are also discouraged from aggressive technical innovation. Other things being equal,[29] innovations that reduce capital costs and/or complexity also tend to reduce fees for private sector designers and local construction employment and payroll.[30] As one publicly funded program manager put it,[31] "I have seen [publicly funded] construction engineers *forcing* designers to design simpler, winter hardy systems"(emphasis added).

Professional risk aversion can also retard innovation. The *Cold Regions Utilities Monograph* (ASCE 1996) defines the prevailing industry standards for design and construction. Innovation under this broad umbrella is generally limited to: 1) adjustments for local conditions, 2) selection of specific products such as pumps, and 3) system integration and control. There is some evidence that technical innovation is subject to professional inertia even when it reduces costs *and* increases system resilience. A good example of this is the length of time (several years) that it took to adopt "freeze-friendly" plastic pipe technology. Although plastic pipe reduced both labor and materials requirements, the use of iron pipe was a well-established national practice.

Finally, current subsidies are almost completely directed toward the production side of the utility system. There are few rewards for efficiency improvements in homes and buildings. The most striking example of this is the fact that total PCE reimbursements to a small utility will go *down* if the utility helps its customers invest in more efficient appliances or light bulbs. That's because total sales eligible for PCE will probably drop. In addition the utility's fixed cost will be spread over fewer kWh, driving up the average cost to other ratepayers.

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[28] The exact amount depends on how many total kWh sold are eligible for PCE credit and how many are not. Cost reductions are spread over *all* kWh when determining a utility's total allowable costs for PCE purposes.

[29] In reality, system complexity is heavily determined by the local water quality and operating environment (Dan Easton, personal communication, 5/9/2001).

[30] Financial incentives for public sector designers and engineers are clearly different. In the short run, agencies have an incentive to innovate toward simplification in order to spread a given amount of funding over more communities. In the long run, however, the total size of an agency budget is often linked to the number and complexity of projects it delivers.

[31] Pete Wallis, Director, Office of Environmental Health and Engineering,

Incentive Reform: The PCE Efficiency Standards

Hoping to tie PCE payments to efficiency, the Alaska Legislature in 1988 required state agencies to consider modifications to the PCE program that would encourage fuel efficiency and other forms of savings. The Alaska Public Utilities Commission (now the Regulatory Commission of Alaska) responded with prescriptive fuel efficiency standards for generation and adopted a standard of "reasonableness" for personnel costs, but declined to go further towards performance-based approval of expenses.

Roughly 1/3 of the all-diesel generation utilities that applied for PCE in the years 1990 – 1995 did not meet the generation efficiency standards adopted in 1989. A decade after adoption of the efficiency standards, roughly 23% of the all-diesel utilities still failed to meet the standards. In short, a net of 15 utilities moved into compliance over the decade out of a total of roughly 90 utilities that were not in compliance at the beginning of the decade. Aggregate generating efficiency did improve during this time, but this was probably due to the replacement of older generating units with newer, smaller units that were more efficient and better matched with system loads.

Thus, while a prescriptive or "top-down" standards approach to rural Alaska utilities may appear attractive on its face, evidence from the PCE experience suggests that at best standards can only be considered part of a larger program to improve performance and at worst standards may lead to punitive results for individual utilities.

Incentives: Schools and Other Large Customers

It has also been suggested that the local school is a large, steady customer that should be able to provide economies of scale for local utility systems – electric, water, sewer, and bulk fuel storage facilities – enabling lower costs for both the school and the local village system. While this conventional wisdom appears to be widely expressed by utility managers, it does not appear to be as widely embraced by school principals and school maintenance personnel based on the interviews we conducted.

