ELECTRICITY DEMAND FORECAST
FOR THE
BRISTOL BAY REGIONAL POWER PLAN

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by

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Introduction

This report projects electrical energy consumption for eighteen study-area communities included in the Bristol Bay Regional Power Plan. It is intended to aid the Alaska Power Authority (APA) and residents of the Bristol Bay study area in choosing the most appropriate future electricity generation methods. Many factors influence the level of electricity demand in a region, but the price and availability of electricity relative to other energy sources are the most important factors in this region. Therefore, three electricity consumption projections are reported here, each corresponding to different assumptions about electricity prices and availability. These projections correspond to and are meant to be used in conjunction with the three alternative generation plans developed for the study region by Stone and Webster Engineering Corporation (SWEC). The price assumptions used in all three projections are based upon analyses of the cost of electricity arising from the alternative plans developed by SWEC as modified by APA.

Table I.1 presents the regionwide results of the three alternative projections. Each projection corresponds to an alternative electricity-supply scenario described below:

TABLE I.1. BRISTOL BAY POWER PLAN ELECTRICITY PROJECTIONS
ANNUAL MEGAWATT HOURS
(Percent of Total)

	Residential		Commercial/Gov't		Industrial		Military		Total
				Business As Usual					
1980	4,143	(15)	9,662	(35)	7,898	(29)	5,600	(21)	27,303
1982	5,686	(19)	10,798	(35)	8,481	(28)	5,600	(18)	30,565
1987	7,375	(20)	14,321	(40)	8,769	(24)	5,600	(16)	36,065
1992	9,392	(22)	19,199	(45)	8,866	(21)	5,600	(13)	43,057
2002	14,321	(23)	34,386	(54)	8,963	(14)	5,600	(9)	63,270
				Regional Diesel					
1980	4,143	(15)	9,662	(35)	7,898	(29)	5,600	(21)	27,303
1982	5,902	(19)	11,040	(36)	8,481	(27)	5,600	(18)	31,023
1987	7,841	(21)	15,069	(40)	8,769	(24)	5,600	(15)	37,279
1992	9,788	(22)	20,707	(46)	8,866	(20)	5,600	(12)	44,961
2002	14,933	(22)	38,921	(57)	8,963	(13)	5,600	(8)	68,417
				Newhalen Regional					
1980	4,143	(15)	9,662	(35)	7,898	(29)	5,600	(21)	27,303
1982	5,726	(18)	11,424	(37)	8,481	(27)	5,600	(18)	31,231
1987	7,139	(19)	15,323	(42)	8,769	(24)	5,600	(15)	36,831
1992	10,233	(22)	22,012	(47)	8,866	(19)	5,600	(12)	46,711
2002	16,559	(22)	44,809	(59)	8,963	(12)	5,600	(7)	75,931

Business as Usual. The Business as Usual (BAU) scenario corresponds to the base case. Here, we assume that electricity is produced from decentralized diesel generators. Electricity prices escalate at the same rate as fuel-oil prices--2.6 percent per year in real terms.[1] State intervention, through the Power Cost Assistance program, lowers consumer electricity prices below cost throughout the forecast period, consistent with reductions experienced in 1981.

Regional Diesel. The Regional Diesel (RD) scenario assumes a regional transmission intertie connecting all 18 study-area communities to the REA electric utility co-operatives in Dillingham and Naknek. Electricity remains diesel powered, but generation becomes centralized in 1982. At the same time, electricty prices become uniform across all study-area communities. Economies of scale from regional centralization and from growing demand offset transmission line costs and rising fuel prices, and the real electricity price eventually stabilizes. State intervention to lower consumer electricity prices is comparable to that assumed in the BAU scenario.

Newhalen Regional. In the Newhalen Regional (NR) scenario, a sixteen megawatt hydroelectric facility begins operation in 1988.

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[1]The use of this growth rate was mandated by the Alaska Power Authority.

Prior to 1988, this scenario is identical to the BAU case. A regional intertie is established, and electricity prices become uniform throughout the region when the hydro facility begins operation. Starting in 1988, prices decline steadily in real terms. Again, the effect of state intervention is comparable to the previous two scenarios.

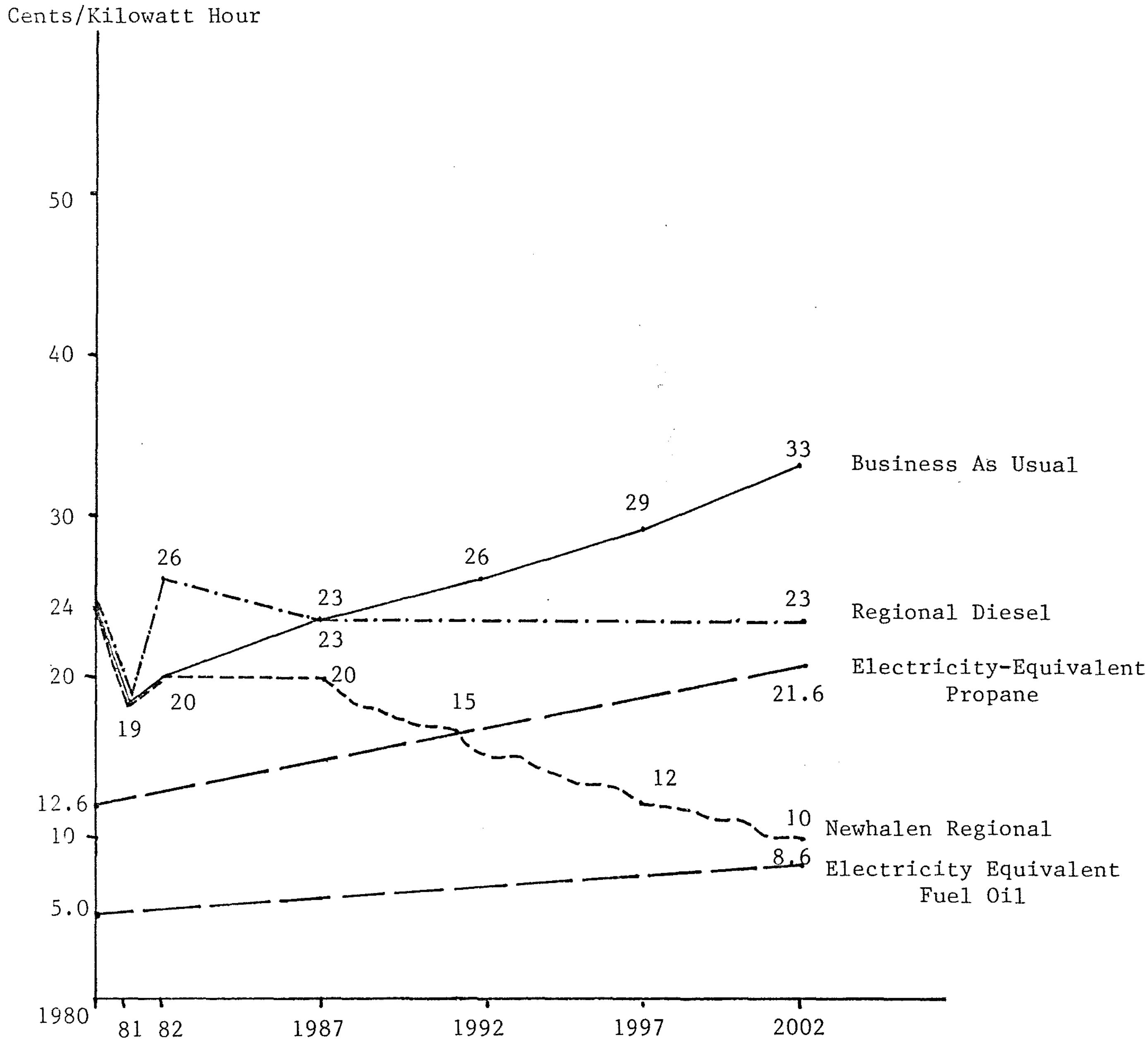
Future electricity prices corresponding to each supply scenario are shown graphically in Figure I.1.

Summary of Results

1. Total electricity consumption is projected to grow from 27,303 megawatt hours (mwh) in 1980, to between 63,270 and 75,930 mwh in 2002, depending on the price and availability of electricity.

2. Projected total electricity consumption does not vary widely under different assumptions about growth in electricity prices. If, at one extreme, the inflation-adjusted consumer price of electricity increased at 2.6 percent per year -- the same rate as fuel price escalation -- reaching a 2002 level of 33 cents per kilowatt hour (kwh), then total consumption would grow at an average annual rate of 3.9 percent. If, at the other extreme, real electricity prices declined at an average annual rate of 3.5 percent per year to 10 cents per kwh (in constant 1982 dollars), then total consumption would grow at 4.8 percent per year. A

FIGURE I.1. PRICES CORRESPONDING TO ALTERNATE ENERGY SCENARIOS (CONSTANT 1982 DOLLARS)



constant real consumer price of electricity, at 23 cents per kwh, would be accompanied by a 4.3 percent average annual rate of consumption growth.

The relatively narrow range of growth in consumption occurs because the projection scenarios share several important features in common. First, electrification of all communities occurs by 1988 in all three cases. Second, electric space heating does not occur in any scenario. Third, electricity is a special form of energy for which few substitutes are available. Under most circumstances, the consumer has a clear choice between electrical energy and other fuels. If, as depicted in the NR scenario, the price of electricity eventually became low enough to compete with propane, then electricity would be a reasonable substitute for propane for certain appliances such as dryers and ranges. Nevertheless, the consumption increase represented by this price-induced shift toward electric appliances would be a modest proportion of total pure appliance consumption. Finally, projected military and industrial consumption is not sensitive to price variation in the range projected for the future.

3. The growth rate of total consumption--3.9 to 4.8 percent--strongly reflects modest expansion in the military and industrial sectors. By itself, residential consumption would grow at 5.8 to 6.5 percent per year, and jumps from the smallest (15 percent of

total consumption) to the second largest consumer category (22 to 23 percent of total consumption) during the forecast period.

Commercial/government consumption would grow at 5.9 to 7.2 percent per year. As a group, Commercial/Government (C/G) consumers use more electricity than any other consumer category throughout the forecast period. The proportion of total electricity consumed by C/G customers is projected to increase from one third to more than one half from 1980 to 2002 in all three scenarios.

By comparison, the industrial sector would experience modest consumption growth at 0.6 percent per year, while military consumption would remain constant. As a result, military and industrial electricity consumption diminishes as a proportion of total consumption.

4. Over four-fifths of total electricity consumption in 2002 is concentrated in three of the eighteen study area communities: Dillingham, Naknek, and King Salmon. The same communities accounted for just over two-thirds of the total study area consumption in 1980. Thus, while the level of electricity consumption is projected to increase in all communities, consumption in the outlying, more rural villages will grow more slowly than in the regional centers.

5. Peak demand across all consumers in the Bristol Bay study area would increase nearly twofold from 10,956 kw in 1980 to 19,467 kw in 2002. Of this peak demand in 2002, approximately half (11,494 kw) would be serviced by REA utility cooperatives and school generators as well as community and private utilities. This portion of total peak demand represents 100 percent of peak capacity requirements for residential, commercial/government, and military consumption. However, it includes only a fraction of industrial demand. As in 1980, the largest portion of industrial peak demand in 2002 would be met through self-generation. Thus, the remaining 8,003 kw of peak demand in 2002 would be serviced by industrial in-house generator capacity.

6. The electricity-equivalent of total space-heat energy consumption in 1980 and as projected in 2002 is between four and five times larger than pure appliance electricity consumption in those years. Should electricity prices decline in real terms to levels that compete with the price of fuel oil, currently the primary space heating fuel, then the overall level and pattern of electricity use could change dramatically. Even if the price of electricity were to gradually fall to fuel-oil equivalent levels, and only a small portion of space-heat consumption in 2002 were captured by electricity, the electric space heating load alone would exceed the pure-appliance electricity consumption load (see Part VII).

Methodology Overview

The forecast methodology used throughout this study uses the following equation:

$$\text{Annual Electricity Consumption} = \begin{matrix}\text{Number of} \\ \text{Customers}\end{matrix} \times \begin{matrix}\text{Electricity} \\ \text{Use Per Customer}\end{matrix}$$

The number of consumers (N) and average use per customer (U) were estimated in the base year (1980) for four consumer categories--residential, commercial/government, industrial and military--for each of the eighteen Bristol Bay communities. The base year estimates of N and U were calculated from data collected in the fall of 1981 by study team members of the Institute of Social and Economic Research (ISER).

For the study area as a whole, baseline and historical data was obtained from utilities within and outside Bristol Bay, from the U. S. Bureau of the Census, from public offices on a local, state, and federal level, from fuel distributors and seafood processors, from Native corporations and associations, and from private individuals and public officials knowledgeable about energy use in Bristol Bay. Community-level baseline and historical data was obtained primarily through site investigations, surveys, and interviews with village leaders.

Residential customers are defined the same as the utility classification. For communities without utilities, residential consumers are equal to the number of households that are hooked into village or school electricity or that have their own generators.

Commercial/Government (C/G) consumers encompass all other civilian electricity customers except those involved in seafood processing which is the only significant industrial use of electricity in the region. Thus, our definition of C/G consumers includes both small commercial and large power customers under the conventional utility classification. This classification covers a wide range of users having varied energy-use characteristics such as schools and the village store. To account for these differences, we have divided C/G consumers into categories having relatively uniform energy-use characteristics such as schools, village stores, and community centers.

Industrial consumers consist exclusively of large shore-based seafood processors, fish camps and buyers. At present, seafood processing represents Bristol Bay's only significant industry. Seafood processors use large quantities of electricity during the short fishing season creating special circumstances for forecasting.

The military category consists of the Alaska Air Command Station in King Salmon.

Several factors were incorporated into the analysis of the growth in customers and in use per customer. They are:

- Population Size and Geographic Distribution
- Household Size
- Appliance Ownership
- Consumer Responsiveness to Changes in Price, Income, and Electricity Availability
- Economic Development of the Region
- Industrial Consumption
- Relation of Total Consumption to Peak Demand
- Space Heat and Conservation Potential.

Use per customer projections were made using a variety of forecasting methods. End-use analysis was used to establish initial estimates of use per customer for each consumer category in each study-area community. Growth in use per customer was projected independently using historical trend analysis. Historic growth patterns outside the study area were used to supplement missing historic data from within Bristol Bay, and as a forecasting guideline. An analysis of the proportion of household income spent on electricity was conducted as an additional check against projection results. Together these methods resulted in a consistent forecast.

As discussed above, a base case projection (BAU) was produced by assuming no major departure from historic patterns of consumption, price, or availability of electricity over the forecast period. Moderate economic growth and stable fish-harvesting activity at levels comparable to those observed in 1980 and 1981 were assumed to occur at the same level in all scenarios.

A price elasticity measure was derived from the results of the base case projection. This measure of consumer responsiveness to changing price was applied in the alternate scenarios (RD and NR) to gauge the effects of different future price paths on consumption.

The future price paths corresponding to each scenario were derived in part from a cost analysis of supply technologies by Stone and Webster Engineering Corporation and from assumptions made by the Alaska Power Authority about fuel-price escalation and price subsidies.

The eighteen study-area communities have been grouped into categories reflecting the degree of electrification in the 1980 base year. These categories are:

<u>Central-Station Utility</u>

Dillingham Aleknagik	(Nushagak Electric Co-operative - NEC)
Naknek South Naknek King Salmon	(Naknek Electric Association - NEA)
Egegik	(Egegik Light and Power[a])
Manokotak	(Manokotak City Electric)
New Stuyahok	(Alaska Village Electric Co-operative - AVEC)

Seasonal/Central-Station Utility
<u>(school generator off in summer)</u>

Portage Creek Ekwok Koliganek	(Southwest Regional School District)

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[a]Previously NEA.

Noncentral-Station

Iliamna
Newhalen
Nondalton
Clarks Point
Ekuk
Levelock
Igiugig

Central-station utilities include the REA Electric Co-operatives in Dillingham (NEC), Naknek (NEA) and New Stuyahok (AVEC), as well as smaller private (Egegik) and municipal (Manokotak) utilities. These utilities offer a central source of electricity to electric users in the community. The seasonal/central-station utility category refers exclusively to Southwest Regional school generators which distribute power to other village users on a seasonal basis. These utilities typically shutdown completely in summer. Noncentral-station communities do not have a central source of electricity. Electricity is produced on an individual basis from home generators ranging in size from about 3 to 5 kilowatts. As discussed in Appendix E, Section 2, the unit cost of noncentral electricity is considerably higher than either central or seasonal/central.

These electrification categories were developed for two reasons. First, setting aside differences in economic characteristics, communities having similar electrification properties are likely to share common price levels and availability constraints, which are important determinants of electricity-use. Second, limited data restricted the accuracy and scope of the analysis on a community level. By merging communities into larger groups, the information base was enlarged and more reliability was introduced.

II. ECONOMIC ANALYSIS OF BRISTOL BAY REGION

Review of the Economy

Bristol Bay's economy has two kinds of structure: (1) small village economies with very seasonal cash flows and greater reliance on subsistence and (2) larger, more diversified economies where regional population is more concentrated and steady, year-round employment is more common.

In the summer fishing months, the smaller upriver villages will tend to empty out as their residents migrate to fish camps and the larger fish processing centers. During these months, a great deal of cash income from fishing is earned. The larger processor centers such as Dillingham, King Salmon, and Naknek will fill up with people. Some families will earn their entire yearly income within three to six weeks and, in some cases, have it spent by January. Income is spent on such things as fishing gear, past debts, winter supplies, and in some cases building materials for new homes.

The larger places tend to have a more stable economy with larger government and support sector employment than their smaller neighbors. Dillingham, for example, has become a transportation, trade, and services center for the Bristol Bay region. It has a major airport and several government agencies centered there such as State of Alaska Fish and Game, Department of Highways, Federal Aviation Administration, and the Southwest Regional School District offices. Its support sector includes a hardware, general merchandise, food, and liquor store as well as a lumber yard, movie theater, pool halls, hotels, restaurants, and bars.[1] Very few smaller villages have any of these resources.

Employment opportunities are often restricted to fishing in the smaller communities, although a few stable jobs in the schools, post offices, and, in some cases, utilities exist.

Population. A look at Table II-1 shows that the total regional population has changed very little over time. The drop between the 1900 count of 3,400 to 2,015 in 1920 can be partly accounted for by poor health care delivery and the introduction of outside diseases such as the post-World War I influenza epidemic on the Native population. As public health programs became effective, population subsequently increased. World War II resulted in the manning of the first defense station in the area as well as the federal government's movement of Aleuts from the Aleutian Chain into the region. This, combined with post-war military installations, accounts for the 1939-1950 population increase.

Between 1950 and 1960, a 46 percent population increase occurred. The active duty military increase of 439 personnel accounted for most

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[1]As reported by the Bristol Bay Native Association internal report 1981.

TABLE II.1

POPULATION TRENDS OF THE BRISTOL BAY REGION

	Military	Bristol Bay Borough	Bristol Bay Division	Total Region
1740				2,400
1880[1]				2,679
1900				3,400
1909				2,271
1920				2,015
1929				2,198
1939				1,992
1950	100			2,756
1960	539			4,024
1970	400	1,147	3,485	4,632
1971	420	1,027	3,200	4,227
1972	400	1,121	3,572	4,693
1973	440	1,199	3,659	4,858
1974	529	1,239	3,875	5,114
1975	456	1,914	3,847	5,761
1976	452	1,252	3,500	4,752
1977	459	1,102	3,521	4,623
1978	310	1,400	3,900	5,300
1979	369	1,233	3,971	5,204
1980	375	1,094	4,616	5,710

[1]1880 census reported 2,331 persons in this area. Oswalt considers this to be a gross over-count, however, and suggests 1,000 as being closer to the actual population (Oswalt, op. cit.), p. 9. Other references consulted support this view.

SOURCE: J. W. Swanton, The Indian Tribes of North America (1952); W. H. Oswalt, Alaska Eskimos (1967); U. S. Bureau of the Census, 1880-1980.

Alaska Department of Labor, 1971-1979.

of this population increase when considering the impact of their dependents and secondary civilian employment caused by the increase (Table II-1).

Important determinants of growth in the 1960-1970 era include: growing government programs, increased employment in the government sector, and better health care delivery.

Population continued to increase through the 1970-1980 period by 23 percent as a result of increased employment in the fishing and government sectors of the economy. The 1971 Alaska Native Claims Settlement Act and creation of the Bristol Bay Native Corporation also caused increased service employment in the region and had a positive effect on the population and economy of Bristol Bay.

Table II-2 presents the populations of villages within our study region as well as the total Bristol Bay region and census divisions. The table is broken into geographical regions. The largest of these is the Nushagak Bay region with a 1980 population of 2,097. It has increased in population every census year since 1950. The largest increase was 49.6 percent between 1970 and 1980. The largest place in the region as well as in the study area is Dillingham. Dillingham's population fell between 1950 and 1960 but showed an increase of 115 percent between 1960 and 1970. However, much of this increase occurred in 1963, when it incorporated over a twenty-two square mile area and absorbed the populations of Kanakanak, Nelsonville, and Wood River Village as well as populations on the roads to those villages.

TABLE II.2. POPULATION OF STUDY AREA VILLAGES

	Oct. 1 1929	Oct. 1 1939	Apr. 1 1950 Census	Apr. 1 1960 Census	Apr. 1 1970 Census	1975 Census Estimate	1976 Census Estimate	1977-1978 H&SS Village Nurse Survey	1979 Revenue Sharing	Apr. 1 1980 Census	Jan. 1 1981 Revenue Sharing	Percent Change 1950-1960	Percent Change 1960-1970	Percent Change 1970-1980	1980 Percent Native
Nushagak Bay Region			978	982	1402					2097		.4	42.8	49.6	
Aleknagik		78	153	231	128	179	175	209	227	154	227	51.0	-5.2	20.3	89.6
Clarks Point	25	22	128	138	95	95	88	35	98	79	98	7.8	-31.2	-16.8	88.6
Dillingham	85	278	577	424	914	1160	1207	1326	1360	1563	1656	-26.5	115.6	71.0	57.0
Ekuk				40	51	NA	NA	NA	NA	P7	NA	-	27.5	-86.3	NA
Manakotak			120	149	214	234	250	263	250	294	250	24.2	43.6	37.4	92.9
Nushagak River Region			309	351	521					576		13.6	48.4	10.6	
Ekwok	40	68	131	106	103	118	111	103	111	P79	111	-19.1	-2.8	23.3	NA
Koliganek			90	100	142	NA	NA	NA	NA	P116	NA	11.1	42.0	-18.3	NA
New Stuyahok			88	145	216	294	306	296	297	331	297	64.8	49.0	53.2	94.0
Portage Creek					*60	NA	NA	NA	NA	P50	NA	-	-	20.0	NA
Iliamna Lake Region			195	315	366					387		61.5	16.2	5.7	
Igiugig					36	NA	NA	NA	NA	P33	NA	11.1	42.0	-18.3	NA
Iliamna	100	30	44	47	58	NA	NA	NA	NA	P94	NA	6.8	23.4	62.1	NA
Newhalen		55	48	63	88	99	105	204	105	87	105	31.3	39.7	-1.1	94.3
Nondalton	24	82	103	205	184	219	224	207	226	173	226	99.0	-10.2	29.1	93.1
Other Places		125	195	238	222					155		13.8	7.2	-30.2	
Egegik		125	119	150	148	NA	NA	NA	NA	P75	NA	26.1	-1.3	49.3	NA
Levelock			76	88	74	NA	NA	NA	NA	P80	NA	15.8	15.9	9.1	NA
Bristol Bay Borough - Civilian					391	744					719		90.3	3.5	
King Salmon				227	202	NA	NA	NA	NA	170	NA	-	-11.0	15.8	NA
Naknek	173	152	174	249	318	NA	NA	NA	NA	318	NA	43.1	27.7	0.0	NA
South Naknek				142	154	NA	NA	NA	NA	145	NA	-	8.5	-4.8	NA
South Naknek Outskirts					70					86		-	-	22.9	NA
Military			100	539	400					375		439.0	-25.8	-6.3	NA
Study Area Total			1951	2504	3655					4215		28.3	46.0	15.3	NA
Bristol Bay Borough (Total)					1147					1094		-	-	-4.6	32.9
Bristol Bay Division (Total)					3485					4616		-	-	32.5	76.3
Total Bristol Bay Region	2198	1992	2756	4024	4632	5389	5221	NA	5204	5710	NA	46.0	15.1	23.3	68.0

P - Preliminary 1980 Census. NA - Not Available.

SOURCES: U.S. Census Bureau 1939, 50, 60, 70, and 80.
State of Alaska, Community and Regional Affairs 1979 and 1981.
State of Alaska, Department of Health and Social Services, 1977-78.

*Bristol Bay Native Corporation, "Presentation to Senate Public Works Subcommittee on Water Resources - August 1973," p. 21, gives the population as sixty. Dillingham Comprehensive Plan, 1971, p. 33, estimates the population as seventy. The application submitted in November 1970 for incorporation as a fourth class city gives the population as ninety.

The 1960 population would have been 800 if the same area as 1970 had been counted.[2] The Dillingham increase between 1970 and 1980 of 71.0% is due to increased fish processing, government employment and transportation.

Other places affecting 1970-1980 growth in the Nushagak Bay region were Manakotak (37.4%), and Aleknagik (20.3%). Ekuk, a fish processing village, had a population decrease of 44 people between 1970 and 1980.

Within the Nushagak River region, New Stuyahok stands out as the largest place. It has grown in all years reported in Table II-2 except 1977-1978 and 1979. This could be due to different estimating techniques used by the Alaska Department of Community and Regional Affairs and the Alaska Department of Health and Social Services. The region as a whole has grown consistently between census years. The population was 94% Native in 1980; most all of this is Eskimo. The economy depends mostly on commercial fishing, although it has a school, a post office, a sewer system, and cooperative store (Kresge, 1974).

In general, the rest of the Nushagak River region has a very mobile Native population that can cause individual village populations to fluctuate between years.

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[2]Alaska State Housing Authority, City of Dillingham Comprehensive Report, 1972.

The Iliamna Lake region is a geographically isolated area that has shown a large growth between 1950 and 1960 as a result of military inmigration to Nondalton.

Each year many Iliamna area residents migrate to fishing communities for the fishing season for both employment and subsistence fishing (see Kresge, 1974).

The Bristol Bay Borough region was created in 1962. The borough's population has fallen 4.6% between 1970 and 1980. King Salmon was the largest place in the subregion during 1980 with 536 people, of which 366 were military. Both Naknek and South Naknek are fishing communities. Naknek has not grown between 1970 and 1980, remaining at 318, while South Naknek has decreased by 4.8% in the same period. As a result of the King Salmon Air Force Station, the Bristol Bay Borough census division population was 32% Native in 1980, much lower than any of the subregions under study or the Bristol Bay division. One of the reasons for this is the high military population in the region.

Other places in the study area communities include Levelock and Egegik, which have similar sized 1980 populations, but Levelock has been steadily growing while Egegik has decreased in population between 1960 and 1980.

Table II-3 shows that Natives as a percent of total population in the region remained stable at 63% between 1960 and 1970, but picked up to 68% in 1980. The lower 1970 percent may be due to the problem of definition of Native; the 1971 Native Claims Settlement Act and its one-quarter blood eligibility requirement may have caused some people who would have defined themselves as non-Native in the 1970 census to define themselves as Native in the 1980 census. Thus, it is difficult to say whether a real percent increase has taken place between 1970 and 1980.

Another look at Table II-3 shows the percent of the population below 18 and over 65 increased from 46.7% to 49.9% between 1960 and 1970. Better health care delivery and concomitant lower infant mortality rates played a large role in this increase.

Educational attainment has increased in terms of median years completed, and number of high school graduates between 1960 and 1970 (Table II-3). Of those who worked in 1970, most either worked 50-52 weeks or less than 26 weeks. Since fishing seasons are less than 26 weeks long and are such a large part of the economy, it is probably safe to assume that many of the workers who worked less than 26 weeks were involved in the fishing industry.

Income. Historically, the sources of income to residents have been a combination of wages and salaries, government transfer payments, fishing and subsistence activity. The fishing industry

TABLE II.3

Bristol Bay Region — General Social and Economic Characteristics of Population

1960 - 1980

	April 1, 1960	April 1, 1970	April 1, 1980
TOTAL POPULATION	4,024	4,632	5,710
% of increase 1960-70		15.1%	23.3%
Race			
Native	2,534	2,949	3,880
Non-Native	1,490	1,683	1,830
-- percent Native	63.0%	53.7%	68%
Sex			
Male	2,404	2,632	N/A
Female	1,620	2,000	N/A
-- males per 100 females	148.4	131.6	N/A
Age			
Under 18 years	1,783	2,182	N/A
Over 65 years	96	131	N/A
-- percent under 18 over 65	46.7%	49.9%	N/A
Family Income and Poverty Status[a]			
Median income, all families with incomes	$ 5,955	$ 7,284	N/A
(Deflated by BLS Consumer Price Index, 1957-59 = 100)	(5,776)	(5,384)	N/A
Percent of families with:			
-- Income less than poverty level	21.1%	29.5%	N/A
-- Income less than 75% poverty level	14.6	23.7	N/A
-- Income less than 125% poverty level	30.8	39.0	N/A
-- Income more than 125% poverty level	69.2	61.0	N/A
Educational Attainment (persons 25 years and over):			
Median years complete:			
-- males	8.7	9.7	N/A
-- females	5.2	7.3	N/A
Percentage high school graduates:			
-- males	34.1	45.6	N/A
-- females	26.1	33.4	N/A
Infant Mortality Rates, Calendar Years (deaths under 1 year of age per 1,000 live births)	70.1	29.4	N/A
Employment Status			
Armed Forces	536	439	N/A
Civilian Labor Force	654	882	N/A
(Unemployed)	(145)	(133)	N/A
Ratio Non-workers	2.373	2.506	N/A
Weeks Worked in 1969			
Percentage male population 16 years and over:			
--- 50-52 weeks		39.1%	N/A
--- 27-49 weeks		15.7	N/A
--- 26 weeks or less		37.2	N/A
--- did not work		8.0	N/A
Percentage females population 16 years and over:			
--- 50-52 weeks		12.4	N/A
--- 27-49 weeks		10.3	N/A
--- 26 weeks or less		40.1	N/A
--- did not work		37.2	N/A
Labor Mobility of Males[b]			
Percentage of males 30-49 years old in 1970:			
-- non-worker 1965, non-worker 1970	30.1%		N/A
-- non-worker 1965, worker 1970	6.5		N/A
-- worker 1965, worker 1970	57.0		N/A
-- worker 1965, non-worker 1970	6.4		N/A

[a] Excludes inmates of institutions, members of Armed Forces, college students in dorms and unrelated individuals under 14 years. 1970 poverty level for all families @ $3,388. For 1960 poverty level for all families = $3,000.

[b] "Worker" includes members of Armed Forces.

SOURCE: U.S. Bureau of the Census 1970: PC(1)-C3, Alaska; 1960: PC(1)-3C, Alaska.
Infant mortality data from Alaska Department of Health and Social Services, 1980 Census Advanced Report.

plays a larger roll in the cash economy of small village residents. However, measuring the income from fishing activities is very difficult. Neither the Alaska Department of Labor (DOL) nor the U.S. Bureau of Economics Analysis (BEA) have managed to accurately capture fishing income in their estimates of wages and salaries or personal income. Using 1979 as an example, the BEA estimates $896,000 (Tables II-5a and II-5b) of income by place of work in agriculture forestry and fisheries. By contrast, Table II-10 shows that the value of salmon harvesting alone amounted to 139.547 million in the same year.

Table II-4 shows personal, per capita and real per capita income (deflated with the Anchorage Consumer Price Index) have all grown between 1965 and 1979. Real per capita income in the Bristol Bay region has doubled in this period while statewide real per capita income has grown 1.6 times. The 1965 ratio of Alaska's real per capita income to Bristol Bay's was 1.83; by 1979 it had fallen to 1.47, a 19.7% decrease in 14 years. Unfortunately, these tables do not reflect the full impact of the fishing industry, but only the more stable components of the economy.

Tables II-5a and II-5b break out the components of personal income in the Bristol Bay Borough and Bristol Bay census division (they are both census divisions) for the years 1965 through 1979. A comparison of the last row in each table will reveal that the Bristol Bay Borough has had more than twice the real per capita income than

TABLE II.4

PERSONAL INCOME, PER CAPITA INCOME, AND
REAL PER CAPITA INCOME
BRISTOL BAY, 1970-1979

	(1) Personal Income (Millions)	(2) Population[1] in Thousands	(3) 1/2 Per Capita Income ($000)	(4) 3/4 Real[2] Per Capita Income (000)	(5) Alaska Statewide Real Per Capita
1965	7.6	4.4	1.7	1.8	3.3
1966	8.1	4.3	1.9	1.9	3.4
1967	8.4	4.6	1.8	1.8	3.7
1968	9.1	4.6	1.9	1.9	3.8
1969	11.9	4.6	2.6	2.4	4.0
1970	13.1	4.7	2.8	2.5	4.2
1971	14.6	4.7	3.1	2.7	4.3
1972	14.2	4.8	3.0	2.5	4.5
1973	24.9	4.8	5.2	4.2	4.9
1974	23.9	5.0	4.8	3.4	5.1
1975	27.6	5.2	5.3	3.4	6.1
1976	28.9	5.5	5.3	3.1	6.1
1977	29.8	5.5	5.4	3.1	5.9
1978	32.6	5.3	6.2	3.2	5.6
1979	39.4	5.2	7.6	3.6	5.3

[1]For the sake of consistency, BEA population estimates were used instead of Alaska Department of Labor estimates presented in Table II.1.

[2]Deflated by the Anchorage Consumer Price Index.

SOURCES: U.S. Department of Commerce, Bureau of Economic Analysis,
U.S. Department of Labor, Bureau of Labor Statistics.

TABLE II-5a
PERSONAL INCOME BY MAJOR SOURCES 1965-1979
BRISTOL BAY DIVISION
(in thousands of dollars)

	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Income by place of work															
Ag. For. fish	NA	NA	NA	NA	NA	NA	1568	490	1037	1337	461	550	799	790	841
Mining	L	L	L	L	D	D	L	L	L	0	0	0	0	0	0
Manufacturing	D	D	D	D	906	D	1316	1150	2066	2076	1591	2879	3419	5463	D
Construction	148	158	177	185	205	D	306	332	387	728	D	304	1478	627	1201
Trans. Comm. & Utility	168	166	228	240	302	D	495	486	650	798	1582	1800	2826	3368	3731
Wholesale	238	238	288	298	355	D	L	L	L	L	D	0	0	D	D
Retail	238	238	288	298	355	D	619	514	633	759	753	849	972	1094	1326
Finance	L	L	L	L	D	D	61	84	110	135	D	738	1337	D	D
Services	118	136	150	157	162	181	251	275	416	492	1466	1668	2665	3141	3614
Civilian Fed. Gov't	502	509	543	574	644	754	959	1011	960	1059	1376	1440	1637	1796	1883
Military Fed. Gov't	406	438	496	537	578	618	112	137	144	144	149	155	169	185	187
State & Local Gov't	743	859	936	1066	773	1474	1954	2519	2957	3462	4116	4871	3512	3989	4342
Total Labor & Proprietor's income by place of work	3597	3847	3944	4255	4349	5679	7676	7034	9391	11018	13274	15254	18814	21817	29311
Net labor & proprietors' income/place of residence	3409	3617	3740	3999	4231	5154	5803	5016	6587	7833	9685	11049	12974	14561	18404
Dividends, interest and rent	95	94	113	111	122	162	204	228	469	503	699	928	1052	1040	1203
Transfer payments	402	464	519	643	757	1091	1341	1609	8455	5572	5849	4253	3992	4035	4113
Total personal income by place of residence	3906	4175	4372	4753	5110	6407	7348	6853	15511	13908	16233	16230	18018	19636	23720
Per capita income by place of residence	1196	1294	1260	1378	1476	1829	2085	1854	4152	3635	4088	3857	4257	4645	5973
Anchorage CPI	94.2	97.9	1.0	102.6	107.3	111.5	114.3	116.9	123.8	140.2	157.4	167.6	172.3	193.8	211.4
Real per capita income by place of residence (1967 and deflated w/Anchorage Oct. CPI)	1270	1322	1260	1343	1376	1640	1824	1586	3354	2593	2597	2301	2401	2397	2825

SOURCE: U.S. Bureau of Economic Analysis Printouts
U.S. Bureau of Labor Statistics, Consumer Price Index

(D) Not shown to avoid disclosure of confidental information; data are included in totals.
(L) Less than $50,000; data are included in totals.

TABLE II.5b

PERSONAL INCOME BY MAJOR SOURCES 1965-1979
BRISTOL BAY BOROUGH
(in thousands of dollars)

	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Income by place of work															
Ag. For. fish	NA	NA	NA	NA	NA	NA	683	565	846	798	6	6	55	D	55
Mining	L	L	L	L	D	L	D	D	L	0	0	0	0	0	0
Manufacturing	D	D	D	D	1186	D	1718	1503	1827	1838	2981	2831	2790	4381	6549
Construction	191	204	228	238	267	253	D	D	296	546	L	1563	862	51	D
Trans. Comm. & Utility	D	D	D	D	391	D	567	614	610	690	2027	1991	831	775	1021
Wholesale	D	D	D	D	380	D	D	D	L	L	L	57	D	57	L
Retail	D	D	D	D	380	D	523	506	536	639	374	535	376	470	1488
Finance	L	L	L	L	D	54	D	D	88	117	L	228	D	D	D
Services	D	D	D	D	132	D	317	268	241	271	259	768	586	705	501
Civilian Fed. Gov't	860	869	934	990	1144	1237	1313	1335	1259	1430	1433	1805	1861	2312	2428
Military Fed. Gov't	1988	2119	2415	2621	2746	2923	3246	3274	4241	4404	4793	4721	4611	4530	4709
State & Local Gov't	262	304	332	379	557	484	640	825	967	1133	1348	1596	1461	1667	1672
Total Labor & Proprietor's income by place of work	5576	5897	6141	6611	7452	8311	9467	9352	10935	11883	13298	16136	13536	15251	19463
Net labor & proprietors' income/place of residence	3396	3612	3698	3975	6288	5188	6542	6479	7865	8626	9685	10972	9933	11190	13668
Dividends, interest and rent	145	145	177	172	196	191	147	132	183	258	303	398	462	476	554
Transfer payments	164	190	214	266	288	379	615	728	1248	1144	1431	1337	1366	1348	1483
Total personal income by place of residence	3705	3947	4089	4413	6772	5758	7304	7339	9296	10028	11419	12707	11671	13014	15705
Per capita income by place of residence	3447	3703	3574	3878	5946	4994	6041	6678	8352	8462	9157	9678	8890	10711	12737
Anchorage CPI	94.2	97.9	100	102.6	107.3	111.5	114.3	116.9	123.8	140.2	157.4	167.6	177.3	193.8	211.4
Real per capita income by place of residence (1967 and deflated w/Anchorage Oct. CPI)	3659	3782	3574	3780	5541	4479	5290	5713	6746	6036	5818	5774	5014	5527	6025

SOURCE: U.S. Bureau of Economic Analysis Printouts
U.S. Bureau of Labor Statistics

(D) Not shown to avoid disclosure of confidental information; data are included in totals.
(L) Less than $50,000; data are included in totals.

the Bristol Bay division between 1965 and 1979. Transfer payments between 1972 and 1979 fluctuated with Native land claims cash dispursements that resulted from the Alaska Native Land Claims Settlement Act of 1971.

Tables II-5a and II-5b show that government wages and salaries made up the largest proportion of income by place of work in both census divisions, comprising over 50% of the Bristol Bay borough's income in most all years, while in the Division it fell from 45.9% in 1965 to 21.9% in 1979. Interestingly enough, income from service industries in the Division was 4.17 times higher in the year 1974 than 1965, then grew from $492 to $3.614 million between 1974 and 1979. It comprised 12.3% of the Division's income in 1979, up from 3.3% in 1965 (see Table II-6). The jump in service income is partially a result of nonprofit Native organization activity (i.e., Bristol Bay Native Association).

Table II-7 presents 1978 income tax data by study area community. Over half of the taxable income within the study region came from Dillingham. King Salmon had over $2 million dollars in taxable income, as did Naknek. Dillingham also had the largest average tax paid per return ($637), although Naknek and King Salmon followed close with $607 and $548, respectively.

Average taxable income per taxpayer in Table II-7 ranges from $9,832 in Dillingham to $2,159 in Levelock. The average of the study region was $7,894. The average of the study excluding Dillingham was $6,583.

TABLE II.6

GOVERNMENT AND SERVICE PERCENT OF TOTAL LABOR AND PROPRIETORS' INCOME BY PLACE OF WORK IN BRISTOL BAY FOR SELECTED YEARS

	Government Percent of WS and Pr. Income	Services Percent of WS and Pr. Income
Bristol Bay Borough		
1965	55.8	D
1969	59.7	1.8
1975	57.0	10.8
1979	45.3	2.6
Bristol Bay Division		
1965	45.9	3.3
1969	45.9	3.7
1975	42.5	11.0
1979	21.9	12.3

SOURCE: Table II-5.

TABLE II.7
1978 INCOME TAX PAID BY PLACE

	No. of Returns	No. of Taxpayers	Tax Paid	Average Tax Paid per Return	Average Tax Paid Per Taxpayer	Taxable Income	Average Exemptions	Average Taxable Income Per Taxpayer
Aleknagik	44	66	11,893	270	180	412,147	125	6,245
Clarks Point	27	37	10,873	403	294	285,210	68	7,708
Dillingham	544	799	346,414	637	434	7,855,791	1,391	9,832
Egegik	22	28	2,919	135	106	101,051	46	3,609
Ekuk	NA							
Ekwok	28	41	1,364	49	33	107,368	77	2,619
Iguigig				(Included with King Salmon)				
Iliamna	69	106	17,309	251	163	644,543	198	6,081
Koliganek	30	45	3,487	116	77	191,107	107	4,247
Levelock	28	40	25,539	91	63	86,342	69	2,159
Manakotak	78	118	10,737	138	91	494,775	266	4,193
New Stuyahok	89	133	13,144	148	99	546,616	278	4,110
Newhalen				(Included with Iliamna)				
Nondalton	33	46	4,371	132	95	161,463	92	3,510
Portage Creek				(Included with Dillingham)				
King Salmon	176	254	96,492	548	380	2,371,060		9,335
Naknek	153	214	92,843	607	434	2,082,599	336	9,732
South Naknek	36	53	7,651	213	144	290,052	85	5,473
TOTAL	1,357	1,980	646,036	326	2,593	15,630,124	3,138	7,894

SOURCE: Alaska Department of Revenue, Individual Income Tax paid in 1978 by Alaskan Communities.

Labor Force Patterns. Caution should be exercised when using Table II-8 because 1961 through 1974 statistics were not found consistent with current population survey guidelines instituted by the U. S. Department of Commerce via the Alaska Department of Labor in 1975. 1975 to 1980 statistics were found with those guidelines, however, so trend analysis can be misleading using Table II-8. Using it to compare with the statewide characteristics, however, reveals that labor force participation rates in Bristol Bay are usually 5 to 15% lower than the state, and that the unemployment rate was generally higher than the statewide rate until 1973; from that time it has remained roughly 1% lower than the state.

Table II-9 presents employment by industry in the region. The sources for this data are not from the same series as Table II-8. Thus, comparisons between the tables are not used in this analysis.

Table II-9 shows a positive trend in employment growth for the Bristol Bay region 1969-1979 period. Annual average total employment grew from 2,166 to 3,470. Employment in the month of July for the same period went from 7,861 to 10,752. In all of these years except 1974, commercial fishing comprised over half the employment in the month of July. Commercial fishing and manufacturing (which is mostly fish processing) comprised over 75 percent of employment for the same time frame during July. On an annual average basis, manufacturing and commercial fishing comprised less than 50 percent of total employment for most of that same 10 year period.

TABLE II.8
LABOR FORCE CHARACTERISTICS
BRISTOL BAY AND ALASKA 1961-1980

	BRISTOL BAY					ALASKA	
	Labor Force	Labor Force Participation Rate (%)	No. Employed	No. Unemployed	Unemployment Rate (%)	Labor Force Participation Rate (%)	Unemployment Rate (%)
1961	1,294	32.8	1,192	102	7.9	37.0	9.9
1962	1,076	26.5	964	112	10.4	36.5	9.4
1963	1,138	27.1	989	149	13.1	37.2	9.3
1964	1,073	28.1	942	131	12.2	38.0	9.4
1965	1,388	34.6	1,242	146	10.5	38.7	8.6
1966	1,282	31.1	1,133	149	11.6	38.9	9.0
1967	1,089	24.8	971	118	10.8	39.5	8.7
1968	1,194	26.6	1,048	146	12.2	39.7	9.1
1969	1,355	29.6	1,185	170	12.5	41.2	8.7
1970	1,468	34.7	1,291	177	12.1	39.9	9.0
1971	1,483	39.0	1,280	203	13.7	41.2	10.4
1972	1,384	32.2	1,228	156	11.3	44.6	10.5
1973	1,547	35.0	1,399	148	9.6	42.8	10.8
1974	1,601	34.9	1,494	107	6.7	39.4	7.9
1975	2,005	37.8	1,897	108	5.4	43.6	6.9
1976	2,096	48.7	1,943	153	7.3	43.5	8.3
1977	1,928	46.3	1,778	150	7.8	44.8	9.2
1978	1,661	33.3	1,497	164	9.9	47.6	11.0
1979	1,838	38.0	1,679	159	8.7	48.0	9.4
1980	1,824	34.2	1,673	151	8.3	49.6	9.6

SOURCES: AK Department of Labor, Labor Force Estimates, various issues, 1961-1977.
AK Department of Labor, special tabulations of labor force, 1978-1980.
AK Department of Labor, Alaska Population Overview, 1979.
AK Department of Labor, special tabulation of population for Alaska, 1970-1980.
AK Department of Labor, Current Population Estimates, 1960-1970.

TABLE II.9

Total Estimated Wage and Salary and Commercial Fishing Employment by Major Industrial Classification
Bristol Bay Region

Industry	Annual Average 1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	Month of July 1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
Total Employment	2,166	2,474	2,427	2,260	2,355	2,107	2,430	2,756	2,689	2,902	3,605	7,861	9,310	8,866	7,145	5,868	4,610	6,994	7,479	7,169	8,830	10,752
Commodity Producing																						
—Commercial Fishing	634	817	764	722	562	312	465	706	802	1,100	1,356	4,579	4,870	4,752	4,210	3,181	2,134	3,884	4,263	4,581	5,722	6,353
—Mfg. (primarily fish processing)[a]	515	680	642	402	446	235	288	306	264	204	330	2,141	3,320	3,102	1,835	1,446	729	1,342	1,406	1,052	1,471	2,611
—Mining (including oil & gas)[a]	0	0	0	1	0	1	3	1	0	0	0	0	0	0	2	0	2	10	0		0	0
—Construction[a]	2	2	1	13	36	26	41	42	25	12	45	0	0	0	15	24	59	80	68	70	20	51
Subtotal	1,151	1,499	1,407	1,138	1,044	574	797	1,055	1,091	1,316	1,731	6,720	8,190	7,854	6,062	4,651	2,924	5,316	5,737	5,703	7,213	9,077
Government																						
—Federal-Military	470	400	420	400	440	529	456	452	459	310	369	470	400	420	400	440	529	456	452	459	310	369
—Federal-Civilian	146	160	120	171	190	192	194	196	194	96	191	169	250	137	165	200	207	206	211	209	205	196
—State & Local	190	210	264	317	368	395	473	507	437	578	636	211	200	207	243	264	522	448	483	258	390	351
Subtotal	806	770	804	888	998	1,116	1,123	1,155	1,090	984	1,196	850	850	764	808	904	1,258	1,110	1,146	926	905	916
Distributive Industries																						
—Transportation, communications, public utilities	117	110	110	104	170	172	192	213	215	234	182	159	140	134	130	147	169	217	234	209	249	227
—Trade	42	50	46	59	59	74	103	92	80	100	71	52	30	41	53	62	89	149	110	84	98	69
—Finance, Insurance, Real Estate[a]	20	20	27	25	28	28	28	39	43	33	32	40	40	35	21	35	30	30	36	50	31	25
—Services	25	20	33	45	55	142	187	201	170	235	393	31	60	38	59	66	134	172	216	197	334	438
Subtotal	204	200	216	233	312	416	510	545	508	602	678	282	270	248	263	310	422	568	596	540	712	759
Miscellaneous & Unclassified[c]	5	5	0	1	1	1	0	1	0	0	0	9	0	0	12	3	6	0	0	0	0	0

[a]Estimated by author for months not disclosed.

[b]Figures not disclosed.

[c]Excludes ADL estimates of covered employment in commercial fish harvesting.

Sources: Population: Alaska Department of Labor, *Current Population Estimates by Census Divisions* (July 1, annual).
Employment: Alaska Department of Labor, *Alaska Labor Force Estimates by Area* (annual), Total "Non-Agricultural Wage and Salary Employment" less "covered employment in fisheries."
Military: from annual population estimates, Alaska Department of Labor, *Commercial Fisheries*, from monthly estimates.

Annual average government employment has increased 48%, from 806 in 1969 to 1,196 in 1979 (Table II-9). Most of this growth was in state and local government, which increased 235% in the same 10 year period from 190 in 1969 to 636 in 1979. Military employment dropped 21%, from 470 to 369 in this period.

The fastest growing industry in the 1969 - 1979 period was the services, which went from 25 to 393, comprising most of the growth in the distributive industries. Much of this growth can be attributed to the profit Bristol Bay Native Association (BBNA) and the Nonprofit Bristol Bay Native Corporation (BBNC).

Fishing. Fish harvesting and processing has been the largest industry in Bristol Bay in terms of employment (see Table II-9) and income (see Tables II-5a, II-5b, and II-10). Historically, salmon has been the principal species caught. Table II-10 presents the work of Joseph Terry, et al, 1980. A look at the weight columns in this table illustrates the extreme fluctuation in total salmon harvest from year to year. When compared to the number of fishermen employed in Table II-9, it becomes apparent that the productivity of the fishermen in terms of fish caught per fisherman also fluctuates wildly. These fluctuations will make fishing projections very difficult.

There is a certain amount of seasonality in the fishing industry; Table II-9 shows a notable difference between annual average employment and July employment in the commercial fishing and

TABLE II.10

Bristol Bay Salmon Harvest
1969-1979

Year	Catch: Weight: Pounds (1,000)	Catch: Weight: Metric Tons	Catch: Value ($1,000): Nominal	Catch: Value ($1,000): Real[1]	Exvessel Price ($/Pound): Nominal	Exvessel Price ($/Pound): Real
1969	46035	20881	10607	23185	0.23	0.50
1970	115834	52542	26967	55650	0.23	0.48
1971	66660	30237	16608	32860	0.25	0.49
1972	20838	9452	5231	10019	0.25	0.48
1973	14493	6574	4232	7631	0.29	0.53
1974	16007	7261	6641	10791	0.41	0.67
1975	29714	13478	11675	17382	0.39	0.58
1976	48554	22024	23259	32740	0.48	0.67
1977	47792	21678	28478	37657	0.60	0.79
1978	83363	37813	57038	70057	0.68	0.84
1979	130058	58994	139547	154337	1.07	1.19

Sources: This table was generated from data contained in (1) Commercial Fisheries Entry Commission Gross Earnings Files, and (2) Alaska Department of Fish and Game Reports.

As reported by Terry, et al, 1980

[1] The real values and prices were calculated using the U.S. CPI; 1980 is the base period.

NOTE: 1978 and 1979 data are preliminary.

manufacturing industries. For several years the ratio of July to annual average employment is well over three to one. This, of course, is a result of the fishing season starting in June and ending in August. It causes a very large economic in-migration to the processing centers -- Dillingham, Naknek, South Naknek, Clarks Point, Egigik and Ekuk. It is estimated by the author (based on interviews with most of the large processors in the region) that roughly only 17 percent of the fish processing employees are Bristol Bay residents. The remaining 83 percent are comprised of college students, transients, and others mostly from out of state. Most residents who work at the processing centers are students, housewives, from families of permit holders, and others who, like their migrant cohorts, seek only temporary employment.

Herring has a potential in the area as well as salmon. Typical roe herring harvest estimated by Terry, et al, amounts to 18,700 metric tons annually (based on preliminary Alaska Department of Fish and Game estimates of the number of boats in Bristol Bay in 1980). This is roughly one third of the 1979 salmon harvest. Table II-11 presents estimates of typical herring harvest activity.

Based on these estimates of catch, 298 fishermen are employed annually (see Table II-11).

Table II.11

BRISTOL BAY, TYPICAL HERRING HARVEST

<u>Catch</u>

Weight (metric tons)	Real Value (millions of 1980 $)	Seasonal Employment	Annual Avg. Employment[a]
18,700	8.2	1,789	298

[a]Assuming an average season length of two months.

SOURCE: Terry, et al., OCS Technical Report #51.
Alaska Department of Fish and Game - discussions with Bristol Bay game biologists.

Table II-12 shows the number of fishing gear units by residence of operator that fish in the Bristol Bay region and the number of Bristol Bay resident gear units who fish outside Bristol Bay. Between 1973 and 1976, the number of Bristol Bay gear owners who fished outside Bristol Bay has remained stable at around 30. This amounts to roughly 4 percent in each of those years.

Of the total number of fishing gear owners that fish Bristol Bay, the percent that are residents increased dramatically between 1972 and 1974 as a result of the limited entry licensing restrictions that went into effect during that time. 1975 and 1976, however, show a large influx of non-Alaskan and unknown origin gear owners. It is possible that much of this influx is due to nongear owner permit holders selling these permits to non-Bristol Bay fishermen.

TABLE II.12
UNITS OF GEAR FISHED BY FISHERY AND RESIDENCE
OF OPERATOR 1970 - 1976

Fishery	RESIDENCE OF GEAR OWNER				Bristol Bay as a Percent of Total
	Bristol Bay	Other Alaska	Non-Alaska	Unknown	
1970					
Bristol Bay					
Drift gill net	533	426	667	153	
Set gill net	354	125	62	47	
Other	2	2	0	0	
Total	889	553	729	100	39.1
Other[a]					
Drift gill net	9				
Set gill net	5				
Other	5				
1971					
Bristol Bay					
Drift gill net	574	377	816	154	
Set gill net	328	76	67	86	
Other	0	0	0	0	
Total	902	453	883	240	36.4
Other[a]					
Drift gill net	6				
Set gill net	4				
Other	0				
1972					
Bristol Bay					
Drift gill net	554	315	611	138	
Set gill net	348	71	59	59	
Other	0	0	0	0	
Total	902	396	670	197	41.7
Other[a]					
Drift gill net	1				
Set gill net	6				
Other	1				
1973					
Bristol Bay					
Drift gill net	1,052	407	740	109	
Set gill net	384	58	36	3	
Other	0	0	0	0	
Total	1,436	465	776	112	51.5

TABLE II.12 (CONTINUED)

Fishery	RESIDENCE OF GEAR OWNER: Bristol Bay	Other Alaska	Non-Alaska	Unknown	Bristol Bay as a Percent of Total
Other[a]					
Drift gill net	16				
Set gill net	12				
Other	7				
1974					
Bristol Bay					
Drift gill net	388	104	148	24	
Set gill net	177	35	23	10	
Other	0	0	0	0	
Total	565	139	171	34	62.2
Other[a]					
Drift gill net	15				
Set gill net	14				
Other	2				
1975					
Bristol Bay					
Drift gill net	491	251	501	97	
Set gill net	262	72	37	31	
Other	0	0	0	0	
Total	753	323	538	128	43.2
Other[a]					
Drift gill net	14				
Set gill net	8				
Other	7				
1976					
Bristol Bay					
Drift gill net	506	260	557	89	
Set gill net	315	88	57	42	
Other	0	0	0	0	
Total	821	328	617	131	43.3
Other[a]					
Drift gill net	10				
Set gill net	18				
Other	5				

TABLE II-12 (CONTINUED)

Fishery	RESIDENCE OF GEAR OWNER: Bristol Bay	Other Alaska	Non-Alaska	Unknown	Bristol Bay as a Percent of Total
1979[b]					
Bristol Bay					
Drift gill net	662	337	720	0	
Set gill net	567	196	149	0	
Total	1,229	533	877	0	46.8
Other[a]	(None)				

[a]Other fisheries fished by Bristol Bay fisherman.

[b]As reported by P. J. Hill, Unpublished Outercontinental Shelf Work, January 1982.

SOURCE: AK Department of Fish and Game, as reported by ISER, George Rodgers et al, Measuring the Socioeconomic Impacts of Alaska's Fisheries, 1980.

For some residents, fishing is the main source of economic well being. They prepare for the season in the spring, migrate to fish camps during early summer, sell most of their catch, and keep the rest for subsistence. The money that they make will have to keep them supplied until the next fishing season.

Comparing total value of the salmon harvest with total personal income by place of residence (Tables II-10 and II-4) gives an idea of how much income is not captured in Table II-4's BEA personal income by residence estimate. If 43.3 percent of all fish were harvested by local residents (based on Table II-12's 1979 residence of gear owner), then over 65 million dollars of gross income (.433 * $139.547 million) was overlooked by the U.S. Bureau of Economic Analysis. Sixty-five million dollars is probably a high for an estimate, however, because Bristol Bay resident gear owners don't possess the same degree of technology in the gear they use as many of the outside (the region) gear owners do.[3] Thus, resident fishing is not as capital intensive or productive as the average.

Mining. Although historically mining has been all but nonexistent, there are known deposits of gold, silver, mercury and iron ore (see Figure II-1). According to C. C. Hawley and Associates and U.S. geological maps, the development of known iron ore reserves

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[3]Based on discussions with Department of Fish and Game biologists in Bristol Bay.

west of Koliganek (see Figure II-1) could employ as many as 500 people annually. The total of all other minerals (excluding oil and gas) development could add another 125 annual average jobs to the region (see Table II-13). Other undeveloped mineral resources not included in Table II-13 include copper (see Figure II-1) and coal. Unfortunately, manpower estimates on these resources were not available at the time of this writing.

TABLE II-13

BRISTOL BAY POTENTIAL MINERAL DEVELOPMENT EMPLOYMENT

Mineral	Estimated Average Annual Employment per Operation	Estimated No. of Potential Operations	Estimated Total Potential Employment
Mercury	5 to 20	3	60
Placer gold	5	3	15
Hard rock gold and precious metals	25	2	50
Iron - titanium	500	1	500
Total			625

SOURCE: U.S. Geological Survey maps and discussions with geologist C. C. Hawley.

Petroleum Development Potential. Leasing of state onshore land for petroleum exploration and development in the Bristol Bay southwest uplands is scheduled for January 1984 (sale 41). The area under

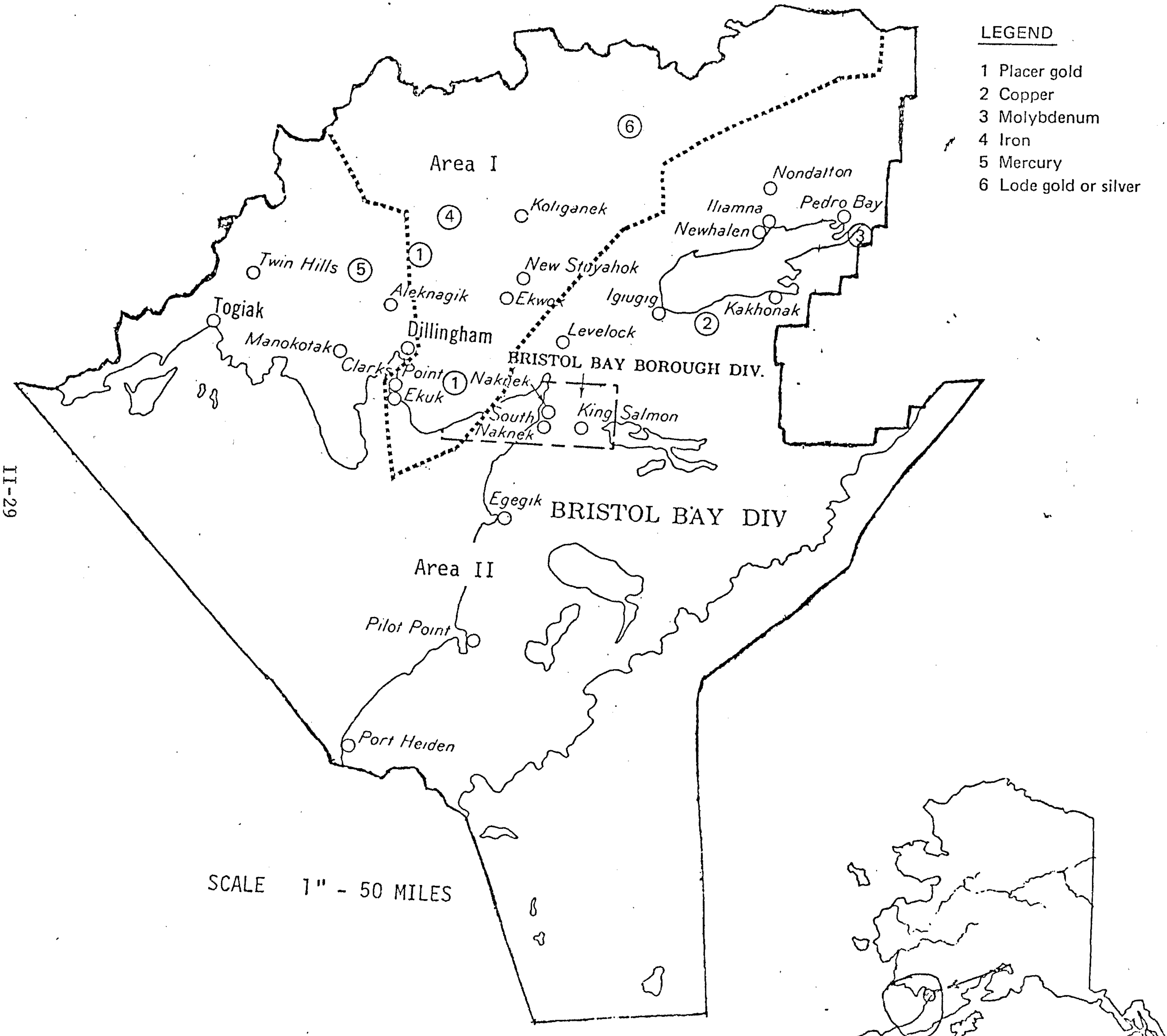

FIGURE II.1
MINING POTENTIAL IN BRISTOL BAY

consideration is presented in Figure II-2. Potential of significant discoveries and development of petroleum has been stated as being low to moderate by the Department of Natural Resources "Five Year Leasing Program" (1981). Probabilities of discovery and/or development have not been estimated, but discussions with the Department of Natural Resources in December 1981 indicated that they were very close to zero. Further discussions indicated that it would be very realistic to assume exploration to begin within one year of the lease sale and exploration could last for three to four years.[4] A detailed discussion of Bristol Bay onshore oil potential is in the appendices to this report.

The closest federal offshore oil lease sale that could affect Bristol Bay is the North Aleutian Shelf Sale 75 (see map, Figure II-3). It is scheduled by the BLM-OCS office for October 1983. Figure II-3 shows that its proximity to Bristol Bay is remote. Scenarios developed by John D. Tremont (BLM-OCS Technical Paper #1, 1981) indicate support bases serving petroleum exploration and development efforts would be located in the Dutch Harbor/Unalaska area. Transportation of petroleum would take the form of either an overland pipeline to a south side Alaska peninsula gas liquefaction and oil storage terminal or for storing and processing on individual platforms and deepwater loading onto oil and gas tankers.

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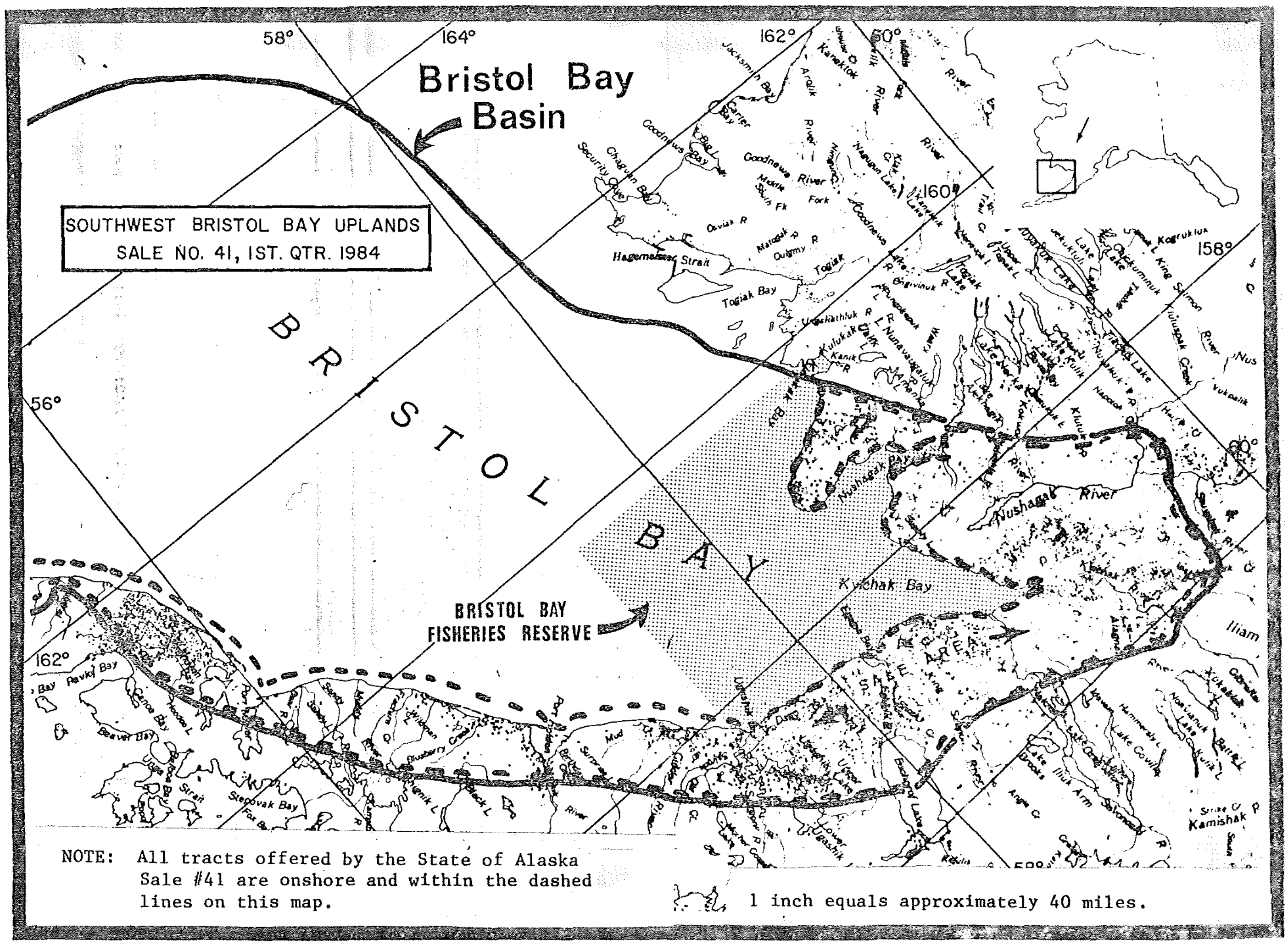
[4]Based on a discussion with Ed Phillips and Bob Butts.

FIGURE II.2

ONSHORE PETROLEUM POTENTIAL

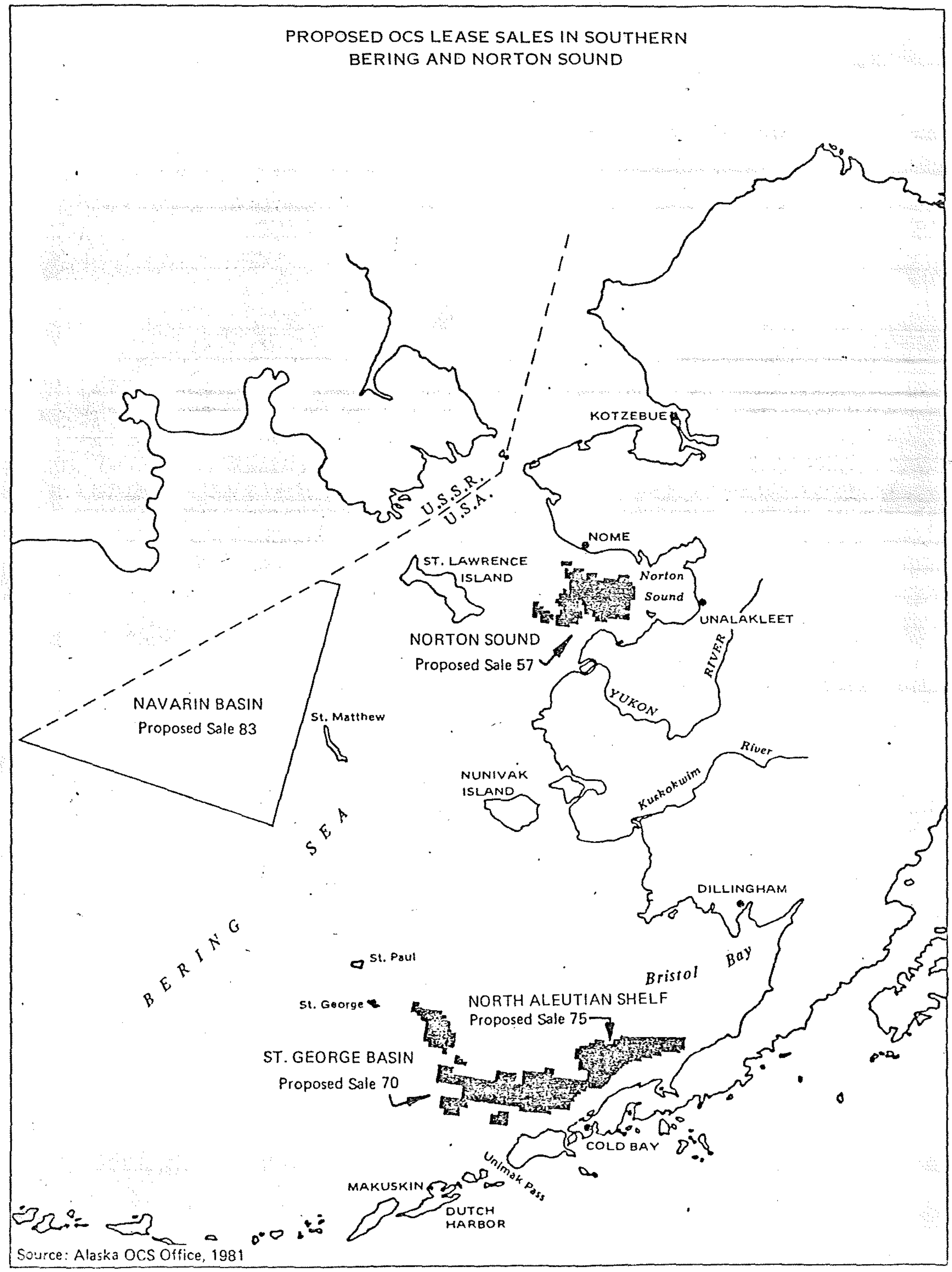


NOTE: All tracts offered by the State of Alaska Sale #41 are onshore and within the dashed lines on this map.

1 inch equals approximately 40 miles.

SOURCE: Alaska Department of Natural Resources, Five Year Leasing Program, 1981.

FIGURE II.3



PROPOSED OCS LEASE SALES IN SOUTHERN
BERING AND NORTON SOUND
KOTZEBUE
U.S.S.R.
U.S.A.
NOME
ST. LAWRENCE
ISLAND
Norton
Sound
UNALAKLEET
NORTON SOUND
Proposed Sale 57
YUKON
RIVER
NAVARIN BASIN
Proposed Sale 83
St. Matthew
River
Kuskokwim
NUNIVAK
ISLAND
SEA
BERING
DILLINGHAM
St. Paul
Bristol
Bay
St. George
NORTH ALEUTIAN SHELF
Proposed Sale 75
ST. GEORGE BASIN
Proposed Sale 70
COLD BAY
Unimak Pass
MAKUSKIN
DUTCH
HARBOR
Source: Alaska OCS Office, 1981

Based on this information, it is probably safe to assume that the impact of offshore petroleum exploration and development in the North Aleutian Shelf will not affect significantly the Bristol Bay region.

Projections for the Future

Overview

The application of the Small Community Population Impact Model (SCIMP) to Bristol Bay is at the census division level. The two census divisions, Bristol Bay Borough and Bristol Bay Division, have been combined for the formal modeling procedure because smaller levels of disaggregation for SCIMP input are very difficult to find and/or decrease the accuracy of the estimates. Three scenarios were run; a control, moderate industrialization, and high industrialization (see Figure II.4). The control scenario assumes no mining activity except for petroleum exploration and minimal growth in the fishing and government sectors. The moderate scenario includes some mining and moderate levels of fishing and exogenous government growth. The highest industrial scenario is the same as moderate but also assumes petroleum development based upon economic discoveries.

One of the largest potential exogenous projects in the region is the development of the known iron ore west of Koliganek; if developed, it could employ as many as 500 workers. However, the cost of getting the ore to market would be very high because existing transportation infrastructure on that scale is nonexistent in this area. Therefore, we have assumed that the price of iron ore will not reach a high enough level to make it an economically feasible project in the next 20 years, and have not included it in any of the scenarios.

FIGURE II-4

SALIENT ASSUMPTIONS OF PROJECTIONS

Control Case

1. Fish harvesting and processing employment: used the harvesting projections in Table C-8. The low projections in Table C-9 are used for processing employment (see Appendix C).

2. Mining: constant at current level of zero.

3. Oil and gas: exploration only. See Tables C-10 through C-13.

4. Federal government: no growth.

5. State and local government. Consistent with mean case government growth projected in the "Railbelt study" (Goldsmith and Porter, October 1981).

Moderate Industrialization

1. Fish harvesting and processing employment: used the same harvesting employment projections as in the control case (Tables C-8 and C-9 in Appendix C). High projections in Table C-8 are used for processing employment.

2. Mining: three gold placer and one hard rock plus one mercury deposits are developed. A total of 52 people are employed annually. Twenty-six are assumed to be resident.

3. Oil and gas: exploration only (as in control scenario). See Appendix C.

4. Federal government: civilian grows at one percent and military grows at two percent annually.

5. State and local government: consistent with high case "Railbelt study" projections (Goldsmith and Porter, October 1981).

Moderate Industrialization plus Petroleum Development

Same as the moderate industrialization case except the addition of a minimum find scenario of oil and gas (see Table C-13 in Appendix C for input).

For a detailed discussion of all three scenario assumptions, see Appendix C.

The Projections - A Summary

The salient SCIMP projections are presented in Tables II.14 through II.31. Additional SCIMP output is presented in Tables II.32 through II.49. The projections presented in this chapter include six tables for each of the three scenarios. The tables are organized by scenario and present the major population, employment, and income variables generated by the SCIMP model.

It should be noted that the secondary employment generated by petroleum development scenarios was not large enough to require imported labor in any of the scenarios. Thus, Tables II.20, II.21 and II.27 show total petroleum related employment larger than imported petroleum related population. The difference is the local residents who filled the secondary jobs.

Control case - The highest probability case. Population is summarized in Table II.14. Total population grows from 6,458 in 1981 to 10,231 in 2002, an annual average percent increase of 2.11 percent. Civilian resident population grew at an annual average percent of 2.44 percent in the same period, starting at 5,374 and growing to 9,152 by the end of the projection period. The Native population grew from a total of 3,828 to 5,992 in the projection period and at an average rate of 2.06 percent annually. Civilian non-Native non-enclave population grows at a 3.3 percent average annual rate. Positive employment growth (Table II.15) explains the difference between Native and non-Native civilian, non-enclave growth rates, because most imported labor is assumed to be filled by non-Natives.[5]

Moderate Industrialization Case

Total population grows from 6,514 to 12,905, at an annual average rate of 3.16 percent. This is 50 percent higher than the non-industrialization case. Civilian resident population grows at almost the same annual average rate as the lower case (2.44 percent in the middle case versus 2.45 percent in the low case). Native population grows at a 2.36 percent annual average rate while civilian resident population grows at 5.5 percent. So while the Native population grows .3 percent more annually than in the base case, non-Natives are assumed to be getting more of the new jobs and, thus, their population grows faster. The biggest growth in population in this case, is in the non-resident and military components. Military grows at two percent a year (as opposed to zero percent in the low case), and 26 extra non-resident miners, plus increased manufacturing employment cause an annual average growth of .67 percent in non-resident employment (versus zero percent in the low case).

Total employment grows from 3,132 to 4,415 in the projection period -- an annual rate of 1.57 percent. In this case, most of the

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[5]Appendix B includes a detailed discussion of economic migration.

growth takes place as a result of near doubling of state and local government employment. All other components of basic employment remain static except for petroleum exploration activities, which create a total of 28 jobs between 1985 and 1991. Total support industry growth (including construction) grew from 690 to 1,349 in this period, thus an increase of 630 jobs in government created 658 jobs in the support related industries.

High Case - Industrialization with Minimal Petroleum Development

This case is identical to the middle case except that a petroleum development scenario has been added. The long term impact of this development is an addition of 19 people to total population and a slight increase in per capita income.

Thus, we could say oil development would have very little permanent impact on the population of the region in the long run. Development in the peak year will have an impact of 101 direct local jobs (in 1989). Thus, even the short run impacts will not be tremendous.

There are three important reasons for the small impact of development: (1) the scenario is a minimum find and is a relatively small; (2) the petroleum industry is capital intensive (i.e., very little manpower is required to produce a given amount of product); and (3) a large percent of the manpower requirements are for highly skilled workers who will be enclave employees (i.e., not maintain a residence in the region).

Total employment grows from 3,184 in 1981 to 5,996 in this case. This is an annual average rate of 2.92 percent (1.35 percent higher than the low case). The major differences between this case and the control case are the increases in the annual military and civilian federal government growth rates (assumed to be 2 percent and 1 percent respectively). Other basic employment increases include 52 miners (half resident) and increasing fishing processing employment.

Support sector response to the basic employment increases are pronounced. Total support grows from 712 in 1981 to 2,084 in 2002. This is a 5 percent annual average growth (1.91 percent higher than the control case).

All Cases

Total real income shown in Tables II.19, II.25, and II.31 increases as employment grows. These same tables show real per capita income falling, however, because the percent of people in the age cohorts 0-14, 15-20, and 65+ increase as a percent of total population.[6] These age groups are assumed to have much lower labor force participation rates than the rest of the population; hence, the per capita work force is smaller and so is per capita income. This occurs to both civilian and total per capita income.

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[6]Population by age, sex, and race are presented in Tables II.32 through II.49.

TABLE II.14

CONTROL CASE

POPULATION SUMMARY

YEAR	NON-PETROLEUM CIVILIAN RESIDENT	NON-PETROLEUM TOTAL ALL COMPONENTS	NON-PETROLEUM RELATED COMPONENTS: NON-NATIVE RESIDENT	NATIVE	NON-RESIDENT CIVILIAN	MILITARY ACTIVE DUTY	IMPORTED PETROLEUM RELATED	TOTAL PETRO + NONPETRO
1981	5374.	6458.	1546.	3828.	709.	375.	0.	6458.
1982	5483.	6566.	1578.	3904.	709.	375.	0.	6566.
1983	5620.	6702.	1628.	3991.	708.	375.	0.	6702.
1984	5769.	6851.	1688.	4081.	707.	375.	0.	6851.
1985	5926.	7007.	1753.	4173.	706.	375.	29.	7036.
1986	6087.	7168.	1822.	4265.	706.	375.	30.	7198.
1987	6252.	7333.	1892.	4360.	706.	375.	30.	7363.
1988	6419.	7500.	1964.	4455.	706.	375.	30.	7530.
1989	6589.	7671.	2037.	4552.	706.	375.	30.	7701.
1990	6763.	7844.	2112.	4651.	706.	375.	30.	7874.
1991	6938.	8019.	2188.	4750.	705.	375.	30.	8049.
1992	7118.	8198.	2266.	4852.	705.	375.	1.	8199.
1993	7301.	8381.	2345.	4956.	705.	375.	0.	8381.
1994	7488.	8568.	2427.	5061.	705.	375.	0.	8568.
1995	7679.	8759.	2510.	5169.	705.	375.	0.	8759.
1996	7874.	8955.	2595.	5279.	705.	375.	0.	8955.
1997	8074.	9155.	2683.	5391.	705.	375.	0.	9155.
1998	8279.	9360.	2773.	5506.	705.	375.	0.	9360.
1999	8489.	9570.	2866.	5624.	705.	375.	0.	9570.
2000	8704.	9784.	2961.	5744.	705.	375.	0.	9784.
2001	8925.	10005.	3058.	5867.	705.	375.	0.	10005.
2002	9152.	10231.	3159.	5992.	705.	375.	0.	10231.

TABLE II.15

CONTROL CASE

EMPLOYMENT SUMMARY

YEAR	NON-PETROLEUM RELATED: CIVILIAN RESIDENT TE	NON-PETROLEUM RELATED: TOTAL TOTE	PETROLEUM RELATED: TOCSE	TOTAL EMPLOYMENT: CIVILIAN GTE	TOTAL EMPLOYMENT: TOTAL GTOE
1981	2048.	3132.	0.	2048.	3132.
1982	2092.	3175.	0.	2092.	3175.
1983	2136.	3219.	0.	2136.	3219.
1984	2183.	3265.	0.	2183.	3265.
1985	2230.	3312.	34.	2265.	3346.
1986	2280.	3361.	37.	2317.	3398.
1987	2332.	3413.	37.	2368.	3450.
1988	2385.	3466.	37.	2421.	3503.
1989	2439.	3520.	37.	2476.	3557.
1990	2496.	3577.	37.	2533.	3614.
1991	2554.	3634.	37.	2590.	3671.
1992	2614.	3694.	2.	2616.	3697.
1993	2676.	3757.	0.	2676.	3757.
1994	2740.	3821.	0.	2740.	3821.
1995	2807.	3887.	0.	2807.	3887.
1996	2875.	3956.	0.	2875.	3956.
1997	2946.	4026.	0.	2946.	4026.
1998	3019.	4099.	0.	3019.	4099.
1999	3094.	4175.	0.	3094.	4175.
2000	3172.	4251.	0.	3172.	4251.
2001	3252.	4332.	0.	3252.	4332.
2002	3335.	4415.	0.	3335.	4415.

TABLE II.16

CONTROL CASE

NON-PETROLEUM RELATED EMPLOYMENT

YEAR	LOCAL STATE & EML	GOVERNMENT FEDERAL FGVT	TOTAL EMG	SUPPORT I [1]EMS	SUPPORT II [2]EMC
1981	657.	191.	848.	655.	35.
1982	678.	191.	869.	677.	35.
1983	700.	191.	891.	700.	35.
1984	723.	191.	914.	723.	36.
1985	746.	191.	937.	747.	36.
1986	771.	191.	962.	772.	36.
1987	796.	191.	987.	798.	37.
1988	822.	191.	1013.	825.	37.
1989	849.	191.	1040.	853.	37.
1990	876.	191.	1067.	881.	38.
1991	905.	191.	1096.	910.	38.
1992	934.	191.	1125.	941.	39.
1993	964.	191.	1155.	972.	39.
1994	996.	191.	1187.	1004.	39.
1995	1028.	191.	1219.	1038.	40.
1996	1062.	191.	1253.	1072.	40.
1997	1096.	191.	1287.	1108.	41.
1998	1132.	191.	1323.	1145.	41.
1999	1169.	191.	1360.	1183.	42.
2000	1207.	191.	1398.	1222.	42.
2001	1246.	191.	1437.	1263.	43.
2002	1287.	191.	1478.	1304.	44.

[1]EMS = Transportation + Communication + Public Utilities + Trade + Finance, Insurance & Real Estate + Services.

[2]EMC = Construction.

TABLE II.17

CONTROL CASE

EMPLOYMENT

YEAR	FISHING & MANUFAC-TRUING EMA	MINING & SPECIAL PROJECTS EMX	NON-RESIDENT EMPLOYMENT ENCL	MILITARY EMM
1981	510.	0.	709.	375.
1982	510.	0.	709.	375.
1983	510.	0.	708.	375.
1984	510.	0.	707.	375.
1985	510.	0.	706.	375.
1986	510.	0.	706.	375.
1987	510.	0.	706.	375.
1988	510.	0.	706.	375.
1989	510.	0.	706.	375.
1990	510.	0.	706.	375.
1991	510.	0.	705.	375.
1992	510.	0.	705.	375.
1993	510.	0.	705.	375.
1994	510.	0.	705.	375.
1995	510.	0.	705.	375.
1996	510.	0.	705.	375.
1997	510.	0.	705.	375.
1998	510.	0.	705.	375.
1999	510.	0.	705.	375.
2000	509.	0.	705.	375.
2001	509.	0.	705.	375.
2002	509.	0.	705.	375.

EMA=RESIDENT FISH HARVESTING & PROCESSING
ENCL=NON-RESIDENT FISH HARVESTING & PROCESSING + NON-RESIDENT EMX

TABLE II.18

CONTROL CASE

EMPLOYMENT BY INDUSTRY

	STATE & LOCAL GOVERNMENT			*FINANCE TRADE & SERVICES		
YEAR	BASELINE EML	SECONDARY SEML	TOTAL TEML	BASELINE EMS	SECONDARY SEMS	TOTAL TEMS
1981	657.	0.	657.	655.	0.	655.
1982	678.	0.	678.	677.	0.	677.
1983	700.	0.	700.	700.	0.	700.
1984	723.	0.	723.	723.	0.	723.
1985	746.	0.	746.	747.	2.	750.
1986	771.	2.	773.	772.	2.	775.
1987	796.	2.	798.	798.	2.	801.
1988	822.	2.	824.	825.	2.	827.
1989	849.	2.	851.	853.	2.	855.
1990	876.	2.	879.	881.	2.	883.
1991	905.	2.	907.	910.	2.	913.
1992	934.	2.	937.	941.	0.	941.
1993	964.	0.	965.	972.	0.	972.
1994	996.	0.	996.	1004.	0.	1004.
1995	1028.	0.	1028.	1038.	0.	1038.
1996	1062.	0.	1062.	1072.	0.	1072.
1997	1096.	0.	1096.	1108.	0.	1108.
1998	1132.	0.	1132.	1145.	0.	1145.
1999	1169.	0.	1169.	1183.	0.	1183.
2000	1207.	0.	1207.	1222.	0.	1222.
2001	1246.	0.	1246.	1263.	0.	1263.
2002	1287.	0.	1287.	1304.	0.	1304.

NOTE:

SEMS = SECONDARY SUPPORT RESPONSE FROM PETROLEUM RELATED EMPLOYMENT
SEML = SECONDARY LOCAL GOVERNMENT RESPONSE TO PETROLEUM RELATED EMPLOYMENT
EML = BASELINE STATE & LOCAL GOVERNMENT & GROWS AT A RATE CONSISTANT WITH PROJECTIONS MADE IN THE "RAIL BELT STUDY" (GOLDSMITH & PORTER, OCT. 1981)

*EMS, SEMS and TEMS also includes Transportation, Communication and Public Utilities.

TABLE II.19

CONTROL CASE

TOTAL RESIDENT INCOME (IN THOUSANDS OF 1980 DOLLARS)

	CIVILIAN		TOTAL	
	TOTAL	PER CAPITA	TOTAL	PER CAPITA
1981	79213.	14740.	84188.	13037.
1982	80472.	14678.	85447.	13013.
1983	81744.	14546.	86720.	12939.
1984	83117.	14407.	88093.	12858.
1985	85511.	14430.	90487.	12913.
1986	87173.	14321.	92149.	12855.
1987	88738.	14194.	93714.	12780.
1988	90372.	14078.	95347.	12712.
1989	92043.	13968.	97019.	12648.
1990	93734.	13861.	98710.	12584.
1991	95443.	13756.	100419.	12523.
1992	96174.	13512.	101149.	12338.
1993	97888.	13408.	102864.	12273.
1994	99750.	13322.	104726.	12223.
1995	101723.	13247.	106699.	12181.
1996	103635.	13161.	108611.	12129.
1997	105657.	13086.	110632.	12085.
1998	107704.	13009.	112679.	12039.
1999	109862.	12941.	114837.	12000.
2000	112046.	12873.	117022.	11961.
2001	113908.	12763.	118884.	11883.
2002	115801.	12653.	120777.	11804.

TABLE II.20

MODERATE INDUSTRIALIZATION

POPULATION SUMMARY

YEAR	NON-PETROLEUM CIVILIAN RESIDENT	NON-PETROLEUM TOTAL ALL COMPONENTS	NON-PETROLEUM RELATED COMPONENTS: NON-NATIVE RESIDENT	NATIVE	NON-RESIDENT CIVILIAN	MILITARY ACTIVE DUTY	IMPORTED PETROLEUM RELATED	TOTAL PETRO + NONPETRO
1981	5412.	6514.	1548.	3864.	1102.	383.	0.	6514.
1982	5570.	6683.	1615.	3954.	1113.	390.	0.	6683.
1983	5799.	6948.	1740.	4060.	1149.	398.	0.	6948.
1984	6027.	7187.	1862.	4165.	1161.	406.	0.	7187.
1985	6258.	7430.	1988.	4270.	1172.	414.	29.	7459.
1986	6494.	7678.	2117.	4378.	1184.	422.	30.	7708.
1987	6737.	7933.	2250.	4487.	1196.	431.	30.	7963.
1988	6986.	8195.	2389.	4597.	1208.	439.	30.	8225.
1989	7243.	8464.	2533.	4711.	1221.	448.	30.	8494.
1990	7508.	8742.	2682.	4826.	1234.	457.	30.	8772.
1991	7781.	9029.	2838.	4944.	1247.	466.	30.	9059.
1992	8063.	9324.	2999.	5064.	1261.	476.	1.	9325.
1993	8354.	9629.	3167.	5187.	1275.	485.	0.	9629.
1994	8656.	9945.	3342.	5314.	1289.	495.	0.	9945.
1995	8967.	10271.	3524.	5443.	1303.	505.	0.	10271.
1996	9290.	10608.	3714.	5576.	1318.	515.	0.	10608.
1997	9624.	10957.	3911.	5713.	1333.	525.	0.	10957.
1998	9971.	11319.	4118.	5853.	1348.	536.	0.	11319.
1999	10331.	11695.	4333.	5998.	1364.	546.	0.	11695.
2000	10704.	12084.	4558.	6146.	1380.	557.	0.	12084.
2001	11091.	12486.	4792.	6298.	1395.	568.	0.	12486.
2002	11493.	12905.	5038.	6456.	1412.	580.	0.	12905.