Because power outages severely disrupt their educational mission, schools have a perceived need for high reliability – a level that may exceed that for which the entire village is willing to pay. To meet this need, they often feel compelled to invest in the fixed cost of self generation capability. But once this cost is paid, it is in the school's economic interest to self generate – incurring the incremental cost of fuel (about 15 cents per kWh) while saving the full amount of the village utility's retail rate (perhaps 30 or 40 cents per kWh). In short, schools may require a significantly higher level of service than the rest of the community desires or is willing to pay for, and once they have invested in the fixed cost of this higher level of service, the school has a fairly strong incentive to self-generate. There is no simple solution to this problem unless the village utility is willing to bring its reliability level up to levels significantly above 99%.

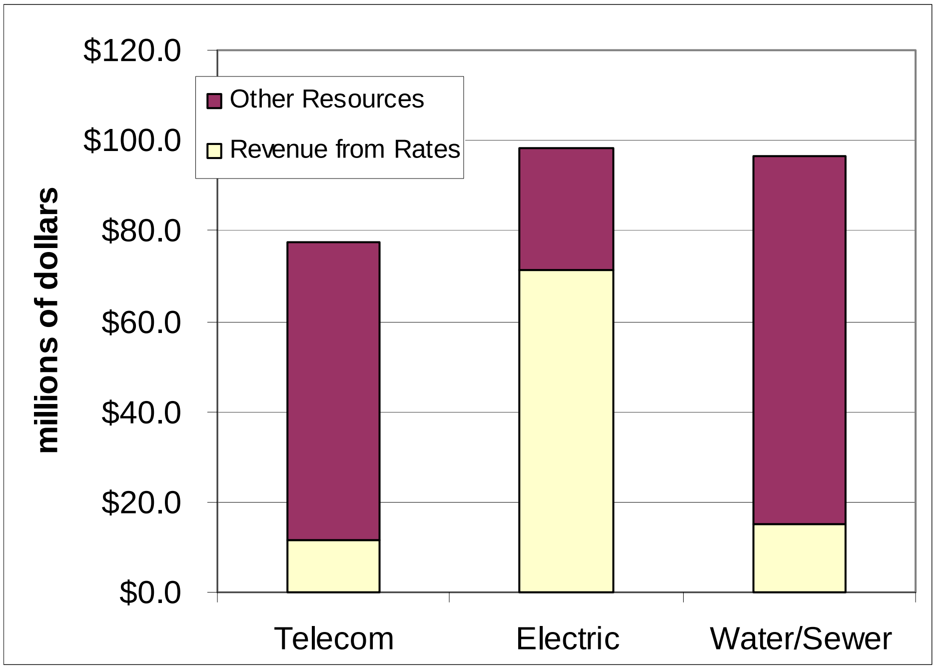
Schools have similar dilemmas when considering their water and sewer needs. Water and sewer is often not metered and monthly flat rates are often negotiated on an ad hoc basis that may have little relation to the cost of the service provided.

1.7. The True Cost of Utility Service

We estimate that it costs between \$80 million and \$120 million per year to provide each of the major utilities – electricity, water/sewer, and telecommunications – to rural Alaska consumers. Although they are provided by private sector firms, telecommunications costs are highly subsidized in both urban and rural Alaska through various mechanisms that serve to bring ratepayer dollars into Alaska from other states. As Figure 3 shows, consumers pay only about 15% of the cost of telephone and water/sewer costs through rates, but they pay between 60 and 75%[32] of electric costs. Utility rates often bear little or no relation to the cost of service.

[32] The range in this number results from counting or not counting low interest loans as a form of subsidy.

Figure 3
True Cost of Major Rural Utilities and Fraction Covered by Rates



Source: PCE database, FCC filings, Author calculations (omm_draft8.xls)

Notes: Electric cost includes all PCE communities, Water/Sewer is an estimate for all VSW communities

The true cost of utility service includes reasonable and prudent operating and maintenance costs plus some measure of the cost of providing, renewing, or replacing capital equipment. The cost of capital includes a replacement component (depreciation) as well as a "return on investment" component that reflects the time value of money. All utilities incur these costs, whether they are operated by Municipal, cooperative, tribal, or private for-profit entities. However, some of these costs may not be accounted for in a utility's financial records (the utility's "books").