TABLE II.21

MODERATE INDUSTRIALIZATION

EMPLOYMENT SUMMARY

	NON-PETROLEUM RELATED		PETROLEUM RELATED	TOTAL EMPLOYMENT	
YEAR	CIVILIAN RESIDENT TE	TOTAL TOTE	TOCSE	CIVILIAN GTE	TOTAL GTOE
1981	2082.	3184.	0.	2082.	3184.
1982	2158.	3271.	0.	2158.	3271.
1983	2269.	3419.	0.	2269.	3419.
1984	2352.	3512.	0.	2352.	3512.
1985	2437.	3609.	34.	2471.	3643.
1986	2526.	3710.	37.	2563.	3746.
1987	2619.	3815.	37.	2656.	3852.
1988	2716.	3924.	37.	2753.	3961.
1989	2817.	4038.	37.	2853.	4075.
1990	2922.	4156.	37.	2959.	4193.
1991	3031.	4279.	37.	3068.	4315.
1992	3145.	4406.	2.	3147.	4408.
1993	3264.	4538.	0.	3264.	4538.
1994	3387.	4677.	0.	3387.	4677.
1995	3516.	4819.	0.	3516.	4819.
1996	3651.	4969.	0.	3651.	4969.
1997	3790.	5123.	0.	3790.	5123.
1998	3936.	5284.	0.	3936.	5284.
1999	4088.	5452.	0.	4088.	5452.
2000	4247.	5627.	0.	4247.	5627.
2001	4411.	5807.	0.	4411.	5807.
2002	4584.	5996.	0.	4584.	5996.

TABLE II.22

MODERATE INDUSTRIALIZATION

NON-PETROLEUM RELATED EMPLOYMENT

YEAR	LOCAL STATE & EML	GOVERNMENT FEDERAL FGVT	TOTAL EMG	SUPPORT I EMS[1]	SUPPORT II EMC[2]
1981	665.	193.	858.	677.	35.
1982	696.	195.	890.	719.	36.
1983	728.	197.	924.	768.	37.
1984	761.	199.	960.	814.	37.
1985	796.	201.	997.	861.	38.
1986	832.	203.	1035.	911.	39.
1987	870.	205.	1075.	962.	40.
1988	910.	207.	1117.	1015.	40.
1989	952.	209.	1161.	1070.	41.
1990	996.	211.	1207.	1128.	42.
1991	1041.	213.	1254.	1188.	43.
1992	1089.	215.	1304.	1250.	44.
1993	1139.	217.	1356.	1315.	45.
1994	1191.	220.	1411.	1382.	46.
1995	1246.	222.	1468.	1452.	47.
1996	1303.	224.	1527.	1525.	48.
1997	1363.	226.	1589.	1601.	49.
1998	1425.	228.	1654.	1680.	50.
1999	1491.	231.	1721.	1762.	51.
2000	1559.	233.	1792.	1848.	53.
2001	1630.	235.	1866.	1937.	54.
2002	1705.	238.	1943.	2029.	55.

[1] EMS = Transportation + Communication + Public Utilities + Trade + Finance, Insurance & Real Estate + Services.

[2] EMC = Construction.

TABLE II.23

MODERATE INDUSTRIALIZATION

EMPLOYMENT

YEAR	FISHING & MANUFAC-TRUING EMA	MINING & SPECIAL PROJECTS EMX	NON-RESIDENT EMPLOYMENT ENCL	MILITARY EMM
1981	513.	0.	719.	383.
1982	513.	0.	723.	390.
1983	514.	26.	751.	398.
1984	514.	26.	755.	406.
1985	515.	26.	758.	414.
1986	516.	26.	761.	422.
1987	517.	26.	765.	431.
1988	517.	26.	769.	439.
1989	518.	26.	773.	448.
1990	519.	26.	777.	457.
1991	520.	26.	781.	466.
1992	521.	26.	785.	476.
1993	522.	26.	789.	485.
1994	523.	26.	794.	495.
1995	523.	26.	799.	505.
1996	524.	26.	804.	515.
1997	525.	26.	808.	525.
1998	526.	26.	813.	536.
1999	527.	26.	818.	546.
2000	528.	26.	823.	557.
2001	529.	26.	827.	568.
2002	530.	26.	833.	580.

TABLE II.24

MODERATE INDUSTRIALIZATION

EMPLOYMENT BY INDUSTRY

	STATE & LOCAL GOVERNMENT			*FINANCE TRADE & SERVICES		
YEAR	BASELINE EML	SECONDARY SEML	TOTAL TEML	BASELINE EMS	SECONDARY SEMS	TOTAL TEMS
1981	665.	0.	665.	677.	0.	677.
1982	696.	0.	696.	719.	0.	719.
1983	728.	0.	728.	768.	0.	768.
1984	761.	0.	761.	814.	0.	814.
1985	796.	0.	796.	861.	2.	864.
1986	832.	2.	835.	911.	2.	913.
1987	870.	2.	873.	962.	2.	964.
1988	910.	2.	913.	1015.	2.	1017.
1989	952.	2.	955.	1070.	2.	1073.
1990	996.	2.	998.	1128.	2.	1130.
1991	1041.	2.	1044.	1188.	2.	1190.
1992	1089.	2.	1092.	1250.	0.	1250.
1993	1139.	0.	1139.	1315.	0.	1315.
1994	1191.	0.	1191.	1382.	0.	1382.
1995	1246.	0.	1246.	1452.	0.	1452.
1996	1303.	0.	1303.	1525.	0.	1525.
1997	1363.	0.	1363.	1601.	0.	1601.
1998	1425.	0.	1425.	1680.	0.	1680.
1999	1491.	0.	1491.	1762.	0.	1762.
2000	1559.	0.	1559.	1848.	0.	1848.
2001	1630.	0.	1630.	1937.	0.	1937.
2002	1705.	0.	1705.	2029.	0.	2029.

NOTE:
SEMS = SECONDARY SUPPORT RESPONSE FROM PETROLEUM RELATED EMPLOYMENT
SEML = SECONDARY LOCAL GOVERNMENT RESPONSE TO PETROLEUM RELATED EMPLOYMENT
EML = BASELINE STATE & LOCAL GOVERNMENT & GROWS AT A RATE CONSISTANT WITH PROJECTIONS MADE IN THE 'RAIL BELT STUDY" (GOLDSMITH & PORTER, OCT. 1981)

*EMS, SEMS and TEMS also includes Transportation, Communication and Public Utilities.

TABLE II.25

MODERATE INDUSTRIALIZATION

TOTAL RESIDENT INCOME (IN THOUSANDS OF 1980 DOLLARS)

	CIVILIAN		TOTAL	
	TOTAL	PER CAPITA	TOTAL	PER CAPITA
1981	80239.	14827.	85314.	13098.
1982	82055.	14733.	87231.	13054.
1983	84791.	14621.	90071.	12963.
1984	86772.	14398.	92158.	12822.
1985	89798.	14349.	95291.	12825.
1986	92124.	14186.	97728.	12729.
1987	94382.	14009.	100098.	12617.
1988	96739.	13847.	102569.	12517.
1989	99167.	13691.	105113.	12418.
1990	101650.	13538.	107715.	12321.
1991	104187.	13389.	110373.	12225.
1992	105781.	13119.	112091.	12022.
1993	108397.	12975.	114834.	11926.
1994	111205.	12848.	117770.	11842.
1995	114161.	12731.	120858.	11767.
1996	117106.	12605.	123936.	11683.
1997	120202.	12489.	127169.	11606.
1998	123377.	12374.	130483.	11528.
1999	126717.	12266.	133965.	11455.
2000	130136.	12158.	137530.	11381.
2001	133277.	12017.	140819.	11278.
2002	136512.	11878.	144204.	11174.

TABLE II.26

MODERATE INDUSTRIALIZATION PLUS PETROLEUM DEVELOPMENT

POPULATION SUMMARY

YEAR	NON-PETROLEUM CIVILIAN RESIDENT	TOTAL ALL COMPONENTS	NON-PETROLEUM RELATED COMPONENTS: NON-NATIVE RESIDENT	NATIVE	NON-RESIDENT CIVILIAN	MILITARY ACTIVE DUTY	IMPORTED PETROLEUM RELATED	TOTAL PETRO + NONPETRO
1981	5412.	6514.	1548.	3864.	1102.	383.	0.	6514.
1982	5570.	6683.	1615.	3954.	1113.	390.	0.	6683.
1983	5799.	6948.	1740.	4060.	1149.	398.	0.	6948.
1984	6027.	7187.	1862.	4165.	1161.	406.	0.	7187.
1985	6258.	7430.	1988.	4270.	1172.	414.	29.	7459.
1986	6494.	7678.	2117.	4378.	1184.	422.	30.	7708.
1987	6737.	7933.	2250.	4487.	1196.	431.	96.	8029.
1988	6986.	8195.	2389.	4597.	1208.	439.	266.	8461.
1989	7243.	8464.	2533.	4711.	1221.	448.	275.	8740.
1990	7508.	8742.	2682.	4826.	1234.	457.	65.	8807.
1991	7781.	9029.	2838.	4944.	1247.	466.	82.	9111.
1992	8063.	9324.	2999.	5064.	1261.	476.	39.	9363.
1993	8354.	9629.	3167.	5187.	1275.	485.	37.	9666.
1994	8656.	9945.	3342.	5314.	1289.	495.	19.	9964.
1995	8967.	10271.	3524.	5443.	1303.	505.	19.	10289.
1996	9290.	10608.	3714.	5576.	1318.	515.	19.	10627.
1997	9624.	10957.	3911.	5713.	1333.	525.	19.	10976.
1998	9971.	11319.	4118.	5853.	1348.	536.	19.	11338.
1999	10331.	11695.	4333.	5998.	1364.	546.	19.	11713.
2000	10704.	12084.	4558.	6146.	1380.	557.	19.	12102.
2001	11091.	12486.	4792.	6298.	1395.	568.	19.	12505.
2002	11493.	12905.	5038.	6456.	1412.	580.	19.	12924.

TABLE II.27

MODERATE INDUSTRIALIZATION PLUS PETROLEUM DEVELOPMENT

EMPLOYMENT SUMMARY

YEAR	NON-PETROLEUM RELATED: CIVILIAN RESIDENT TE	NON-PETROLEUM RELATED: TOTAL TOTE	PETROLEUM RELATED TOCSE	TOTAL EMPLOYMENT: CIVILIAN GTE	TOTAL EMPLOYMENT: TOTAL GTOE
1981	2082.	3184.	0.	2082.	3184.
1982	2158.	3271.	0.	2158.	3271.
1983	2269.	3419.	0.	2269.	3419.
1984	2352.	3512.	0.	2352.	3512.
1985	2437.	3609.	34.	2471.	3643.
1986	2526.	3710.	37.	2563.	3746.
1987	2619.	3815.	115.	2734.	3930.
1988	2716.	3924.	354.	3070.	4278.
1989	2817.	4038.	383.	3199.	4421.
1990	2922.	4156.	87.	3008.	4243.
1991	3031.	4279.	95.	3126.	4373.
1992	3145.	4406.	46.	3191.	4452.
1993	3264.	4538.	43.	3306.	4581.
1994	3387.	4677.	23.	3411.	4700.
1995	3516.	4819.	22.	3538.	4841.
1996	3651.	4969.	22.	3672.	4991.
1997	3790.	5123.	22.	3812.	5145.
1998	3936.	5284.	22.	3958.	5306.
1999	4088.	5452.	22.	4110.	5474.
2000	4247.	5627.	22.	4269.	5648.
2001	4411.	5807.	22.	4433.	5829.
2002	4584.	5996.	22.	4606.	6018.

TABLE II.28

MODERATE INDUSTRIALIZATION PLUS PETROLEUM DEVELOPMENT

NON-PETROLEUM RELATED EMPLOYMENT

YEAR	LOCAL STATE & EML	GOVERNMENT FEDERAL FGVT	TOTAL EMG	SUPPORT I EMS[1]	SUPPORT II EMC[2]
1981	665.	193.	858.	677.	35.
1982	696.	195.	890.	719.	36.
1983	728.	197.	924.	768.	37.
1984	761.	199.	960.	814.	37.
1985	796.	201.	997.	861.	38.
1986	832.	203.	1035.	911.	39.
1987	870.	205.	1075.	962.	40.
1988	910.	207.	1117.	1015.	40.
1989	952.	209.	1161.	1070.	41.
1990	996.	211.	1207.	1128.	42.
1991	1041.	213.	1254.	1188.	43.
1992	1089.	215.	1304.	1250.	44.
1993	1139.	217.	1356.	1315.	45.
1994	1191.	220.	1411.	1382.	46.
1995	1246.	222.	1468.	1452.	47.
1996	1303.	224.	1527.	1525.	48.
1997	1363.	226.	1589.	1601.	49.
1998	1425.	228.	1654.	1680.	50.
1999	1491.	231.	1721.	1762.	51.
2000	1559.	233.	1792.	1848.	53.
2001	1630.	235.	1866.	1937.	54.
2002	1705.	238.	1943.	2029.	55.

[1]EMS = Transportation + Communication + Public Utilities + Trade + Finance, Insurance & Real Estate + Services.

[2]EMC = Construction.

TABLE II.29

MODERATE INDUSTRIALIZATION PLUS PETROLEUM DEVELOPMENT

EMPLOYMENT

YEAR	FISHING & MANUFAC-TRUING EMA	MINING & SPECIAL PROJECTS EMX	NON-RESIDENT EMPLOYMENT ENCL	MILITARY EMM
1981	513.	0.	719.	383.
1982	513.	0.	723.	390.
1983	514.	26.	751.	398.
1984	514.	26.	755.	406.
1985	515.	26.	758.	414.
1986	516.	26.	761.	422.
1987	517.	26.	765.	431.
1988	517.	26.	769.	439.
1989	518.	26.	773.	448.
1990	519.	26.	777.	457.
1991	520.	26.	781.	466.
1992	521.	26.	785.	476.
1993	522.	26.	789.	485.
1994	523.	26.	794.	495.
1995	523.	26.	799.	505.
1996	524.	26.	804.	515.
1997	525.	26.	808.	525.
1998	526.	26.	813.	536.
1999	527.	26.	818.	546.
2000	528.	26.	823.	557.
2001	529.	26.	827.	568.
2002	530.	26.	833.	580.

TABLE II.30

MODERATE INDUSTRIALIZATION PLUS PETROLEUM DEVELOPMENT

EMPLOYMENT BY INDUSTRY

YEAR	STATE & LOCAL GOVERNMENT BASELINE EML	SECONDARY: SEML	TOTAL TEML	*FINANCE TRADE & SERVICES BASELINE EMS	SECONDARY: SEMS	TOTAL TEMS
1981	665.	0.	665.	677.	0.	677.
1982	696.	0.	696.	719.	0.	719.
1983	728.	0.	728.	768.	0.	768.
1984	761.	0.	761.	814.	0.	814.
1985	796.	0.	796.	861.	2.	864.
1986	832.	2.	835.	911.	2.	913.
1987	870.	2.	873.	962.	8.	970.
1988	910.	8.	918.	1015.	31.	1046.
1989	952.	22.	974.	1070.	34.	1105.
1990	996.	22.	1018.	1128.	4.	1132.
1991	1041.	5.	1047.	1188.	6.	1193.
1992	1089.	7.	1096.	1250.	2.	1253.
1993	1139.	3.	1142.	1315.	2.	1317.
1994	1191.	3.	1194.	1382.	1.	1384.
1995	1246.	2.	1248.	1452.	1.	1454.
1996	1303.	2.	1305.	1525.	1.	1527.
1997	1363.	2.	1364.	1601.	1.	1602.
1998	1425.	2.	1427.	1680.	1.	1681.
1999	1491.	2.	1492.	1762.	1.	1764.
2000	1559.	2.	1561.	1848.	1.	1849.
2001	1630.	2.	1632.	1937.	1.	1938.
2002	1705.	2.	1707.	2029.	1.	2031.

NOTE:
SEMS = SECONDARY SUPPORT RESPONSE FROM PETROLEUM RELATED EMPLOYMENT
SEML = SECONDARY LOCAL GOVERNMENT RESPONSE TO PETROLEUM RELATED EMPLOYMENT
EML = BASELINE STATE & LOCAL GOVERNMENT & GROWS AT A RATE CONSISTANT WITH PROJECTIONS MADE IN THE "RAIL BELT STUDY" (GOLDSMITH & PORTER, OCT. 1981)

*EMS, SEMS and TEMS also includes Transportation, Communication and Public Utilities.

TABLE II.31

MODERATE INDUSTRIALIZATION PLUS PETROLEUM DEVELOPMENT

TOTAL RESIDENT INCOME (IN THOUSANDS OF 1980 DOLLARS)

	CIVILIAN		TOTAL	
	TOTAL	PER CAPITA	TOTAL	PER CAPITA
1981	80239.	14827.	85314.	13098.
1982	82055.	14733.	87231.	13054.
1983	84791.	14621.	90071.	12963.
1984	86772.	14398.	92158.	12822.
1985	89798.	14349.	95291.	12825.
1986	92124.	14186.	97728.	12729.
1987	96870.	14379.	102586.	12931.
1988	107144.	15336.	112974.	13786.
1989	110389.	15240.	116335.	13744.
1990	102944.	13711.	109009.	12469.
1991	105951.	13616.	112138.	12420.
1992	107089.	13281.	113399.	12162.
1993	109684.	13129.	116120.	12060.
1994	111898.	12928.	118463.	11912.
1995	114828.	12805.	121525.	11832.
1996	117772.	12677.	124602.	11746.
1997	120868.	12559.	127835.	11667.
1998	124044.	12441.	131150.	11586.
1999	127383.	12331.	134632.	11512.
2000	130803.	12220.	138196.	11437.
2001	133944.	12077.	141485.	11332.
2002	137178.	11936.	144870.	11225.

DETAILED POPULATION PROJECTIONS BY AGE, SEX, AND RACE

Detailed Age-Sex-Race Distribution

The following tables describe the age-sex-race distribution of the population resident civilian population and the total population for the years 1981 (year 1), 1985 (year 5), 1990 (year 10), 1995 (year 15), 2000 (year 20), and 2002 (year 22). The age cohorts are as follows:

1 = 0-14
2 = 15-19
3 = 20-24
4 = 25-29
5 = 30-44
6 = 45-64
7 = 65 +

TABLE II.32

CONTROL CASE

YEAR 1 BPOP

AGE	NON-NATIVE MALES	NON-NATIVE FEMALES	NATIVE MALES	NATIVE FEMALES
1	171.	168.	662.	633.
2	68.	100.	223.	214.
3	106.	106.	195.	189.
4	94.	93.	199.	168.
5	158.	182.	392.	317.
6	141.	109.	241.	215.
7	29.	21.	109.	71.

YEAR 1 BPOPP = 5374.
YEAR 1 BASPP = 6458.
YEAR 1 NNPOP = 1546.
YEAR 1 TNPOP = 3828.
YEAR 1 NNPOPX= 1084.

YEAR 1 TOTPP

AGE	NON-NATIVE MALES	NON-NATIVE FEMALES	NATIVE MALES	NATIVE FEMALES
1	171.	168.	662.	633.
2	192.	105.	223.	214.
3	270.	116.	195.	189.
4	297.	101.	199.	168.
5	546.	196.	392.	317.
6	283.	127.	241.	215.
7	35.	21.	109.	71.

YEAR 1 TOTPOP= 6458.

BPOP = Civilian Resident Population by age, sex and race
BPOPP = Total Civilian Resident
BASPP = Total Population minus Petroleum Related Impact Population
NNPOP = Non-Native Civilian Resident
TNPOP = Total Native Population (all assumed to be civilian resident)
TOTPP = Total Population by age, sex and race
TOTPOP = Total Population

Note: Σ BPOP (A,S,R) and Σ TOTPP (A,S,R) may not sum to BPOPP and TOTPP (respectively) because of rounding.

TABLE II.33

CONTROL CASE

YEAR 5 BPOP

AGE	NON-NATIVE MALES	NON-NATIVE FEMALES	NATIVE MALES	NATIVE FEMALES
1	213.	209.	737.	717.
2	67.	80.	220.	218.
3	87.	99.	204.	198.
4	100.	104.	193.	176.
5	201.	212.	422.	346.
6	149.	128.	259.	223.
7	58.	47.	144.	115.

YEAR 5 BPOPP = 5926.
YEAR 5 BASPP = 7007.
YEAR 5 NNPOP = 1753.
YEAR 5 TNPOP = 4173.
YEAR 5 NNPOPX= 1081.

YEAR 5 TOTPP

AGE	NON-NATIVE MALES	NON-NATIVE FEMALES	NATIVE MALES	NATIVE FEMALES
1	213.	209.	737.	717.
2	194.	85.	220.	218.
3	255.	109.	204.	198.
4	307.	113.	193.	176.
5	598.	227.	422.	346.
6	295.	146.	259.	223.
7	64.	47.	144.	115.

YEAR 5 TOTPOP= 7036.

BPOP = Civilian Resident Population by age, sex and race
BPOPP = Total Civilian Resident
BASPP = Total Population minus Petroleum Related Impact Population
NNPOP = Non-Native Civilian Resident
TNPOP = Total Native Population (all assumed to be civilian resident)
TOTPP = Total Population by age, sex and race
TOTPOP = Total Population

Note: Σ BPOP (A,S,R) and Σ TOTPP (A,S,R) may not sum to BPOPP and TOTPP (respectively) because of rounding.

TABLE II.34

CONTROL CASE

YEAR 10 BPOP

AGE	NON-NATIVE MALES	NON-NATIVE FEMALES	NATIVE MALES	NATIVE FEMALES
1	266.	259.	828.	815.
2	80.	83.	238.	242.
3	89.	94.	221.	212.
4	103.	110.	203.	187.
5	259.	254.	453.	380.
6	182.	160.	284.	240.
7	91.	82.	184.	164.

YEAR 10 BPOPP = 6763.
YEAR 10 BASPP = 7844.
YEAR 10 NNPOP = 2112.
YEAR 10 TNPOP = 4651.
YEAR 10 NNPOPX= 1081.

YEAR 10 TOTPP

AGE	NON-NATIVE MALES	NON-NATIVE FEMALES	NATIVE MALES	NATIVE FEMALES
1	266.	259.	828.	815.
2	207.	89.	238.	242.
3	257.	104.	221.	212.
4	310.	120.	203.	187.
5	656.	269.	453.	380.
6	328.	178.	284.	240.
7	97.	82.	184.	164.

YEAR 10 TOTPOP= 7874.

BPOP = Civilian Resident Population by age, sex and race
BPOPP = Total Civilian Resident
BASPP = Total Population minus Petroleum Related Impact Population
NNPOP = Non-Native Civilian Resident
TNPOP = Total Native Population (all assumed to be civilian resident)
TOTPP = Total Population by age, sex and race
TOTPOP = Total Population

Note: Σ BPOP (A,S,R) and Σ TOTPP (A,S,R) may not sum to BPOPP and TOTPP (respectively) because of rounding.

TABLE II.35

CONTROL CASE

YEAR 15 BPOP

AGE	NON-NATIVE MALES	NON-NATIVE FEMALES	NATIVE MALES	NATIVE FEMALES
1	315.	305.	921.	915.
2	96.	96.	263.	271.
3	103.	100.	242.	234.
4	112.	115.	220.	203.
5	312.	290.	486.	414.
6	224.	195.	310.	259.
7	127.	121.	221.	211.

YEAR 15 BPOPP = 7679.
YEAR 15 BASPP = 8759.
YEAR 15 NNPOP = 2510.
YEAR 15 TNPOP = 5169.
YEAR 15 NNPOPX= 1080.

YEAR 15 TOTPP

AGE	NON-NATIVE MALES	NON-NATIVE FEMALES	NATIVE MALES	NATIVE FEMALES
1	315.	305.	921.	915.
2	220.	101.	263.	271.
3	266.	110.	242.	234.
4	314.	124.	220.	203.
5	698.	304.	486.	414.
6	365.	213.	310.	259.
7	133.	121.	221.	211.

YEAR 15 TOTPOP= 8759.

BPOP = Civilian Resident Population by age, sex and race
BPOPP = Total Civilian Resident
BASPP = Total Population minus Petroleum Related Impact Population
NNPOP = Non-Native Civilian Resident
TNPOP = Total Native Population (all assumed to be civilian resident)
TOTPP = Total Population by age, sex and race
TOTPOP = Total Population

Note: Σ BPOP (A,S,R) and Σ TOTPP (A,S,R) may not sum to BPOPP and TOTPP (respectively) because of rounding.

TABLE II.36

CONTROL CASE

YEAR 20 BPOP

AGE	NON-NATIVE MALES	NON-NATIVE FEMALES	NATIVE MALES	NATIVE FEMALES
1	367.	354.	1024.	1021.
2	114.	112.	292.	304.
3	121.	113.	270.	261.
4	129.	127.	243.	224.
5	367.	325.	525.	451.
6	272.	230.	336.	281.
7	168.	163.	256.	255.

YEAR 20 BPOPP = 8704.
YEAR 20 BASPP = 9784.
YEAR 20 NNPOP = 2961.
YEAR 20 TNPOP = 5744.
YEAR 20 NNPOPX= 1080.

YEAR 20 TOTPP

AGE	NON-NATIVE MALES	NON-NATIVE FEMALES	NATIVE MALES	NATIVE FEMALES
1	367.	354.	1024.	1021.
2	238.	117.	292.	304.
3	285.	123.	270.	261.
4	331.	136.	243.	224.
5	753.	339.	525.	451.
6	412.	248.	336.	281.
7	173.	163.	256.	255.

YEAR 20 TOTPOP= 9784.

BPOP = Civilian Resident Population by age, sex and race
BPOPP = Total Civilian Resident
BASPP = Total Population minus Petroleum Related Impact Population
NNPOP = Non-Native Civilian Resident
TNPOP = Total Native Population (all assumed to be civilian resident)
TOTPP = Total Population by age, sex and race
TOTPOP = Total Population

Note: Σ BPOP (A,S,R) and Σ TOTPP (A,S,R) may not sum to BPOPP and TOTPP (respectively) because of rounding.

TABLE II.37

CONTROL CASE

YEAR 22 BPOP

AGE	NON-NATIVE MALES	NON-NATIVE FEMALES	NATIVE MALES	NATIVE FEMALES
1	389.	376.	1068.	1067.
2	121.	119.	305.	318.
3	130.	120.	282.	273.
4	137.	133.	254.	234.
5	391.	340.	544.	468.
6	292.	244.	348.	291.
7	185.	181.	269.	273.

YEAR 22 BASPP = 10231.
YEAR 22 NNPOP = 3159.
YEAR 22 TNPOP = 5992.
YEAR 22 NNPOPX= 1080.
BPOPP = 9152

YEAR 22 TOTPP

AGE	NON-NATIVE MALES	NON-NATIVE FEMALES	NATIVE MALES	NATIVE FEMALES
1	389.	376.	1068.	1067.
2	245.	124.	305.	318.
3	293.	130.	282.	273.
4	339.	142.	254.	234.
5	777.	354.	544.	468.
6	433.	262.	348.	291.
7	191.	181.	269.	273.

YEAR 22 TOTPOP= 10231.

BPOP = Civilian Resident Population by age, sex and race
BPOPP = Total Civilian Resident
BASPP = Total Population minus Petroleum Related Impact Population
NNPOP = Non-Native Civilian Resident
TNPOP = Total Native Population (all assumed to be civilian resident)
TOTPP = Total Population by age, sex and race
TOTPOP = Total Population

Note: Σ BPOP (A,S,R) and Σ TOTPP (A,S,R) may not sum to BPOPP and TOTPP (respectively) because of rounding.

TABLE II.38

MODERATE INDUSTRIALIZATION

YEAR 1 BPOP

AGE	NON-NATIVE MALES	NON-NATIVE FEMALES	NATIVE MALES	NATIVE FEMALES
1	172.	168.	664.	635.
2	68.	100.	224.	215.
3	106.	106.	207.	190.
4	94.	93.	206.	169.
5	159.	182.	396.	318.
6	142.	109.	245.	215.
7	29.	21.	109.	71.

YEAR 1 BPOPP = 5412.
YEAR 1 BASPP = 6514.
YEAR 1 NNPOP = 1548.
YEAR 1 TNPOP = 3864.
YEAR 1 NNPOPX= 1102.

YEAR 1 TOTPP

AGE	NON-NATIVE MALES	NON-NATIVE FEMALES	NATIVE MALES	NATIVE FEMALES
1	172.	168.	664.	635.
2	195.	106.	224.	215.
3	273.	116.	207.	190.
4	300.	102.	206.	169.
5	552.	196.	396.	318.
6	285.	127.	245.	215.
7	35.	21.	109.	71.

YEAR 1 TOTPOP= 6514.

BPOP = Civilian Resident Population by age, sex and race
BPOPP = Total Civilian Resident
BASPP = Total Population minus Petroleum Related Impact Population
NNPOP = Non-Native Civilian Resident
TNPOP = Total Native Population (all assumed to be civilian resident)
TOTPP = Total Population by age, sex and race
TOTPOP = Total Population

Note: Σ BPOP (A,S,R) and Σ TOTPP (A,S,R) may not sum to BPOPP and TOTPP (respectively) because of rounding.

TABLE II.39

MODERATE INDUSTRIALIZATION

YEAR 5 BPOP

AGE	NON-NATIVE MALES	NON-NATIVE FEMALES	NATIVE MALES	NATIVE FEMALES
1	246.	237.	744.	723.
2	75.	87.	222.	220.
3	103.	109.	225.	199.
4	117.	121.	214.	179.
5	241.	229.	440.	349.
6	177.	138.	269.	225.
7	60.	48.	146.	115.

YEAR 5 BPOPP = 6258.
YEAR 5 BASPP = 7430.
YEAR 5 NNPOP = 1988.
YEAR 5 TNPOP = 4270.
YEAR 5 NNPOPX= 1172.

YEAR 5 TOTPP

AGE	NON-NATIVE MALES	NON-NATIVE FEMALES	NATIVE MALES	NATIVE FEMALES
1	246.	237.	744.	723.
2	212.	93.	222.	220.
3	285.	120.	225.	199.
4	342.	131.	214.	179.
5	670.	245.	440.	349.
6	334.	158.	269.	225.
7	66.	48.	146.	115.

YEAR 5 TOTPOP= 7459.

BPOP = Civilian Resident Population by age, sex and race
BPOPP = Total Civilian Resident
BASPP = Total Population minus Petroleum Related Impact Population
NNPOP = Non-Native Civilian Resident
TNPOP = Total Native Population (all assumed to be civilian resident)
TOTPP = Total Population by age, sex and race
TOTPOP = Total Population

Note: Σ BPOP (A,S,R) and Σ TOTPP (A,S,R) may not sum to BPOPP and TOTPP (respectively) because of rounding.

TABLE II.40

MODERATE INDUSTRIALIZATION

YEAR 10 BPOP

AGE	NON-NATIVE MALES	NON-NATIVE FEMALES	NATIVE MALES	NATIVE FEMALES
1	342.	327.	841.	827.
2	101.	102.	242.	245.
3	121.	116.	246.	215.
4	141.	144.	235.	191.
5	356.	303.	494.	386.
6	250.	186.	305.	243.
7	106.	87.	190.	165.

YEAR 10 BPOPP = 7508.
YEAR 10 BASPP = 8742.
YEAR 10 NNPOP = 2682.
YEAR 10 TNPOP = 4826.
YEAR 10 NNPOPX= 1234.

YEAR 10 TOTPP

AGE	NON-NATIVE MALES	NON-NATIVE FEMALES	NATIVE MALES	NATIVE FEMALES
1	342.	327.	841.	827.
2	246.	109.	242.	245.
3	314.	128.	246.	215.
4	378.	154.	235.	191.
5	807.	320.	494.	386.
6	412.	208.	305.	243.
7	112.	87.	190.	165.

YEAR 10 TOTPOP= 8772.

BPOP = Civilian Resident Population by age, sex and race
BPOPP = Total Civilian Resident
BASPP = Total Population minus Petroleum Related Impact Population
NNPOP = Non-Native Civilian Resident
TNPOP = Total Native Population (all assumed to be civilian resident)
TOTPP = Total Population by age, sex and race
TOTPOP = Total Population

Note: Σ BPOP (A,S,R) and Σ TOTPP (A,S,R) may not sum to BPOPP and TOTPP (respectively) because of rounding.

TABLE II.41

MODERATE INDUSTRIALIZATION

YEAR 15 BPOP

AGE	NON-NATIVE MALES	NON-NATIVE FEMALES	NATIVE MALES	NATIVE FEMALES
1	447.	424.	943.	933.
2	134.	131.	270.	277.
3	154.	139.	276.	239.
4	173.	169.	262.	209.
5	480.	382.	554.	423.
6	344.	245.	346.	265.
7	165.	136.	233.	213.

YEAR 15 BPOPP = 8967.
YEAR 15 BASPP = 10271.
YEAR 15 NNPOP = 3524.
YEAR 15 TNPOP = 5443.
YEAR 15 NNPOPX= 1303.

YEAR 15 TOTPP

AGE	NON-NATIVE MALES	NON-NATIVE FEMALES	NATIVE MALES	NATIVE FEMALES
1	447.	424.	943.	933.
2	285.	138.	270.	277.
3	356.	151.	276.	239.
4	420.	180.	262.	209.
5	943.	399.	554.	423.
6	506.	268.	346.	265.
7	171.	136.	233.	213.

YEAR 15 TOTPOP= 10271.

BPOP = Civilian Resident Population by age, sex and race
BPOPP = Total Civilian Resident
BASPP = Total Population minus Petroleum Related Impact Population
NNPOP = Non-Native Civilian Resident
TNPOP = Total Native Population (all assumed to be civilian resident)
TOTPP = Total Population by age, sex and race
TOTPOP = Total Population

Note: Σ BPOP (A,S,R) and Σ TOTPP (A,S,R) may not sum to BPOPP and TOTPP (respectively) because of rounding.

TABLE II.42

MODERATE INDUSTRIALIZATION

YEAR 20 BPOP

AGE	NON-NATIVE MALES	NON-NATIVE FEMALES	NATIVE MALES	NATIVE FEMALES
1	572.	541.	1057.	1051.
2	174.	168.	302.	313.
3	199.	174.	315.	269.
4	219.	206.	299.	233.
5	624.	472.	624.	466.
6	459.	315.	392.	291.
7	239.	195.	277.	259.

YEAR 20 BPOPP = 10704.
YEAR 20 BASPP = 12084.
YEAR 20 NNPOP = 4558.
YEAR 20 TNPOP = 6146.
YEAR 20 NNPOPX= 1380.

YEAR 20 TOTPP

AGE	NON-NATIVE MALES	NON-NATIVE FEMALES	NATIVE MALES	NATIVE FEMALES
1	572.	541.	1057.	1051.
2	334.	175.	302.	313.
3	415.	188.	315.	269.
4	481.	217.	299.	233.
5	1114.	490.	624.	466.
6	627.	340.	392.	291.
7	246.	195.	277.	259.

YEAR 20 TOTPOP= 12084.

BPOP = Civilian Resident Population by age, sex and race
BPOPP = Total Civilian Resident
BASPP = Total Population minus Petroleum Related Impact Population
NNPOP = Non-Native Civilian Resident
TNPOP = Total Native Population (all assumed to be civilian resident)
TOTPP = Total Population by age, sex and race
TOTPOP = Total Population

Note: Σ BPOP (A,S,R) and Σ TOTPP (A,S,R) may not sum to BPOPP and TOTPP (respectively) because of rounding.

TABLE II.43

MODERATE INDUSTRIALIZATION

YEAR 22 BPOP

AGE	NON-NATIVE MALES	NON-NATIVE FEMALES	NATIVE MALES	NATIVE FEMALES
1	629.	595.	1108.	1101.
2	192.	185.	316.	328.
3	219.	191.	332.	283.
4	242.	225.	316.	244.
5	690.	514.	656.	485.
6	512.	346.	412.	302.
7	274.	222.	295.	278.

YEAR 22 BASPP = 12905.
YEAR 22 NNPOP = 5038.
YEAR 22 TNPOP = 6456.
YEAR 22 NNPOPX= 1412.

YEAR 22 TOTPP

AGE	NON-NATIVE MALES	NON-NATIVE FEMALES	NATIVE MALES	NATIVE FEMALES
1	629.	595.	1108.	1101.
2	357.	192.	316.	328.
3	442.	205.	332.	283.
4	510.	237.	316.	244.
5	1191.	533.	656.	485.
6	683.	372.	412.	302.
7	281.	222.	295.	278.

YEAR 22 TOTPOP= 12905.

BPOP = Civilian Resident Population by age, sex and race
BPOPP = Total Civilian Resident
BASPP = Total Population minus Petroleum Related Impact Population
NNPOP = Non-Native Civilian Resident
TNPOP = Total Native Population (all assumed to be civilian resident)
TOTPP = Total Population by age, sex and race
TOTPOP = Total Population

Note: Σ BPOP (A,S,R) and Σ TOTPP (A,S,R) may not sum to BPOPP and TOTPP (respectively) because of rounding.

TABLE II.44

MODERATE INDUSTRIALIZATION PLUS PETROLEUM DEVELOPMENT

YEAR 1 BPOP

AGE	NON-NATIVE MALES	NON-NATIVE FEMALES	NATIVE MALES	NATIVE FEMALES
1	172.	168.	664.	635.
2	68.	100.	224.	215.
3	106.	106.	207.	190.
4	94.	93.	206.	169.
5	159.	182.	396.	318.
6	142.	109.	245.	215.
7	29.	21.	109.	71.

YEAR 1 BPOPP = 5412.
YEAR 1 BASPP = 6514.
YEAR 1 NNPOP = 1548.
YEAR 1 TNPOP = 3864.
YEAR 1 NNPOPX= 1102.

YEAR 1 TOTPP

AGE	NON-NATIVE MALES	NON-NATIVE FEMALES	NATIVE MALES	NATIVE FEMALES
1	172.	168.	664.	635.
2	195.	106.	224.	215.
3	273.	116.	207.	190.
4	300.	102.	206.	169.
5	552.	196.	396.	318.
6	285.	127.	245.	215.
7	35.	21.	109.	71.

YEAR 1 TOTPOP= 6514.

BPOP = Civilian Resident Population by age, sex and race
BPOPP = Total Civilian Resident
BASPP = Total Population minus Petroleum Related Impact Population
NNPOP = Non-Native Civilian Resident
TNPOP = Total Native Population (all assumed to be civilian resident)
TOTPP = Total Population by age, sex and race
TOTPOP = Total Population

Note: Σ BPOP (A,S,R) and Σ TOTPP (A,S,R) may not sum to BPOPP and TOTPP (respectively) because of rounding.

TABLE II.45

MODERATE INDUSTRIALIZATION PLUS PETROLEUM DEVELOPMENT

YEAR 5 BPOP

AGE	NON-NATIVE MALES	NON-NATIVE FEMALES	NATIVE MALES	NATIVE FEMALES
1	246.	237.	744.	723.
2	75.	87.	222.	220.
3	103.	109.	225.	199.
4	117.	121.	214.	179.
5	241.	229.	440.	349.
6	177.	138.	269.	225.
7	60.	48.	146.	115.

YEAR 5 BPOPP = 6258.
YEAR 5 BASPP = 7430.
YEAR 5 NNPOP = 1988.
YEAR 5 TNPOP = 4270.
YEAR 5 NNPOPX= 1172.

YEAR 5 TOTPP

AGE	NON-NATIVE MALES	NON-NATIVE FEMALES	NATIVE MALES	NATIVE FEMALES
1	246.	237.	744.	723.
2	212.	93.	222.	220.
3	285.	120.	225.	199.
4	342.	131.	214.	179.
5	670.	245.	440.	349.
6	334.	158.	269.	225.
7	66.	48.	146.	115.

YEAR 5 TOTPOP= 7459.

BPOP = Civilian Resident Population by age, sex and race
BPOPP = Total Civilian Resident
BASPP = Total Population minus Petroleum Related Impact Population
NNPOP = Non-Native Civilian Resident
TNPOP = Total Native Population (all assumed to be civilian resident)
TOTPP = Total Population by age, sex and race
TOTPOP = Total Population

Note: Σ BPOP (A,S,R) and Σ TOTPP (A,S,R) may not sum to BPOPP and TOTPP (respectively) because of rounding.

TABLE II.46

MODERATE INDUSTRIALIZATION PLUS PETROLEUM DEVELOPMENT

YEAR 10 BPOP

AGE	NON-NATIVE MALES	NON-NATIVE FEMALES	NATIVE MALES	NATIVE FEMALES
1	342.	327.	841.	827.
2	101.	102.	242.	245.
3	121.	116.	246.	215.
4	141.	144.	235.	191.
5	356.	303.	494.	386.
6	250.	186.	305.	243.
7	106.	87.	190.	165.

YEAR 10 BPOPP = 7508.
YEAR 10 BASPP = 8742.
YEAR 10 NNPOP = 2682.
YEAR 10 TNPOP = 4826.
YEAR 10 NNPOPX= 1234.

YEAR 10 TOTPP

AGE	NON-NATIVE MALES	NON-NATIVE FEMALES	NATIVE MALES	NATIVE FEMALES
1	343.	328.	841.	827.
2	249.	110.	242.	245.
3	317.	129.	246.	215.
4	385.	156.	235.	191.
5	819.	322.	494.	386.
6	414.	208.	305.	243.
7	113.	87.	190.	165.

YEAR 10 TOTPOP= 8807.

BPOP = Civilian Resident Population by age, sex and race
BPOPP = Total Civilian Resident
BASPP = Total Population minus Petroleum Related Impact Population
NNPOP = Non-Native Civilian Resident
TNPOP = Total Native Population (all assumed to be civilian resident)
TOTPP = Total Population by age, sex and race
TOTPOP = Total Population

Note: Σ BPOP (A,S,R) and Σ TOTPP (A,S,R) may not sum to BPOPP and TOTPP (respectively) because of rounding.

TABLE II.47

MODERATE INDUSTRIALIZATION PLUS PETROLEUM DEVELOPMENT

YEAR 15 BPOP

AGE	NON-NATIVE MALES	NON-NATIVE FEMALES	NATIVE MALES	NATIVE FEMALES
1	447.	424.	943.	933.
2	134.	131.	270.	277.
3	154.	139.	276.	239.
4	173.	169.	262.	209.
5	480.	382.	554.	423.
6	344.	245.	346.	265.
7	165.	136.	233.	213.

YEAR 15 BPOPP = 8967.
YEAR 15 BASPP = 10271.
YEAR 15 NNPOP = 3524.
YEAR 15 TNPOP = 5443.
YEAR 15 NNPOPX= 1303.

YEAR 15 TOTPP

AGE	NON-NATIVE MALES	NON-NATIVE FEMALES	NATIVE MALES	NATIVE FEMALES
1	447.	424.	943.	933.
2	286.	138.	270.	277.
3	357.	152.	276.	239.
4	423.	180.	262.	209.
5	951.	400.	554.	423.
6	509.	269.	346.	265.
7	171.	136.	233.	213.

YEAR 15 TOTPOP= 10289.

BPOP = Civilian Resident Population by age, sex and race
BPOPP = Total Civilian Resident
BASPP = Total Population minus Petroleum Related Impact Population
NNPOP = Non-Native Civilian Resident
TNPOP = Total Native Population (all assumed to be civilian resident)
TOTPP = Total Population by age, sex and race
TOTPOP = Total Population

Note: $\sum$ BPOP (A,S,R) and $\sum$ TOTPP (A,S,R) may not sum to BPOPP and TOTPP (respectively) because of rounding.

TABLE II.48

MODERATE INDUSTRIALIZATION PLUS PETROLEUM DEVELOPMENT

YEAR 20 BPOP

AGE	NON-NATIVE MALES	NON-NATIVE FEMALES	NATIVE MALES	NATIVE FEMALES
1	572.	541.	1057.	1051.
2	174.	168.	302.	313.
3	199.	174.	315.	269.
4	219.	206.	299.	233.
5	624.	472.	624.	466.
6	459.	315.	392.	291.
7	239.	195.	277.	259.

YEAR 20 BPOPP = 10704.
YEAR 20 BASPP = 12084.
YEAR 20 NNPOP = 4558.
YEAR 20 TNPOP = 6146.
YEAR 20 NNPOPX= 1380.

YEAR 20 TOTPP

AGE	NON-NATIVE MALES	NON-NATIVE FEMALES	NATIVE MALES	NATIVE FEMALES
1	572.	541.	1057.	1051.
2	335.	175.	302.	313.
3	416.	188.	315.	269.
4	484.	218.	299.	233.
5	1122.	492.	624.	466.
6	630.	340.	392.	291.
7	246.	195.	277.	259.

YEAR 20 TOTPOP= 12102.

BPOP = Civilian Resident Population by age, sex and race
BPOPP = Total Civilian Resident
BASPP = Total Population minus Petroleum Related Impact Population
NNPOP = Non-Native Civilian Resident
TNPOP = Total Native Population (all assumed to be civilian resident)
TOTPP = Total Population by age, sex and race
TOTPOP = Total Population

Note: Σ BPOP (A,S,R) and Σ TOTPP (A,S,R) may not sum to BPOPP and TOTPP (respectively) because of rounding.

TABLE II.49

MODERATE INDUSTRIALIZATION PLUS PETROLEUM DEVELOPMENT

YEAR 22 BPOP

AGE	NON-NATIVE MALES	NON-NATIVE FEMALES	NATIVE MALES	NATIVE FEMALES
1	629.	595.	1108.	1101.
2	192.	185.	316.	328.
3	219.	191.	332.	283.
4	242.	225.	316.	244.
5	690.	514.	656.	485.
6	512.	346.	412.	302.
7	274.	222.	295.	278.

YEAR 22 BASPP = 12905.
YEAR 22 NNPOP = 5038.
YEAR 22 TNPOP = 6456.
YEAR 22 NNPOPX= 1412.