There are two primary ways in which true cost can exceed book cost. First, a powerhouse or water plant that is funded by a grant of public money will often not be shown as an asset on a small utility's books. Hence, a utility in that situation will probably not include on its books the annual depreciation, interest, or return on capital expenses associated with that asset.[33] Second, a

[33] Such allocations are not allowable expenses or the PCE program. Although it would be possible for a utility to keep a separate set of books that included the amortization of grants as an expense, the utility would have very few reasons to take on this extra and potentially confusing task.

cash-strapped utility may simply seek to defer or avoid some maintenance expenses. This neglect will sometimes show up as a costly failure at some later date.

True Cost of Electricity

Our estimates of the true cost of electric utility service were compiled community by community and include the following elements:

- Costs reported in annual PCE filings[34]
- Cost of state and federally funded capital projects, expressed as annual depreciation
- Cost of operations and maintenance assistance programs including the Circuit Rider and Rural Utility Business Advisor programs
- Interest subsidies from low interest loans
- Finally, we estimated the return on capital as 25% of the amount of capital invested in utility plant, net of depreciation.[35]

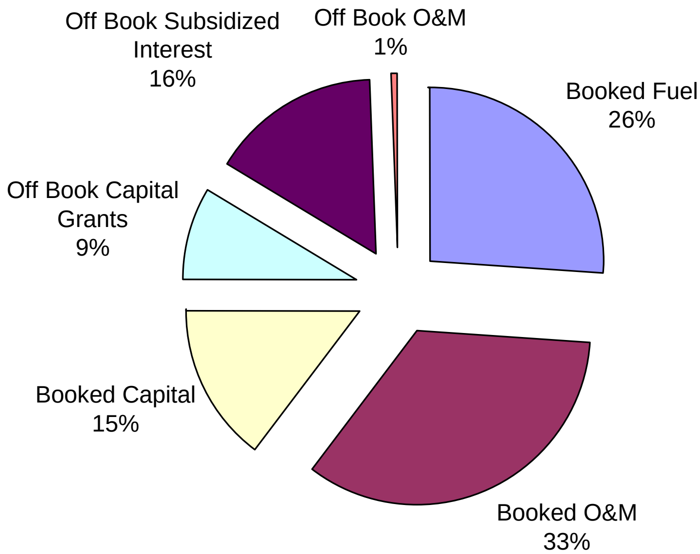
The true cost of rural electric utility service runs from 17 cents per kWh for larger regional center communities (Naknek) up to around 180 cents per kWh for small remote communities (Pedro Bay and Chalkyitsik). The true cost of rural electric utility service for 90% of rural Alaska villages runs less than 45 cents per kWh.

On a statewide basis (considering all PCE communities), the major costs are fuel and booked operation and maintenance, which together account for 59% of total cost. Capital costs carried on utility books account for 15% of cost. The remaining 26% is "off-book" and consists almost completely of government-funded capital construction. Government funded O&M assistance accounts for less than 1% of the total true cost of electricity.

[34] There are numerous limitations to the self-reported (albeit examined) PCE data filings. For a discussion of these limitations see Chapter 7 – True Cost, Book Cost, and Revenue from Rates, Section 7.3 (Electricity).

[35] The return on capital factor was added to all capital support received from the Division of Energy. It was also added to investor-owned utilities cost data where return on rate base data was not readily available As of this writing, Alaska Power Company currently has a rate case in front of the Regulatory Commission of Alaska so we used the allowable return filed in that case rather than a surrogate estimate.

Figure 4
Components of Total True Cost of Electric Service
(all PCE Communities)



Electric System Physical Condition

The true cost of electric service could be even higher than calculated above if significant costs are slowly accumulating due to the neglect of facilities. The cost of past neglect already shows up to some degree in the capital grants numbers. What we don't know is whether a significantly increased future liability is being generated due to current neglect.

The AEA recently completed a comprehensive electric utility condition assessment of almost 150 small utility systems. These data show that stand-alone community utilities as a group have a condition number about 20% higher (worse) than the overall average, while regional coops and private utilities have numbers between 35% and 50% lower (better) than the average. However, we were unable to demonstrate any statistical relationship between the condition numbers and the apparent "book" cost for each utility. In summary, it is not possible to say that utilities with lower book costs are more likely to show neglect of assets as indicated by the assessment data.

Table 3
Electric System Condition by Management Structure
(higher number indicates a poorer condition)

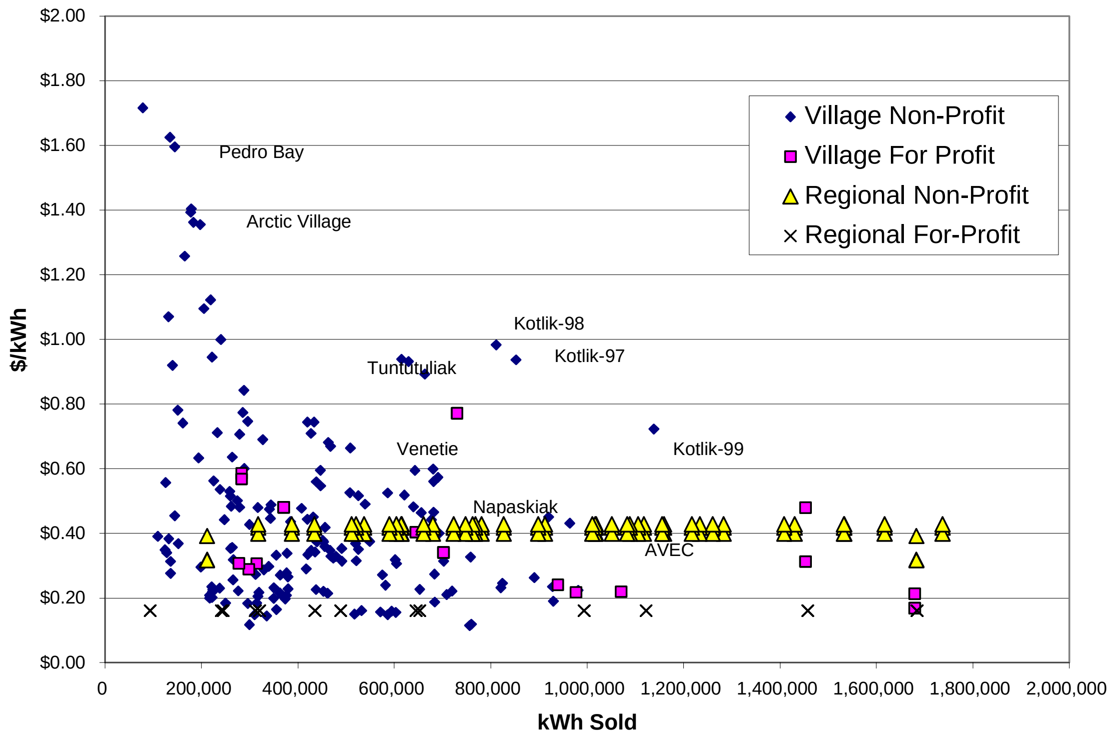
Utility Management Structure	Average Condition Number	Difference from Overall
Overall Average	214	
Community Stand-Alone	256	20%
Regional	141	-34%
Private	114	-47%

True Cost vs. Type of Management Structure

Multiple regression analysis shows that our estimate of the true cost of electric service is statistically unrelated to management structure, with one significant exception: After controlling for utility size and condition of facilities, Alaska Power Company (the electric subsidiary of Alaska Power and Telephone) has average reported non-fuel costs that are about 15 cents per kWh lower than those of other utilities. There are no other statistically significant relationships between reported cost and management structure: Specifically, neither regional utilities nor private utilities other than APC show a systematic cost advantage compared to stand-alone community utilities. Figure 5 demonstrates that the true non-fuel cost of electricity per kWh is largely a scatterplot, especially within a given range of kWh sales. The figure is based on the true cost data generated by the adjustments described above. Although these data are far from perfect, they have been adjusted to include the major "off-book" costs described above. Unless the inaccuracies that remain are *systematically* related to the type of management structure, the central message conveyed by the figure is valid: With the exception of APC, there is no significant correlation between the true cost of electricity and utility management structure.