YEAR 22 TOTPP

AGE	NON-NATIVE MALES	NON-NATIVE FEMALES	NATIVE MALES	NATIVE FEMALES
1	629.	595.	1108.	1101.
2	358.	193.	316.	328.
3	443.	206.	332.	283.
4	513.	237.	316.	244.
5	1199.	534.	656.	485.
6	686.	372.	412.	302.
7	281.	223.	295.	278.

YEAR 22 TOTPOP= 12924.

BPOP = Civilian Resident Population by age, sex and race
BPOPP = Total Civilian Resident
BASPP = Total Population minus Petroleum Related Impact Population
NNPOP = Non-Native Civilian Resident
TNPOP = Total Native Population (all assumed to be civilian resident)
TOTPP = Total Population by age, sex and race
TOTPOP = Total Population

Note: Σ BPOP (A,S,R) and Σ TOTPP (A,S,R) may not sum to BPOPP and TOTPP (respectively) because of rounding.

III. BUSINESS AS USUAL BASE CASE ELECTRICITY PROJECTIONS

Assumptions

The Business-As-Usual (BAU) scenario serves two functions in this study. First, it represents a continuation of recent historic patterns in economic development, in electricity supply and in electricity consumption. Second, it functions as a base case, or a frame of reference, for further analysis of changes in key determinants of electricity use.

Historical patterns of electricity consumption, prices and household income, indicate that rising electricity consumption in Bristol Bay occurred at a time when electricity prices were also rising in real, inflation-adjusted terms. We believe that an increase in electricity availability and rising household income explain much of this historical consumption growth.

Important assumptions of the Business-as-Usual scenario are as follows:

1. Electricity is primarily diesel powered.
2. Electricity production remains decentralized so that economies of scale (savings in money outlays due to efficiencies inherent in larger-scale operations) do not offset rising fuel prices. Consequently, electricity prices escalate at the same rate as fuel oil prices--2.6 percent per year above the general rate of inflation.
3. Electricity prices are not uniform across study-area communities.

4. The effect of state intervention to lower consumer electricity prices continues throughout the forecast period, consistent with levels experienced in 1981.

5. Electricity-use patterns do not change dramatically from those observed in the recent past. Thus, electric space heating and energy conservation are assumed not to occur in this forecast.

6. Economic development continues at a moderate pace. The industrial sector composed of large, shore-based seafood processors does not experience major capacity increases; there are no projected on- or offshore petroleum discoveries; and mineral development remains small in scale and regionally disbursed. Activities that are projected to drive the Bristol Bay economy include government spending, fishing, and (to some extent) tourism and recreation. This is the base case economic projection.

7. Consumers are responsive to changes in the real price of electricity.

8. Consumers are responsive to changes in their income.

9. Average household size, which fell dramatically during the 1970s, stabilizes in the future.

Results

The BAU projections are shown by community in Tables III.1 through III.20.

Total electricity consumption includes all appliances, but not electric space heat, and is, consequently, referred to as "pure appliance use." The price assumptions do not permit electricity to compete with fuel oil or wood for space heat. Appliance consumption is divided into two types: base consumption and price-sensitive consumption. Base consumption consists of those types of appliances currently in use in the region as observed from survey data, interviews, and site investigations. Price-sensitive consumption consists of those types of appliances not currently in use in the region because a non-electric alternative is more cost effective (a propane range, for example). In the BAU scenario, price-sensitive consumption does not occur in any consumer category because electricity prices remain higher than the electricity-equivalent price of competing fuels (wood, propane, and fuel oil).

TABLE III.1 BRISTOL BAY ELECTRICITY CONSUMPTION
BUSINESS AS USUAL SCENARIO
ALL COMMUNITIES

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	956	1,013	1,260	1,521	2,077
2. Base Consmp. per Customer (kwh)	4,334	5,613	5,853	6,175	6,895
3. Total Base Consmp. (1x2) (mwh)	4,143	5,686	7,375	9,392	14,321
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
5. Total Consmp. (3+4) (mwh)	4,143	5,686	7,375	9,392	14,321
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	436	468	563	673	968
7. Base Consmp. per Customer (kwh)	19,839	20,910	23,639	26,777	34,306
8. Total Base Consmp. (6x7) (mwh)	8,650	9,786	13,309	18,021	33,208
SCHOOL					
9. Total School Consmp. (mwh)	1,012	1,012	1,012	1,178	1,178
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
11. Total Consmp. (8+9+10) (mwh)	9,662	10,798	14,321	19,199	34,386
MILITARY					
12. Total Base Consmp. (mwh)	5,600	5,600	5,600	5,600	5,600
13. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
14. Total Consmp. (12+13) (mwh)	5,600	5,600	5,600	5,600	5,600
INDUSTRIAL					
PROCESSORS					
15. Customers	13	14	14	14	14
16. Base Consmp. per Customer (kwh)	533,668	537,192	557,752	564,680	571,609
17. Total Base Consmp. (15x16) (mwh)	6,938	7,521	7,809	7,906	8,003
FISH CAMPS/BUY STATIONS					
18. Customers	40	40	40	40	40
19. Base Consmp. per Customer (kwh)	24,000	24,000	24,000	24,000	24,000
20. Total Base Consmp. (18x19) (mwh)	960	960	960	960	960
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
22. Total Consmp. (17+20+21) (mwh)	7,898	8,481	8,769	8,866	8,963
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	27,303	30,565	36,065	43,057	63,270

TABLE III.2 BRISTOL BAY ELECTRICITY CONSUMPTION
BUSINESS AS USUAL SCENARIO
DILLINGHAM

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	410	440	557	683	990
2. Base Consmp. per Customer (kwh)	5,112	6,383	6,703	7,049	7,708
3. Total Base Consmp. (1x2) (mwh)	2,096	2,809	3,734	4,814	7,631
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
5. Total Consmp. (3+4) (mwh)	2,096	2,809	3,734	4,814	7,631
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	184	199	242	294	433
7. Base Consmp. per Customer (kwh)	24,610	25,805	29,054	32,712	41,468
8. Total Base Consmp. (6x7) (mwh)	4,528	5,135	7,031	9,617	17,956
SCHOOL					
9. Total School Consmp. (mwh)	N/A	N/A	N/A	N/A	N/A
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
11. Total Consmp. (8+9+10) (mwh)	4,528	5,135	7,031	9,617	17,956
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers	2	3	3	3	3
16. Base Consmp. per Customer (kwh)	283,842	383,561	383,561	383,561	383,561
17. Total Base Consmp. (15x16) (mwh)	568	1,151	1,151	1,151	1,151
FISH CAMPS/BUY STATIONS					
18. Customers	10	10	10	10	10
19. Base Consmp. per Customer (kwh)	24,000	24,000	24,000	24,000	24,000
20. Total Base Consmp. (18x19) (mwh)	240	240	240	240	240
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
22. Total Consmp. (17+20+21) (mwh)	808	1,391	1,391	1,391	1,391
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	7,432	9,335	12,156	15,822	26,978

TABLE III.3 BRISTOL BAY ELECTRICITY CONSUMPTION
BUSINESS AS USUAL SCENARIO
ALEKNAGIK

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	33	35	43	52	72
2. Base Consmp. per Customer (kwh)	5,112	6,383	6,703	7,049	7,708
3. Total Base Consmp. (1x2) (mwh)	169	223	288	367	555
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
5. Total Consmp. (3+4) (mwh)	169	223	288	367	555
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	10	11	13	15	20
7. Base Consmp. per Customer (kwh)	24,610	25,805	29,054	32,712	41,468
8. Total Base Consmp. (6x7) (mwh)	246	284	378	491	829
SCHOOL					
9. Total School Consmp. (mwh)	N/A	N/A	N/A	N/A	N/A
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
11. Total Consmp. (8+9+10) (mwh)	246	284	378	491	829
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers					
16. Base Consmp. per Customer (kwh)					
17. Total Base Consmp. (15x16) (mwh)					
FISH CAMPS/BUY STATIONS					
18. Customers					
19. Base Consmp. per Customer (kwh)					
20. Total Base Consmp. (18x19) (mwh)					
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)					
22. Total Consmp. (17+20+21) (mwh)					
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	415	507	666	858	1,384

TABLE III.4 BRISTOL BAY ELECTRICITY CONSUMPTION
BUSINESS AS USUAL SCENARIO
NAKNEK

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	82	87	104	123	173
2. Base Consmp. per Customer (kwh)	5,328	6,472	6,771	7,088	7,717
3. Total Base Consmp. (1x2) (mwh)	437	563	704	872	1,335
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
5. Total Consmp. (3+4) (mwh)	437	563	704	872	1,335
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers					
7. Base Consmp. per Customer (kwh)					
8. Total Base Consmp. (6x7) (mwh)					
SCHOOL					
9. Total School Consmp. (mwh)			(See Table III.7)		
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)					
11. Total Consmp. (8+9+10) (mwh)					
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers	5	5	5	5	5
16. Base Consmp. per Customer (kwh)	505,741	505,741	563,308	563,308	563,308
17. Total Base Consmp. (15x16) (mwh)	2,529	2,529	2,817	2,817	2,817
FISH CAMPS/BUY STATIONS					
18. Customers	8	8	8	8	8
19. Base Consmp. per Customer (kwh)	24,000	24,000	24,000	24,000	24,000
20. Total Base Consmp. (18x19) (mwh)	192	192	192	192	192
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
22. Total Consmp. (17+20+21) (mwh)	2,721	2,721	3,009	3,009	3,009
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh) [a]	3,158	3,284	3,713	3,881	4,344

[a] Total excludes Commercial/Government consumption.

TABLE III.5 BRISTOL BAY ELECTRICITY CONSUMPTION
BUSINESS AS USUAL SCENARIO
KING SALMON

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	112	116	124	134	156
2. Base Consmp. per Customer (kwh)	5,328	6,472	6,771	7,088	7,717
3. Total Base Consmp. (1x2) (mwh)	597	751	840	950	1,204
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
5. Total Consmp. (3+4) (mwh)	597	751	840	950	1,204
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers					
7. Base Consmp. per Customer (kwh)					
8. Total Base Consmp. (6x7) (mwh)					
SCHOOL					
9. Total School Consmp. (mwh)			(See Table III.7)		
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)					
11. Total Consmp. (8+9+10) (mwh)					
MILITARY					
12. Total Base Consmp. (mwh)	5,600	5,600	5,600	5,600	5,600
13. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
14. Total Consmp. (12+13) (mwh)	5,600	5,600	5,600	5,600	5,600
INDUSTRIAL					
PROCESSORS					
15. Customers					
16. Base Consmp. per Customer (kwh)					
17. Total Base Consmp. (15x16) (mwh)					
FISH CAMPS/BUY STATIONS					
18. Customers	7	7	7	7	7
19. Base Consmp. per Customer (kwh)	24,000	24,000	24,000	24,000	24,000
20. Total Base Consmp. (18x19) (mwh)	168	168	168	168	168
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
22. Total Consmp. (17+20+21) (mwh)	168	168	168	168	168
GRAND TOTAL					
23. Total Consmp., All Sectors[a] (5+11+14+22) (mwh)	6,365	6,519	6,608	6,718	6,972

[a] Total excludes Commercial/Government consumption.

TABLE III.6 BRISTOL BAY ELECTRICITY CONSUMPTION
BUSINESS AS USUAL SCENARIO
SOUTH NAKNEK

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	47	49	53	60	73
2. Base Consmp. per Customer (kwh)	5,328	6,472	6,771	7,088	7,717
3. Total Base Consmp. (1x2) (mwh)	250	317	359	425	563
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
5. Total Consmp. (3+4) (mwh)	250	317	359	425	563
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	6	6	7	8	9
7. Base Consmp. per Customer (kwh)	20,538	21,536	24,247	27,300	34,606
8. Total Base Consmp. (6x7) (mwh)	123	129	170	218	311
SCHOOL					
9. Total School Consmp. (mwh)	NA	NA	NA	NA	NA
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
11. Total Consmp. (8+9+10) (mwh)	123	129	170	218	311
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers	2	2	2	2	2
16. Base Consmp. per Customer (kwh)	793,150	793,150	793,150	793,150	793,150
17. Total Base Consmp. (15x16) (mwh)	1,586	1,586	1,586	1,586	1,586
FISH CAMPS/BUY STATIONS					
18. Customers	8	8	8	8	8
19. Base Consmp. per Customer (kwh)	24,000	24,000	24,000	24,000	24,000
20. Total Base Consmp. (18x19) (mwh)	192	192	192	192	192
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
22. Total Consmp. (17+20+21) (mwh)	1,778	1,778	1,778	1,778	1,778
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	2,151	2,224	2,307	2,421	2,652

TABLE III.7 BRISTOL BAY ELECTRICITY CONSUMPTION
BUSINESS AS USUAL SCENARIO
NAKNEK/KING SALMON

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	194	203	228	257	329
2. Base Consmp. per Customer (kwh)	5,330	6,473	6,772	7,089	7,717
3. Total Base Consmp. (1x2) (mwh)	1,034	1,314	1,544	1,822	2,539
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
5. Total Consmp. (3+4) (mwh)	1,034	1,314	1,544	1,822	2,539
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	130	141	171	207	306
7. Base Consmp. per Customer (kwh)	20,538	21,536	24,247	27,300	34,606
8. Total Base Consmp. (6x7) (mwh)	2,670	3,037	4,146	5,651	10,589
SCHOOL					
9. Total School Consmp. (mwh)	NA	NA	NA	NA	NA
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
11. Total Consmp. (8+9+10) (mwh)	2,670	3,037	4,146	5,651	10,589
MILITARY					
12. Total Base Consmp. (mwh)	5,600	5,600	5,600	5,600	5,600
13. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
14. Total Consmp. (12+13) (mwh)	5,600	5,600	5,600	5,600	5,600
INDUSTRIAL					
PROCESSORS					
15. Customers	5	5	5	5	5
16. Base Consmp. per Customer (kwh)	505,741	505,741	563,308	563,308	563,308
17. Total Base Consmp. (15x16) (mwh)	2,529	2,529	2,817	2,817	2,817
FISH CAMPS/BUY STATIONS					
18. Customers	15	15	15	15	15
19. Base Consmp. per Customer (kwh)	24,000	24,000	24,000	24,000	24,000
20. Total Base Consmp. (18x19) (mwh)	360	360	360	360	360
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
22. Total Consmp. (17+20+21) (mwh)	2,889	2,889	3,177	3,177	3,177
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	12,193	12,840	14,467	16,250	21,905

TABLE III.8 BRISTOL BAY ELECTRICITY CONSUMPTION
BUSINESS AS USUAL SCENARIO
EGEGIK

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	23	24	31	35	44
2. Base Consmp. per Customer (kwh)	2,329	4,718	5,073	5,438	6,129
3. Total Base Consmp. (1x2) (mwh)	54	113	157	190	270
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
5. Total Consmp. (3+4) (mwh)	54	113	157	190	270
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	8	8	9	10	11
7. Base Consmp. per Customer (kwh)	9,551	10,015	11,276	12,695	16,093
8. Total Base Consmp. (6x7) (mwh)	76	80	101	127	177
SCHOOL					
9. Total School Consmp. (mwh)	6	6	6	6	6
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
11. Total Consmp. (8+9+10) (mwh)	82	86	107	133	183
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers	2	2	2	2	2
16. Base Consmp. per Customer (kwh)	534,500	534,500	534,500	583,000	583,000
17. Total Base Consmp. (15x16) (mwh)	1,069	1,069	1,069	1,166	1,166
FISH CAMPS/BUY STATIONS					
18. Customers	6	6	6	6	6
19. Base Consmp. per Customer (kwh)	24,000	24,000	24,000	24,000	24,000
20. Total Base Consmp. (18x19) (mwh)	144	144	144	144	144
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
22. Total Consmp. (17+20+21) (mwh)	1,213	1,213	1,213	1,310	1,310
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	1,349	1,412	1,477	1,633	1,763

TABLE III.9 BRISTOL BAY ELECTRICITY CONSUMPTION
BUSINESS AS USUAL SCENARIO
MANOKOTAK

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	49	52	63	74	98
2. Base Consmp. per Customer (kwh)	3,308	5,278	5,544	5,798	6,474
3. Total Base Consmp. (1x2) (mwh)	162	274	349	429	634
4. Price Sensitive Consmp. (mwh)	∅	∅	∅	∅	∅
5. Total Consmp. (3+4) (mwh)	162	274	349	429	634
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	7	7	9	10	13
7. Base Consmp. per Customer (kwh)	6,485	6,800	7,656	8,620	10,927
8. Total Base Consmp. (6x7) (mwh)	45	48	69	86	142
SCHOOL					
9. Total School Consmp. (mwh)	81	81	81	81	81
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	∅	∅	∅	∅	∅
11. Total Consmp. (8+9+10) (mwh)	126	129	150	167	223
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers					
16. Base Consmp. per Customer (kwh)					
17. Total Base Consmp. (15x16) (mwh)					
FISH CAMPS/BUY STATIONS					
18. Customers					
19. Base Consmp. per Customer (kwh)					
20. Total Base Consmp. (18x19) (mwh)					
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)					
22. Total Consmp. (17+20+21) (mwh)					
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	288	403	499	596	857

TABLE III.10 BRISTOL BAY ELECTRICITY CONSUMPTION
BUSINESS AS USUAL SCENARIO
NEW STUYAHOK

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	54	56	70	84	112
2. Base Consmp. per Customer (kwh)	1,944	3,627	4,012	4,386	5,244
3. Total Base Consmp. (1x2) (mwh)	105	203	281	368	587
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
5. Total Consmp. (3+4) (mwh)	105	203	281	368	587
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	10	11	12	14	18
7. Base Consmp. per Customer (kwh)	5,767	6,047	6,808	7,666	9,717
8. Total Base Consmp. (6x7) (mwh)	58	67	82	107	175
SCHOOL					
9. Total School Consmp. (mwh)	145	145	145	145	145
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
11. Total Consmp. (8+9+10) (mwh)	203	212	227	252	320
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers					
16. Base Consmp. per Customer (kwh)					
17. Total Base Consmp. (15x16) (mwh)					
FISH CAMPS/BUY STATIONS					
18. Customers					
19. Base Consmp. per Customer (kwh)					
20. Total Base Consmp. (18x19) (mwh)					
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)					
22. Total Consmp. (17+20+21) (mwh)					
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	308	415	508	620	907

TABLE III.11 BRISTOL BAY ELECTRICITY CONSUMPTION
BUSINESS AS USUAL SCENARIO
PORTAGE CREEK

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	12	13	15	17	22
2. Base Consmp. per Customer (kwh)	1,536	2,592	2,938	3,335	4,113
3. Total Base Consmp. (1x2) (mwh)	18	34	44	57	90
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
5. Total Consmp. (3+4) (mwh)	18	34	44	57	90
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	5	5	6	7	10
7. Base Consmp. per Customer (kwh)	2,931	3,051	3,374	3,730	4,561
8. Total Base Consmp. (6x7) (mwh)	15	15	20	26	46
SCHOOL					
9. Total School Consmp. (mwh)	66	66	66	117	117
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
11. Total Consmp. (8+9+10) (mwh)	81	81	86	143	163
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers					
16. Base Consmp. per Customer (kwh)					
17. Total Base Consmp. (15x16) (mwh)					
FISH CAMPS/BUY STATIONS					
18. Customers					
19. Base Consmp. per Customer (kwh)					
20. Total Base Consmp. (18x19) (mwh)					
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)					
22. Total Consmp. (17+20+21) (mwh)					
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	99	115	130	200	253

TABLE III.12 BRISTOL BAY ELECTRICITY CONSUMPTION
BUSINESS AS USUAL SCENARIO
EKWOK

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	20	21	23	25	31
2. Base Consmp. per Customer (kwh)	1,536	3,471	3,767	4,133	4,854
3. Total Base Consmp. (1x2) (mwh)	31	73	87	103	150
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
5. Total Consmp. (3+4) (mwh)	31	73	87	103	150
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	5	5	6	6	8
7. Base Consmp. per Customer (kwh)	7,795	8,115	8,972	9,921	12,129
8. Total Base Consmp. (6x7) (mwh)	39	41	54	60	97
SCHOOL					
9. Total School Consmp. (mwh)	47	47	47	47	47
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
11. Total Consmp. (8+9+10) (mwh)	86	88	101	107	144
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers					
16. Base Consmp. per Customer (kwh)					
17. Total Base Consmp. (15x16) (mwh)					
FISH CAMPS/BUY STATIONS					
18. Customers					
19. Base Consmp. per Customer (kwh)					
20. Total Base Consmp. (18x19) (mwh)					
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)					
22. Total Consmp. (17+20+21) (mwh)					
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	117	161	188	210	294

TABLE III.13 BRISTOL BAY ELECTRICITY CONSUMPTION
BUSINESS AS USUAL SCENARIO
KOLIGANEK

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	36	38	43	49	62
2. Base Consmp. per Customer (kwh)	1,104	3,098	3,443	3,838	4,670
3. Total Base Consmp. (1x2) (mwh)	40	118	148	188	290
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
5. Total Consmp. (3+4) (mwh)	40	118	148	188	290
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	7	7	9	10	13
7. Base Consmp. per Customer (kwh)	9,189	9,566	10,577	11,695	14,298
8. Total Base Consmp. (6x7) (mwh)	64	67	95	117	186
SCHOOL					
9. Total School Consmp. (mwh)	51	51	51	51	51
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
11. Total Consmp. (8+9+10) (mwh)	115	118	146	168	237
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers					
16. Base Consmp. per Customer (kwh)					
17. Total Base Consmp. (15x16) (mwh)					
FISH CAMPS/BUY STATIONS					
18. Customers					
19. Base Consmp. per Customer (kwh)					
20. Total Base Consmp. (18x19) (mwh)					
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)					
22. Total Consmp. (17+20+21) (mwh)					
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	155	236	294	356	527

TABLE III.14 BRISTOL BAY ELECTRICITY CONSUMPTION
BUSINESS AS USUAL SCENARIO
ILIAMNA

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	21	23	27	33	47
2. Base Consmp. per Customer (kwh)	3,149	3,324	3,916	3,997	4,479
3. Total Base Consmp. (1x2) (mwh)	66	76	106	132	211
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
5. Total Consmp. (3+4) (mwh)	66	76	106	132	211
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	31	34	41	49	73
7. Base Consmp. per Customer (kwh)	20,636	21,482	23,753	26,264	32,110
8. Total Base Consmp. (6x7) (mwh)	640	730	974	1,287	2,344
SCHOOL					
9. Total School Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
11. Total Consmp. (8+9+10) (mwh)	640	730	974	1,287	2,344
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers					
16. Base Consmp. per Customer (kwh)					
17. Total Base Consmp. (15x16) (mwh)					
FISH CAMPS/BUY STATIONS					
18. Customers					
19. Base Consmp. per Customer (kwh)					
20. Total Base Consmp. (18x19) (mwh)					
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)					
22. Total Consmp. (17+20+21) (mwh)					
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	706	806	1,080	1,419	2,555

TABLE III.15 BRISTOL BAY ELECTRICITY CONSUMPTION
BUSINESS AS USUAL SCENARIO
NEWHALEN

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	18	19	22	25	34
2. Base Consmp. per Customer (kwh)	2,847	2,977	3,556	3,868	4,373
3. Total Base Consmp. (1x2) (mwh)	51	57	78	97	149
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
5. Total Consmp. (3+4) (mwh)	51	57	78	97	149
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	8	9	10	12	16
7. Base Consmp. per Customer (kwh)	1,716	1,786	1,975	2,184	2,670
8. Total Base Consmp. (6x7) (mwh)	14	16	20	26	43
SCHOOL					
9. Total School Consmp. (mwh)	230	230	230	230	230
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
11. Total Consmp. (8+9+10) (mwh)	244	246	250	256	273
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers					
16. Base Consmp. per Customer (kwh)					
17. Total Base Consmp. (15x16) (mwh)					
FISH CAMPS/BUY STATIONS					
18. Customers					
19. Base Consmp. per Customer (kwh)					
20. Total Base Consmp. (18x19) (mwh)					
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)					
22. Total Consmp. (17+20+21) (mwh)					
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	295	303	328	353	422

TABLE III.16 BRISTOL BAY ELECTRICITY CONSUMPTION
BUSINESS AS USUAL SCENARIO
NONDALTON

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	11	11	30	50	58
2. Base Consmp. per Customer (kwh)	922	1,089	1,948	2,744	3,617
3. Total Base Consmp. (1x2) (mwh)	10	12	58	137	210
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
5. Total Consmp. (3+4) (mwh)	10	12	58	137	210
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	9	9	10	11	13
7. Base Consmp. per Customer (kwh)	3,788	3,943	4,360	4,821	5,894
8. Total Base Consmp. (6x7) (mwh)	34	35	44	53	77
SCHOOL					
9. Total School Consmp. (mwh)	152	152	152	152	152
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
11. Total Consmp. (8+9+10) (mwh)	186	187	196	205	229
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers					
16. Base Consmp. per Customer (kwh)					
17. Total Base Consmp. (15x16) (mwh)					
FISH CAMPS/BUY STATIONS					
18. Customers					
19. Base Consmp. per Customer (kwh)					
20. Total Base Consmp. (18x19) (mwh)					
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)					
22. Total Consmp. (17+20+21) (mwh)					
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	196	199	254	342	439

TABLE III.17 BRISTOL BAY ELECTRICITY CONSUMPTION
BUSINESS AS USUAL SCENARIO
CLARKS POINT

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	10	10	18	28	34
2. Base Consmp. per Customer (kwh)	2,369	2,564	3,189	3,583	4,148
3. Total Base Consmp. (1x2) (mwh)	24	26	57	100	141
4. Price Sensitive Consmp. (mwh)	∅	∅	∅	∅	∅
5. Total Consmp. (3+4) (mwh)	24	26	57	100	141
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	5	5	6	6	8
7. Base Consmp. per Customer (kwh)	4,326	4,503	4,979	5,506	6,731
8. Total Base Consmp. (6x7) (mwh)	22	23	30	33	54
SCHOOL					
9. Total School Consmp. (mwh)	48	48	48	117	117
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	∅	∅	∅	∅	∅
11. Total Consmp. (8+9+10) (mwh)	70	71	78	150	171
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers	1	1	1	1	1
16. Base Consmp. per Customer (kwh)	486,000	486,000	486,000	486,000	583,000
17. Total Base Consmp. (15x16) (mwh)	486	486	486	486	583
FISH CAMPS/BUY STATIONS					
18. Customers	1	1	1	1	1
19. Base Consmp. per Customer (kwh)	24,000	24,000	24,000	24,000	24,000
20. Total Base Consmp. (18x19) (mwh)	24	24	24	24	24
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)	∅	∅	∅	∅	∅
22. Total Consmp. (17+20+21) (mwh)	510	510	510	510	607
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	604	607	645	760	919

TABLE III.18 BRISTOL BAY ELECTRICITY CONSUMPTION
BUSINESS AS USUAL SCENARIO
LEVELOCK

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	11	12	28	39	57
2. Base Consmp. per Customer (kwh)	1,381	1,488	2,002	3,200	4,197
3. Total Base Consmp. (1x2) (mwh)	15	18	56	125	239
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
5. Total Consmp. (3+4) (mwh)	15	18	56	125	239
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	8	8	9	10	12
7. Base Consmp. per Customer (kwh)	6,711	6,986	7,725	8,541	10,442
8. Total Base Consmp. (6x7) (mwh)	54	56	70	85	125
SCHOOL					
9. Total School Consmp. (mwh)	72	72	72	117	117
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
11. Total Consmp. (8+9+10) (mwh)	126	128	142	202	242
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers					
16. Base Consmp. per Customer (kwh)					
17. Total Base Consmp. (15x16) (mwh)					
FISH CAMPS/BUY STATIONS					
18. Customers					
19. Base Consmp. per Customer (kwh)					
20. Total Base Consmp. (18x19) (mwh)					
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)					
22. Total Consmp. (17+20+21) (mwh)					
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	141	146	198	327	481

TABLE III.19 BRISTOL BAY ELECTRICITY CONSUMPTION
BUSINESS AS USUAL SCENARIO
IGIUGIG

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	7	7	9	10	14
2. Base Consmp. per Customer (kwh)	2,549	2,678	3,180	3,787	4,412
3. Total Base Consmp. (1x2) (mwh)	18	19	29	38	62
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
5. Total Consmp. (3+4) (mwh)	18	19	29	38	62
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	3	3	3	4	5
7. Base Consmp. per Customer (kwh)	7,294	7,593	8,396	9,283	11,350
8. Total Base Consmp. (6x7) (mwh)	22	23	25	37	57
SCHOOL					
9. Total School Consmp. (mwh)	115	115	115	115	115
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
11. Total Consmp. (8+9+10) (mwh)	137	138	140	152	172
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers					
16. Base Consmp. per Customer (kwh)					
17. Total Base Consmp. (15x16) (mwh)					
FISH CAMPS/BUY STATIONS					
18. Customers					
19. Base Consmp. per Customer (kwh)					
20. Total Base Consmp. (18x19) (mwh)					
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)					
22. Total Consmp. (17+20+21) (mwh)					
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	155	157	169	190	234

TABLE III.20 BRISTOL BAY ELECTRICITY CONSUMPTION
BUSINESS AS USUAL SCENARIO
EKUK

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers					
2. Base Consmp. per Customer (kwh)					
3. Total Base Consmp. (1x2) (mwh)			(Included in Industrial)		
4. Price Sensitive Consmp. (mwh)					
5. Total Consmp. (3+4) (mwh)					
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers					
7. Base Consmp. per Customer (kwh)					
8. Total Base Consmp. (6x7) (mwh)					
SCHOOL					
9. Total School Consmp. (mwh)			(Included in Industrial)		
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)					
11. Total Consmp. (8+9+10) (mwh)					
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers	1	1	1	1	1
16. Base Consmp. per Customer (kwh)	700,000	700,000	700,000	700,000	700,000
17. Total Base Consmp. (15x16) (mwh)	700	700	700	700	700
FISH CAMPS/BUY STATIONS					
18. Customers					
19. Base Consmp. per Customer (kwh)					
20. Total Base Consmp. (18x19) (mwh)					
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
22. Total Consmp. (17+20+21) (mwh)	700	700	700	700	700
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	700	700	700	700	700

Total electricity consumption in all sectors is projected to more than double from 27,303 mwh in 1980 to 63,270 mwh in 2002. This implies an average annual rate of consumption growth equal to 3.9 percent. The residential and commercial/government (C/G) sectors would contribute the bulk of overall expansion in electricity consumption. The level of base year consumption in both of these sectors would increase by over twofold. The industrial sector would experience a modest 0.6 percent rate of growth, and military would remain constant.

As a proportion of total electricity consumption, the C/G sector would experience the largest increase from 35 to 54 percent over the forecast period. Almost all of this increase would occur in the nonschool, C/G sector. Electricity consumption in the schools would increase only as a result of upgraded, more energy-intensive school facilities in certain villages. The residential share should also increase from 15 to 23 percent. The share captured by the industrial sector would decline from 29 to 14 percent. The military's share would also decline as the other sectors expanded.

From a regional standpoint, Dillingham accounts for the largest proportion (43 percent) of total study-area electricity consumption in 2002, followed by Naknek and King Salmon combined (35 percent). This distribution is not the same as the base year. In 1980, Naknek and King Salmon accounted for 45 percent of total consumption, compared with 27 percent in Dillingham. Although the rate of population growth was assumed to be the same in Dillingham and Naknek, the larger population base in Dillingham resulted in a concentration of population, which also led growth in Dillingham's C/G sector. Also, we assumed that residential use per customer would increase more rapidly in Dillingham than in Naknek due to patterns of appliance ownership. Furthermore, while consumption in Dillingham's residential and C/G sector was expanding faster than that of Naknek, electricity consumption in Naknek's industrial sector, which accounted for 24 percent of Naknek's base-year consumption, declined to 15 percent of Naknek's overall consumption in 2002.

Together, the two major utility districts serviced by Nushaguk Electric Co-operative and Naknek Electric Association would account for 84 percent (52,919 mwh) of total study-area electricity consumption in 2002, representing a modest increase from 81 percent in 1980.

Lower projected gains in the residential sector reflect the assumption that C/G customers are more responsive than residential customers to changes in electricity prices.

As in the BAU scenario, RD consumption in both the residential and C/G sectors increases as a proportion of total consumption in all sectors. As in the BAU case, price-sensitive consumption due to a switch to electric appliances because of a favorable electricity price does not occur.

The effect of long run stable prices in the RD scenario are distributed evenly across study-area communities. The NEC and NEA utility-district communities again account for 84 percent of the total study-area consumption in 2002.

TABLE IV.1 BRISTOL BAY ELECTRICITY CONSUMPTION
REGIONAL DIESEL
ALL COMMUNITIES

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	956	1,099	1,363	1,569	2,086
2. Base Consmp. per Customer (kwh)	4,334	5,370	5,753	6,238	7,159
3. Total Base Consmp. (1x2) (mwh)	4,143	5,902	7,841	9,788	14,933
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
5. Total Consmp. (3+4) (mwh)	4,143	5,902	7,841	9,788	14,933
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	436	468	563	673	968
7. Base Consmp. per Customer (kwh)	19,839	21,427	24,968	29,018	38,991
8. Total Base Consmp. (6x7) (mwh)	8,650	10,028	14,057	19,529	37,743
SCHOOL					
9. Total School Consmp. (mwh)	1,012	1,012	1,012	1,178	1,178
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
11. Total Consmp. (8+9+10) (mwh)	9,662	11,040	15,069	20,707	38,921
MILITARY					
12. Total Base Consmp. (mwh)	5,600	5,600	5,600	5,600	5,600
13. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
14. Total Consmp. (12+13) (mwh)	5,600	5,600	5,600	5,600	5,600
INDUSTRIAL					
PROCESSORS					
15. Customers	13	14	14	14	14
16. Base Consmp. per Customer (kwh)	533,668	537,192	557,752	564,680	571,609
17. Total Base Consmp. (15x16) (mwh)	6,938	7,521	7,809	7,906	8,003
FISH CAMPS/BUY STATIONS					
18. Customers	40	40	40	40	40
19. Base Consmp. per Customer (kwh)	24,000	24,000	24,000	24,000	24,000
20. Total Base Consmp. (18x19) (mwh)	960	960	960	960	960
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
22. Total Consmp. (17+20+21) (mwh)	7,898	8,481	8,769	8,866	8,963
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	27,303	31,023	37,279	44,961	68,417

TABLE IV.2 BRISTOL BAY ELECTRICITY CONSUMPTION
REGIONAL DIESEL
DILLINGHAM

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	410	470	593	704	990
2. Base Consmp. per Customer (kwh)	5,112	6,176	6,640	7,077	7,940
3. Total Base Consmp. (1x2) (mwh)	2,096	2,903	3,938	4,982	7,861
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
5. Total Consmp. (3+4) (mwh)	2,096	2,903	3,938	4,982	7,861
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	184	199	242	294	433
7. Base Consmp. per Customer (kwh)	24,610	26,012	30,596	35,302	46,824
8. Total Base Consmp. (6x7) (mwh)	4,528	5,176	7,404	10,379	20,275
SCHOOL					
9. Total School Consmp. (mwh)	NA	NA	NA	NA	NA
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
11. Total Consmp. (8+9+10) (mwh)	4,528	5,176	7,404	10,379	20,275
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers	2	3	3	3	3
16. Base Consmp. per Customer (kwh)	283,842	383,561	383,561	383,561	383,561
17. Total Base Consmp. (15x16) (mwh)	568	1,151	1,151	1,151	1,151
FISH CAMPS/BUY STATIONS					
18. Customers	10	10	10	10	10
19. Base Consmp. per Customer (kwh)	24,000	24,000	24,000	24,000	24,000
20. Total Base Consmp. (18x19) (mwh)	240	240	240	240	240
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
22. Total Consmp. (17+20+21) (mwh)	808	1,391	1,391	1,391	1,391
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	7,432	9,470	12,733	16,752	29,527

TABLE IV.3 BRISTOL BAY ELECTRICITY CONSUMPTION
REGIONAL DIESEL
ALEKNAGIK

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	33	38	46	54	72
2. Base Consmp. per Customer (kwh)	5,112	6,176	6,640	7,077	7,940
3. Total Base Consmp. (1x2) (mwh)	169	235	305	382	572
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
5. Total Consmp. (3+4) (mwh)	169	235	305	382	572
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	10	11	13	15	20
7. Base Consmp. per Customer (kwh)	24,610	26,012	30,596	35,302	46,824
8. Total Base Consmp. (6x7) (mwh)	246	286	398	530	936
SCHOOL					
9. Total School Consmp. (mwh)	NA	NA	NA	NA	NA
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
11. Total Consmp. (8+9+10) (mwh)	246	286	398	530	936
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers					
16. Base Consmp. per Customer (kwh)					
17. Total Base Consmp. (15x16) (mwh)					
FISH CAMPS/BUY STATIONS					
18. Customers					
19. Base Consmp. per Customer (kwh)					
20. Total Base Consmp. (18x19) (mwh)					
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)					
22. Total Consmp. (17+20+21) (mwh)					
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	415	521	703	912	1,508

TABLE IV.4 BRISTOL BAY ELECTRICITY CONSUMPTION
REGIONAL DIESEL
NAKNEK

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	82	87	104	123	173
2. Base Consmp. per Customer (kwh)	5,328	6,392	6,848	7,262	8,121
3. Total Base Consmp. (1x2) (mwh)	437	556	712	893	1,405
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
5. Total Consmp. (3+4) (mwh)	437	556	712	893	1,405
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers					
7. Base Consmp. per Customer (kwh)					
8. Total Base Consmp. (6x7) (mwh)					
SCHOOL					
9. Total School Consmp. (mwh)			(See Table IV.7)		
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)					
11. Total Consmp. (8+9+10) (mwh)					
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers	5	5	5	5	5
16. Base Consmp. per Customer (kwh)	505,741	505,741	563,308	563,308	563,308
17. Total Base Consmp. (15x16) (mwh)	2,529	2,529	2,817	2,817	2,817
FISH CAMPS/BUY STATIONS					
18. Customers	8	8	8	8	8
19. Base Consmp. per Customer (kwh)	24,000	24,000	24,000	24,000	24,000
20. Total Base Consmp. (18x19) (mwh)	192	192	192	192	192
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
22. Total Consmp. (17+20+21) (mwh)	2,721	2,721	3,009	3,009	3,009
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)[a]	3,158	3,277	3,721	3,902	4,414

[a]Total excludes Commercial/Government consumption.

TABLE IV.5 BRISTOL BAY ELECTRICITY CONSUMPTION
REGIONAL DIESEL
KING SALMON

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	112	116	124	134	156
2. Base Consmp. per Customer (kwh)	5,328	6,392	6,848	7,262	8,121
3. Total Base Consmp. (1x2) (mwh)	597	741	849	973	1,267
4. Price Sensitive Consmp. (mwh)	∅	∅	∅	∅	∅
5. Total Consmp. (3+4) (mwh)	597	741	849	973	1,267
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers					
7. Base Consmp. per Customer (kwh)					
8. Total Base Consmp. (6x7) (mwh)					
SCHOOL					
9. Total School Consmp. (mwh)			(See Table IV.7)		
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)					
11. Total Consmp. (8+9+10) (mwh)					
MILITARY					
12. Total Base Consmp. (mwh)	5,600	5,600	5,600	5,600	5,600
13. Price Sensitive Consmp. (mwh)	∅	∅	∅	∅	∅
14. Total Consmp. (12+13) (mwh)	5,600	5,600	5,600	5,600	5,600
INDUSTRIAL					
PROCESSORS					
15. Customers					
16. Base Consmp. per Customer (kwh)					
17. Total Base Consmp. (15x16) (mwh)					
FISH CAMPS/BUY STATIONS					
18. Customers	7	7	7	7	7
19. Base Consmp. per Customer (kwh)	24,000	24,000	24,000	24,000	24,000
20. Total Base Consmp. (18x19) (mwh)	168	168	168	168	168
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)	∅	∅	∅	∅	∅
22. Total Consmp. (17+20+21) (mwh)	168	168	168	168	168
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh) [a]	6,365	6,509	6,617	6,741	7,035

[a] Total excludes Commercial/Government consumption.