Figure 5
True Non-Fuel Cost of Electricity vs. Annual Sales, for Different Management Structures

(Village Level Data for Places with Electric Sales of Less Than 2 million kWh/yr)



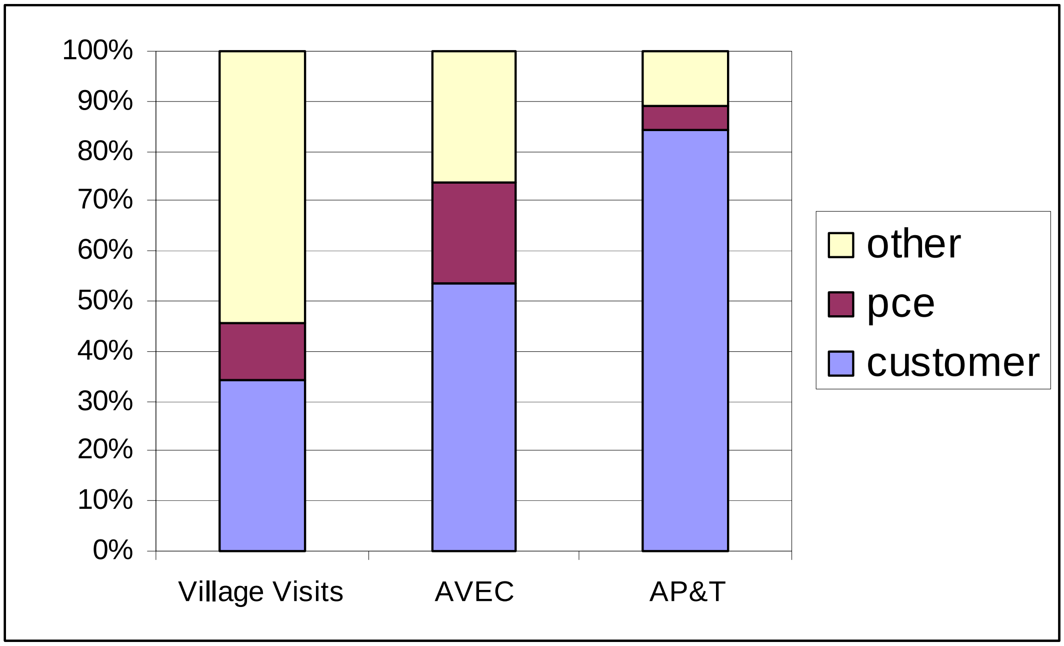
Electric Utility Costs vs. Utility Rates

Utility rates in rural Alaska often do not reflect the true cost of utility service, and they sometimes fail to reflect even those costs that are carried on the utility books. For many public and non-profit electric utilities, rates are set to recover operating expenses, depreciation on utility-funded capital, and interest. Customers receive a credit on their bill reflecting the PCE program support. In many cases, the interest rates on long-term debt remain significantly below market rates, reflecting a long-standing federal commitment to fund rural electric utilities through taxpayer as opposed to ratepayer support. Private sector electric utilities set rates to recover the full cost of service including operating expenses, depreciation on utility-funded capital, and a return on debt *and equity capital* invested. However, even private utilities sometimes obtain government-funded capital, and typically do not recover the cost of that capital, thus shielding ratepayers from the full cost of service.

There is no systematic statewide data set on electric utility rates compared to costs. For our village case study communities, we estimate that only about 45% of the true cost of electric service is accounted for in rates and paid for either by customers (34%) or by the PCE program (11%). The remaining 55% is paid for by government capital grants (54%) and O&M programs (1%). For an established regional coop such as AVEC, the numbers are substantially different: about 54% of the true cost is covered by customer payments, about 20% by PCE, and about 26% by government capital subsidies, mostly in the form of low-interest loans.[36] The figure also shows an estimate of cost coverage for a private utility, Alaska Power and Telephone. AP&T customers pay about 84% of total cost, PCE pays about 5%, and other sources (chiefly low interest loans) account for the remaining 11%. The most likely explanation for this difference is that AP&T has a smaller fraction of costs covered by PCE because its total costs are low and because it serves larger communities in which the majority of kWh sold are not eligible for the PCE program

[36] The value of this interest rate support is significant. For example, the effective interest rate of regional non-profits like AVEC and THREA was on the order of 3% in 1999, while the market rate was on the order of 9.25% (National Rural Utility Finance Corporation). In nominal terms, this amounts to a difference of [(1.0925)/(1.03)]-1 = 6.07%. With long-term debt ranging between 56¢/kWh and 92¢/kWh, this difference amounts to roughly 3 to 6¢ per kWh on total non-fuel costs of around 25 to 30¢ per kWh. See Chapter 5 for more details.

Figure 6
Sources of Funds to Cover Cost of Electric Service



True Cost of Water and Sewer

We estimate that the total true cost of water and sewer service to rural communities is about $100 million per year, with about 75% of this being capital cost.[37] Of the $25 million O&M, customers pay about $10-15 million. This leaves a shortfall of about $5-10 that is covered by some mixture of community revenue sources, cross-subsidies, and deferred or avoided maintenance. For lack of this $5-10 million, a $ 1.5 billion investment is at risk.

Ongoing publicly funded operation and maintenance resources are extremely limited. The Remote Maintenance Worker (RMW) program provides approximately $1.2 million worth of maintenance advisory services and training, while the RUBA program provides a similar amount of business advisory services and training. Due to the sporadic nature of system failures and emergencies followed by replacements or emergency repairs, we still do not know what the true cost of water and sewer service will turn out to be over time scales that encompass capital replacement.

[37] The $75 million number is based on the amortization of $1.5 billion in capital investment using a 3% real discount rate.

True Cost of Bulk Fuel

In order to characterize the true cost of service for bulk fuel service in Rural Alaska, we developed estimates based upon projected fuel volumes and actual project costs for specific tank farms. The following example is based on our site visit to Tuntutuliak, augmented by design data for a proposed new project.

Table 4
Estimated True Cost of Bulk Fuel Storage

Capital Project Cost:	$1.6 Million	
Estimated Life:	30 years	
Annual Depreciation:	$53,333	
Avg. Annual Interest	$80,802	($1.6 million, 20 yrs, 9%)[38]
Projected Fuel Volume:	160,000 gallons per year	
Capital Cost Per Gallon:	$0.84/gallon	
Operations & Maintenance	$20,000 per year	
O&M Cost per Gallon:	$0.12/gallon	
Spill response capability:	$0.60/gallon	
TOTAL COST	**$1.56/gallon**	

Given that the cost of fuel *delivered to the villages* in the Yukon-Kuskokwim River Delta may be running around $1.08 per gallon,[39] the full cost of these new bulk fuel facilities adds almost 90% to the total delivered cost of bulk fuel in the local community.

Bulk fuel storage facilities are largely fixed cost installations whose cost is driven by the design capacity of the facility. Thus, *the unit cost of service ($ per gallon) is highly dependent upon the number of times the volume of the tanks is expected to turn over each year.* Facilities designed to hold a full year of storage – considered a prudent practice in many rural Alaskan settings – have approximately 12 times the capital cost per gallon delivered than urban facilities designed for only one month of storage.