TABLE IV.6 BRISTOL BAY ELECTRICITY CONSUMPTION
REGIONAL DIESEL
SOUTH NAKNEK

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	47	49	53	60	73
2. Base Consmp. per Customer (kwh)	5,328	6,392	6,848	7,262	8,121
3. Total Base Consmp. (1x2) (mwh)	250	313	363	436	593
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
5. Total Consmp. (3+4) (mwh)	250	313	363	436	593
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	6	6	7	8	9
7. Base Consmp. per Customer (kwh)	20,538	21,708	25,533	29,460	39,076
8. Total Base Consmp. (6x7) (mwh)	123	130	179	236	352
SCHOOL					
9. Total School Consmp. (mwh)	NA	NA	NA	NA	NA
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
11. Total Consmp. (8+9+10) (mwh)	123	130	179	236	352
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers	2	2	2	2	2
16. Base Consmp. per Customer (kwh)	793,150	793,150	793,150	793,150	793,150
17. Total Base Consmp. (15x16) (mwh)	1,586	1,586	1,586	1,586	1,586
FISH CAMPS/BUY STATIONS					
18. Customers	8	8	8	8	8
19. Base Consmp. per Customer (kwh)	24,000	24,000	24,000	24,000	24,000
20. Total Base Consmp. (18x19) (mwh)	192	192	192	192	192
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
22. Total Consmp. (17+20+21) (mwh)	1,778	1,778	1,778	1,778	1,778
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	2,151	2,221	2,320	2,450	2,723

TABLE IV.7 BRISTOL BAY ELECTRICITY CONSUMPTION
REGIONAL DIESEL
NAKNEK/KING SALMON

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	194	203	228	257	329
2. Base Consmp. per Customer (kwh)	5,330	6,389	6,846	7,261	8,122
3. Total Base Consmp. (1x2) (mwh)	1,034	1,297	1,561	1,866	2,672
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
5. Total Consmp. (3+4) (mwh)	1,034	1,297	1,561	1,866	2,672
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	130	141	171	207	306
7. Base Consmp. per Customer (kwh)	20,538	21,708	25,533	29,460	39,076
8. Total Base Consmp. (6x7) (mwh)	2,670	3,061	4,366	6,098	11,957
SCHOOL					
9. Total School Consmp. (mwh)	NA	NA	NA	NA	NA
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
11. Total Consmp. (8+9+10) (mwh)	2,670	3,061	4,366	6,098	11,957
MILITARY					
12. Total Base Consmp. (mwh)	5,600	5,600	5,600	5,600	5,600
13. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
14. Total Consmp. (12+13) (mwh)	5,600	5,600	5,600	5,600	5,600
INDUSTRIAL					
PROCESSORS					
15. Customers	5	5	5	5	5
16. Base Consmp. per Customer (kwh)	505,741	505,741	563,308	563,308	563,308
17. Total Base Consmp. (15x16) (mwh)	2,529	2,529	2,817	2,817	2,817
FISH CAMPS/BUY STATIONS					
18. Customers	15	15	15	15	15
19. Base Consmp. per Customer (kwh)	24,000	24,000	24,000	24,000	24,000
20. Total Base Consmp. (18x19) (mwh)	360	360	360	360	360
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
22. Total Consmp. (17+20+21) (mwh)	2,889	2,889	3,177	3,177	3,177
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	12,193	12,847	14,704	16,741	23,406

TABLE IV.8 BRISTOL BAY ELECTRICITY CONSUMPTION
REGIONAL DIESEL
EGEGIK

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	23	28	36	38	44
2. Base Consmp. per Customer (kwh)	2,329	4,303	4,731	5,138	5,940
3. Total Base Consmp. (1x2) (mwh)	54	120	170	195	261
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
5. Total Consmp. (3+4) (mwh)	54	120	170	195	261
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	8	8	9	10	11
7. Base Consmp. per Customer (kwh)	9,551	10,095	11,874	13,700	18,171
8. Total Base Consmp. (6x7) (mwh)	76	81	107	137	200
SCHOOL					
9. Total School Consmp. (mwh)	6	6	6	6	6
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
11. Total Consmp. (8+9+10) (mwh)	82	87	113	143	206
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers	2	2	2	2	2
16. Base Consmp. per Customer (kwh)	534,500	534,500	534,500	583,000	583,000
17. Total Base Consmp. (15x16) (mwh)	1,069	1,069	1,069	1,166	1,166
FISH CAMPS/BUY STATIONS					
18. Customers	6	6	6	6	6
19. Base Consmp. per Customer (kwh)	24,000	24,000	24,000	24,000	24,000
20. Total Base Consmp. (18x19) (mwh)	144	144	144	144	144
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
22. Total Consmp. (17+20+21) (mwh)	1,213	1,213	1,213	1,310	1,310
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	1,349	1,420	1,496	1,648	1,777

TABLE IV.9 BRISTOL BAY ELECTRICITY CONSUMPTION
REGIONAL DIESEL
MANOKOTAK

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	49	56	68	77	98
2. Base Consmp. per Customer (kwh)	3,308	5,358	5,761	6,105	6,997
3. Total Base Consmp. (1x2) (mwh)	162	300	392	470	686
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
5. Total Consmp. (3+4) (mwh)	162	300	392	470	686
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	7	7	9	10	13
7. Base Consmp. per Customer (kwh)	6,485	6,855	8,063	9,303	12,339
8. Total Base Consmp. (6x7) (mwh)	45	48	73	93	160
SCHOOL					
9. Total School Consmp. (mwh)	81	81	81	81	81
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
11. Total Consmp. (8+9+10) (mwh)	126	129	154	174	241
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers					
16. Base Consmp. per Customer (kwh)					
17. Total Base Consmp. (15x16) (mwh)					
FISH CAMPS/BUY STATIONS					
18. Customers					
19. Base Consmp. per Customer (kwh)					
20. Total Base Consmp. (18x19) (mwh)					
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)					
22. Total Consmp. (17+20+21) (mwh)					
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	288	429	546	644	927

TABLE IV.10 BRISTOL BAY ELECTRICITY CONSUMPTION
REGIONAL DIESEL
NEW STUYAHOK

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	54	62	77	88	112
2. Base Consmp. per Customer (kwh)	1,944	3,558	4,024	4,454	5,457
3. Total Base Consmp. (1x2) (mwh)	105	221	310	392	611
4. Price Sensitive Consmp. (mwh)	∅	∅	∅	∅	∅
5. Total Consmp. (3+4) (mwh)	105	221	310	392	611
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	10	11	12	14	18
7. Base Consmp. per Customer (kwh)	5,767	6,095	7,169	8,272	10,972
8. Total Base Consmp. (6x7) (mwh)	58	67	86	116	197
SCHOOL					
9. Total School Consmp. (mwh)	145	145	145	145	145
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	∅	∅	∅	∅	∅
11. Total Consmp. (8+9+10) (mwh)	203	212	231	261	342
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers					
16. Base Consmp. per Customer (kwh)					
17. Total Base Consmp. (15x16) (mwh)					
FISH CAMPS/BUY STATIONS					
18. Customers					
19. Base Consmp. per Customer (kwh)					
20. Total Base Consmp. (18x19) (mwh)					
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)					
22. Total Consmp. (17+20+21) (mwh)					
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	308	433	541	653	953

TABLE IV.11 BRISTOL BAY ELECTRICITY CONSUMPTION
REGIONAL DIESEL
Portage Creek

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	12	13	16	18	24
2. Base Consmp. per Customer (kwh)	1,536	2,589	2,998	3,444	4,347
3. Total Base Consmp. (1x2) (mwh)	18	34	48	62	104
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
5. Total Consmp. (3+4) (mwh)	18	34	48	62	104
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	5	5	6	7	10
7. Base Consmp. per Customer (kwh)	2,931	3,083	3,549	4,007	5,270
8. Total Base Consmp. (6x7) (mwh)	15	15	21	28	53
SCHOOL					
9. Total School Consmp. (mwh)	66	66	66	117	117
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
11. Total Consmp. (8+9+10) (mwh)	81	81	87	145	170
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers					
16. Base Consmp. per Customer (kwh)					
17. Total Base Consmp. (15x16) (mwh)					
FISH CAMPS/BUY STATIONS					
18. Customers					
19. Base Consmp. per Customer (kwh)					
20. Total Base Consmp. (18x19) (mwh)					
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)					
22. Total Consmp. (17+20+21) (mwh)					
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	99	115	135	207	274

TABLE IV.12 BRISTOL BAY ELECTRICITY CONSUMPTION
REGIONAL DIESEL
EKWOK

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	20	21	23	25	31
2. Base Consmp. per Customer (kwh)	1,536	3,525	3,913	4,346	5,228
3. Total Base Consmp. (1x2) (mwh)	31	74	90	109	162
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
5. Total Consmp. (3+4) (mwh)	31	74	90	109	162
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	5	5	6	6	8
7. Base Consmp. per Customer (kwh)	7,795	8,201	9,441	10,657	14,018
8. Total Base Consmp. (6x7) (mwh)	39	41	57	64	112
SCHOOL					
9. Total School Consmp. (mwh)	47	47	47	47	47
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
11. Total Consmp. (8+9+10) (mwh)	86	88	104	111	159
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers					
16. Base Consmp. per Customer (kwh)					
17. Total Base Consmp. (15x16) (mwh)					
FISH CAMPS/BUY STATIONS					
18. Customers					
19. Base Consmp. per Customer (kwh)					
20. Total Base Consmp. (18x19) (mwh)					
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)					
22. Total Consmp. (17+20+21) (mwh)					
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	117	162	194	220	321

TABLE IV.13 BRISTOL BAY ELECTRICITY CONSUMPTION
REGIONAL DIESEL
KOLIGANEK

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	36	40	48	54	69
2. Base Consmp. per Customer (kwh)	1,104	3,094	3,515	3,968	4,940
3. Total Base Consmp. (1x2) (mwh)	40	124	169	214	341
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
5. Total Consmp. (3+4) (mwh)	40	124	169	214	341
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	7	7	9	10	13
7. Base Consmp. per Customer (kwh)	9,189	9,669	11,130	12,564	16,527
8. Total Base Consmp. (6x7) (mwh)	64	68	100	126	215
SCHOOL					
9. Total School Consmp. (mwh)	51	51	51	51	51
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
11. Total Consmp. (8+9+10) (mwh)	115	119	151	177	266
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers					
16. Base Consmp. per Customer (kwh)					
17. Total Base Consmp. (15x16) (mwh)					
FISH CAMPS/BUY STATIONS					
18. Customers					
19. Base Consmp. per Customer (kwh)					
20. Total Base Consmp. (18x19) (mwh)					
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)					
22. Total Consmp. (17+20+21) (mwh)					
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	155	243	320	391	607

TABLE IV.14 BRISTOL BAY ELECTRICITY CONSUMPTION
REGIONAL DIESEL
ILIAMNA

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	21	23	28	33	47
2. Base Consmp. per Customer (kwh)	3,149	3,527	3,955	4,092	4,707
3. Total Base Consmp. (1x2) (mwh)	66	81	111	135	221
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
5. Total Consmp. (3+4) (mwh)	66	81	111	135	221
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	31	34	41	49	73
7. Base Consmp. per Customer (kwh)	20,636	25,662	25,872	29,712	39,083
8. Total Base Consmp. (6x7) (mwh)	640	873	1,061	1,456	2,853
SCHOOL					
9. Total School Consmp. (mwh)	NA	NA	NA	NA	NA
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
11. Total Consmp. (8+9+10) (mwh)	640	873	1,061	1,456	2,853
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers					
16. Base Consmp. per Customer (kwh)					
17. Total Base Consmp. (15x16) (mwh)					
FISH CAMPS/BUY STATIONS					
18. Customers					
19. Base Consmp. per Customer (kwh)					
20. Total Base Consmp. (18x19) (mwh)					
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)					
22. Total Consmp. (17+20+21) (mwh)					
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	706	954	1,172	1,591	3,074

TABLE IV.15 BRISTOL BAY ELECTRICITY CONSUMPTION
REGIONAL DIESEL
NEWHALEN

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	18	19	22	25	34
2. Base Consmp. per Customer (kwh)	2,847	3,159	3,593	3,959	4,592
3. Total Base Consmp. (1x2) (mwh)	51	60	79	99	156
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
5. Total Consmp. (3+4) (mwh)	51	60	79	99	156
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	8	9	10	12	16
7. Base Consmp. per Customer (kwh)	1,716	2,134	2,152	2,471	3,250
8. Total Base Consmp. (6x7) (mwh)	14	19	22	30	52
SCHOOL					
9. Total School Consmp. (mwh)	230	230	230	230	230
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
11. Total Consmp. (8+9+10) (mwh)	244	249	252	260	282
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers					
16. Base Consmp. per Customer (kwh)					
17. Total Base Consmp. (15x16) (mwh)					
FISH CAMPS/BUY STATIONS					
18. Customers					
19. Base Consmp. per Customer (kwh)					
20. Total Base Consmp. (18x19) (mwh)					
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)					
22. Total Consmp. (17+20+21) (mwh)					
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	295	309	331	359	438

TABLE IV.16 BRISTOL BAY ELECTRICITY CONSUMPTION
REGIONAL DIESEL
NONDALTON

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	11	27	47	50	58
2. Base Consmp. per Customer (kwh)	922	1,152	1,995	2,839	3,824
3. Total Base Consmp. (1x2) (mwh)	10	31	94	142	222
4. Price Sensitive Consmp. (mwh)	∅	∅	∅	∅	∅
5. Total Consmp. (3+4) (mwh)	10	31	94	142	222
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	9	9	10	11	13
7. Base Consmp. per Customer (kwh)	3,788	4,711	4,749	5,454	7,174
8. Total Base Consmp. (6x7) (mwh)	34	42	47	60	93
SCHOOL					
9. Total School Consmp. (mwh)	152	152	152	152	152
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	∅	∅	∅	∅	∅
11. Total Consmp. (8+9+10) (mwh)	186	194	199	212	245
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers					
16. Base Consmp. per Customer (kwh)					
17. Total Base Consmp. (15x16) (mwh)					
FISH CAMPS/BUY STATIONS					
18. Customers					
19. Base Consmp. per Customer (kwh)					
20. Total Base Consmp. (18x19) (mwh)					
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)					
22. Total Consmp. (17+20+21) (mwh)					
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	196	225	293	354	467

TABLE IV.17 BRISTOL BAY ELECTRICITY CONSUMPTION
REGIONAL DIESEL
CLARKS POINT

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	10	17	25	28	34
2. Base Consmp. per Customer (kwh)	2,369	2,717	3,226	3,671	4,357
3. Total Base Consmp. (1x2) (mwh)	24	46	81	103	148
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
5. Total Consmp. (3+4) (mwh)	24	46	81	103	148
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	5	5	6	6	8
7. Base Consmp. per Customer (kwh)	4,326	5,380	5,424	6,229	8,193
8. Total Base Consmp. (6x7) (mwh)	22	27	33	37	66
SCHOOL					
9. Total School Consmp. (mwh)	48	48	48	117	117
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
11. Total Consmp. (8+9+10) (mwh)	70	75	81	154	183
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers	1	1	1	1	1
16. Base Consmp. per Customer (kwh)	486,000	486,000	486,000	486,000	583,000
17. Total Base Consmp. (15x16) (mwh)	486	486	486	486	583
FISH CAMPS/BUY STATIONS					
18. Customers	1	1	1	1	1
19. Base Consmp. per Customer (kwh)	24,000	24,000	24,000	24,000	24,000
20. Total Base Consmp. (18x19) (mwh)	24	24	24	24	24
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
22. Total Consmp. (17+20+21) (mwh)	510	510	510	510	607
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	604	631	672	767	938

TABLE IV.18 BRISTOL BAY ELECTRICITY CONSUMPTION
REGIONAL DIESEL
LEVELOCK

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	11	25	43	47	57
2. Base Consmp. per Customer (kwh)	1,381	1,608	2,204	3,358	4,503
3. Total Base Consmp. (1x2) (mwh)	15	40	95	158	257
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
5. Total Consmp. (3+4) (mwh)	15	40	95	158	257
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	8	8	9	10	12
7. Base Consmp. per Customer (kwh)	6,711	8,345	8,414	9,662	12,710
8. Total Base Consmp. (6x7) (mwh)	54	67	76	97	153
SCHOOL					
9. Total School Consmp. (mwh)	72	72	72	117	117
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
11. Total Consmp. (8+9+10) (mwh)	126	139	148	214	270
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers					
16. Base Consmp. per Customer (kwh)					
17. Total Base Consmp. (15x16) (mwh)					
FISH CAMPS/BUY STATIONS					
18. Customers					
19. Base Consmp. per Customer (kwh)					
20. Total Base Consmp. (18x19) (mwh)					
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)					
22. Total Consmp. (17+20+21) (mwh)					
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	141	179	243	372	527

TABLE IV.19 BRISTOL BAY ELECTRICITY CONSUMPTION
REGIONAL DIESEL
IGIUGIG

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	7	8	10	11	14
2. Base Consmp. per Customer (kwh)	2,549	2,895	3,509	3,919	4,680
3. Total Base Consmp. (1x2) (mwh)	18	23	35	43	66
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
5. Total Consmp. (3+4) (mwh)	18	23	35	43	66
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	3	3	3	4	5
7. Base Consmp. per Customer (kwh)	7,294	9,070	9,145	10,502	13,814
8. Total Base Consmp. (6x7) (mwh)	22	27	27	42	69
SCHOOL					
9. Total School Consmp. (mwh)	115	115	115	115	115
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
11. Total Consmp. (8+9+10) (mwh)	137	142	142	157	184
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers					
16. Base Consmp. per Customer (kwh)					
17. Total Base Consmp. (15x16) (mwh)					
FISH CAMPS/BUY STATIONS					
18. Customers					
19. Base Consmp. per Customer (kwh)					
20. Total Base Consmp. (18x19) (mwh)					
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)					
22. Total Consmp. (17+20+21) (mwh)					
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	155	165	177	200	250

TABLE IV.20 BRISTOL BAY ELECTRICITY CONSUMPTION
REGIONAL DIESEL
EKUK

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers					
2. Base Consmp. per Customer (kwh)					
3. Total Base Consmp. (1x2) (mwh)			(Included in industrial)		
4. Price Sensitive Consmp. (mwh)					
5. Total Consmp. (3+4) (mwh)					
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers					
7. Base Consmp. per Customer (kwh)					
8. Total Base Consmp. (6x7) (mwh)					
SCHOOL					
9. Total School Consmp. (mwh)			(Included in industrial)		
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)					
11. Total Consmp. (8+9+10) (mwh)					
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers	1	1	1	1	1
16. Base Consmp. per Customer (kwh)	700,000	700,000	700,000	700,000	700,000
17. Total Base Consmp. (15x16) (mwh)	700	700	700	700	700
FISH CAMPS/BUY STATIONS					
18. Customers					
19. Base Consmp. per Customer (kwh)					
20. Total Base Consmp. (18x19) (mwh)					
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
22. Total Consmp. (17+20+21) (mwh)	700	700	700	700	700
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	700	700	700	700	700

V. NEWHALEN REGIONAL ELECTRICITY CONSUMPTION PROJECTIONS

Assumptions

The key features of the Newhalen Regional (NR) as they differ from the Business as Usual Case (BAU) are outlined below:

1. A sixteen megawatt hydroelectric facility on the Newhalen River begins operation in 1988.
2. A regional intertie is completed in 1988.
3. Electricity prices become uniform in 1988 and decline steadily in real terms throughout the twenty year forecast period.
4. State intervention to lower consumer electricity prices continues throughout the forecast period, consistent with levels experienced in 1981.

Results

Electricity consumption in the NR scenario grows to the highest level of all three scenarios as a direct result of the projected decline in real electricity prices. Between 1980 and 2002, total consumption in all sectors almost triples from 27,303 to 75,931 mwh, as shown in Tables V-1 through V-20. This is an average annual rate of growth equal to 4.8 percent per year.

At this rate, consumption doubles every 15 years, compared with a doubling every 18 years in the BAU scenario, where consumption grows at an average rate of 3.9 percent per year.

TABLE V.1 BRISTOL BAY ELECTRICITY CONSUMPTION
NEWHALEN REGIONAL
ALL COMMUNITIES

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	956	1,013	1,190	1,569	2,086
2. Base Consmp. per Customer (kwh)	4,334	5,652	5,999	6,491	7,665
3. Total Base Consmp. (1x2) (mwh)	4,143	5,726	7,139	10,184	15,989
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	49	570
5. Total Consmp. (3+4) (mwh)	4,143	5,726	7,139	10,233	16,559
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	436	468	563	673	968
7. Base Consmp. per Customer (kwh)	19,839	22,248	25,419	30,822	43,510
8. Total Base Consmp. (6x7) (mwh)	8,650	10,412	14,311	20,743	42,118
SCHOOL					
9. Total School Consmp. (mwh)	1,012	1,012	1,012	1,178	1,178
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	91	1,513
11. Total Consmp. (8+9+10) (mwh)	9,662	11,424	15,323	22,012	44,809
MILITARY					
12. Total Base Consmp. (mwh)	5,600	5,600	5,600	5,600	5,600
13. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
14. Total Consmp. (12+13) (mwh)	5,600	5,600	5,600	5,600	5,600
INDUSTRIAL					
PROCESSORS					
15. Customers	13	14	14	14	14
16. Base Consmp. per Customer (kwh)	533,668	537,192	557,752	564,680	571,609
17. Total Base Consmp. (15x16) (mwh)	6,938	7,521	7,809	7,906	8,003
FISH CAMPS/BUY STATIONS					
18. Customers	40	40	40	40	40
19. Base Consmp. per Customer (kwh)	24,000	24,000	24,000	24,000	24,000
20. Total Base Consmp. (18x19) (mwh)	960	960	960	960	960
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
22. Total Consmp. (17+20+21) (mwh)	7,898	8,481	8,769	8,866	8,963
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	27,303	31,231	36,831	46,711	75,931

TABLE V.2 BRISTOL BAY ELECTRICITY CONSUMPTION
NEWHALEN REGIONAL
DILLINGHAM

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	410	440	522	704	990
2. Base Consmp. per Customer (kwh)	5,112	6,370	6,776	7,391	8,539
3. Total Base Consmp. (1x2) (mwh)	2,096	2,803	3,537	5,203	8,454
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
5. Total Consmp. (3+4) (mwh)	2,096	2,803	3,537	5,217	8,633
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	184	199	242	294	433
7. Base Consmp. per Customer (kwh)	24,610	27,101	31,253	37,622	52,408
8. Total Base Consmp. (6x7) (mwh)	4,528	5,393	7,563	11,061	22,693
SCHOOL					
9. Total School Consmp. (mwh)	N/A	N/A	N/A	N/A	N/A
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	30	481
11. Total Consmp. (8+9+10) (mwh)	4,528	5,393	7,563	11,091	23,174
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers	2	3	3	3	3
16. Base Consmp. per Customer (kwh)	283,842	383,561	383,561	383,561	383,561
17. Total Base Consmp. (15x16) (mwh)	568	1,151	1,151	1,151	1,151
FISH CAMPS/BUY STATIONS					
18. Customers	10	10	10	10	10
19. Base Consmp. per Customer (kwh)	24,000	24,000	24,000	24,000	24,000
20. Total Base Consmp. (18x19) (mwh)	240	240	240	240	240
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
22. Total Consmp. (17+20+21) (mwh)	808	1,391	1,391	1,391	1,391
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	7,432	9,587	12,491	17,699	33,198

TABLE V.3 BRISTOL BAY ELECTRICITY CONSUMPTION
NEWHALEN REGIONAL
ALEKNAGIK

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	33	35	40	54	72
2. Base Consmp. per Customer (kwh)	5,112	6,370	6,776	7,391	8,539
3. Total Base Consmp. (1x2) (mwh)	169	223	271	399	615
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	1	13
5. Total Consmp. (3+4) (mwh)	169	223	271	400	628
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	10	11	13	15	20
7. Base Consmp. per Customer (kwh)	24,610	27,101	31,253	37,622	52,408
8. Total Base Consmp. (6x7) (mwh)	246	298	406	564	1,048
SCHOOL					
9. Total School Consmp. (mwh)	N/A	N/A	N/A	N/A	N/A
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	1	22
11. Total Consmp. (8+9+10) (mwh)	246	298	406	565	1,070
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers					
16. Base Consmp. per Customer (kwh)					
17. Total Base Consmp. (15x16) (mwh)					
FISH CAMPS/BUY STATIONS					
18. Customers					
19. Base Consmp. per Customer (kwh)					
20. Total Base Consmp. (18x19) (mwh)					
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)					
22. Total Consmp. (17+20+21) (mwh)					
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	415	521	677	965	1,698

TABLE V.4 BRISTOL BAY ELECTRICITY CONSUMPTION
NEWHALEN REGIONAL
NAKNEK

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	82	87	104	123	173
2. Base Consmp. per Customer (kwh)	5,328	6,560	6,951	7,546	8,687
3. Total Base Consmp. (1x2) (mwh)	437	571	723	928	1,503
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	24
5. Total Consmp. (3+4) (mwh)	437	571	723	928	1,527
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers		(See Table V.7)			
7. Base Consmp. per Customer (kwh)					
8. Total Base Consmp. (6x7) (mwh)					
SCHOOL					
9. Total School Consmp. (mwh)					
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)					
11. Total Consmp. (8+9+10) (mwh)					
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers	5	5	5	5	5
16. Base Consmp. per Customer (kwh)	505,741	505,741	563,308	563,308	563,308
17. Total Base Consmp. (15x16) (mwh)	2,529	2,529	2,817	2,817	2,817
FISH CAMPS/BUY STATIONS					
18. Customers	8	8	8	8	8
19. Base Consmp. per Customer (kwh)	24,000	24,000	24,000	24,000	24,000
20. Total Base Consmp. (18x19) (mwh)	192	192	192	192	192
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
22. Total Consmp. (17+20+21) (mwh)	2,721	2,721	3,009	3,009	3,009
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)[a]	3,158	3,292	3,732	3,937	4,536

[a] Total excludes Commercial/Government consumption.

TABLE V.5 BRISTOL BAY ELECTRICITY CONSUMPTION
NEWHALEN REGIONAL
KING SALMON

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	112	116	124	134	156
2. Base Consmp. per Customer (kwh)	5,328	6,560	6,951	7,546	8,687
3. Total Base Consmp. (1x2) (mwh)	597	761	862	1,011	1,355
4. Price Sensitive Consmp. (mwh)	∅	∅	∅	2	24
5. Total Consmp. (3+4) (mwh)	597	761	862	1,013	1,379
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers		(See Table V.7)			
7. Base Consmp. per Customer (kwh)					
8. Total Base Consmp. (6x7) (mwh)					
SCHOOL					
9. Total School Consmp. (mwh)					
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)					
11. Total Consmp. (8+9+10) (mwh)					
MILITARY					
12. Total Base Consmp. (mwh)	5,600	5,600	5,600	5,600	5,600
13. Price Sensitive Consmp. (mwh)	∅	∅	∅	∅	∅
14. Total Consmp. (12+13) (mwh)	5,600	5,600	5,600	5,600	5,600
INDUSTRIAL					
PROCESSORS					
15. Customers					
16. Base Consmp. per Customer (kwh)					
17. Total Base Consmp. (15x16) (mwh)					
FISH CAMPS/BUY STATIONS					
18. Customers	7	7	7	7	7
19. Base Consmp. per Customer (kwh)	24,000	24,000	24,000	24,000	24,000
20. Total Base Consmp. (18x19) (mwh)	168	168	168	168	168
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)	∅	∅	∅	∅	∅
22. Total Consmp. (17+20+21) (mwh)	168	168	168	168	168
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)[a]	6,365	6,529	6,630	6,781	7,147

[a]Total excludes Commerical/Government consumption.

TABLE V.6 BRISTOL BAY ELECTRICITY CONSUMPTION
NEWHALEN REGIONAL
SOUTH NAKNEK

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	47	49	53	60	73
2. Base Consmp. per Customer (kwh)	5,328	6,560	6,951	7,546	8,687
3. Total Base Consmp. (1x2) (mwh)	250	321	368	453	634
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	10
5. Total Consmp. (3+4) (mwh)	250	321	368	453	644
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	6	6	7	8	9
7. Base Consmp. per Customer (kwh)	20,538	22,617	26,082	31,397	43,736
8. Total Base Consmp. (6x7) (mwh)	123	136	183	251	394
SCHOOL					
9. Total School Consmp. (mwh)	N/A	N/A	N/A	N/A	N/A
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	6
11. Total Consmp. (8+9+10) (mwh)	123	136	183	251	400
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers	2	2	2	2	2
16. Base Consmp. per Customer (kwh)	793,150	793,150	793,150	793,150	793,150
17. Total Base Consmp. (15x16) (mwh)	1,586	1,586	1,586	1,586	1,586
FISH CAMPS/BUY STATIONS					
18. Customers	8	8	8	8	8
19. Base Consmp. per Customer (kwh)	24,000	24,000	24,000	24,000	24,000
20. Total Base Consmp. (18x19) (mwh)	192	192	192	192	192
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
22. Total Consmp. (17+20+21) (mwh)	1,778	1,778	1,778	1,778	1,778
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	2,151	2,235	2,329	2,482	2,822

TABLE V.7 BRISTOL BAY ELECTRICITY CONSUMPTION
NEWHALEN REGIONAL
NAKNEK/KING SALMON

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	194	203	228	257	329
2. Base Consmp. per Customer (kwh)	5,330	6,562	6,952	7,545	8,687
3. Total Base Consmp. (1x2) (mwh)	1,034	1,332	1,585	1,939	2,858
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	2	48
5. Total Consmp. (3+4) (mwh)	1,034	1,332	1,585	1,941	2,906
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	130	141	171	207	306
7. Base Consmp. per Customer (kwh)	20,538	22,617	26,082	31,397	43,736
8. Total Base Consmp. (6x7) (mwh)	2,670	3,189	4,460	6,499	13,383
SCHOOL					
9. Total School Consmp. (mwh)	N/A	N/A	N/A	N/A	N/A
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	6	229
11. Total Consmp. (8+9+10) (mwh)	2,670	3,189	4,460	6,505	13,612
MILITARY					
12. Total Base Consmp. (mwh)	5,600	5,600	5,600	5,600	5,600
13. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
14. Total Consmp. (12+13) (mwh)	5,600	5,600	5,600	5,600	5,600
INDUSTRIAL					
PROCESSORS					
15. Customers	5	5	5	5	5
16. Base Consmp. per Customer (kwh)	505,741	505,741	563,308	563,308	563,308
17. Total Base Consmp. (15x16) (mwh)	2,529	2,529	2,817	2,817	2,817
FISH CAMPS/BUY STATIONS					
18. Customers	15	15	15	15	15
19. Base Consmp. per Customer (kwh)	24,000	24,000	24,000	24,000	24,000
20. Total Base Consmp. (18x19) (mwh)	360	360	360	360	360
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
22. Total Consmp. (17+20+21) (mwh)	2,889	2,889	3,177	3,177	3,177
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	12,193	13,010	14,822	17,223	25,295

TABLE V.8 BRISTOL BAY ELECTRICITY CONSUMPTION
NEWHALEN REGIONAL
EGEGIK

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	23	24	26	38	44
2. Base Consmp. per Customer (kwh)	2,329	4,508	4,905	5,450	6,481
3. Total Base Consmp. (1x2) (mwh)	54	108	128	207	285
4. Price Sensitive Consmp. (mwh)	∅	∅	∅	2	15
5. Total Consmp. (3+4) (mwh)	54	108	128	209	300
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	8	8	9	10	11
7. Base Consmp. per Customer (kwh)	9,551	10,517	12,129	14,601	20,339
8. Total Base Consmp. (6x7) (mwh)	76	84	109	146	224
SCHOOL					
9. Total School Consmp. (mwh)	6	6	6	6	6
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	∅	∅	∅	∅	∅
11. Total Consmp. (8+9+10) (mwh)	82	90	115	153	242
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers	2	2	2	2	2
16. Base Consmp. per Customer (kwh)	534,500	534,500	534,500	583,000	583,000
17. Total Base Consmp. (15x16) (mwh)	1,069	1,069	1,069	1,166	1,166
FISH CAMPS/BUY STATIONS					
18. Customers	6	6	6	6	6
19. Base Consmp. per Customer (kwh)	24,000	24,000	24,000	24,000	24,000
20. Total Base Consmp. (18x19) (mwh)	144	144	144	144	144
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)	∅	∅	∅	∅	∅
22. Total Consmp. (17+20+21) (mwh)	1,213	1,213	1,213	1,310	1,310
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	1,349	1,411	1,456	1,672	1,852

TABLE V.9 BRISTOL BAY ELECTRICITY CONSUMPTION
NEWHALEN REGIONAL
MANOKOTAK

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	49	52	58	77	98
2. Base Consmp. per Customer (kwh)	3,308	5,461	5,808	6,300	7,430
3. Total Base Consmp. (1x2) (mwh)	162	284	337	485	728
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	5	62
5. Total Consmp. (3+4) (mwh)	162	284	337	490	790
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	7	7	9	10	13
7. Base Consmp. per Customer (kwh)	6,485	7,142	8,236	9,914	13,811
8. Total Base Consmp. (6x7) (mwh)	45	50	74	99	180
SCHOOL					
9. Total School Consmp. (mwh)	81	81	81	81	81
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	2	22
11. Total Consmp. (8+9+10) (mwh)	126	131	155	182	283
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers					
16. Base Consmp. per Customer (kwh)					
17. Total Base Consmp. (15x16) (mwh)					
FISH CAMPS/BUY STATIONS					
18. Customers					
19. Base Consmp. per Customer (kwh)					
20. Total Base Consmp. (18x19) (mwh)					
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)					
22. Total Consmp. (17+20+21) (mwh)					
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	288	415	492	672	1,073

IV. REGIONAL DIESEL ELECTRICITY CONSUMPTION PROJECTIONS

Assumptions

The key features of the regional diesel scenario which distinguish it from the base case are outlined below:

1. Electricity is primarily diesel powered from central-station utilities in Dillingham and Naknek.
2. A regional transmission intertie connecting all eighteen communities is constructed and completed in 1982.
3. Village generators are used as backup systems only.
4. Electricity prices are uniform across all communities when the intertie is completed.
5. Economies of scale from centralization and from growing demand offset transmission line costs and rising fuel prices so that real electricity prices eventually stabilize.
6. The effect of state intervention to lower consumer electricity prices continues throughout the forecast period and is consistent with levels experienced in 1981.

Results

Total electricity consumption in all sectors increases from the base-year level of 27,303 kwh to 68,417 mwh in 2002, implying an average annual rate of growth of 4.3 percent (see Tables IV-1 through IV-20). The overall effect of regionally-uniform, stable electricity prices is to increase the 2002 level consumption by 5,147 mwh or about 8.1 percent above the Business As Usual case (BAU).

A ballon payment to cover diesel system upgrading is responsible for a temporary rise in RD electricity prices above those in the BAU scenario, prior to 1987. This produces a dampening effect on consumption which prevents consumption in the RD scenario from rising further above the BAU level.

That total consumption in the RD scenario increased above consumption in the BAU, during the early forecast years is due to the effects of uniform pricing and availability. In spite of the ballon payment, the effect of the intertie and uniform pricing substantially lower electricity prices below those in the BAU case and stimulate consumption in many communities. Furthermore, widespread electrification, resulting from the regional interite in 1982, pushed forward consumption increases that were assumed to occur at a later time in the BAU scenario. The combined effects of uniform pricing and immediate widespread availability result in a net increase in RD consumption above levels projected in the BAU during the early forecast years when the RD price level exceeds the average price in the BAU scenario.

The effects of a different price and availability in the RD scenario are be felt most heavily in the Commercial/Government (C/G) sector. As shown in Table IV.1, C/G consumption increases to 38,921 mwh in 2002, capturing 57 percent of total consumption in all sectors. This represents a 12 percent increase over C/G consumption in the BAU in the year 2002. By comparison, residential consumption in the RD scenario is only 4.3 percent higher than BAU residential levels.

TABLE V.10 BRISTOL BAY ELECTRICITY CONSUMPTION
NEWHALEN REGIONAL
NEW STUYAHOK

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	54	56	64	88	112
2. Base Consmp. per Customer (kwh)	1,944	3,657	4,095	4,635	5,833
3. Total Base Consmp. (1x2) (mwh)	105	205	262	408	653
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	4	43
5. Total Consmp. (3+4) (mwh)	105	205	262	412	696
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	10	11	12	14	18
7. Base Consmp. per Customer (kwh)	5,767	6,350	7,323	8,816	12,280
8. Total Base Consmp. (6x7) (mwh)	58	70	88	123	221
SCHOOL					
9. Total School Consmp. (mwh)	145	145	145	145	145
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	2	25
11. Total Consmp. (8+9+10) (mwh)	203	215	233	270	391
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers					
16. Base Consmp. per Customer (kwh)					
17. Total Base Consmp. (15x16) (mwh)					
FISH CAMPS/BUY STATIONS					
18. Customers					
19. Base Consmp. per Customer (kwh)					
20. Total Base Consmp. (18x19) (mwh)					
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)					
22. Total Consmp. (17+20+21) (mwh)					
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	308	420	495	682	1,087

TABLE V.11 BRISTOL BAY ELECTRICITY CONSUMPTION
NEWHALEN REGIONAL
PORTAGE CREEK

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	12	13	15	18	24
2. Base Consmp. per Customer (kwh)	1,536	2,649	3,037	3,565	4,618
3. Total Base Consmp. (1x2) (mwh)	18	34	46	64	111
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	4
5. Total Consmp. (3+4) (mwh)	18	34	46	64	115
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	5	5	6	7	10
7. Base Consmp. per Customer (kwh)	2,931	3,212	3,624	4,290	5,929
8. Total Base Consmp. (6x7) (mwh)	15	16	22	30	59
SCHOOL					
9. Total School Consmp. (mwh)	66	66	66	117	117
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	6
11. Total Consmp. (8+9+10) (mwh)	81	82	88	147	182
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers					
16. Base Consmp. per Customer (kwh)					
17. Total Base Consmp. (15x16) (mwh)					
FISH CAMPS/BUY STATIONS					
18. Customers					
19. Base Consmp. per Customer (kwh)					
20. Total Base Consmp. (18x19) (mwh)					
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)					
22. Total Consmp. (17+20+21) (mwh)					
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	99	116	134	211	297

TABLE V.12 BRISTOL BAY ELECTRICITY CONSUMPTION
NEWHALEN REGIONAL
EKWOK

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	20	21	23	25	31
2. Base Consmp. per Customer (kwh)	1,536	3,592	3,947	4,482	5,542
3. Total Base Consmp. (1x2) (mwh)	31	75	91	112	172
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	11
5. Total Consmp. (3+4) (mwh)	31	75	91	112	183
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	5	5	6	6	8
7. Base Consmp. per Customer (kwh)	7,795	8,545	9,640	11,412	15,771
8. Total Base Consmp. (6x7) (mwh)	39	43	58	68	126
SCHOOL					
9. Total School Consmp. (mwh)	47	47	47	47	47
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	11
11. Total Consmp. (8+9+10) (mwh)	86	90	105	115	184
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers					
16. Base Consmp. per Customer (kwh)					
17. Total Base Consmp. (15x16) (mwh)					
FISH CAMPS/BUY STATIONS					
18. Customers					
19. Base Consmp. per Customer (kwh)					
20. Total Base Consmp. (18x19) (mwh)					
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)					
22. Total Consmp. (17+20+21) (mwh)					
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	117	165	196	227	367

TABLE V.13 BRISTOL BAY ELECTRICITY CONSUMPTION
NEWHALEN REGIONAL
KOLIGANEK

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	36	38	43	54	69
2. Base Consmp. per Customer (kwh)	1,104	3,166	3,560	4,107	5,251
3. Total Base Consmp. (1x2) (mwh)	40	120	153	222	362
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	4
5. Total Consmp. (3+4) (mwh)	40	120	153	222	366
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	7	7	9	10	13
7. Base Consmp. per Customer (kwh)	9,189	10,074	11,365	13,454	18,593
8. Total Base Consmp. (6x7) (mwh)	64	71	102	135	242
SCHOOL					
9. Total School Consmp. (mwh)	51	51	51	51	51
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	4
11. Total Consmp. (8+9+10) (mwh)	115	122	153	186	297
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers					
16. Base Consmp. per Customer (kwh)					
17. Total Base Consmp. (15x16) (mwh)					
FISH CAMPS/BUY STATIONS					
18. Customers					
19. Base Consmp. per Customer (kwh)					
20. Total Base Consmp. (18x19) (mwh)					
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)					
22. Total Consmp. (17+20+21) (mwh)					
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	155	242	306	408	663

TABLE V.14 BRISTOL BAY ELECTRICITY CONSUMPTION
NEWHALEN REGIONAL
ILIAMNA

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	21	23	27	33	47
2. Base Consmp. per Customer (kwh)	3,149	3,573	3,966	4,203	4,974
3. Total Base Consmp. (1x2) (mwh)	66	82	107	139	234
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	2	39
5. Total Consmp. (3+4) (mwh)	66	82	107	141	273
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	31	34	41	49	73
7. Base Consmp. per Customer (kwh)	20,636	25,851	25,464	30,516	42,185
8. Total Base Consmp. (6x7) (mwh)	640	879	1,044	1,495	3,080
SCHOOL					
9. Total School Consmp. (mwh)	N/A	N/A	N/A	N/A	N/A
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	22	513
11. Total Consmp. (8+9+10) (mwh)	640	879	1,044	1,517	3,593
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers					
16. Base Consmp. per Customer (kwh)					
17. Total Base Consmp. (15x16) (mwh)					
FISH CAMPS/BUY STATIONS					
18. Customers					
19. Base Consmp. per Customer (kwh)					
20. Total Base Consmp. (18x19) (mwh)					
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)					
22. Total Consmp. (17+20+21) (mwh)					
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	706	961	1,151	1,658	3,866

TABLE V.15 BRISTOL BAY ELECTRICITY CONSUMPTION
NEWHALEN REGIONAL
NEWHALEN

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	18	19	22	25	34
2. Base Consmp. per Customer (kwh)	2,847	3,172	3,571	4,024	4,802
3. Total Base Consmp. (1x2) (mwh)	51	60	79	101	163
4. Price Sensitive Consmp. (mwh)	∅	∅	∅	1	26
5. Total Consmp. (3+4) (mwh)	51	60	79	102	189
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	8	9	10	12	16
7. Base Consmp. per Customer (kwh)	1,716	2,150	2,118	2,538	3,508
8. Total Base Consmp. (6x7) (mwh)	14	19	21	30	56
SCHOOL					
9. Total School Consmp. (mwh)	230	230	230	230	230
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	∅	∅	∅	2	46
11. Total Consmp. (8+9+10) (mwh)	244	249	251	262	332
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers					
16. Base Consmp. per Customer (kwh)					
17. Total Base Consmp. (15x16) (mwh)					
FISH CAMPS/BUY STATIONS					
18. Customers					
19. Base Consmp. per Customer (kwh)					
20. Total Base Consmp. (18x19) (mwh)					
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)					
22. Total Consmp. (17+20+21) (mwh)					
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	295	309	330	364	521

TABLE V.16 BRISTOL BAY ELECTRICITY CONSUMPTION
NEWHALEN REGIONAL
NONDALTON

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	11	11	30	50	58
2. Base Consmp. per Customer (kwh)	922	1,156	1,990	2,881	3,976
3. Total Base Consmp. (1x2) (mwh)	10	13	60	144	231
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	5	39
5. Total Consmp. (3+4) (mwh)	10	13	60	149	270
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	9	9	10	11	13
7. Base Consmp. per Customer (kwh)	3,788	4,745	4,674	5,602	7,744
8. Total Base Consmp. (6x7) (mwh)	34	43	47	62	101
SCHOOL					
9. Total School Consmp. (mwh)	152	152	152	152	152
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	7	43
11. Total Consmp. (8+9+10) (mwh)	186	195	199	221	296
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers					
16. Base Consmp. per Customer (kwh)					
17. Total Base Consmp. (15x16) (mwh)					
FISH CAMPS/BUY STATIONS					
18. Customers					
19. Base Consmp. per Customer (kwh)					
20. Total Base Consmp. (18x19) (mwh)					
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)					
22. Total Consmp. (17+20+21) (mwh)					
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	196	208	259	370	566

TABLE V.17 BRISTOL BAY ELECTRICITY CONSUMPTION
NEWHALEN REGIONAL
CLARKS POINT

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	10	10	18	28	34
2. Base Consmp. per Customer (kwh)	2,369	2,728	3,208	3,730	4,552
3. Total Base Consmp. (1x2) (mwh)	24	27	58	104	155
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	2	18
5. Total Consmp. (3+4) (mwh)	24	27	58	106	173
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	5	5	6	6	8
7. Base Consmp. per Customer (kwh)	4,326	5,420	5,338	6,397	8,844
8. Total Base Consmp. (6x7) (mwh)	22	27	32	38	71
SCHOOL					
9. Total School Consmp. (mwh)	48	48	48	117	117
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	3	22
11. Total Consmp. (8+9+10) (mwh)	70	75	80	158	210
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers	1	1	1	1	1
16. Base Consmp. per Customer (kwh)	486,000	486,000	486,000	486,000	583,000
17. Total Base Consmp. (15x16) (mwh)	486	486	486	486	583
FISH CAMPS/BUY STATIONS					
18. Customers	1	1	1	1	1
19. Base Consmp. per Customer (kwh)	24,000	24,000	24,000	24,000	24,000
20. Total Base Consmp. (18x19) (mwh)	24	24	24	24	24
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
22. Total Consmp. (17+20+21) (mwh)	510	510	510	510	607
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	604	612	648	774	990

TABLE V.18 BRISTOL BAY ELECTRICITY CONSUMPTION
NEWHALEN REGIONAL
LEVELOCK

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	11	12	13	47	57
2. Base Consmp. per Customer (kwh)	1,381	1,615	2,194	3,398	4,671
3. Total Base Consmp. (1x2) (mwh)	15	19	29	160	266
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	11	54
5. Total Consmp. (3+4) (mwh)	15	19	29	171	320
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	8	8	9	10	12
7. Base Consmp. per Customer (kwh)	6,711	8,407	8,281	9,924	13,718
8. Total Base Consmp. (6x7) (mwh)	54	67	75	99	165
SCHOOL					
9. Total School Consmp. (mwh)	72	72	72	117	117
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	15	57
11. Total Consmp. (8+9+10) (mwh)	126	139	147	231	339
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers					
16. Base Consmp. per Customer (kwh)					
17. Total Base Consmp. (15x16) (mwh)					
FISH CAMPS/BUY STATIONS					
18. Customers					
19. Base Consmp. per Customer (kwh)					
20. Total Base Consmp. (18x19) (mwh)					
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)					
22. Total Consmp. (17+20+21) (mwh)					
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	141	158	176	402	659

TABLE V.19 BRISTOL BAY ELECTRICITY CONSUMPTION
NEWHALEN REGIONAL
IGIUGIG

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers	7	7	8	11	14
2. Base Consmp. per Customer (kwh)	2,549	2,907	3,490	3,985	4,891
3. Total Base Consmp. (1x2) (mwh)	18	20	28	44	68
4. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	5
5. Total Consmp. (3+4) (mwh)	18	20	28	44	73
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers	3	3	3	4	5
7. Base Consmp. per Customer (kwh)	7,294	9,137	9,000	10,786	14,910
8. Total Base Consmp. (6x7) (mwh)	22	27	27	43	75
SCHOOL					
9. Total School Consmp. (mwh)	115	115	115	115	115
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	14
11. Total Consmp. (8+9+10) (mwh)	137	142	142	158	204
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers					
16. Base Consmp. per Customer (kwh)					
17. Total Base Consmp. (15x16) (mwh)					
FISH CAMPS/BUY STATIONS					
18. Customers					
19. Base Consmp. per Customer (kwh)					
20. Total Base Consmp. (18x19) (mwh)					
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)					
22. Total Consmp. (17+20+21) (mwh)					
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	155	162	170	202	277

TABLE V.20 BRISTOL BAY ELECTRICITY CONSUMPTION
NEWHALEN REGIONAL
EKUK

	1980	1982	1987	1992	2002
RESIDENTIAL					
1. Customers					
2. Base Consmp. per Customer (kwh)			(Included in Industrial)		
3. Total Base Consmp. (1x2) (mwh)					
4. Price Sensitive Consmp. (mwh)					
5. Total Consmp. (3+4) (mwh)					
COMMERCIAL/GOVERNMENT					
NONSCHOOL					
6. Customers					
7. Base Consmp. per Customer (kwh)					
8. Total Base Consmp. (6x7) (mwh)			(Included in Industrial)		
SCHOOL					
9. Total School Consmp. (mwh)					
ALL COMMERCIAL					
10. Price Sensitive Consmp. (mwh)					
11. Total Consmp. (8+9+10) (mwh)					
MILITARY					
12. Total Base Consmp. (mwh)					
13. Price Sensitive Consmp. (mwh)					
14. Total Consmp. (12+13) (mwh)					
INDUSTRIAL					
PROCESSORS					
15. Customers	1	1	1	1	1
16. Base Consmp. per Customer (kwh)	700,000	700,000	700,000	700,000	700,000
17. Total Base Consmp. (15x16) (mwh)	700	700	700	700	700
FISH CAMPS/BUY STATIONS					
18. Customers					
19. Base Consmp. per Customer (kwh)					
20. Total Base Consmp. (18x19) (mwh)					
ALL INDUSTRIAL					
21. Price Sensitive Consmp. (mwh)	Ø	Ø	Ø	Ø	Ø
22. Total Consmp. (17+20+21) (mwh)	700	700	700	700	700
GRAND TOTAL					
23. Total Consmp., All Sectors (5+11+14+22) (mwh)	700	700	700	700	700

Commercial/Government (C/G) consumption increases nearly fourfold from 9,662 to 44,809 mwh. Similarily, residential consumption reflects a threefold increase from 4,143 to 16,559 mwh. Together, electricity consumption by residential and C/G customers grows at an average annual rate of 7.0 percent per year. The overall annual growth rate of consumption is less than 7.0 percent because industrial consumption experiences relatively modest growth, while military consumption remains constant.

During the twenty-year period between 1982 and 2002, the average annual rate of growth in total consumption jumps from 4.1 percent in the first decade (1982-1992) to 5.0 percent in the second decade. This reflects the accelerating effect that the regional intertie and declining prices have after 1987. By comparison, growth in the BAU scenario is distributed more evenly across the first and second decades of the forecast period (3.5 and 3.9 percent, respectively).

The regional distribution of electricity consumption is roughly the same as that projected in the BAU and RD scenarios. By 2002, the NEC and NEA utility district communities capture 83 percent of total study-area electricity consumption.

The NR scenario is the only case in which the electricity price is assumed to fall below the price of a substitute fuel--propane. Comparability of the price of electricity and the electricity-equivalent price of propane occurs in 1991 at about 16 cents per kwh

After 1991, a combination of new purchases and conversions by residential and C/G consumers from certain propane appliances to their electric counterparts would gradually augment appliance consumption. This price sensitive substitution represents about 3 percent of overall 2002 consumption in the NR scenario. Base appliance consumption refers to consumption from electric appliances historically used by residential and nonresidential consumers in the study region because of the absence of substitute appliances which use an alternate and cheaper fuel.

VI. ELECTRIC SPACE HEATING

Under the current relative price structure of electricity and diesel fuel in Bristol Bay, the cost of using electricity for residential space heating is considerably greater than that of oil. There is only one home in the eighteen study-area communities that uses electricity for space heating.[1] Projected relative prices in all three electricity-supply scenarios precludes electricity as a cost-effective alternative to fuel oil or wood (see Figure E.5.1). Nevertheless, the question of electric space heating is important for design of electricity plants. In this chapter, we analyze more closely the economics of heating with electricity in Bristol Bay. We also project total space heating consumption by community and show the amount of electricity that would be required to meet this demand.

Although wood is becoming an increasingly popular fuel for space heating in Bristol Bay, most households still rely on fuel oil as their primary heating fuel. Our analysis of residential space heating requirements in Bristol Bay suggests that a typical urban or rural household having 800 square feet of single-story floor space uses about 1,000 gallons of heating fuel annually. Using 1981 fuel oil prices in Dillingham ($1.42/gal.), it would cost the typical homeowner about $1,420 to heat with oil. After correcting for oil furnace seasonal efficiency (i.e., efficiency of the combustion process averaged

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[1]In this case, the circumstances do not reflect the existing relative price structure.

over the entire heating season), an equivalent amount of heat from electric baseboard radiant heaters would be about 97 million BTUs, or 28,300 kwhs. Using an average price of $.25/kwh, which is typical of base-year electricity prices in the region, heating with electricity would cost $7,075 per year, nearly five times that of fuel-oil.

Aside from the cost of the alternate heating systems, the above analysis shows that for electricity to be competitive with fuel oil for space heating, the price per kilowatt would have to be about $.05 ($1,420 ÷ 28,300 kwh). If the purchase and installation cost of converting from a common, oil-fired heating system to radiant baseboard electric heaters is included, then the electricity price must be somewhat less (see Table VI.1).

In the nonsubsidy example shown in Table VI.1, the cost of converting to electric space heat ranges from 0.5 to 1.2 cents per kwh, depending on the type of electric space heating system. The annual capital recovery cost was calculated by assuming a twenty-year equipment life and a 12 percent interest rate.

We illustrate the contribution space heating would make to pure appliance electricity consumption, under the limiting case in which 100 percent of space-heat requirements were met by electricity. We do this by converting total space-heating fuel-oil consumption projected in 2002 to an electricity equivalent measure for residential, commercial/government, industrial and military customers.

TABLE VI.1. ELECTRICITY BREAK-EVEN PRICES FOR TYPICAL RESIDENTIAL HEATING SYSTEM CONVERSIONS IN BRISTOL BAY

(real 1981 dollars)

Conversion	Purchase and Installation Cost ($)	Annual Capital Recovery Cost		Electricity Break-Even Prices (¢/kwh)	
		$/Yr	¢/kwh/yr	1981	2002
1. Fully Subsidized	0	0	0	5	8.8
2. Baseboard Radiant	1,000	134	0.5	4.5	8.3
3. Hydronic Baseboard in Place	2,500	340	1.2	3.8	7.6

Assume:

1. Household annual heating requirement = 97 million BTUs; 1,000 gallons heating fuel; 28,300 kwh
2. Oil furnace efficiency = 70 percent
3. 3,413 BTU/kwh
4. 138,000 BTU/gallon
5. $1.42/gallon (Dillingham 1981)
6. Heating system life = 20 years; amortized at 12 percent interest rate

The analysis of space heating energy demand is based exclusively on heating oil consumption. Wood, although increasing in demand, was supplemental as a source of residential space-heat energy in the study area. Its primary use was for steamhouse heat, an active winter pastime in many Bristol Bay communities. Electricity was occasionally used for space heating under extenuating circumstances such as fuel shortages or extreme cold. Its contribution to total space-heat energy in 1980 was negligible, except in the industrial sector. We ignore these elements of space-heat energy under the assumption that the base-year estimates of average heating oil use per customer apply to all customers, including those that may actually have used wood or electricity.

Total base-year heating oil consumption by residential and commercial/government, (C/G) consumers was estimated from survey data collected in each community. Data from fuel distributors was generally incomplete and used mainly as a reliability check against the survey data. No attempt was made to net out that portion of annual 1980 heating oil consumption used for either cooking or water heating by residential and C/G consumers. As a result, our figures may include these uses of fuel oil. We estimate that this component is about 7-to-10 percent of total heating fuel consumption in the residential sector and possibly twice that amount in the commercial/government sector.

Residential. In the preliminary forecast, an estimate of average annual heating oil consumption per customer was calculated from the household survey data for each village and multiplied by the 1980 census count of households to derive an estimate of total village fuel oil consumption for space heating. These estimates are shown in Table VI.2. The village-by-village fuel consumption estimates are converted to an electricity equivalent by assuming:

1. 138,000 BTUs per gallon of fuel oil
2. Seasonal furnace efficiency of 70 percent
3. 3,413 BTU/kwh

To project total residential space-heating energy demand, we assume that use per residential customer grows at an average annual rate of 1 percent per year, reflecting an assumed increase in average floor area, with the base year levels of consumption per square foot remaining constant. Forecasted consumption per customer in each village was multiplied by the projected number of households to derive total space-heating demand. An electricity equivalent was calculated by assuming the same BTU conversion factors and furnace efficiency used in the base year.

TABLE VI.2. RESIDENTIAL SPACE HEATING IN 1980 IN THE EIGHTEEN STUDY-AREA COMMUNITIES

	(1) Average Fuel Consumption Per Customer[a] (gal./ household/year)	(2) Number of Households	(1) x (2) Total Residential Heating Fuel Consumption (gal./year)	Electricity Equivalent Total 1980 Heating Fuel Consumption (mwh)
Dillingham	1,080	467	504,360	14,273
Aleknagik		38	41,040	1,161
Naknek		75	111,900	3,167
King Salmon	1,492	103	153,676	4,349
South Naknek		43	64,156	1,816
Egegik	1,289	32	41,248	1,167
Manokotak	770	57	43,890	1,242
New Stuyahok	985	65	64,025	1,812
All Villages	1,164	880	1,024,295	28,988
Portage Creek	1,035	13	13,455	381
Ekwok	1,083	20	21,660	613
Koliganek	930	40	37,200	1,053
All Villages	991	73	72,315	2,047
Iliamna	1,033	22	22,726	643
Newhalen	1,033	18	18,594	526
Nondalton	1,033	42	43,386	1,228
Clarks Point	1,364	22	30,008	849
Ekuk	1,800	1	1,800	51
Levelock	2,009	37	74,333	2,104
Igiugig	1,063	9	9,567	271
All Villages	1,327	151	200,414	5,672
Total All 18 Villages	1,175	1,104	1,297,024	36,706

[a]Includes fuel for water heating and some cooking.

Commercial/Government. As with residential consumers, electric space heating did not actually take place in any measurable quantity during the base year. Space heating energy demand in the C/G sector was derived in the same manner as residential. An estimated base-year level of heating oil consumption per customer was multiplied by the number of customers to calculate 1980 C/G space heat demand and its electricity equivalent (see Table VI.3).

The number of C/G customers in each village was allowed to grow in accordance with growth rate assumed for the corresponding village grouping (i.e., central, seasonal central, and noncentral). Consumption per consumer was assumed to grow at 1 percent per year over the forecast period.

Industrial. Industrial space-heat demand is based on energy-use data collected directly from the Bristol Bay shore-based fish processors. Industrial space heat was required mainly for bunkhouses and offices. Fuel oil used for in-house electricity generation and for boiler operation was netted out of total processor fuel oil consumption. We estimated average processor space-heat demand (i.e., consumption per customer) from available data and applied this average (310,000 kwh) to processors for which base-year data was not available (see Table VI.4). We assumed that space heating consumption per customer was constant over the forecast period. Thus, the increase in total industrial, space-heat energy demand resulted from the addition of one new processing facility in Dillingham in 1982.

TABLE VI.3. SPACE HEATING BY COMMERCIAL/GOVERNMENT USERS IN 1980

	Average Fuel Consumption per Customer (Gal/Customer/Year)	Number of Customers	Total Heating Fuel Consumption (Gal/Year)	Elec. Equiv. of 1980 Heating Fuel Consumption (mwh)
Dillinaham Aleknagik	7,789	194	1,511,066	42,763
Naknek King Salmon South Naknek	7,789	136	1,059,304	29,978
Egegik	3,713	9	33,416	946
Manokotak	8,245	8	65,958	1,867
New Stuyahok	4,080	11	44,881	1,270
All Central-Station Villages	7,583	358	2,714,625	76,824
Portage Creek	1,789	6	10,735	304
Ekwok	1,819	6	11,338	321
Koliganek	2,534	8	20,269	,574
All Seasonal Central Villages	2,117	20	42,342	1,198
Iliamna	2,360	31	73,149	2,070
Newhalen	2,075	9	18,860	534
Nondalton	2,960	10	29,597	838
Clark's Point Ekuk	1,985	6	11,907	337
Levelock	2,514	9	22,630	640
Igiugig	4,166	4	16,663	472
All Noncentral Villages	2,504	69	172,806	4,890
All Eighteen Villages	6,554	447	2,929,673	82,913

TABLE VI.4. SPACE HEAT ENERGY CONSUMPTION BY BRISTOL BAY SEAFOOD PROCESSORS IN 1980

	Heating Fuel Consumption (Gallons)	Electricity Equivalent (kwh)	Floor Area of Heated Space (Sq. Ft.)	Kilowatt Hours Per Sq. Foot (kwh)
Dillingham				
Peter Pan Seafoods	1,700	21,250	27,000	.79
Engstrom Brothers	(1,700)[c]	21,250[a]	NA	NA
Total	(3,400)[c]	42,500	NA	NA
Ekuk				
Columbia Wards	3,000[b]	37,500	30,000	1.25
Clarks Point				
Queen Fisheries	(24,795)[c]	(309,939)[c]	NA	NA
Naknek				
Alaska Far East Corp.	(2,080)[c]	26,000[d]	NA	NA
Nelbro Packing Co.	16,926[e]	211,584[e]		
	14,706	183,825	54,634	7.24
Whitney-Fidalgo Seafoods	31,176	389,700	32,100	12.14
Red Salmon Co.	24,317[f]	303,963	55,000	5.53
Kodiak King Crab (Peterson Pt.)	20,000	250,000	45,000	5.56
Total	(109,206)c	1,365,072		
South Naknek				
Bumble Bee Seafoods	31,223[f]	390,288	NA	NA
Alaska Packers Assoc.	57,012[f]	712,650	NA	NA
Total	(88,235)[c]	1,102,938	NA	NA
Egegik				
Kodiak King Crab (Egegik Seafoods)	(24,795)[c]	(309,939)	14,450	21.45
Egegik Resource Devel. (Diamond "E")	(24,795)[c]	(309,939)	NA	NA
Total	(49,590)[c]	619,878	NA	NA
Total All Processors	(278,226)[c]	3,477,827	NA	NA

TABLE VI.4 (CONTINUED)

Footnotes

[a]Assume lowest known kwh (that of Peter Pan) since office space is only heated area known in Engstrom Brothers plant.

[b]Processor reported total of 60,000 gallons fuel oil used in plant in 1980, with 5 percent of total used for space heat.

[c]Kilowatt hours in parentheses are based on average kwh derived from available data (see "Methodology"). Gallons in parentheses derived by dividing corresponding kwh by 12.5.

[d]Number reflects total kwh's used in housing area of plant in 1980. Plant purchased all power from utility. Number includes electricity used in construction activities as well as for space heat.

[e]Processor reported 211,584 kwh's used in electrically heated bunk houses and 14,706 gallons fuel oil used for other space heating. Processor reported 16,926 gallons fuel oil used to produce 211,584 kwh, giving a conversion factor of 12.5.

[f]These numbers reported by Chevron distributor in Naknek.

Methodology

1. Convert total gallons of heating fuel consumed by those processors for whom data is available to kwh by multiplying total gallons by conversion factor of 12.5 (see footnote e).

2. To derive average kwh per processor: total kwh from 8 processors for whom heating energy data is available (Peter Pan, Columbia Wards, Nelbro, Whitney-Fidalgo, Red Salmon, Kodiak King Crab-Pederson Pt., Bumble Bee and Alaska Packers) 2,479,510 : 8 processors = 309,939 kwh/processor.

3. Apply average (309,939) to those processors for whom no data is available.

4. Add one new customer to Dillingham. New customer consumes same amount as other Dillingham processors (1,700 gallons).

A few processors indicated that they used some electric space heating. This represents residual load from self-generated electricity which helps to raise the processor's electric generation plant factor but does not contribute to electricity load at the utilities. We, therefore, did not attempt to project the proportion of total industrial space heat that was furnished by self-generated electricity in 2002.

Military. Annual space-heating fuel consumption was estimated to be 473,000 gallons based on Alaska Air Command records for the first ten months of 1980. We assume this level remains constant over the forecast period.

Total space-heat energy consumption in all communities was projected to grow at an average annual rate of 4.2 percent per year, as shown in Table VI.5. Base year and projected levels of space-heat energy consumption are shown by community in Tables VI.6 through VI.24.

In summary, the key assumption regarding the estimates of space heating energy demand is that it remains nonelectric in all three electricity-supply scenarios. The electricity-equivalent measure was calculated to illustrate the maximum potential electricity energy demand if electricity prices were competitive with those of fuel oil. Under the base-year structure of relative energy prices, the cost of 1 million BTUs of electric heat at $.25 per kwh is seven times greater than the cost of a comparable amount of fuel oil at $1.42 per gallon.

TABLE VI.5. SPACE HEAT ENERGY CONSUMPTION
TOTAL ALL COMMUNITIES

	1980	2002
Residential		
1. Customers	1,104	2,054
2. Consumption Per Customer (Gallons)	1,175	1,444
3. Total Consumption (1x2) (Gallons)	1,297,024	2,966,740
4. Total Consumption Electricity Equivalent (mwh)	36,706	83,959
Commercial/Government		
5. Customers	447	1,105
6. Consumption per Customer (Gallons)	6,554	7,452
7. Total Consumption (5x6) (Gallons)	2,929,673	8,234,404
8. Total Consumption Electricity Equivalent (mwh)	82,913	233,034
Military		
9. Total Consumption (Gallons)	472,819	472,819
10. Total Consumption Electricity Equivalent (mwh)	13,381	13,831
Industrial		
11. Customers	13	14
12. Total Consumption (Gallons)	278,226	279,926
13. Total Consumption Electricity Equivalent (mwh)	3,478	3,499
Total Space Heat Consumption (4+8+10+13) (mwh)	136,478	333,873

TABLE VI.6. SPACE HEAT ENERGY CONSUMPTION
DILLINGHAM

	1980	2002
Residential		
1. Customers	467	990
2. Consumption Per Customer (Gallons)	1,080	1,344
3. Total Consumption (1x2) (Gallons)	504,360	1,330,560
4. Total Consumption Electricity Equivalent (mwh)	14,273	37,655
Commercial/Government		
5. Customers	184	433
6. Consumption per Customer (Gallons)	7,789	9,695
7. Total Consumption (5x6) (Gallons)	1,433,176	4,197,935
8. Total Consumption Electricity Equivalent (mwh)	40,559	118,802
Military		
9. Total Consumption (Gallons)		
10. Total Consumption Electricity Equivalent (mwh)		
Industrial		
11. Customers	2	3
12. Total Consumption (Gallons)	3,400	5,100
13. Total Consumption Electricity Equivalent (mwh)	43	64
Total Space Heat Consumption (4+8+10+13) (mwh)	54,875	156,521

TABLE VI.7 . SPACE HEAT ENERGY CONSUMPTION
ALEKNAGIK

	1980	2002
Residential		
1. Customers	38	72
2. Consumption Per Customer (Gallons)	1,080	1,344
3. Total Consumption (1x2) (Gallons)	41,040	96,768
4. Total Consumption Electricity Equivalent (mwh)	1,161	2,739
Commercial/Government		
5. Customers	10	20
6. Consumption per Customer (Gallons)	7,789	9,695
7. Total Consumption (5x6) (Gallons)	77,890	193,900
8. Total Consumption Electricity Equivalent (mwh)	2,204	5,487
Military		
9. Total Consumption (Gallons)		
10. Total Consumption Electricity Equivalent (mwh)		
Industrial		
11. Customers		
12. Total Consumption (Gallons)		
13. Total Consumption Electricity Equivalent (mwh)		
Total Space Heat Consumption (4+8+10+13) (mwh)	3,365	8,226

TABLE VI.8. SPACE HEAT ENERGY CONSUMPTION
NAKNEK

	1980	2002
Residential		
1. Customers	75	159
2. Consumption Per Customer (Gallons)	1,492	1,857
3. Total Consumption (1x2) (Gallons)	111,900	295,263
4. Total Consumption Electricity Equivalent (mwh)	3,167	8,356
Commercial/Government		
5. Customers		
6. Consumption per Customer (Gallons)	(See Table VI.11)	
7. Total Consumption (5x6) (Gallons)		
8. Total Consumption Electricity Equivalent (mwh)		
Military		
9. Total Consumption (Gallons)		
10. Total Consumption Electricity Equivalent (mwh)		
Industrial		
11. Customers	5	5
12. Total Consumption (Gallons)	109,206	109,206
13. Total Consumption Electricity Equivalent (mwh)	1,365	1,365
Total Space Heat Consumption (4+8+10+13) (mwh) [a]	4,532	9,721

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[a]Total excludes Commercial/Government consumption.

TABLE VI.9. SPACE HEAT ENERGY CONSUMPTION
KING SALMON

	1980	2002
Residential		
1. Customers	103	143
2. Consumption Per Customer (Gallons)	1,492	1,857
3. Total Consumption (1x2) (Gallons)	153,676	265,551
4. Total Consumption Electricity Equivalent (mwh)	4,349	7,515
Commercial/Government		
5. Customers		
6. Consumption per Customer (Gallons)	(See Table VI.11)	
7. Total Consumption (5x6) (Gallons)		
8. Total Consumption Electricity Equivalent (mwh)		
Military		
9. Total Consumption (Gallons)	472,819	472,819
10. Total Consumption Electricity Equivalent (mwh)	13,381	13,381
Industrial		
11. Customers		
12. Total Consumption (Gallons)		
13. Total Consumption Electricity Equivalent (mwh)		
Total Space Heat Consumption (4+8+10+13) (mwh) [a]	17,730	20,896

[a] Total excludes Commercial/Government consumption.

TABLE VI.10. SPACE HEAT ENERGY CONSUMPTION
SOUTH NAKNEK

	1980	2002
Residential		
1. Customers	43	67
2. Consumption Per Customer (Gallons)	1,492	1,857
3. Total Consumption (1x2) (Gallons)	64,156	124,419
4. Total Consumption Electricity Equivalent (mwh)	1,816	3,521
Commercial/Government		
5. Customers	6	9
6. Consumption per Customer (Gallons)	7,789	9,695
7. Total Consumption (5x6) (Gallons)	46,734	87,255
8. Total Consumption Electricity Equivalent (mwh)	1,323	2,469
Military		
9. Total Consumption (Gallons)		
10. Total Consumption Electricity Equivalent (mwh)		
Industrial		
11. Customers	2	2
12. Total Consumption (Gallons)	88,235	88,235
13. Total Consumption Electricity Equivalent (mwh)	1,103	1,103
Total Space Heat Consumption (4+8+10+13) (mwh)	4,242	7,093

TABLE VI.11. SPACE HEAT ENERGY CONSUMPTION
NAKNEK/KING SALMON

	1980	2002
Residential		
1. Customers	178	302
2. Consumption Per Customer (Gallons)	1,492	1,857
3. Total Consumption (1x2) (Gallons)	265,576	560,814
4. Total Consumption Electricity Equivalent (mwh)	7,516	15,871
Commercial/Government		
5. Customers	130	306
6. Consumption per Customer (Gallons)	7,789	9,695
7. Total Consumption (5x6) (Gallons)	1,012,570	2,966,670
8. Total Consumption Electricity Equivalent (mwh)	28,656	83,957
Military		
9. Total Consumption (Gallons)	472,819	472,819
10. Total Consumption Electricity Equivalent (mwh)	13,381	13,381
Industrial		
11. Customers	5	5
12. Total Consumption (Gallons)	109,206	109,206
13. Total Consumption Electricity Equivalent (mwh)	1,365	1,365
Total Space Heat Consumption (4+8+10+13)	50,918	114,574

TABLE VI.12. SPACE HEAT ENERGY CONSUMPTION
EGEGIK

	1980	2002
Residential		
1. Customers	32	44
2. Consumption Per Customer (Gallons)	1,289	1,604
3. Total Consumption (1x2) (Gallons)	41,248	70,576
4. Total Consumption Electricity Equivalent (mwh)	1,167	1,997
Commercial/Government		
5. Customers	9	12
6. Consumption per Customer (Gallons)	3,713	4,622
7. Total Consumption (5x6) (Gallons)	33,416	55,464
8. Total Consumption Electricity Equivalent (mwh)	946	1,570
Military		
9. Total Consumption (Gallons)		
10. Total Consumption Electricity Equivalent (mwh)		
Industrial		
11. Customers	2	2
12. Total Consumption (Gallons)	49,590	49,590
13. Total Consumption Electricity Equivalent (mwh)	620	620
Total Space Heat Consumption (4+8+10+13)	2,733	4,187

TABLE VI.13. SPACE HEAT ENERGY CONSUMPTION
MANOKOTAK

	1980	2002
Residential		
1. Customers	57	98
2. Consumption Per Customer (Gallons)	770	958
3. Total Consumption (1x2) (Gallons)	43,890	93,884
4. Total Consumption Electricity Equivalent (mwh)	1,242	2,657
Commercial/Government		
5. Customers	8	14
6. Consumption per Customer (Gallons)	8,245	10,263
7. Total Consumption (5x6) (Gallons)	65,958	143,682
8. Total Consumption Electricity Equivalent (mwh)	1,867	4,066
Military		
9. Total Consumption (Gallons)		
10. Total Consumption Electricity Equivalent (mwh)		
Industrial		
11. Customers		
12. Total Consumption (Gallons)		
13. Total Consumption Electricity Equivalent (mwh)		
Total Space Heat Consumption (4+8+10+13) (mwh)	3,109	6,723

TABLE VI.14. SPACE HEAT ENERGY CONSUMPTION
NEW STUYAHOK

	1980	2002
Residential		
1. Customers	65	112
2. Consumption Per Customer (Gallons)	985	1,226
3. Total Consumption (1x2) (Gallons)	64,025	137,312
4. Total Consumption Electricity Equivalent (mwh)	1,812	3,886
Commercial/Government		
5. Customers	11	19
6. Consumption per Customer (Gallons)	4,080	5,078
7. Total Consumption (5x6) (Gallons)	44,881	96,482
8. Total Consumption Electricity Equivalent (mwh)	1,270	2,730
Military		
9. Total Consumption (Gallons)		
10. Total Consumption Electricity Equivalent (mwh)		
Industrial		
11. Customers		
12. Total Consumption (Gallons)		
13. Total Consumption Electricity Equivalent (mwh)		
Total Space Heat Consumption (4+8+10+13) (mwh)	3,082	6,616

TABLE VI.15. SPACE HEAT ENERGY CONSUMPTION
PORTAGE CREEK

	1980	2002
Residential		
1. Customers	13	24
2. Consumption Per Customer (Gallons)	1,035	1,288
3. Total Consumption (1x2) (Gallons)	13,455	30,912
4. Total Consumption Electricity Equivalent (mwh)	381	875
Commercial/Government		
5. Customers	6	11
6. Consumption per Customer (Gallons)	1,789	2,227
7. Total Consumption (5x6) (Gallons)	10,735	24,497
8. Total Consumption Electricity Equivalent (mwh)	304	693
Military		
9. Total Consumption (Gallons)		
10. Total Consumption Electricity Equivalent (mwh)		
Industrial		
11. Customers		
12. Total Consumption (Gallons)		
13. Total Consumption Electricity Equivalent (mwh)		
Total Space Heat Consumption (4+8+10+13) (mwh)	685	1,568

TABLE VI.16. SPACE HEAT ENERGY CONSUMPTION
EKWOK

	1980	2002
Residential		
1. Customers	20	31
2. Consumption Per Customer (Gallons)	1,083	1,348
3. Total Consumption (1x2) (Gallons)	21,660	41,788
4. Total Consumption Electricity Equivalent (mwh)	613	1,183
Commercial/Government		
5. Customers	6	9
6. Consumption per Customer (Gallons)	1,819	2,264
7. Total Consumption (5x6) (Gallons)	11,338	20,376
8. Total Consumption Electricity Equivalent (mwh)	321	577
Military		
9. Total Consumption (Gallons)		
10. Total Consumption Electricity Equivalent (mwh)		
Industrial		
11. Customers		
12. Total Consumption (Gallons)		
13. Total Consumption Electricity Equivalent (mwh)		
Total Space Heat Consumption (4+8+10+13) (mwh)	934	1,760

TABLE VI. 17. SPACE HEAT ENERGY CONSUMPTION
KOLIGANEK

	1980	2002
Residential		
1. Customers	40	69
2. Consumption Per Customer (Gallons)	930	1,158
3. Total Consumption (1x2) (Gallons)	37,200	79,902
4. Total Consumption Electricity Equivalent (mwh)	1,053	2,261
Commercial/Government		
5. Customers	8	14
6. Consumption per Customer (Gallons)	2,534	3,154
7. Total Consumption (5x6) (Gallons)	20,269	44,156
8. Total Consumption Electricity Equivalent (mwh)	574	1,250
Military		
9. Total Consumption (Gallons)		
10. Total Consumption Electricity Equivalent (mwh)		
Industrial		
11. Customers		
12. Total Consumption (Gallons)		
13. Total Consumption Electricity Equivalent (mwh)		
Total Space Heat Consumption (4+8+10+13) (mwh)	1,627	3,511

TABLE VI.18. SPACE HEAT ENERGY CONSUMPTION
ILIAMNA

	1980	2002
Residential		
1. Customers	22	47
2. Consumption Per Customer (Gallons)	1,033	1,286
3. Total Consumption (1x2) (Gallons)	22,726	60,442
4. Total Consumption Electricity Equivalent (mwh)	643	1,711
Commercial/Government		
5. Customers	31	73
6. Consumption per Customer (Gallons)	2,360	2,938
7. Total Consumption (5x6) (Gallons)	73,149	214,474
8. Total Consumption Electricity Equivalent (mwh)	2,070	6,070
Military		
9. Total Consumption (Gallons)		
10. Total Consumption Electricity Equivalent (mwh)		
Industrial		
11. Customers		
12. Total Consumption (Gallons)		
13. Total Consumption Electricity Equivalent (mwh)		
Total Space Heat Consumption (4+8+10+13) (mwh)	2,713	7,781

TABLE VI. 19. SPACE HEAT ENERGY CONSUMPTION
NEWHALEN

	1980	2002
Residential		
1. Customers	18	34
2. Consumption Per Customer (Gallons)	1,033	1,286
3. Total Consumption (1x2) (Gallons)	18,594	43,724
4. Total Consumption Electricity Equivalent (mwh)	526	1,237
Commercial/Government		
5. Customers	9	17
6. Consumption per Customer (Gallons)	2,075	2,583
7. Total Consumption (5x6) (Gallons)	18,860	43,911
8. Total Consumption Electricity Equivalent (mwh)	534	1,243
Military		
9. Total Consumption (Gallons)		
10. Total Consumption Electricity Equivalent (mwh)		
Industrial		
11. Customers		
12. Total Consumption (Gallons)		
13. Total Consumption Electricity Equivalent (mwh)		
Total Space Heat Consumption (4+8+10+13) (mwh)	1,060	2,480

TABLE VI. 20. SPACE HEAT ENERGY CONSUMPTION
NONDALTON

	1980	2002
Residential		
1. Customers	42	58
2. Consumption Per Customer (Gallons)	1,033	1,286
3. Total Consumption (1x2) (Gallons)	43,386	74,588
4. Total Consumption Electricity Equivalent (mwh)	1,228	2,111
Commercial/Government		
5. Customers	10	14
6. Consumption per Customer (Gallons)	2,960	3,684
7. Total Consumption (5x6) (Gallons)	29,597	51,576
8. Total Consumption Electricity Equivalent (mwh)	838	1,460
Military		
9. Total Consumption (Gallons)		
10. Total Consumption Electricity Equivalent (mwh)		
Industrial		
11. Customers		
12. Total Consumption (Gallons)		
13. Total Consumption Electricity Equivalent (mwh)		
Total Space Heat Consumption (4+8+10+13) (mwh)	2,066	3,571

TABLE VI.21. SPACE HEAT ENERGY CONSUMPTION
CLARKS POINT

	1980	2002
Residential		
1. Customers	22	34
2. Consumption Per Customer (Gallons)	1,364	1,698
3. Total Consumption (1x2) (Gallons)	30,008	57,732
4. Total Consumption Electricity Equivalent (mwh)	849	1,634
Commercial/Government		
5. Customers	6	9
6. Consumption per Customer (Gallons)	1,985	2,471
7. Total Consumption (5x6) (Gallons)	11,907	22,239
8. Total Consumption Electricity Equivalent (mwh)	337	629
Military		
9. Total Consumption (Gallons)		
10. Total Consumption Electricity Equivalent (mwh)		
Industrial		
11. Customers	1	1
12. Total Consumption (Gallons)	24,795	24,795
13. Total Consumption Electricity Equivalent (mwh)	310	310
Total Space Heat Consumption (4+8+10+13) (mwh)	1,496	2,573

TABLE VI.22. SPACE HEAT ENERGY CONSUMPTION
EKUK

	1980	2002
Residential		
1. Customers	1	1
2. Consumption Per Customer (Gallons)	1,800	2,240
3. Total Consumption (1x2) (Gallons)	1,800	2,240
4. Total Consumption Electricity Equivalent (mwh)	51	63
Commercial/Government		
5. Customers		
6. Consumption per Customer (Gallons)	(Included in Industrial)	
7. Total Consumption (5x6) (Gallons)		
8. Total Consumption Electricity Equivalent (mwh)		
Military		
9. Total Consumption (Gallons)		
10. Total Consumption Electricity Equivalent (mwh)		
Industrial		
11. Customers	1	1
12. Total Consumption (Gallons)	3,000	3,000
13. Total Consumption Electricity Equivalent (mwh)	38	38
Total Space Heat Consumption (4+8+10+13) (mwh)	89	101

TABLE VI.23. SPACE HEAT ENERGY CONSUMPTION
LEVELOCK

	1980	2002
Residential		
1. Customers	37	57
2. Consumption Per Customer (Gallons)	2,009	2,501
3. Total Consumption (1x2) (Gallons)	74,333	142,557
4. Total Consumption Electricity Equivalent (mwh)	2,104	4,034
Commercial/Government		
5. Customers	9	13
6. Consumption per Customer (Gallons)	2,514	3,129
7. Total Consumption (5x6) (Gallons)	22,630	40,677
8. Total Consumption Electricity Equivalent (mwh)	640	1,151
Military		
9. Total Consumption (Gallons)		
10. Total Consumption Electricity Equivalent (mwh)		
Industrial		
11. Customers		
12. Total Consumption (Gallons)		
13. Total Consumption Electricity Equivalent (mwh)		
Total Space Heat Consumption (4+8+10+13) (mwh)	2,744	5,185

TABLE VI.24. SPACE HEAT ENERGY CONSUMPTION
IGIUGIG

	1980	2002
Residential		
1. Customers	9	14
2. Consumption Per Customer (Gallons)	1,063	1,323
3. Total Consumption (1x2) (Gallons)	9,567	18,522
4. Total Consumption Electricity Equivalent (mwh)	271	524
Commercial/Government		
5. Customers	4	6
6. Consumption per Customer (Gallons)	4,166	5,185
7. Total Consumption (5x6) (Gallons)	16,663	31,110
8. Total Consumption Electricity Equivalent (mwh)	472	880
Military		
9. Total Consumption (Gallons)		
10. Total Consumption Electricity Equivalent (mwh)		
Industrial		
11. Customers		
12. Total Consumption (Gallons)		
13. Total Consumption Electricity Equivalent (mwh)		
Total Space Heat Consumption (4+8+10+13) (mwh)	743	1,404

VII. SENSITIVITY ANALYSIS

Introduction

In Chapters III through V, consumer responsiveness to different future electricity prices (expressed in constant 1982 dollars) was examined in the context of three energy-supply scenarios. The price paths assumed in these alternate scenarios represented a broad range of probable future electricity prices. Within that range, electricity prices did not fall below the level required to compete with fuel oil or wood for space heating. In this chapter, we briefly examine the consumer responsiveness to electricity prices under circumstances where electric space heating is economically feasible. We also examine consumer responsiveness to changes in personal income and to alternative assumptions concerning future economic conditions as well as the impact of conservation measures.

Consumer Responsiveness to Changing Electricity Prices

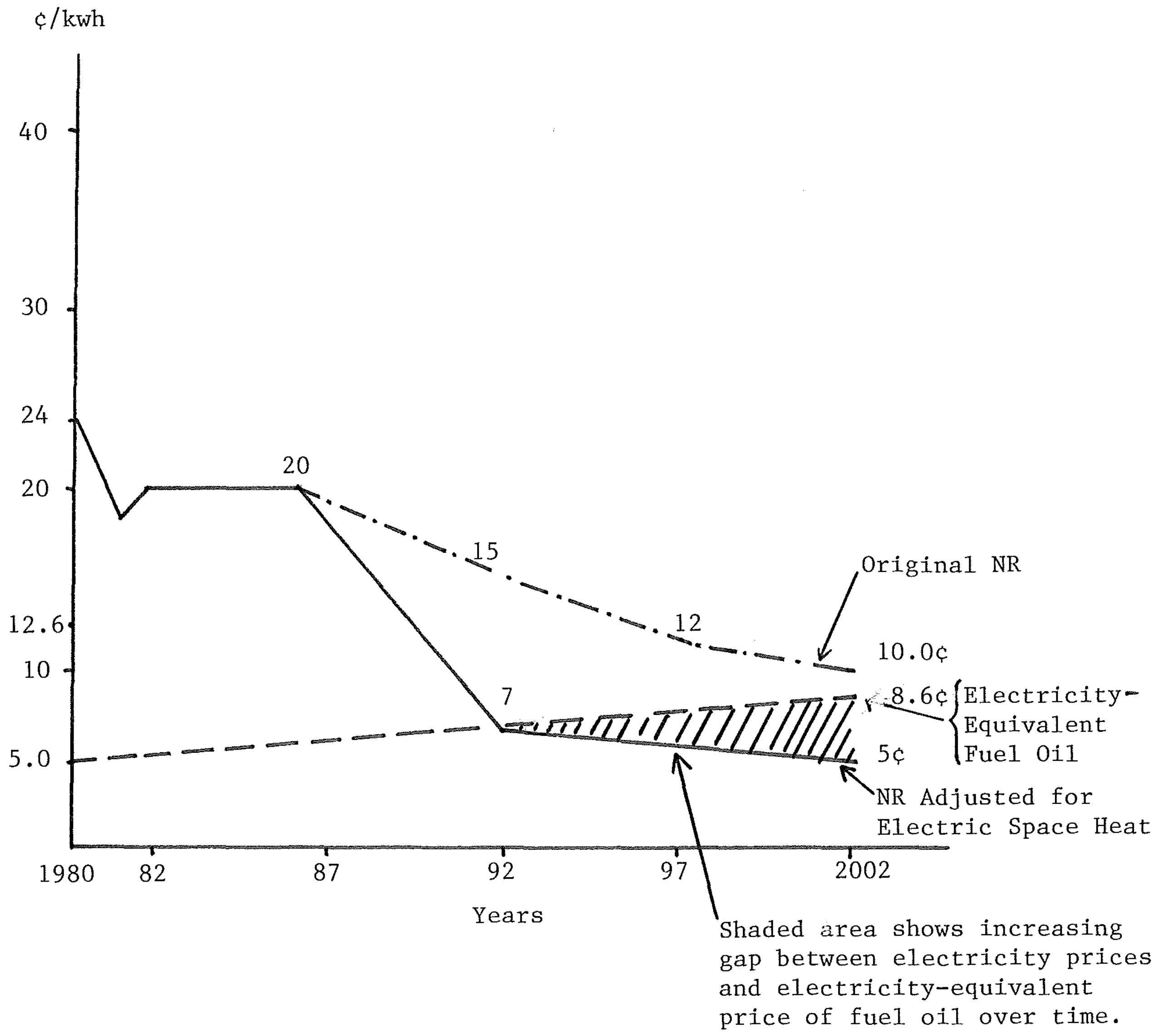
We have already shown that broad differences in future electricity-price paths would have a modest overall effect on "pure-appliance" electricity consumption. The analytical framework used to evaluate consumer responsiveness to changing price was the price elasticity of demand (see Appendix E, Section 5). Because electricity prices were assumed to remain above the threshold that would economically justify electric space heating, this potential component of overall electricity demand was excluded from the earlier price-elasticity analysis. If for some reason electricity prices ultimately fell below the fuel-oil equivalent threshold (including conversion and installation costs), electric space heating would compete with fuel oil. How would electricity consumption be affected?

To answer this question, we return to the analysis of electricity consumption in the Newhalen Regional (NR) scenario, the only scenario in which the real price of electricity declines and approaches the electricity-equivalent price of fuel oil (8.6 cents per kwh in 2002). It is possible that the electricity price could be lower than we have projected if there were a higher state subsidy or greater economies of scale in generation and distribution.

In order to calculate the effect of low-cost electricity on consumer demand for electric space heat, we must assume a future price of electricity and a price elasticity of demand for space heat (i.e., consumer responsiveness to changes in price). Using the NR scenario as a reference point, we assume that through subsidy or other means, the price of electricity falls from the original NR level of 20 cents per kwh in 1987 to 7 cents per kwh in 1992 and continues to decline to 5 cents per kwh by 2002. The 7 cent price in 1992 is roughly competitive with fuel oil in that year. After 1992, electricity prices are lower than fuel oil prices as shown by the shaded area in Figure VII.1.

The analysis of space heating requirements for the region in Chapter IV projected that total space-heating energy consumption,

FIGURE VII.1. ELECTRIC SPACE HEATING PRICE ASSUMPTIONS



expressed in units of electricity, would more than double from 136,000 mwh in 1980 to 334,000 mwh in 2002. This 2002 level would be more than four times that of pure appliance consumption (76,000 mwh) in the same year (see Table VII.1). By itself, projected space-heating energy consumption expressed in units of electricity would be two-and-a-half times the maximum annual output capability of the NR hydroelectric facility (16 mw capacity x 8,760 hours per year equals 140,000 mwh of annual output). Consequently, diesel generation of electricity would need to augment the hydroelectric facility if space heating was fully supplied by electricity.

TABLE VII.1. COMPARISON OF PURE-APPLIANCE ELECTRICITY CONSUMPTION IN THE NEWHALEN REGIONAL SCENARIO WITH SPACE HEAT ENERGY[1] CONSUMPTION (mwh)

	1980	2002
NR Pure-Appliance Consumption	27,303	75,931
100 Percent Electric Space Heat Consumption	136,478	333,873

[1]Expressed in kilowatt hours of electricity although actual 1980 space heat consumption was primarily fuel oil and wood.

The proportion of total space heating that would be serviced by electricity at any point in time would depend on the price of relative fuel-oil and electricity prices and on the cost of converting from fuel or wood to electricity. As shown in Figure VII.1, we assume electricity prices fall below the electricity-equivalent price of fuel oil late in the forecast period between 1992 and 1997. Thus, the time period available for cost-effective electric space heating would be limited to not more than the second half of the forecast interval.

Perhaps more important than timing is the future gap between fuel oil and electricity prices. If electricity prices remained roughly comparable to the electricity-equivalent fuel oil price, then the incentive to switch to electric space heating would be less than if the electricity price fell dramatically below that of fuel oil.

The purchase and installation of electric heaters represents an important fixed cost that influences both conversions and first-time purchases and, ultimately, the proportion of total space heat captured by electricity. Households and businesses with fuel-oil and wood heating systems in place would probably retain these for backup in the event of power failure or extreme cold. If we assume that electric baseboard radiant heaters have a 20-year life and could be purchased and installed for about $1,000, then their fixed cost equals about one-half cent per kwh. This relatively low cost suggests that, from the standpoint of initial investment, electric heaters would be preferred to oil furnaces and possibly wood stoves. For the purposes of this analysis, we assume that purchase and installation costs are negligible so that only relative fuel and electricity prices enter into the electric space-heating decision.

Under these circumstances, electric space heating would occur on a modest level starting in 1992 as new construction installations utilized electric space heat and increase as the gap between electricity and fuel-oil prices widened. Over the 10-year period from 1992 to 2002, we assume that electric space heating, as a proportion of total space-heating energy, increases from zero to 10 percent. At the same time, appliance demand would also increase in accordance with earlier assumptions about consumer responsiveness to price (i.e. price elasticity equals -0.1).

The combined effect on consumption of a reduction in electricity price to a level that justifies electric space heat and stimulates additional pure-appliance consumption among residential and commercial government consumers is shown in Table VII.2. Excluded from this analysis are industrial and military consumers.

The figures in Table VII.2 suggest that by 2002 the increase in consumption caused by electric space heating would be significantly greater than the corresponding increase in pure-appliance consumption. The level of residential consumption in the original NR scenario would increase by more than 50 percent in 2002, with the bulk of the

TABLE VII.2. ELECTRICITY CONSUMPTION IN THE NR SCENARIO ASSUMING MARKET PENETRATION OF ELECTRIC SPACE HEATING

		Total Consumption (mwh)			
		Residential		Commercial Government	
		1992	2002	1992	2002
1.	Original NR Scenario	10,233	16,559	22,012	44,809
2.	NR with Lower Electricity Price	10,608	25,503	23,419	70,825
3.	Price Induced Increase in Pure Appliance Consumption[a]	375	548	1,407	2,713
4.	Electric Space Heat Increment	Ø	8,396	Ø	23,303
5.	Total Increase in Consumption (2) + (3)	375	8,944	1,407	26,016
6.	Proportionate Increase (5) ÷ (1) (Percent)	3.7	54.0	6.4	52.0

[a]Based on the same price elasticity assumptions used in the original NR scenario

increase (94 percent) caused by electric space heating. Similarly, consumption in the C/G sector would increase 52 percent from original NR levels. Ninety percent of this increase would reflect electric space heating.

However, this overall consumption increase represents only a small portion (10 percent) of potential space-heat energy (see Tables VI.5 through VI.24). Total 2002 electricity consumption in all sectors would increase from 76,000 mwh to 110,900 mwh according to the price and elasticity assumptions discussed above. This would still be considerably less than the annual output capacity of the Newhalen hydroelectric facility and, therefore, would not require additions to diesel capacity.

It is important to realize that the price of electricity is related to the level of demand. A low-cost hydroelectric facility that is not large enough to supply the total load must be augmented by more expensive diesel. The average cost of electricity from the two sources yields an average price above the cost of electricity from hydro alone, and this price in turn dampens the level of demand relative to a price based upon hydro alone.

For example, if we assume the following about annual hydroelectric output capacity and energy prices in the year 2002:

Annual Hydro Capacity	140,000 mwh
Price of Hydroelectricity	$.05 per kwh
Electricity-Equivalent Price of Fuel Oil	$.086 per kwh
Diesel Generated Electricity Price	$.23 per kwh

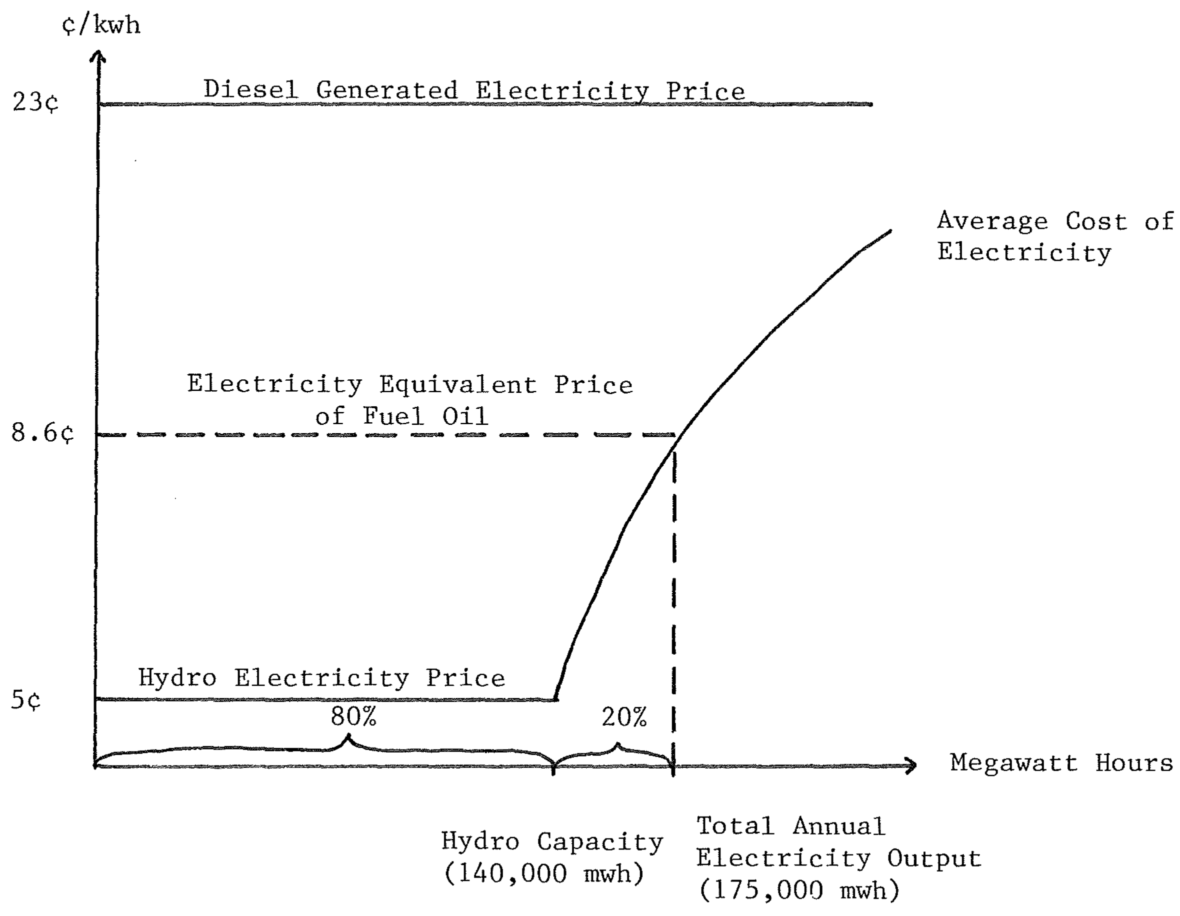
then total electricity consumption in 2002 might be about 175,000 mwh, of which 80 percent would be hydroelectric and the remaining 35,000 mwh would be diesel generated. This result is based upon the average cost of producing electricity from a mix of hydro and diesel-generating systems and is illustrated in Figure VII.2. The 175,000 mwh would cover total pure-appliance consumption equal to 76,000 mwh in the NR scenario, plus an additional 99,000 of potential electric space-heat consumption. The rest of the space heating load would be met with fuel oil at a price less than additional electricity generated by diesel.