[38] Return on capital = average annual interest payments assuming 100% debt financing with 9% interest, $1.6 million over 20 years.
[39] Reported cost of delivered fuel by Tuntutuliak in PCE filings in 2000.

Given an average fuel efficiency of 12 kWh/gallon for new generator sets, the $1.56 cents per gallon to recover the bulk fuel storage facility and handling costs would amount to roughly 12 cents per kWh in the cost of electricity generated from fuel stored in these tanks. That is, if the electric utility had to pay a fuel cost that reflected the true cost of the tank farm and had to recover those costs from rates, the electric rates would increase by about 25%.

Solid Waste

A community of 100 people can generate on average 600 pounds of garbage per day from residences alone. This figure does not include the waste generated by businesses and schools (ADEC 2001). Most rural communities have unpermitted open dumps (Sarcone 1999). Those with permitted landfills have so-called "Class III" facilities that meet minimal realistic standards pursuant to the intent of the federal Resource Conservation and Recovery Act (RCRA).[40] Currently there are insufficient funds to close open dumps that may present health and environmental risks. The level of need for solid waste funding has not been carefully assessed, making it difficult to know exactly what funds are necessary to carry out needed open dump closures, solid waste management planning and new landfill development. By one measure, the Indian Health Service Sanitation Deficiency System, there is a backlog of at least $60 million just to close down open dumps in Alaska.

Based on this unmet need to bring village solid waste facilities up to a minimally adequate level of service, the "true cost" of solid waste on a statewide basis is being paid to a great extent in the form of health and environmental risks rather than dollars.

True Cost vs. Size – The Role of Economies of Scale

The true cost data reviewed here indicate some correlation between the size of the community served and the true cost of utility service. Only the electricity cost data permit us to investigate this correlation. The upper boundary of costs for communities with 4 million kWh sales per year or more is less than 20 cents per kWh, while the upper boundary of costs for communities between 2 million and 4 million kWh per year is about 40 cents per kWh. Finally, for communities with less than 2 million kWh a year, Figure 5 shows that the boundary becomes

[40] The State of Alaska has regulatory "primacy" for implementing RCRA and has developed the Class III permitting program with EPA approval.

quite diffuse and especially below 1 million kWh a year it edges up toward 80 cents per kWh or more.

To many people it seems intuitively obvious that there are efficiencies to be obtained by having a larger firm, and anecdotally some larger firms appear to have lower cost structures as a result of achieving certain economies of scale. However, the overall evidence for major economies of scale among small utilities is not particularly strong.[41] This result may not be surprising in light of the growing research into mergers and acquisitions which indicates that while achieving scale economies is one of the most frequently targeted objectives of mergers, it is one of the least-achieved outcomes.[42]

As summarized by Feldman and Spratt (1999):[43]

> Reducing costs [to realize potential economies of scale] invariably proves more difficult than anticipated. On the surface it appears to be a simple matter of eliminating duplication and reducing unnecessary overhead. However, the extraction of costs requires fundamentally altering work processes and procedures, redeploying people, making additional investments in training, and coping with the demoralized and overworked workforce that remains after others are laid off. Reductions in productivity of 20 to 30 per cent are not uncommon, easily offsetting the paper gains that were anticipated…(page 122).

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[41] Several studies suggest that the economies of regionalization may be a perception driven by regulators who see less effort to regulate one large utility as opposed to several small ones. Further, the work of Robert M. Clark and H. Youn Kim indicate that distribution networks, especially serving residential customers, may present diseconomies of scale that offset economies of scale for treatment facilities (see National Regulatory Research Institute, The Regionalization of Water Utilities, NRRI96-21, July 1996, pages 8, 50-53)

[42] Five Frogs On A Log: A CEO's Guide to Accelerating the Transition in Mergers, Acquisitions, and Gut Wrenching Change, Mark L. Feldman & Michael F. Spratt, PriceWaterhouseCoopers, HarperCollins, 1999, pages 121-123.

[43] Ibid.

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