This result depends on the assumption that all 140,000 mwh of hydroelectric output capacity can be obtained upon demand. This may not be possible under conditions where output is tied directly to river flow which, in the case of the Newhalen River, varies in a reverse pattern to that of seasonal space-heat energy consumption.

Consumer Responsiveness to Changing Income

In each of our projections, we assumed that real household income grew at 1 percent per year and that the income elasticity of demand--a measure of consumer responsiveness to changing personal income--equaled 1.8. Thus, electricity consumption is fairly responsive to household income and grows faster than income--other factors constant. For example, if household income grew by 1 percent per year, then electricity consumption would increase by 1.8 percent (.01 x 1.8) per year.

FIGURE VII.2. AVERAGE ELECTRICITY COSTS FOR A MIX OF HYDRO AND DIESEL GENERATION



If household income in Bristol Bay were to experience a growth pattern different from that assumed in the original forecast, how would residential consumption be affected? We examined two possible growth paths of real personal income. In the first, it grows at twice the base case rate; and in the second, it remains constant in real terms. The results are illustrated in Table VII.3.

Doubling household income growth from 1 to 2 percent per year increases the rate of growth of residential consumption in the BAU scenario from 5.8 to 7.2 percent. The long-term effect of this is to increase residential consumption in 2002 by nearly 5,000 mwh, or 33 percent.

If, on the other hand, household income was constant over the forecast interval, then the rate of annual consumption growth would fall to 4.4 percent. The level of total residential consumption would drop 26 percent below the base case from 14,321 to 10,638 mwh.

These results suggest that residential electricity consumption is sensitive to variation in household income growth rates. It is difficult to project this variable accurately although the range of future growth is probably bracketed by 0 to 2 percent. The effect of different household income growth assumptions on total electricity consumption in the original BAU scenario is considerably smaller, ranging from a 6 percent reduction below to a 7 percent increase above the base case in 2002.

TABLE VII.3. THE EFFECT OF CHANGING PERSONAL INCOME GROWTH ON RESIDENTIAL ELECTRICITY CONSUMPTION IN THE BAU SCENARIO

	Total Residential Electricity Consumption (mwh)		
	Original BAU	BAU with 2 Percent Income Growth	BAU with Zero Income Growth
1980	4,143	4,143	4,143
1982	5,686	5,844	5,528
1987	7,375	8,272	6,538
1992	9,392	11,482	7,600
2002	14,321	19,004	10,638
Average Annual Rate of Growth (Percent)	5.8	7.2	4.4

Changing Economic Conditions

In all three projection scenarios, we assumed moderate economic growth concentrating in the government and support sectors of Bristol Bay's economy. Fish processing, representing all of Bristol Bay's industrial sector, would experience relatively modest overall growth and actually decline as a proportion of total electricity consumption among all consumers. The possibility of additional industry growth from oil and gas and mineral development was explored in the economic projections (see Part II). Should these kinds of industry growth occur, they would probably be exploratory in nature and relatively insulated from the rest of the economy. Offshore oil and gas exploration represents an extreme case of enclave industrial activity. The major channel of economic impact on Bristol Bay would be through transportation and distribution. Most of the direct project employment would be specialized and, therefore, nonlocal. Similarly, the enclave nature of these forms of industry growth would also probably be self-contained from the standpoint of electricity use. Exceptions would occur if resource development were to take place in the proximity of a Bristol Bay community with central station power.

In general, additional resource development in Bristol Bay would have two avenues of effect on regional electricity consumption. The direct effect would be reflected in on-site power requirements. For example, a medium-sized placer mine in the Kuskokwim region was reported to have operated one 200-kw generator 24 hours a day over a seven-month operating season, consuming a total of 90,000 gallons of diesel fuel. This implies about 1,000 mwh of electricity consumption per season and would represent about 4 percent of the total Bristol Bay electricity use in the base year.

However, in general, the bulk of the increase in energy consumption would probably occur indirectly through population expansion and commercial/government support. The degree of permanent-resident population expansion would be a function of the extent to which a project is isolated from the rest of the economy.

Population expansion resulting from changes in economic conditions such as resource development would probably have a proportionately larger overall impact on electricity use than more traditional forms of population expansion (i.e., natural increase) because of the establishment of new households associated with construction or other specialized, project-specific employment and attendant high incomes.

Conservation Potential

Conservation measures designed to reduce heat loss in residential and commerical structures are cost effective if the discounted cumulative value of energy savings over the life of the corresponding improvement is less than or equal to the material and installation cost of the improvement. The value of energy savings is directly related to the price of energy, which is relatively high in Bristol Bay.

However, energy conservation will probably not be implemented to the point where the cost of an additional "unit" of conservation is equal to the cost of an additional unit of energy saved. The benefits of energy conservation are inherently hidden from the consumer in that energy conservation reduces the household or business energy budget and, therefore, only indirectly increases household income. Furthermore, conservation requires technical knowledge about materials and their application as well as up-front financing. All of these factors tend to restrain the pace of conservation improvements in both residential and C/G sectors.

We examine residential conservation potential using actual data compiled from energy audits performed by the Rural Alaska Community Action Program (RurAL CAP) on 142 low-income Bristol Bay homes, encompassing 12 of the 18 study-area communities.

In Table VII.4, the average floor area, R-value, and heat-loss characteristics of the homes audited by RurAL CAP are compared to the HUD efficiency standards for the same structure surfaces. If we assume that the floor, ceiling, and wall R-value efficiencies are improved to the corresponding HUD standards, then the total fuel requirement of the average low-income home would decline 31 percent from 1,303 gallons to 900 gallons.

TABLE VII.4. HEAT LOSS CHARACTERISTICS AND ANNUAL ENERGY SAVINGS FROM CONSERVATION

Structure Surfaces	Actual Residential Heat Loss Characteristics[a] Area (Sq. Ft.)	R-Value	Heat Loss (BTU/Hr./ΔT)	HUD Standards of Efficiency[b] R-Value	Heat Loss (BTU/Hr./ΔT)
Floor	612	6.95	88	19	32
Ceiling	612	10.76	57	38	16
Walls	658	11.34	58	19	35
Windows	100	0.89	112	2.79	112
Doors	42	3.04	14	3.99	14
Total Heat Loss:					
Conduction			329		209
Infiltration			150		122[c]
Total			479		331
Annual Space Heat Demand (BTU/Yr.)			126 million		87 million
Furnace Efficiency (percent)			70		70
Annual Heating Fuel Consumption (gallons)			1,303		900

[a]From RurAL CAP energy audits performed in Bristol Bay.

[b]Applied only to floor, ceiling, and wall surfaces in this example.

[c]Weatherstripping improvements.

If fuel prices escalate at 2.6 percent per year above the average annual rate of inflation, and if the conservation improvements under the HUD standards have a twenty-year life, then the full cost of the conservation improvement today would have to be less than or equal to $10,670 to be cost effective. That is, the present value of the cumulative energy savings over the twenty-year period would equal $10,670. It is probable that in this particular case the HUD conservation improvements would satisfy this cost criteria.

In this example, conservation measures would reduce space-heat energy demand by 31 percent of average, preconservation levels. Although it is unrealistic to assume that all Bristol Bay residential households could achieve this result, one could approach the analysis of conservation potential by assuming that a certain proportion of total, study-area households implement conservation measures similar to those depicted in Table VII.4.

The analysis of projected residential space heating demand in village j, originally defined as the product of the number of households (HH_{jt}) and average heating fuel consumption per household (FC_{jt}), is thus modified as follows:

$$SP_{jt} = HH_{jt} * FC_{jt} \quad * \quad (1-CS_{jt} * 0.31)$$

where

Total village space heat demand without conservation	Reduction in village space heat demand resulting from conservation

SP_{jt} = Total space heat demand in year t.

CS_{jt} = Conservation saturation rate (ie, the proportion of village j households that perform conservation up to HUD standards in year t)

0.31 = Parameter that represents the proportion of total household space heat demand reduced by conservation improvements up to the HUD standards.

For example, total residential space heating energy consumption in 2002 was estimated to be 3 million gallons of fuel oil with an electricity equivalent of 84,000 mwh. If we assume that over the next twenty years, 20 percent of village households perform conservation improvements up to HUD standards, then total space heat consumption in 2002 would fall to 94 percent of original levels. This represents savings of about 178,000 gallons of fuel oil and could reduce each conserving household's 2002 average fuel bill ($3,583) by over $1,100 (expressed in constant 1981 dollars).

APPENDIX A

VILLAGE DESCRIPTIONS

Introduction

In this Appendix, we present a description of economic activity and energy use in each of the 18 study area communities gathered from published sources, site visits, and surveys conducted in the fall of 1981. The information presented here was used in developing both the base line electricity consumptions data and also the projections of future consumption.

For the reader's convenience, we have also included a set of summary tables that compare various economic and energy use characteristics across study area communities. The summary tables precede the community descriptions and are listed below:

TABLE A.1. HISTORICAL POPULATION GROWTH IN THE EIGHTEEN STUDY-AREA COMMUNITIES

	Civilian Population			Average Annual Growth Rate (Percent)	
	1960	1970	1980	1960-1980	1970-1980
Central Station					
Dillingham	424	914	1,563	6.7	5.5
Aleknagik	231	128	154	-2.1	1.9
Naknek	249	178	318	1.2	6.0
King Salmon	227	202	170	-1.5	- 1.7
South Naknek	142	154	145	0.1	- 0.6
Egegik	150	148	75	-3.5	- 7.0
Manokotak	149	214	294	3.5	3.2
New Stuyahok	145	216	331	4.2	4.4
All Villages	1,717	2,154	3,050	2.9	3.5
Seasonal-Central Station					
Portage Creek	0	0	48	NA	NA
Ekwok	106	103	77	-1.6	- 3.0
Koliganek	100	142	117	0.8	- 2.0
All Villages	206	245	242	0.8	- 0.1
Noncentral Station					
Iliamna	47	58	94	3.5	5.0
Newhalen	63	88	87	1.6	- 0.1
Nondalton	205	184	173	-0.9	- 0.6
Clarks Point	138	95	79	-2.8	- 1.9
Ekuk	40	51	7	-9.1	-22.0
Levelock	88	74	79	-0.5	0.7
Igiugig	0	35	33	NA	0.9
All Villages	581	586	552	-0.3	- 0.6
Total All Villages	2,504	2,985	3,844	2.2	2.6

SOURCE: U. S. Department of Commerce, Bureau of the Census, 1980.

TABLE A.2. ECONOMIC CHARACTERISTICS OF FISHING AND TRAPPING IN 1981 BY COMMUNITY

	Aleknagik	Manokotak	Koliganek	New Stuyahok	Ekwok	Portage Creek	Igiugig	Levelock	Dillingham
FISHING									
A. Size									
No. of 32' power boats	20	20-25	15	21	4	6	4	15	100-150
No. of permits (Salmon)	20	NA	18		10	10	4	13	100-150
No. of sciffs	1-2	25	0	4	4	NA			
No. of set nets (permits)	6	50	8	0	0	13	2	37	
B. Catch (lbs.)									
Range: Low - High	150,000	boat: 78-90,000 skiff: 15-25,000		25-125,000					
Avg. Catch/Fishermen w/Permit (Drift)	60,000	NA	65,000	50,000		$20-70K			
Avg. Set Net Catch			25,000	10,000				37	
C. Price									
Avg. $/lb (1980-81)	1981	1981	.80-.95	NA					
Buyer			.75						
Processor	Dillingham: .75	Ekuk: .75							
D. Migration									
Village Pop. Decrease?		(decrease)		(decrease)	(stable)	(decrease)	(decrease)	(decrease)	
% to Fish Camps:	nearly everybody	100%	50-75% Ekuk	50% Lewis Pt.	1% Naknek	93% Nushagak, CP, Ekuk	(50%?) Naknek	95% Naknek	
Fish Camp Location	set net/Dill., Ekuk, or Togiak	Iqushik							
Village Pop. Increase?									
Peak Summer Pop.									
% Boats Belong to Village									
Inmigrants from:									
Nearby Villages (√)									
Other Alaska (√)									
Outside Alaska (√)									
TRAPPING									
No. that Trap for Income				25%	few (10%)	very few (2)	50%	25%	
Avg. Harvest	NA			beaver, mink, lynx, fox			otter, lynx, beaver, mink, fox	Mink, otter, lynx, fox, wolverine, wolf	
Avg. Income from Trapping				$5,000 (tops)		$1,500 max.	for expenses	$5,000 max.	

FISHING	Clarks Point	Ekuk	South Naknek	King Salmon/ Naknek	Egegik	Iliamna	Newhalen	Nondalton
A. Size						(all boats)		(all boats)
No. of 32' power boats	5	0	25	20-30	10	9	98% of residents commercial fish	10
No. of permits (Salmon)	25	2	35	20-30	13			
No. of sciffs		Igushik			3			
No. of set nets		(92 + 72) sites		40	NA	5		5
B. Catch (lbs.)								
Range: Low - High	40-160K				60-180,000			
Avg. Catch/Fishermen w/Permit	50-60K		75-80K	45,000	80,000	40-50,000 lbs.		25-30,000 lbs.
Avg. Set Net Catch			35-40K		NA	22,000 lbs.		22,000 lbs.
C. Price								
Avg. $/lb (1980-81)	1981		1981		Processor 1979: .80-.85 1980: .57 1981: .75			Processor 1980: .65 1981: .85
Buyer	1.00							
Processor	.75		.75					
D. Migration								
Village Pop. Decrease?						(stable)	(decrease)	(decrease) 75% leave for fishing and fire-fighting around state.
% to Fish Camps:						(35-40%)		
Fish Camp Location	set net							
Village Pop. Increase?	(increase)	(increase)	(increase)	(increase)	(increase)	(stable)		
Peak Summer Pop.	400	800	2000	5000				
% Boats Belong to Village	NA	NA	NA	40	NA			
Inmigrants from:								
Nearby Villages (√)	√	√	√	√	√			
Other Alaska (√)	√	√	√	√	√	√		
Outside Alaska (√)	√	√	√	√	√	√		
TRAPPING								
No. that Trap for Income		0			3	boys & young men in com. trap varies each year. Don't make much.	boys & young men trap.	10
Avg. Harvest		NA	minor		NA			
Avg. Income from Trapping					not much			1500 max

TABLE A.3. VILLAGE EMPLOYMENT IN 1981 BY COMMUNITY

Nonfishing Jobs	Aleknagik	Clarks Point	Egegik	Ekuk	Ekwok	Igiugig	Iliamna	Koliganek	Levelock	Manokotak	New Stuyahok	Newhalen	Nondalton	Portage Creek
Village Administrator (Mayor)	1 F							1 F	1 F	1 F	1 F			
Village Secretary/Staff	2 ½	1 F	1 ½		1 F	2 F		1 ½	7 F	1 ½		Council		
Police Officer	2 F		1 F								2 F		1 F	
Post Office	1 F	1 ½	1 F				2 F 1 ½	1 F	1 ½	1 F	1 F		1 ½	
School														
Teacher	6 F	2 F	1 F 2 ½		3 F	2 F	8 F	5 F	3 F	4 F	9 F		6 F	2 F
Teacher's Aide		1 ½			1 F	1 ½	5	1	2 F		4½ ½		3 F	1 ½
Janitor	F	1 ½	1 ¼		1 ¼	1 ½	2 F	1 F		1 ½	3[a] F	1 F	1 F	
Cook	2 ½	1 ½	1 ¼		1 ½		2 ½	1 ½		1 ½	2 ½	1 ½	2 ½	
Other (Admin & Maint.)							8 F	3 ½&¼			2 F or more		1 ½	
Bilingual Teacher		1 F			1 F	1 ½		1 ½	1 F					
Generator Maintenance			1 F					1 ½		1 ½	1 F			
Meter Reader								1 ½		1 ½				
Village Store or Coop			2 ¼							2 F				
Owner/Manager Helper								2 F						
Health Aid		1 F	1 F	1 F[b]	1 F	1 F	1 F		2 F		4 ½		1 ½	1 F
Pump House Maint.								1 ½		1 ½				
Project Employment Planner/Coord.								2 ½						
Labor (Temp.)										5 ½				
CETA/Social Worker	1 ½							3 ¼			1 ½			
Airstrip Grader	1 ½	1 ¼			1 ¼						1 ½		1 ¼	1 ½
Proprietor (non-fish)	2 F													
Services							11+ F					Wien	5 F	
Cannery Watchman		1 F		1 F										
Fed & State							FAA ADF&G?							
TOTAL														

[a] One for office and clinic

[b] Seasonal

TABLE A-4. 1980 AVERAGE HOUSEHOLD INCOME IN THE EIGHTEEN BRISTOL BAY COMMUNITIES

	1980 Est. Personal Income ($)[a]	Households	Average Household Income ($/HH)
Dillingham	15,679,040	480	32,665
Aleknagik	822,587	38	21,647
Naknek King Salmon South Naknek	9,467,772	261	36,275
Egegik	201,683	23	8,769
Manokotak	987,500	57	17,325
New Stuyahok	1,090,908	65	16,784
TOTAL	28,249,550	924	30,573
Portage Creek[b]	NA		
Ekwok	214,291	20	10,715
Koliganek	381,422	40	9,536
TOTAL	595,714	60	9,929
Iliamna Newhalen	1,286,416	35 18	24,272
Nondalton	322,257	42	7,673
Clarks Point Ekuk	569,239	22 1	24,750
Levelock	172,326	28	6,155
Igiugig[c]	NA		
TOTAL	2,350,238	146	16,098
Total All Communities	31,195,502	1,130	27,607

SOURCE: Alaska Department of Revenue, "Individual Income Tax Paid in 1978 by Alaskan communities.

U.S. Department of Commerce, Bureau of the Census, 1980.

NOTES: On following page.

Notes: Table A.4.

[a]Base is 1978 taxable income adjusted to personal income as follows:

1. $$\frac{\text{Taxable Income (U.S.)}}{\text{Adjusted Gross Income (U.S.)}} = \frac{1063.3}{1304.2} = .815$$

(1978 Statistics of Income)

2. $$\frac{\text{Adjusted Gross Income}}{\text{Personal Income}} = \frac{1406.0}{1721.8} = .817$$

(BEC Survey of current business, Nov. 1981, pg. 24)

3. $$\frac{\text{Personal Income}}{\text{Taxable Income}} = \frac{1}{.817} \times \frac{1}{.815} = 1.224 \times 1.227 = 1.502$$

4. Thus 1978 taxable income by village was multiplied by 1.502 to derive an estimate of personal income in 1978.

5. 1978 income was multiplied by a 20 percent growth from 1978 to 1979 based upon BEA income data and an assumption of half that growth rate from 1979 to 1980.

[b]Included in Dillingham figures.

[c]Included in King Salmon figures.

TABLE A.5. COMMERCIAL BUILDING STOCK IN 1980

	Aleknagik	Clarks Point	Egegik	Ekuk	Ekwok	Igiugig	Iliamna	Koliganek	Levelock	Manokotak	New Stuyahok	Newhalen	Nondalton	Portage Creek	South Naknek
Commercial															
Store	0	2	2	1	1	0	2	2	0	2	2	1	2	0	1
Bar/Restaurant	0	0	1	0	0	0		0	0	0		0	0	0	1
Lodge		0	0	0	1	8	7	0	1	0	0	0	2	0	0
Other	2	0	1	0	0	1			0	0	0	0		0	
Government/Community															
Post Office	1	1	1	0	0	0	1	1	1		1 (c)	0	1	0	
Village Council/ City Office	1	1	1	0	0	1	0	1	1	1	1	0	0	0	1
Community Hall	0	0		0	0	0		0	0		0	0	1	0	0
Clinic		1	1	1	1	0	1	1	0		1	0	1	1	1
Clinic/Comm. Hall		0		0	1	0		0	1	1	0	1		1	1
Fire Station	0	0	0	0	0	0	2	0	0	/	0	0	0	0	1
Water & Sewer Utility		0		0	0	0		1	0	1	1	0	1	0	
Electric Utility	0	0	1	0	1	0		1	0	1	1	1 (a,f)	1 (f)	0	0
Warehouse	1	0		0	0	0	2	1	1	1	1		0	0	
Hangar		0		0	0	0	2		1		0		0	0	
Airport Lights	0	0		0	0	0	1	0	0		0		0	0	
Church	3	1	1	1	2	1	1	1	2	1	1	1	1 (c)	1	
School Bldgs.	2	1	1	0	1	1	0	2	1	2	2	5	2	2	1
Teacher Housing			2	0	1	1	3	1		6	4		3	1	
Gymnasium		0		0	0	0	0	1	0	1	1				
RCA/Alascom											1				
Others												1	1 (e)		

NOTE: "O" indicates absence of facility known with certainty. A blank indicates absence of facility likely, but not known with certainty.

(a) Utility building under construction
(b) Same building as co-op store
(c) Residence in same building
(d) One store is in residence
(e) Corporation building
(f) School generator building
(g) Across river

SOURCE: ISER Field Survey

TABLE A.6. AVERAGE HOUSEHOLD FLOOR AREA AND ENERGY USE CHARACTERISTICS IN 1980 BY COMMUNITY

	Average Floor Area (sq. ft.)	Average Space Heat Fuel Oil Consumption (gal./year)	Average Electricity Consumption (kwh/year)	Average Propane Consumption (lbs./year)
Dillingham	1,287	1,083	5,112	NA
Aleknagik				
Naknek	1,318	1,492	5,328	NA
King Salmon				
South Naknek	785	1,458	5,328	400
Egegik	760	1,289	2,328	NA
Manokotak	600	770	3,306	NA
New Stuyahok	759	985	1,944	NA
Portage Creek	542	1,035	1,536	200
Ekwok	484	1,083	1,678	567
Koliganek	944	930	1,104	NA
Iliamna	559	1,496		NA
Newhalen				
Nondalton	571	1,033		NA
Clarks Point	NA	NA	NA	NA
Ekuk	600	1,800		600
Levelock	1,007	2,009		NA
Igiugig	457	1,063		525

From ISER household survey.

1. DILLINGHAM

General Description. The community of Dillingham is located at the head of Nushagak Bay at the confluence of the Wood and Nushagak Rivers. The population of the city is geographically dispersed with small settlements along the Wood River Road (3.2 miles), the road to Kanakanak (6.2 miles), and the Lake Road (22 miles to Aleknagik).

In recent years, Dillingham has increasingly become the regional center for the central Bristol Bay region. Many government activities and services for the entire region are administered from Dillingham. These services include the Alaska Department of Transportation and Public Facilities, the Department of Health and Social Services, Alaska Legal Services, the regional Native Health Service hospital, Bristol Bay Housing Authority, and the headquarters for the regional Bristol Bay Native Corporation and Bristol Bay Native Association.

In addition, the headquarters for the western half of Bristol Bay Department of Fish and Game and the Southwestern School District are in Dillingham. The Native village corporations of Ekuk, Aleknagik, and Portage Creek have merged with the Dillingham's local Native Corporation, Choggiung, Ltd.

Dillingham will maintain or increase in position as the regional center of Bristol Bay because the service infrastructure is well-established and because the state government has chosen it as the center for regional programs.

Population. According to the U.S. Bureau of the Census, the population of Dillingham has grown from 914 in 1970 to 1,563 in 1980. The U.S. census data indicate that average household size has fallen to 3.35 in 1980, from 3.84 in 1970. This implies an average annual rate of decline equal to 1.4 percent. In 1981, the city of Dillingham completed a city census that indicated a population of 1,670 people living in 540 households. This suggests a further, more dramatic, decline in average household size of 8.3 percent between 1980 and 1981. The U.S. census statistics show that 57 percent of the 1980 population is Native. In 1970, Native inhabitants accounted for 63 percent of the population. The gradual decline was probably due to the increasing number of non-Natives who have migrated to Dillingham in search of government and service sector jobs.

In the summer, the population of Dillingham approximately triples in size. Many of the summer residents stay with relatives and friends, on boats in the harbor, or in housing provided by the seafood industry. The Dillingham Hotel Annex, open only during the summer, is full almost every night. In addition to the summer residents, there is a steady stream of itinerants during the fishing season.

Economic Base. Commercial fishing and the seafood processing industry support the economic base of Dillingham. Approximately 300 fishing boats are owned by Dillingham residents and about double that number base in Nushagak Bay during the summer season. Two seafood processors operate in Dillingham, Peter Pan Seafoods, and

Engstrom Brothers along with the Bull Brothers and Icicle Seafoods fresh freezing operations. Dragnet Fisheries expect to begin fish processing operations in their new Dillingham plant in 1982.

The services, transportation and tourism also add to Dillingham's economic base. These sectors provide steady, sometimes year-round, employment and represent a stabilizing influence to the economy, although they still experience a summer peak that is tied to seasonal population expansion.

The government sector is the most important stabilizing force in the economy. As noted above, many regional offices of federal, state, and local programs are located in Dillingham.

The 1981 community profile for Dillingham indicates that approximately 50 percent of the year-round population of the city relies to some degree on the subsistence activities of hunting, trapping, and fishing to provide food and some cash income.

Labor Force and Employment. In 1980, 828 full-time-equivalent jobs were offered in the city of Dillingham. The government sector provided 25 percent of those jobs; manufacturing (processing), 21 percent; and services, 20 percent. Major employees in the service sector are the hospital in Kanakanak, the Bristol Bay Regional Housing Corporation, and the Bristol Bay Native Association. An October 1980 survey of employment in Dillingham conducted by Alaska consultants points out that 33 percent of the jobs in Dillingham are fish-industry related. Many of the seasonal summer positions are filled by people that come into Dillingham from other Bristol Bay communities and from outside Alaska.

Personal Income. The estimated average household income in Dillingham for 1980 was $32,665. This is the second highest household income in the study area, behind the Bristol Bay Borough only.

Building Stock Characteristics. The residential buildings in Dillingham, similar to those in all the other communities in the study area, can be generally described as a core structure with cash additions made as money becomes available. A survey of the city tax records indicates that 49 percent of the buildings within the city limits were built before 1960 and 69 percent before 1975. By today's standards, the older buildings are typically not well insulated, if at all. Newer construction reflects the increased emphasis on conservation, with insulation levels raised and even some passive solar and double envelope homes in use or under construction. The average size of all residences listed in the tax records is 1,322 square feet; average size of post-1974 structures is 1,689 square feet. The tax data may be biased toward newer and larger housing because of the tax-exempt status of residences on Native allotments, HUD housing, and some government housing. A survey conducted by Dillingham High School Students in 1981 shows an increasing tendency toward single- and multi-family housing in Dillingham (Table A.7). Fifty HUD houses are currently occupied in Dillingham.

Nushagak Electric Cooperative, Inc., the Dillingham utility, lists an average of 194 commercial/government customers in 1980. We collected detailed data on 41 of these customers, a sample size of 20 percent. As in any city, the commercial/government sector ranges from one room offices to the large customers such as the hospital, N and N Market, the city schools, and the Federal Avaiation Administration. The average size of buildings in our sample is 7,755 square feet.

Electricity Generating System. The Nushagak Electric Cooperative, Inc., (NEC) supplies central-station power to the communities of Dillingham and Aleknagik. In 1981, the generation capacity of NEC was 3,850 kw. Peak demand in 1980 was 1,595 kw in November. Fuel for the utility is brought from Standard Oil at Dillingham. Fuel storage capacity at the utility is 26,000 gallons. The distribution system is three-phase at 7.2 kv.

Electricity Use Pattern. The average number of customers and average annual electricity consumption per customer in 1980 is tabulated below for each customer classification (Table A.8). Electricity use in Dillingham primarily reflects appliance use; the use of electricity for space heating is negligible.

TABLE A.7. DISTRIBUTION OF DILLINGHAM/ALEKNAGIK HOUSING STOCK (Percent)

	All Ages[a]	Built Since 1975[b]
Trailer	2	7
Single Family	59	60
Two Family	4	7
Three Family	6	7
Other	13	13
Unknown	16	6
Total	100	100

SOURCE: Household Survey by Dillingham high school students.

[a]Sample size was 46.

[b]Sample size was 14.

TABLE A.8. NUSHAGAK ELECTRIC COOPERATIVE 1980 CUSTOMER SALES

Customer Classification	Average Number of Customers	Use per Customer (kwh)
Residential	443	5,117
Small Commercial	112	16,698
Large Power	5	347,032
Public Authorities	76	14,870
Street and Highway Lighting	1	38,916
Total	637	

NOTE: These figures include electricity sales to Aleknagik (see Section A.2).

SOURCE: Nushagak Electric Cooperative

An appliance-use survey was conducted by a Dillingham High School class in 1981. Most commonly owned appliances include radio (100 percent), television (93 percent), toaster (93 percent), refrigerator (93 percent), freezer (90 percent), and clothes washer (89 percent).

Fuel Oil Supply Characteristics. Dillingham is a distribution center for Standard Oil (Chevron). Petroleum products are supplied from Dutch Harbor about 8-to-10 times a year, from mid-May to mid-October. The storage capacity at the Dillingham facility is 2.25 million gallons. Chevron keeps accounts for 40 customers; all other sales are termed cash sales, sold over the counter in Dillingham. Between September 1980 and September 1981, 1,664,085 gallons of fuel oil #1 and #2 were sold in Dillingham. From conversations with local fuel distributors, it is estimated that 80 percent of this total was consumed in the immediate area.

Two local companies deliver fuel oil to residential, commercial, and government customers. Moody Oil Service and Rawls Oil Service supply Dillingham and Aleknagik, and bring a very small percentage (estimated 1 percent) of their sales to the airport to be flown to surrounding villages.

Space Heating Pattern. According to a heating/cooling contractor in Dillingham, approximately 50 percent of the residences in the city heat with oil stoves in the center of the house. Oil-fired forced-air furnaces are used in 20 percent of the homes and oil-fired circulating hot water in the remaining 30 percent. "Very, very few" residences use wood as their primary heat source although the use of wood is increasing as a supplementary source of space heat. The results of the high school class survey indicate average annual residential consumption of fuel oil is 1,083 gallons.

The nonresidential sectors in Dillingham also use fuel oil for space heat. In our sample of 41 commercial and government users, annual oil use ranged from 400 to 45,882 gallons, with an average use of 7,275 gallons per year for 1980.

Planned Development. The Dillingham building stock is increasing. In the fall of 1981, a senior citizen's center was near completion, a hotel/ restaurant had been started, an addition was being constructed on the high school, and a new elementary school had just opened. In addition, the U.S. Department of Housing and Urban Development (HUD) has planned a twenty-unit apartment building and twenty houses for 1982.

In addition, eight million dollars have been appropriated for expansion of the boat harbor in the next few years. The city just finished construction of a staging area at the dock. Additional dock improvements are forthcoming.

Summary of Distinguishing Characteristics. In the past decade, Dillingham has assumed the role of regional transportation, service, and government center for the Bristol Bay area. The summer peak in electricity use is a recent change from historical winter peak use patterns, and reflects both an increase in the number of commercial fishermen in the city, and expanding energy consumption by the fishing processing industry. The geographical proximity to many smaller villages, the inflow of government services, the strong salmon fishery, and an active land market ensure continued diversification and economic growth for Dillingham.

2. ALEKNAGIK

General Description. Aleknagik is a fishing village, located seventeen air miles north-northwest of Dillingham on the southern shore of Lake Aleknagik, the southernmost lake in the Wood-Tikchik lake system. Aleknagik is connected to Dillingham via the 22-mile Lake Road. A transmission intertie connects Aleknagik electricity customers to the NEC electric utility based in Dillingham.

In 1918, a major flu epidemic wiped out most of the residents of the Native village of Aleknagik. Surviving children were raised in the orphanage at Kanakanak, southwest of Dillingham. Several years later, these children, now grown, returned to the Native homesite to find an established non-Native population composed primarily of Seventh-Day Adventists.

Aleknagik is divided into three geographic segments: the south shore of the lake outlet, the north shore, and an island. Travel between each segment requires a boat in summer. Competition between the north and the south shore residents is manifested in conflicts over locations of services and village development. The geographic segmentation, the road connection to Dillingham, and the transmission intertie are special features which distinguish Aleknagik from other Nushagak area villages.

Population. According to U.S. Bureau of the Census statistics, the population grew from 128 to 154 from 1970 to 1980, an increase of 20 percent. In 1980, 90 percent of the census population was Native, up from 76 percent Native in 1970. The 1980 census indicates 38 residences in Aleknagik; in 1981, our study team located 44 year-round residences.

In the summer season, most residents of Aleknagik move to fish camps in Nushagak Bay and in the Togiak area. Many of the non-Native families are also involved in fishing, or leave to work on barges for Smith Lighterage or Moody Lighterage, both owned and operated by Aleknagik residents.

There is minimal summer in-migration. A University of Washington Fisheries Research Institute (FRI) field camp and an Alaska Department of Fish and Game hatchery offer seasonal positions. Aleknagik is used as the jumping-off point for the Wood-Tikchik State Park tourist industry, but tourists spend a minimum of time in the village.

Economic Base. Commercial fishing and related activities are important to Aleknagik residents. Twenty drift-net permits and six commercial set-net permits are held by residents.

There are few services in Aleknagik. Residents travel often to Dillingham on the lake road, taking advantage of the well-developed service sector in the larger city. Moody Sea Lighterage and Smith Lighterage are based in Aleknagik, and add some to the economic base.

Economic activity in Aleknagik is low in the summer and the winter seasons, with an increase in spring as residents prepare for the fishing season, and a maximum of activity in fall with construction and pre-winter acquisition of supplies and "grubstake."

Labor Force and Employment. Thirteen full-time and six part-time positions are offered in Aleknagik. The major employers are the school and the village government. The school and the lighterage companies provide seasonal or less than year-round work; all other jobs are on an annual basis. An itinerant labor force is employed during the summer months at the University of Washington FRI station and the hatchery.

Personal Income. It is estimated from tax return information that the average household income in Aleknagik in 1980 was $21,647. The average catch of a drift-net permit holder in Aleknagik is 60,000 pounds of salmon. At a 1981 selling price of $.75/pound, the average fisherman would gross $45,000.

Building Stock Characteristics. The majority of the residences in Aleknagik are aged wood-frame structures with moderate insulation. About six newer residences exist, typically about 1,000 to 1,500 square feet in floor area with insulation levels of R-19 in the floor and ceiling, and R-12 in the walls.

The north shore school building was first constructed in 1959 with additions in 1968 and 1970. Total floor area for the school is 4,365 square feet.

Electricity Generation System. The village of Aleknagik is supplied electricity via a transmission line from the Nushagak Electric Cooperative (NEC) utility in Dillingham.

The school district maintains a 10KW generator in the village for standby power.

Electricity Use Pattern. Information on electricity use in Dillingham and Aleknagik combined was compiled from NEC annual reports and a Dillingham high school class survey. Results are discussed in the Dillingham energy profile.

Aleknagik residents stressed in our discussions that an awareness of electricity consumption and costs exists. Nearly every residence owns a television and a freezer, and most have refrigerators. In the summer, or during periods of low cash flow, clothes dryers and water heaters are not used to keep electricity bills down. However, with installation of the water and sewer system to the entire village, the use of water heaters will undoubtedly increase.

Fuel Oil Supply Characteristics. Moody Sea Lighterage and Smith Lighterage supply fuel oil to 84 percent of the residences from their barges. Many of the houses in Aleknagik have individual bulk storage tanks of 500-1,000 gallons into which fuel oil is pumped directly from the barge. The remainder of the residences supply themselves by boat or truck from Dillingham. Rawls Oil Service in Dillingham hauls fuel oil for some commercial use in Aleknagik.

In 1980 the cost of fuel oil in Dillingham was $1.126 per gallon.

Space Heating Pattern. Some residences use portable electric space heaters for back-up heat, but most residences in Aleknagik rely on oil drip stoves for space heating. It is estimated by a local fuel oil supplier that an average Aleknagik residence consumes about 1,000 gallons per year for space heating. A 1,440 square foot Aleknagik house built in 1979 used 900 gallons in 1980. The estimated average is probably representative, although Aleknagik residents indicated a definite increase in wood consumption in fireplaces and airtight stoves to provide supplemental space heat.

Planned Development. In 1980 and 1981, Aleknagik received a windfall of state and federal monies for future developments to the village. Planned construction includes two marinas, two city municipal buildings, two heated city garages, water and sewer systems, a runway on the north shore, a combined elementary/high school, a bridge to connect the north and south shores, and 16 HUD houses.

Summary of Distinguishing Characteristics. The north shore/south shore split in Aleknagik will affect future energy use patterns because of the desire for duplicate services. The construction of the two sides with a bridge may unify the village, however. The proximity to Dillingham and convenient road access will limit the development of services in Aleknagik. Construction projects in the near future will add substantially to the economic base of the community.

3. BRISTOL BAY BOROUGH (NAKNEK-KING SALMON-SOUTH NAKNEK)

General Description. Naknek, the seat of the Bristol Bay Borough, is located at the mouth of the Naknek River where it empties into Kvichak Bay. South Naknek is located one mile south of Naknek across the Naknek River. King Salmon, connected to Naknek by a fifteen mile road parallel to the north shore of the river, is the site of a U.S. Air Force Alaskan Air Command Station.

The three communities of the Bristol Bay Borough share many services, such as junior high, high school, and the electric utility. The Borough is the distribution center for the Lake and Peninsula region of Alaska, especially serving the communities of Igiugig, Levelock, Egegik, and the Lake Iliamna area.

Population. The civilian population of the Bristol Bay Borough, according to the U.S. Bureau of the Census, dropped from 744 to 719 between the 1970 and 1980 census years. A breakdown of census population for the three communities is presented in Table A-9. Note that although 50 percent of the borough population is Native in 1980, King Salmon residents are only 19 percent Native while 86 percent of South Naknek residents are Native.

Residents of South Naknek describe their town as young. The older proportion of the population is being replaced as many young couples are starting their families.

The Bristol Bay Borough population increases dramatically (during the summer fishing season) with estimates as high as 5,000 temporary residents. Seasonal housing is found with relatives and friends, in tents along the bay, in boats, and in cannery bunkhouses.

Economic Base. The seafood industry is the predominant player in the economy of the Borough. In 1980, there were five shore-based processors in Naknek and two in South Naknek, 25 on-shore fish camps and buy stations located in the Borough, and 27 floaters or buy stations that operate in the Kvichak Bay. The camps are open from mid-May through September. The height of the processing season is mid-June through July. The Kvichak fishery is larger than the Nushagak fishery, with up to 1,200 boats operating in the Kvichak fishery in a good year. It is estimated that 98 percent of the fishermen are from locations outside the Borough. In addition to the salmon fishery, 25-30 boats from the Borough are active in the herring fishery. A total of about 600 boats participate in Bristol Bay's herring fishery.

The seasonal peak of fishing activity is reflected in the service sector. Standard Oil (Chevron) has a distribution center in Naknek. One restaurant, two bars, one hotel, and two marinas are also located in Naknek. King Salmon services are centered around the airport facility: a market, hotel, and air taxi operators. A bar, store and restaurant can be found in South Naknek as well as a small elementary school.

The Borough provides headquarters for some government activities in the Lake and Peninsula area, although many of the regional offices are based in Dillingham. There is hope among Borough residents that the government sector will increase beyond the current presence of the Federal Aviation Administration, the Lake and Peninsula School District headquarters, the Alaska Department of Fish and Game, the National Park Service, local village corporations (Paug-Vik), and Bristol Bay Borough services. The military station at King Salmon provides a stable influence on the borough economy.

The borough tax base is a fish tax of 3¢/pound levied on fish sold within the borough limits. This tax provides revenues to support all borough activities.

Labor Force and Employment. An employment survey of full-time residents of the borough was conducted by reviewing each name listed in the borough phone listing with an informed resident. Job classifications for this survey were (1) fishing primary, (2) fishing secondary, (3) government, (4) services, and (5) transportation. Results of the survey for Naknek/King Salmon and for South Naknek are shown below in Table A.10. In Naknek/ King Salmon a total of 167 people hold the 194 positions; in South Naknek 34 people held 37 positions.

Personal Income. Estimates of household income from tax records show that average household income in the Bristol Bay Borough is among the highest of all study area communities. The borough economy is relatively diversified and provides many residents with year-round employment. Borough residents also earn a high summer income from participation in the fishing industry.

In Naknek there are approximately 25 drift-net and 40 set-net commercial permits. The average salmon catch per drift-net permit is 45,000 to 50,000 pounds. The average catch in a set net is about 35-40 percent of the drift net catch. There are about 35 drift-net permits and 25 boats owned by South Naknek residents. One resident of South Naknek estimated the average catch per permit in 1980 at 75,000 pounds for South Naknek residents. This information gives an estimated range of gross income per permit holder from $33,000 to $56,000.

Building Stock Characteristics. Data on the residential building stock in the Bristol Bay Borough is incomplete because only 163 of the 221 households (73 percent) in the Borough are represented in the tax records (Table A.11). Housing units on Native allotment land is not included in tax records data. Of the residences in the records, 94 percent of the single family houses were built before 1968. As shown in Table A.11, the average size of these pre-1968 residences is 922 square feet; average size for all single-family residences is 898 square feet. This figure contrasts with the average size of 1,318 square feet for a sample of residences surveyed by a local high school class in late 1981.

We were unable to find information on building stock characteristics in the commercial and government sectors. Fish processors in the Borough average 46,684 square feet of housing and office space, and 83,233 square feet for the processing plant.

Electricity Generation System. Central station electric power is provided to the Bristol Bay Borough by Naknek Electric Association (NEA), located in Naknek. The utility owns and operates three 350 kw generators, three 440 kw generators, one 500 kw unit, one 1,000 kw unit, and two 1,200 kw units, for a combined capacity of 6,200 kw. In late 1981, the Air Force Station in King Salmon started to receive power from NEA. The estimated peak load with the new meter will be 2,184 kw.

Five of the seven processors in the Borough self-generate their own electricity in addition to buying power from NEA.

Fuel Oil Supply Characteristics. Fuel oil is barged to the Bristol Bay Borough by Standard Oil (Chevron) and by Alpetco. A distribution center for Chevron petroleum products is located at Naknek. Storage capacity at the center is 1.5 million gallons. Thirty-three accounts are kept by Chevron, all other sales being cash sales at the dock. Between September 1980 and September 1981, a total of 332,750 gallons of diesel oil No. 1 and No. 2 were sold by Chevron. It is estimated that 60 percent of these sales are consumed in the borough.

The Alpetco barge supplies fuel to only the King Salmon military station and the Federal Aviation Administration facility at the King Salmon airport. In 1980, 852,555 gallons were used by the military.

Electricity Use Pattern. A breakdown of new electricity use in 1980 by consumer classification is shown in Table A.12. Annual data for 1970 and 1980 shows a peak in residential monthly consumption of 489 kwh in 1977. In 1980, the average residence used 444 kwh/month.

An analysis of electricity monthly demand (kw) on NEA in 1980 reveals a distinct peak in July. Only in the residential sector is the maximum demand registered in another month (December) with a minor peak in July. The fishing industry is the major contributor to the summer peak, rising from an off-season plateau of about 30 mwh per month to a July maximum of 525 mwh. Total utility sales to the fishing processors in 1980 was 955 mwh.

Self-generated electricity by the seafood processing industry in 1980 was estimated to be 1,875 mwh with a peak demand in July of 5,636 kw (see Appendix E, Section 5).

Space Heating Pattern. An energy use survey conducted by the senior class at the Bristol Bay Borough high school shows an annual average residential consumption of 1,492 gallons of stove oil for space heating. Fuel oil is the only source of space heat in the Bristol Bay Borough. There is no data available on the types of furnaces, stoves, or distribution systems used in the Borough. Waste heat from the NEA generators is used to heat the Borough high school.

Planned Development. There is very little development currently planned in the Bristol Bay Borough. Some new residential construction is evident. However, compared with Dillingham, real estate was relatively inactive. There were discussions in the borough government of development of a dock, port facility, and boat harbor, but no firm plans have been made.

Summary of Distinguishing Characteristics. The Bristol Bay Borough is less active as a regional center than Dillingham. The Borough's prime role is to provide basic services under conditions of enormous seasonal fluctuation in population and energy use. Approximately half of Bristol Bay's entire seafood processing industry is located in the Bristol Bay Borough. As a result, major seasonal fluctuations in energy use were observed. Furthermore, the NEA electric utility services only a fraction of total electricity consumption (kwh) and demand (kw). A much larger portion of total electricity-use is self-generated by seafood processors themselves (see Appendix E, Section 3).

TABLE A.9. BRISTOL BAY BOROUGH POPULATION

	1970		1980		
	Total	Civilian (Percent)	Total	Civilian (Percent)	Natives as a % of Civilian (Percent)
Naknek	318	43%	318	44%	51%
So. Naknek outskirts	224	30	231	32	86
King Salmon-civilian	202	27	170	24	19
King Salmon-military	403		375		
Bristol Bay Borough - civilian	744	100	719	100	50
Bristol Bay Borough - total	1,147		1,094		

SOURCE: U.S. Bureau of the Census.

TABLE A.10. BRISTOL BAY BOROUGH JOBS IN 1981

	Naknek/King Salmon		South Naknek	
	Jobs	Proportion Of Total (Percent)	Jobs	Proportion Of Total (Percent)
Fishing Primary	43	22	31	84
Fishing Secondary	28	14	2	5
Government	85	44	2	5
Services	20	10	2	5
Transportation	18	9	0	0
Total	194	100	37	100

SOURCE: Interview with local residents

TABLE A.11. BRISTOL BAY BOROUGH RESIDENTIAL HOUSING STOCK CHARACTERISTICS

	SINGLE-FAMILY			MULTI-FAMILY			
	Number	Floor Area (Sq. Ft.)	Proportion of Total (Percent)	Number Buildings	Number Units	Floor Area (Sq. Ft.)	Proportion of Total (Percent)
Pre-68	94	922	58	5	13	477	71
68 - 74	29	759	18	0	0	-	0
75 +	37	982	23	1	2	1,128	14
Unknown Date	2	256	1	1	3	300	14
Total	162	898	100	7	18	520	99

SOURCE: Borough Tax Records.

TABLE A.12. NAKNEK ELECTRIC ASSOCIATION 1980 CONSUMER SALES

	Number Of Customers	Use per Customer (kwh/cust./yr)	Total Consumption (kwh/yr)
Residential	282	5,324	1,501,469
Small Commercial	136	20,538	2,793,166
Large Power	8	264,652	2,117,219
Total	426		6,411,854

SOURCE: Naknek Electric Association.

4. EGEGIK

General Description. Egegik is the southernmost community in the 18-community study region. It is approximately 38 air miles southeast of Naknek, on the mouth of the Egegik River, just inside Egegik Bay. The land is mainly flat or rolling tundra with very little tree growth except for scrub alder. Transportation to the community is via air and sea.

Population. The population of Egegik has declined at a rate of 6.6 percent over the last ten years, according to U.S. Census figures. In 1970, census results show 148 people living in 35 households in the community. By 1980, the population had declined to 75 people living in 32 households. Fifty-seven of the 75 permanent residents were native. The 1981 household survey conducted for the energy demand study shows 51 people living in 22 residences in Egegik, giving an average of 2.32 people per household. The decline in the village's population is reflected in the decline in the number of students attending the Egegik school. According to one resident, ten years ago there were about 60 children attending the school. At the time of the site visit in 1981, there were only 14 students.

During the summer months, there is an influx of people into the village. One source estimated that the population grows to 500 people in the summer. Another person estimated that there are as many as 2,000 people in the community during the fishing season. Most of these people are involved either directly with fishing or work at one of two processing plants in the community. One plant, the Diamond "E," owned by two native corporations, housed 188 plant workers in 1980. They expect to cut this number down to 150 people in the 1982 season, due to the high cost of upkeep on the housing facilities. The other processor, Egegik Seafoods, which is division of Kodiak King Crab, employed approximately 80 people in 1980 and in 1981. Some of these were housed in the plant bunk houses.

Economic Base/Labor Force and Employment. Salmon fishing and the fishing industry make up the base of Egegik's economy. There are approximately 13 salmon drift-net permits owned by residents, ten of these for boats and three for skiffs. In addition to the salmon permits, there are four or five herring permits held by residents. One source estimated that 40 percent of the boats fishing in Egegik Bay are from the community.

Several Egegik residents work as managers and maintenance personnel for the two processing plants and the plant stores. Neither plant employs locals for the actual summer processing activities. Only two or three people in the community trap commercially, and not much income is derived from this activity.

The federal government employs a full-time postal clerk in the village. There is a part-time village council secretary, a full-time health aide, a bar manager/owner, and a power plant manager/owner who also employs a maintenance man. The Lake and Peninsula School District employs a part-time cook, a janitor, one full-time teacher, and two itinerate teachers who visit the school on a regular basis.

Personal Income. According to tax return information from the Alaska Department of Revenue, the average household in Egegik had an income of $8,769 in 1980. Egegik residents estimated that boats with driftnet permits brought in an average of 80,000 pounds of fish per boat in 1980. At 75¢/pound in 1981, this implies an average household income of $18,750 from drift net permits alone. Set net catch is unavailable.

Building Stock Characteristics. Residences in Egegik are mainly of wood frame construction. A system of boardwalks connects many of the buildings in the community together. Average floor area of 15 houses surveyed in the household survey is 760 square feet. Several residents plan to build new homes on the other side of the airstrip away from the main village where the ground is higher. At the time of the site visit, there were three houses under construction. The Department of Housing and Urban Development (HUD) plans to build seven two- and four-bedroom houses in Egegik in 1982. When residents move into these new houses, vacated houses may be filled by new residents or used as summer homes.

Commercial/government buildings consist of two churches, one of which is vacant; a village council building; a post office; a clinic;

a recreation hall for the church; a power house for the village utility; a bar; and two stores owned by the processors. There are two school buildings in Egegik, one of which contains two living quarters for teachers. Total floor area for the school buildings is 4,266 square feet.

The two seafood processing plants make up the industrial sector of the community. One of the plants has a total floor area of 50,050 square feet, 14,450 of which is for housing and office space. Floor area of the other plant is unknown.

Electricity Generation System. In 1980, Egegik was provided with power by a Naknek Electric Association owned power plant. The utility was purchased from NEA by a private businessman in 1981, and transfer of ownership is pending approval by the Alaska Public Utilities Commission. The utility, now named Egegik Light and Power, generates power with a 70 kw generator and a 65 kw generator. Only one generator is used at a time.

Total kw sold by the utility in 1980 was 129,617 kwh. The 1980 monthly peak was 14,083 kwh; it occurred in February. There were 23 residential customers served by the utility in 1980, consuming 41 percent of the total energy produced by the utility. The consumer cost per kwh in 1980 was 34.1¢, including a fuel surcharge of 5.7¢. Power cost assistance was not available to Egegik customers in 1980. In 1981, there were approximately 40 residences tied into the utility system, including summer homes. These residential customers consumed 50 percent of the total energy generated by the utility. There were six commercial customers in 1981, including the two processing plants. The utility charged 14.9¢ per kwh;starting from an APUC-approved rate base of 29¢, adding a fuel surcharge of 8.2¢, and then deducting 60 percent of this rate (22.3¢) to account for the power cost assistance subsidy. As a result of power cost assistance, Egegik consumers enjoyed some of the lowest cost electricity in Bristol Bay in 1981.

During the fall, winter, and early spring, the two processing plants buy their power from the community utility. Most of this off-season power is used by the winter caretakers and is also used to run the company stores. The plants generate their own power during the summer operating months. The Diamond "E" plant is provided with power from two 12.5 kw generators, both about two years old. Only one generator is used at a time. Egegik Seafoods has a three generator system. During the processing season, they use a 150 kw generator 50 percent of the time, depending on the load requirements. Both processors express an interest in buying power from the utility year-round, should the utility upgrade its system to accommodate the heavier summer load.

Electricity Use Pattern. The most common appliances in Egegik homes are freezers, washers, televisions, radios, tape decks, C.B.'s, and various kitchen appliances. Refrigerators, dryers, portable space heaters, video recorders, and water pumps are also found in many village homes. Most residents use propane cookstoves. About 30 percent of the homes have hot water heaters, 90 percent of which are oil fired.

Fuel Oil Supply Characteristics. Fuel oil is supplied to Egegik consumers by the native-owned Diamond "E" plant. The processor buys fuel from Chevron in Dillingham and hauls it to Egegik on the company barge. They fill the 50,000 gallon capacity storage tanks once in the spring for summer operations and sales, and once again at the end of the summer for sales to the community. In 1980, the plant sold approximately 54,000 gallons of fuel oil to the village, with price per gallon reported to be from $1.32 to $1.50. Sales are made to residents, to commercial consumers, and to the school.

The Egegik electric utility buys fuel oil directly from Chevron in Dillingham, and then pays Diamond "E" to haul the fuel to Egegik on the company barge and store it in the plant's tanks. There is a line from the plant's storage tanks directly into the utility's holding tanks. The utility used 24,521 gallons of fuel oil in 1980.

Space Heating Pattern. Fuel oil is the most common source of space heating in Egegik homes. Average annual consumption of fuel oil in the residential sector in 1980 was 1,289 gallons per customer, according to the household surveys. Total space heating fuel oil consumption for the 14 residences surveyed was 18,040 gallons.

In the last two years, there has been a trend toward using wood for space heat in the community, either as a primary or a secondary source. In 1980, all homes were heated with fuel oil. By 1981, wood was being used as the primary source of heat in two residences, and as a secondary source in three other homes. Several residents plan to heat their new homes with wood when the homes are built. Residents currently heating with wood get their supply from abandoned cannery buildings, and from the local processing plant's leftovers. Since there is not an abundant natural source of wood in the area, the trend toward heating with wood could create a supply shortage.

Planned Development. Wind power is one alternative source of energy being explored by several residents in the area. One wind generator is currently in operation at a residence across the river from Egegik. Another wind generator is presently under construction in the village.

Land ownership is an important issue in the village. Twelve hundred acres is available to Egegik residents from Becharof Corporation if they collectively choose to change the community's classification to second class or equivalent. This could spark additional residential, commercial, and, possibly, industrial growth, which some residents believe is presently constrained by limited available land to build on.

Industry expansion is limited by a number of factors, but the availability of land seems to be the major limitation, both for new plants that may want to move into the area, and for existing plants that could be expanded.

Some Egegik residents feel there is room in the bay for more processing activity than currently exists. At times during the past several seasons, processors have been unable to handle the volume of fish coming into the plants and have had to fly fish out to processing plants in other communities, or turn away boats trying to sell their load of fish.

The Alaska Department of Transportation and Public Facilities plans to use fiscal year 1983/84 funds to extend the runway at the Egegik airport. There are currently no Department of Transportation funded projects in progress.

5. MANOKOTAK

General Description. Manokotak is a moderate-size fishing community located on the east bank of the Igushik River, about 20 air miles west of Dillingham. Acorn Peak, a small mountain situated between Manokotak and Dillingham, symbolizes Manokotak's relative isolation from the nearby regional center. Unlike Aleknagik and other Nushagak communities, Manokotak is neither road connected nor linked directly via river to Dillingham. The Igushik River provides access to Dillingham via Nushagak Bay.

Population. According to U.S. Census data, Manokotak's population was 294 in 1980. Manokotak is one of the few study area villages that can boast of an increasing share of regional population since 1960. As a proportion of total study area population, Manokotak has made modest gains from 6 percent in 1960 to almost 8 percent in 1980. Over the past twenty years, population has been growing steadily at over 3 percent per year.

Native inhabitants of Manokotak are primarily Eskimo. At 93 percent in 1980, the proportion of Native inhabitants out of total population has declined slightly from 96 percent in 1970.

Population growth over the past two decades has probably resulted from a combination of natural increase and regional in-migration from intermarriage with inhabitants of other communities.

The U.S. Census counted 57 households in 1980, up from 37 in 1970. Part of this increase is due to the decline in average household size from 5.8 persons per household in 1970 to 5.2 in 1980. Average household size in Manokotak was still considerably higher than the 1980 study area average of 3.4 persons per household, reflecting the larger family size of Native households.

Historical data on population and households is summarized in Table A.13.

TABLE A.13. MANOKOTAK POPULATION AND HOUSEHOLDS

	1960	1970	1980
Total Population	149	214	294
Proportion of Total Study Area Population (%)	6.0	7.0	7.6
Proportion of Native Population (%)	NA	96	93
Number of Households	NA	37	57
Number of Persons per Household	NA	5.8	5.2

SOURCE: U.S. Department of Commerce
Bureau of the Census

Economic Base. Fish harvesting is the economic mainstay of Manokotak's economy. ISER survey data indicate that, in 1981, one out of every two households owned a salmon drift-net permit. During the same period, there were approximately 50 set-net permits, one for nearly every household. Collectively, Manokotak residents own 20-to-25 32-foot fishing boats and about the same number of sciffs.

Based on discussions with village residents, we estimated the 1981 average catch per 32-foot boat to be between 78 and 90 thousand pounds of red salmon. This implies an average cash income per boat of about $65,000, excluding the value of set-net harvests, which would each contribute an additional 20 to 30 thousand pounds. The data collected from site visits on average catch, value of catch, and number of permits is summarized in Table A.14. The implications for household income are discussed below.

TABLE A.14. MANOKOTAK 1981 FISHING ECONOMY

Permit (1) Type	Permit (2) Number	(3) Average Catch (lbs)	(4) Value of Catch	(5) Total Value of Catch (2) x (4)
Driftnet	20	78,000-90,000	$65,000	$1,300,000
Setnet	50	20,000-30,100	$18,750	937,500
	Total Fish-Harvesting Income			$2,237,500
	Fish-Harvesting Income per Household			$ 39,575

SOURCE: ISER Data from site visits in Fall, 1981.

Arts and crafts (basket weaving), services, and government activities comprise the remaining elements of Manokotak's economic base. Although the income from these activities would be less seasonal than fishing, the combined total is probably only a fraction of total contribution of fishing income.

Labor Force and Employment. In general, nearly all Manokotak inhabitants vacate the village during fishing season. The village moves as a collective body to a fish camp at the mouth of the Igushik River.

There are about eight full-time jobs and ten half-time jobs in Manokotak's nonfishing economy. The jobs are typical of those found in most moderate-size Bristol Bay villages. They include the mayor, the village secretary, postal staff, school teachers, village store manager, pump house maintenance, meter reader, and occasional project-specific planning positions. Temporary construction jobs become available when, for example, new teachers' quarters are constructed.

Jobs are also available through housing-stock expansion. Homes are usually owner built, providing several months of gainful employment for at least one additional member of the community.

Personal Income. In general, Manokotak's average household income ranked highest among Bristol Bay's smaller, more isolated villages. As shown in Table A.14 above, average household income from fish harvesting, alone, was estimated to be $39,575 in 1981. This estimate is over twice the level of 1980 household income ($17,325) derived from an alternative method using 1978 taxable income, as shown in Table A.4 at the beginning of Appendix A. This discrepancy probably results from successive improvements in Bristol Bay's fishing economy, which altered the level and regional distribution of personal income from those recorded in 1978 income tax data.

Building Stock Characteristics. The building stock in Manokotak is typical of that found in other moderate-income study-area communities. It is composed primarily of owner-built residential dwellings and has a sizable portion of government houses.

In 1980, the residential housing stock included about 50 single-family dwellings, averaging about 600 square feet of floor area. Most homes are wood frame on pilings with unenclosed crawl spaces and unheated attics. The basic surfaces of the homes are constructed with the following materials.

		Fiberglass Insulation	
Surface	Member	Thickness (Inches)	R-Value
Wall Stud	2 x 4	3½	13
Floor Joist	2 x 6	5½	19
Ceiling Truss	2 x 6	5½	19

R-Value is a standard measure of a material's resistance to heat loss.

From a heat loss standpoint, the Manokotak homes are in better condition than those of lower-income communities. (See discussion of RurAlCap energy audits in Section VI.) However, even the newer homes do not have advanced energy-saving features and generally fall short of HUD efficiency standards (R-19 walls and floor; R-38 ceiling).

The housing stock is fairly uniform with age. Older homes can be identified by the number of single-room additions that have been built.

Growth in Manokotak's housing stock is an indicator of relatively high personal income. In October 1981, seven new houses were in progress. Because the homes are owner-built, they are probably not financed. Owners will typically pay cash for building materials shipped from Dillingham or Seattle. This may help to explain the tendency to use common, inexpensive, less energy-efficient materials.

In 1974, the Alaska State Housing Authority (ASHA) built 19 homes in Manokotak, representing over one-third of the community's residential housing stock. Eight of these are less common, two-story structures, offering about twice the floor area of the average 600 square foot home.

On a unit-by-unit basis, there were eight commercial/government (C/G) structures in 1980, representing about 14 percent of the total residential and nonresidential building stock. The C/G facilities include the school, clinic/community hall, cooperative store, private store, city-office building, church, warehouse, and generator house. In September 1981, the pump house began operating. A duplex for more teacher housing was under construction in October 1981. The village corporation, Manokotak Natives, Limited, plans to build a laundromat in the near future.

Electricity Generating System. Village electricity is supplied by three generators having 600 kw of combined capacity. The generators are operated by Manokotak City Electric, a nonprofit, non-REA electric utility. The oldest generator was purchased in 1976. Prior to that, the village obtained power from the school generator, which is now used as a backup system.

Electricity Use Pattern. In 1980, Manokotak City Electric produced approximately 281,000 kwh of village-wide electricity, using 40,000 gallons of diesel fuel. According to meter records, 38,000 kwh was consumed by nonschool C/G customers, leaving 243,000 kwhs for school and residential customers. Using data from several communities served by the Southwest Regional School District, we estimated school electricity consumption to be 81,000 kwh, leaving 162,000 kwh for 49 residential customers. This implies that 1980 average residential consumption equaled 3,306 kwh.

The price of electricity increased from 20¢ to 30¢ per kwh in August 1981. The price charged by Manokotak City Electric is uniform across all users.

Fuel Oil Supply Characteristics. Fuel oil is shipped by barge from Dillingham. The village does not operate as a vender for fuel distribution. Resident and commercial users are responsible for acquisition and storage. Fuel is purchased by resident and commercial users several times a year and is stored in tanks ranging from 55 to

500 gallons. Municipal bulk storage is not available for residential heating fuel. Manokotak City Electric has 50,000 gallons of storage capacity for its generators.

Space Heating. In 1980, a total of 149,000 gallons was consumed for both space heating (109,000 gallons) and for electricity generation (40,000 gallons). The breakdown of space heating fuel consumption by user type is shown below:

Residential		44,000
Commercial/Gov't		64,600
Nonschool	18,800	
School	45,800	
		108,600

The most common type of space heating unit used by both residential and C/G consumers is a gun-fired, forced-air, oil furnace. Residential fuel oil consumption ranges from eight to twenty-one 55-gallon drums per year. We assume that the average household uses 14 drums (770 gallons) of fuel oil per year.

Water heating is usually accomplished with fuel oil. A simple heat exchange coil is commonly used to draw heat from the furnace to a water heating tank. Thus, the 770 gallons per household includes water heating.

Heating oil fuel consumption by C/G customers varies widely, with the school as the largest single user. Other fuels commonly consumed in Manokotak are wood and propane.

Wood was used for primary heating in two Manokotak households in 1981. A much larger source of wood consumption is Manokotak's sixteen steamhouses which use wood exclusively. There are usually three steams per day, requiring two 55-gallon drum loads each, collectively consuming one cord per week in winter months.

Propane is used primarily for cooking in all households. We estimate that a propane cookstove would use about 46 gallons per year per household.

Summary of Distinguishing Features. On the one hand, Manokotak has many features in common with the "typical" Bristol Bay community. These include housing-stock characteristics, relative isolation, and emphasis on fishing. On the other hand, Manokotak is different because a relatively large segment of its population own salmon permits, compared with other Bristol Bay communities. Manokotak is an uncommon example of a strong economy, as reflected in steady population growth, high electricity consumption, and high household income, despite its limited diversification.

6. NEW STOYAHOK

General Description of Village. The community of New Stuyahok is located on the east bank of the Nushagak River, approximately 50 air miles northeast of Dillingham. Its closest neighbor, Ekwok, lies 12 miles to the south. There is a great deal of interaction between the people of New Stuyahok, Ekwok and Koliganek, New Stuyahok's northern neighbor.

New Stuyahok stretches along the edge of the Nushagak River and up along the hillside above the river. Many of the houses are set among stands of trees, providing them some privacy from neighboring homes. New Stuyahok has changed locations twice, once in 1918 and again in 1942.

Population. The majority of New Stuyahok residents are of Yupik descent. According to the U.S. Census, there were 216 people living in the community in 1970 and 331 living in the community in 1980, with 94 percent of the population Native. Population figures collected during the household survey for the energy demand study in 1981 show 270 residents living in 47 houses, giving an average household size of 5.74 people. The actual number of occupied residences varies, depending on the source of information. In 1980, there were 54 residential electricity consumers and nine commercial consumers, according to Alaska Village Electric Cooperative records. Census figures show 65 occupied residences in 1980, with an average of 5.09

people per household. The community population decreases by about 50 percent in the summer, with residents leaving for fishing activities. Many residents subsistence fish at fish camps along Lewis Point. Some residents go to Dillingham to participate in commercial fishing activities.

Economic Base/Labor Force and Employment. The economy of New Stoyahok is based primarily on the commercial salmon fishing industry. There are 25 drift-net permits owned by residents, 21 of these for boats and 4 for skiffs. One source indicated that 50 percent of the community is involved in commercial fishing activities, while another source indicated that only 30 percent is involved. One resident fishes during the herring season, which lasts from mid-May until the end of July.

Trapping is a source of income for about 50 percent of the male population in New Stuyahok. The trapping season lasts one month and income from trapping varies, depending on the fur market and the number of animals available each season.

The Southwest Regional School District employs nine full-time teachers, four part-time teacher's aides, administrative personnel, cooks and janitors. Other employment in the community includes positions on the city council, a full-time postal clerk, three health aides, and one CPR, a part-time grader for the airstrip, a janitor for the city office building and clinic, a part-time social worker, two protection officers (VSPOs), a police officer, and various other maintenance personnel for the Public Health Service and AVEC.

Personal Income. Average household income in New Stuyahok was $16,784 in 1980, according to tax return information from the Alaska Department of Revenue. New Stuyahok residents estimated average catch per boat with drift-net permit to be 50,000 pounds of fish for the 1980 season. Average set net catch was estimated at 10,000 pounds per net for 1980.

Building Stock Characteristics. Residential buildings in New Stuyahok are mainly of wood frame construction, although there are also older log homes in the village. The Alaska State Housing Authority (ASHA) constructed 16 houses in the community. Average floor area of 46 houses surveyed during the household survey is 759 square feet. Rural Alaska Community Action Program (Rural CAP) has conducted home energy audits in about ten homes in New Stuyahok and these homes have been weatherized.

Commercial, government, and community buildings in the village include a clinic, a coop store, a new city hall/office (which is still in the process of being completed), the community building, which is used for recreation purposes, a church, a utility power house, and the village pump house which houses the RCA equipment. There are also various residential and commercial shops in the village. Average floor area for non-school commercial/government buildings is 631 square feet.

The school facilities are divided into three main buildings: the grade school/junior high, the high school, and a new gymnasium built in the spring of 1980. The school district also manages two duplexes in the community which are used as teachers' quarters. New roofs were put on the grade school/junior high and the duplexes in September 1981. There are 91 students enrolled in grades K through 12 this year, with 100 students expected for the 1982/83 school year. A preschool program for three and four year olds was started in 1981 and was held in a community building.

Electricity Generation System. Electricity in New Stuyahok is provided by the Alaska Village Electric Cooperative (AVEC). The AVEC system in the community consists of two 105-kw generators and one 75 kw generator. Only one generator is running at a time. The 75-kw generator is used during the summer months and in the evenings year-round. The two 105-kw generators are alternated during daytime hours in the fall, winter and spring. All three generators were new when installed in 1971 or 1972. Yearly energy demand peaks occur in December or January. The 1980 peak was 82 kw and occurred in December. There are daily peaks at around 9:00 a.m. and 3:30 p.m. Although the school receives most of its power from AVEC, it also has a stand-by 100-kw generator. There are several privately owned generators in the community, but they are not normally used. A few people take small generators to summer fish camp to run radios and televisions.

Electricity Use Pattern. Electricity consumption data was acquired from AVEC records. In 1978, AVEC sold 99,759 kwh to 48 residential customers and 25,329 kwh to three commercial customers, for an average of 2,078 kwh and 8,443 kwh per residential and commercial customers, respectively. The school facilities bought 132,185 kwh that year. In 1980, 54 residential customers consumed a total of 105,346 kwh, eight commercial customers consumed 57,674 kwh, and the school facilities consumed 144,628 kwh of AVEC power. Average residential consumption for 1980 was 1,951 kwh per customer, and average commercial consumption was 7,209 kwh per customer. In 1980, the price per kwh paid by residential customers was 21.3¢; starting from a rate base of 37.2¢, adding an 11.1¢ plus an 11.07¢ fuel surcharge, minus fuel surcharge and then deducting 26.9¢ for power cost assistance. Small commercial customers paid a total of 18.34¢ per kwh. The one large commercial customer, the school, paid a base rate of 32.5¢ per kwh up to the first 1,500 kwh and 24.8¢ per kwh over 1,500 kwh, before adding the 11.07¢ fuel surcharge, and then deducting 26.93¢ for power cost assistance.

The most common appliances found in New Stuyahok residences are freezers, C.B.'s, radios, tape decks, televisions, washers and electric heat tape. Sixty-five percent of the homes have oil fired hot water heaters. There is one phone in the community. The school duplexes are electrically heated and have electric cookstoves. In 1980, the duplexes average 5,656 kwh per unit, compared to the average residential consumption of 1,951 kwh.

Fuel Oil. Smith Lighterage, based in Aleknagik, provides fuel oil to some New Stuyahok residents and to the AVEC power plant. AVEC reported a price of $1.19 per gallon paid for fuel oil delivered by Smith Lighterage in 1980. Prices reported by several residents for 1981 fuel oil range from $1.46 to $1.52 per gallon. AVEC purchased 40,000 gallons of fuel oil from Smith Lighterage in 1981.

Almost half of those residents surveyed in the household survey purchased their fuel in Dillingham and hauled it to New Stuyahok on fishing boats. In 1981, Sorenson Lighterage, based in Dillingham, delivered fuel oil to the Southwest Regional schools, including the New Stuyahok school. The price for fuel oil delivered by Sorenson Lighterage was $1.45 per gallon.

Space Heating Pattern. The majority of New Stuyahok residents heat their homes with fuel oil. Results from the household survey show 46 out of the 47 households surveyed heated their homes with fuel oil, consuming an average of 990 gallons per residence in 1980. One resident used wood in 1980 as the primary source of heat. In 1981, there was an additional residence that was heated primarily with wood and several other homes where woodstoves were used to supplement oil stoves. Trees are plentiful in the area, and at least one family planning a new home intends to heat it with wood when it is constructed.

Planned Development. Because of the increasing demand for electricity in New Stuyahok, AVEC plans to buy two new generators in 1982 to replace the existing units.

7. PORTAGE CREEK

General Description. Portage Creek is located on the Nushagak River approximately 38 river miles and 27 air miles from Dillingham. Historically, the creek from which Portage Creek takes its name was used as a route between the Nushagak River and the western shore of Kvichek Bay. The settlement of Portage Creek is relatively new, the first permanent residences established in 1960 by people from the other Nushagak River villages of Ekwok, New Stuyahok, and Koliganek. Current residents of Portage Creek maintain close ties with the upriver villages and travel to Dillingham is frequent.

Population. In 1981, 34 people lived permanently in 14 residences in Portage Creek. The 1970 and 1980 census figures indicated a village population of 60 and 48, respectively. Yupik Eskimo comprised 92 percent of the 1980 population. However, village residents reject the indication that the village is shrinking and suggest that Portage Creek will grow in the future as people from upriver villages migrate closer to Dillingham and away from the navigational hazards caused by the decreasing water levels of the Nushagak River.

Economic Base. Salmon fishing provides the economic and subsistence base for Portage Creek. Village residents own six power boats and hold ten drift-net and five commercial set-net permits. About 13 of the villagers fish commercially; most others are involved in subsistence fishing. During the fishing season, only four residences remain occupied, three of those by elders who are supplied by other family members.

There are no commercial services offered in Portage Creek. A Russian Orthodox church, a combined community hall - health clinic, and the school are the only non-residential structures in the village.

Labor Force and Employment. Non-fishing employment consists of one health aide on call around the clock, two full-time teachers, one part-time teacher's aide, one part-time bilingual teacher, a school janitor/maintenance man, and one school cook. All of these positions are available for the nine non-summer months. There is no seasonal employment in the village and, therefore, no itinerant summer labor force.

Personal Income. From conversations with village residents, it is estimated that the average gross fishing income per resident with a commercial drift-net permit is $35,000. Tax return data from nearby communities with similar economies suggests an average household income of $15,000.

Building Stock Characteristics. There are several abandoned small wood houses in Portage Creek, which were used by the first village residents. Ten of the current fourteen residences were built in the 1960s. These households are all one story and average 533 square feet of floor area. The four more recent residences averaged

564 square feet in size. Insulation values are low for all residences; all of the 1960 houses have four-inch stud walls, but were either not insulated or the insulation has since deteriorated. Vapor barriers, in general, are not used in the village. The newer houses generally use four inches of wall and ceiling insulation, but one house built in 1976 included no ceiling insulation at all.

A Russian Orthodox Church and the village council building are both built with four inches of wall and ceiling insulation. The church was built in the late 1960's, the village council building after 1975. The Southwest Regional School District manages the Portage Creek elementary school. The main school building was built in 1968. Total floor area for the school is 986 square feet. High school age students leave the village for their education.

The newest houses in Portage Creek were built in 1976. One house was currently under construction in October 1981, with a projected completion date of 1983.

Electricity Generation System. Southwest Regional School District maintains two 50 kw generators at the school. Electricity is sold to each household in Portage Creek for the nine month period that the school operates.

Two private generators are located in the village. A 3.5 kw diesel plant provides summer electricity for two houses. The other light plant, a 4 kw diesel, is rarely used because the family moves out to fish camp for the entire fishing season.

Wind power is used to charge the 12 batteries operating the television translator for Portage Creek. Residents claim, however, that the wind resource is unsteady and, therefore, television reception or any other potential uses of wind power are unreliable.

Electricity Use Pattern. Electricity consumption data for individual residences in Portage Creek was not available. The school sold 18,500 kwh to the village in school year 1980-81. The most commonly owned appliances in Portage Creek are clothes washers, televisions, radios and freezers. Residents empty out their freezers for the powerless summer months.

Fuel Oil Supply Characteristics. Fuel oil is brought to Portage Creek either by barge (Sorenson or Smith Lighterage) or by residents in their own boats from Dillingham. In 1981 Sorenson Lighterage delivered fuel to the school in Portage Creek at a cost of $1.35 per gallon.

Space Heating Pattern. Eleven of the 14 Portage Creek residences use stove oil as their primary fuel for space heating. Oil stoves are kept operating 24 hours a day and used for both cooking and heating. These residences averaged 1,035 gallons of stove oil per year, or 0.69 gallon/square foot conditioned floor area.

One residence used wood as a secondary heating fuel for night use when the oil stove was not needed for cooking. Two residences use wood as the only heating fuel. Wood is gathered by sled or boat from the region immediately around the village. Data on the quantity of wood used annually in these three residences is not available.

Planned Development. During the site visit in late 1981, a new health clinic and one residence were under construction. Both had been started over one year previously, but were expected to be completed in 1982. There are no present development plans beyond these two buildings.

The proximity of Portage Creek to Dillingham may be a factor in the eventual growth in population of the village, but it will probably also hinder development of a commercial and services sector. At present, Dillingham is referred to as "town," and trips to town are frequent for an afternoon shopping spree, for a laundry day, or for recreation.

The seasonal pattern of electricity use in Portage Creek will likely slow the development of or desire for centralized year-round electricity in the village. Residents expressed some inconvenience with the need to empty freezers for the summer, but at the same time, the problem did not lead to an expressed need for summer electricity.

8. EKWOK

General Description. The village of Ekwok lies on the west side of the Nushagak River 15 miles south of New Stuyahok and 60 airmiles northeast of Dillingham. There are very close ties between Ekwok and the other Nushagak River villages, particularly New Stuyahok. Four commercial air taxis run frequently between the river villages.

Population. In December 1981, Ekwok had 82 people in 25 residences for an average household size of 3.28 people. The U.S. Bureau of the Census reports a decrease from 103 to 77 residents from 1970 to 1980. Over the past several decades, the census data for Ekwok has been contested by the residents who maintain that the population of the village has been and currently is stable, and that housing is the limiting factor for population growth. In 1980, 92 percent of the population was Native.

Economic Base. The economic base of Ekwok is commercial fishing, although the village is less active in the commercial fisheries than other villages in the study region. Only one family leaves the village for the entire fishing season. In other families, one person will commercial fish, most commonly for only one month. Approximately ten drift-net permits are held in the village, and four power boats and four skiffs used for commercial fishing. Women and children set net for subsistence in the Nushagak River near the village.

Ekwok Natives, Limited, owns and manages a lodge located 1½ miles downriver from the village. From May to October the lodge provides housing and guide service to fishermen from Alaska, the "Lower 48" and foreign countries.

Labor Force and Employment. The Ekwok school is the largest employer in the village with three full-time teachers, a bilingual teacher, a janitor and a cook. Other employment in the village includes an airstrip grader, a generator maintenance man, a health aide and a village government employee. During the fishing season the Ekwok lodge is staffed by a manager and three to four guides.

Personal Income. From 1978 tax return data, the estimated 1980 average household income in Ekwok was $10,715. This relatively low income level suggests that commercial fishing was less intensively pursued in Ekwok compared with other Bristol Bay communities.

Building Stock Characteristics. There are 25 residences, 3 commercial buildings, 2 churches, and 1 school in Ekwok. Until 1960, the residences were built on the riverfront out of logs. In the past 20 years, most of these log houses have been abandoned as people moved up on the bluff into plywood and prefabricated frame houses. Only three houses built before 1961 are presently inhabited. Residences average 484 square feet of floor area. Houses are built above gravel pads with uninsulated floors. All walls appear to be insulated, some of the newer houses with over six inches of fiberglass. Many houses have double-pane windows, but improper installation has resulted in condensation problems.

Commercial buildings in Ekwok include a new clinic, a combined village council hall/clinic and a store. The new clinic was still under construction during November 1981, and there is, therefore, no annual heating data. The village council building is divided into two distinct sections. The section that houses the present health clinic is heated continuously with an oil heater. The village council section is heated only for council and community events. The building is constructed with 2x4 framing and double-pane windows. The average floor area for commercial buildings in Ekwok is 502 square feet.

The Ekwok school is part of the Southwest Regional School District. It is a new building with a large gymnasium and a total floor area of 4,017 square feet.

<u>Electricity Generation System</u>. During the school year the village of Ekwok draws power from the two 75-kw generators operated by the school. The school district charges the village on a regular basis at a cost of $.25/kwh. The village, in turn, is responsible for the metering electricity use and charging individual customers.

In the summer season a 40-kw village-owned generator supplies all village electricity. The same distribution system is used throughout the year. Power to the Ekwok Lodge is supplied by an on-site 7-kw generator. No specific consumption data is available for this system.

Electricity Use Pattern. From 1975 through 1978, a 20-kw generator met the village's summer electricity needs. In 1979 this generator was replaced with the present 40-kw system. By the summer of 1981, the 40 kw generator was run at full capacity and a larger system was contemplated. The increased demand does not reflect an increase in the number of residences supplied with power, but instead reflects a rise in the level of electricity use per household.

Residences in Ekwok use an average of 1,678 kwh of power annually. Most commonly owned appliances are lights, washing machines, radios and freezers.

The village council building and store used 11,200 kwh and 684 kwh, respectively, in 1980.

Fuel Oil Supply Characteristics. Oil is delivered to Ekwok by both Sorenson Lighterage and Smith Lighterage. Two households buy directly from Standard Oil in Dillingham and haul the barrels to Ekwok by boat. The school has a storage capacity of 28,000 gallons.

Space Heating Pattern. Stove oil is the predominant space-heating fuel in Ekwok. Most residences run an oil stove continuously. Some houses supplement their oil stove with an oil heater. Residences average 18 barrels (1,083 gallons) of stove oil per year for space heating.

Many houses use wood in barrel stoves to supplement oil heat during the coldest winter temperatures. Only two residences use wood as their primary heating fuel. Steam baths fueled with wood are an everyday event in the village. The largest steams use up to 20 cords of wood per year. A total of 18 residences use wood for home or steam heating, with an average of 7½ cords per residence for all uses.

Planned Development. A new clinic was under construction in the fall of 1981. There are currently no plans for major development in the village.

Additional Site-Specific Information. There seems to be less participation by entire families in Ekwok in the fisheries than in other Bristol Bay area villages. Instead of an entire family moving to a summer fish camp, a typical fishing Ekwok family has one family member leave to fish commercially while the others stay in the village for the summer. This pattern, therefore, suggests a more consistent energy consumption pattern for the village that is supported by the electricity use data: two thirds of the total electricity use is consumed during the nine months of the school year, and one third is consumed during the summer months when the village generator is supplying power.

9. KOLIGANEK

General Description of Village. The name "Koliganek" means "Last" or "Upper Village." The village of Koliganek made two site moves, the first in 1940 because of a shortage of firewood in the original site, and the second in 1964 because of flooding problems in the second location. The village is now located on the south side of the Nushagak River, approximately 63 air miles north of Dillingham and 19 miles north of New Stuyahok, its closest neighbor. There are close historical and present ties between the people of Koliganek, New Stuyahok, and Ekwok, which lies farther south along the river. The community is physically split by a creek, with a small foot bridge joining the two halves.

Population. According to the U.S. Census, there were 142 people living in 19 households in Koliganek in 1970. Census results for 1980 show 117 people living in 24 households, giving an average household size of 4.89 people. Of the 117 residents, 96 percent were Native. The household survey conducted for the energy demand study in 1981 shows 137 people living in the 30 households surveyed. One resident indicated that there are currently 40 occupied residences in the village. The village administrator expects an increase in the number of households in Koliganek due to children marrying and establishing residences separate from their parents.

In the summer, from 50-to-75 percent of the village's residents leave the community to participate in commercial and subsistence fishing activities. One source estimated that about 15 people from Koliganek, mostly women, work in the processing plants in Dillingham during the fishing season.

Economic Base/Labor Force and Employment. Commercial fishing is the main source of income for many Koliganek residents. There are 18 drift-net and 8 set-net permits in the community. On average, two people work each boat.

Local, state, and federal government positions include a full-time city administrator, village council administrators, a part-time bi-cultural coordinator, a part-time village secretary, a postal clerk, a part-time meter reader, a pump house maintenance person, and three part-time CETA workers. There are two store managers in the village, one for the coop store and one for the privately owned store. Southwest Regional School District employs six teachers, including one part-time bilingual teacher, a teachers' aide, a part-time cook, two part-time secretaries, and various maintenance and administrative personnel.

Personal Income. Average household income in Koliganek in 1980 was $9,536, according to tax return information from the Alaska Department of Revenue. The 1980 average catch for boats with drift-net permits was 65,000 pounds per boat and average catch made with commercial set nets was 25,000 pounds per net, according to information from Koliganek and other Bristol Bay residents. By comparison, the data on catch imply an average household income that is more than double the well level derived from 1978 tax return data.

Building Stock Characteristics. Many of the houses in Koliganek are small, older structures of log or wood frame construction. The newer houses, built on the outskirts of the main village, are larger, more energy efficient structures. There are no government housing projects currently in or planned for the village. One source indicated that residents feel they can do a better job of constructing their own homes, and there are several new homes planned for the near future. Results from the household survey show an average floor area of 632 square feet in the 39 residences surveyed.

There are nine nonresidential buildings in the community, excluding the school facilities. These include two stores, the post office, a pump house, a village council building, a clinic, several warehouses at the airport, and a church. School buildings include a classroom/teachers' quarters building of 12,066 square feet, a multi-purpose building, and a small shop. There is a shop addition currently being added on to the multipurpose building that will give that building a total area of 6,200 square feet. The old shop will be retired from use when the addition is completed sometime in 1982.

Present Electricity Generation System. The Southwest Regional School power system provides electricity to most of Koliganek's residential and nonresidential consumers for nine months of the year. The school power system consists of two 90 kw generators. During the summer months, a village-owned generator is used to provide electricity to the community. Total kwh generated by the school power house for the period November 1980 to November 1981 was 65,990 kwh.

There are four residences in the community receiving electricity from four privately owned generators. One resident uses a small gasoline generator and is also tied into a neighbor's diesel generator. Of the four generators, one is used only to provide power for construction work on a new house.

Electricity Use Pattern. According to village meter records, there were 30 residential customers tied into the community system in November 1981, using an average of 182 kwh per customer for the month of October. Annual electricity consumption information was available for only six customers. Average consumption for these six was 1,103 kwh per customer for the period November 1980 to November 1981. Electricity is used to power lights, freezers, washers, televisions, radios, and CB's, which are the most common appliances in Koliganek homes. Most cooking is done on oil cookstoves. A maximum of 20 percent of Koliganek residences have hot water heaters. The majority of these heaters are propane fired. The percentage of households in the village with electric kitchen appliances, including refrigerators, is low, as reflected in the comparatively low electricity consumption per household.

Fuel Oil Supply Characteristics. Residents in Koliganek either buy their fuel oil from the Smith Lighterage barge, which delivers fuel to Nushagak River communities in the fall, or from Chevron in Dillingham and haul it to Koliganek on their fishing boats. One resident quoted a price of $1.60 per gallon paid for fuel oil delivered by Smith Lighterage in 1981. Chevron in Dillingham charged $1.126 and $1.236 per gallon for stove oil in 1980 and 1981, respectively, and $1.076 and $1.176 for diesel fuel in those respective years.

Sorenson Lighterage in Dillingham was awarded the 1981 contract to supply fuel oil to Southwest Regional schools. Cost for fuel to be delivered by the Sorenson barge was $1.51 per gallon in 1981. The school has a bulk fuel storage capacity of 40,000 gallons. It used 23,000 gallons of fuel oil for power generation and 15,000 gallons for space heating during the 1980/1981 school year.

Space Heating Pattern. Most Koliganek homes are heated by oil stoves. According to the household survey, 21 out of 30 homes surveyed used fuel oil as the primary source of space heat in 1980, consuming an annual average of 605 gallons of fuel oil per household. One family surveyed uses fuel oil as a supplement to wood heating and consumes an average of 275 gallons of fuel oil per year.

There were eight homes in Koliganek that were heated primarily with wood in 1980. At the time of the site visit in 1981, fifteen woodstoves were being used in the village, and this number is expected to increase to eighteen in the next couple of years. There were approximately ten, wood-heated steam houses in Koliganek. Residents collect wood individually and burn mostly birch in their stoves.

Waste heat from the school power house is used for space heating in the classroom and multipurpose school buildings.

Planned Development. The electricity system provided by the school is not adequate for the current energy needs in Koliganek. There are problems with fluctuations in demand, causing appliance burn-out and brown-outs in the communities.

Leaders in the community are exploring solutions to the energy problem, but they express an overall community feeling that they would rather live with the system as is and maintain their current lifestyle than have their community experience rapid growth through the development of a large energy project in or near the area. Land disposal is a major concern of residents. The area around Koliganek is scheduled for land disposals by the Alaska Department of Natural Resources in the spring of 1982.

The Alaska Department of Transportation and Public Facilities currently has funding allocated for the construction of local service roads, trails, and bridges and the installation of runway lights at the airstrip. Runway lighting cannot be installed until a reliable source of power that will meet the needs of the lighting system is available in the community. Projects proposed for fiscal year 1983-84 include road and bridge supplements and a runway extension.

10. ILIAMNA

General Description of Village. The community of Iliamna is located on the northern shore of Lake Iliamna, approximately 110 air miles northeast of Naknek. Iliamna is connected by road to Newhalen, its closest neighbor, just five miles away. The community is accessible by air and by water, with a lighted runway outside of town and an airstrip inside the community. There are scheduled and charter flights available on Wien Air Alaska and on two other local air taxi services.

Population. The U.S. Census Bureau reported 58 residents living in Iliamna in 1970. This number increased to 94 residents by the time of the 1980 census, with 22 households reported in the community. The population is 40 percent Native according to the Census Bureau.

Iliamna serves as the commercial center for the Iliamna Lake area. With the large number of commercial and government services in the village, the population remains fairly stable year-round. Many of the Native residents leave the community for commercial and subsistence fishing activities in the summer, but there is an influx of tourists into the community in summer and fall for hunting and fishing activities, which offsets the out-migration trend. The majority of the non-Natives in Iliamna either work for the state or federal government or have business enterprises in the community such as lodges and stores.

Economic Base/Labor Force and Employment. Iliamna's economy is based primarily on commercial enterprises and government services. The various businesses which stem from the community's position as commercial center for the area include two retail stores, seven lodges, two air taxi services, a commercial air carrier, a fuel distributor, and several maintenance and salvage operations. Six of the lodges are operated by local residents. Additional lodge employees are hired in summer from outside the area. Both air taxi services are owned and operated by lodge owners, as is one of the stores.

Government employment includes two positions at the flight service station, an airport manager, an Alaska Department of Fish and Game officer, a part-time health aide, two full-time and one part-time postal clerks, council members for the Native council, and a fuel distributor. The school in Newhalen employs from seven to eight teachers, five teacher's aides, and a number of administrators and maintenance personnel. The teachers all live in Iliamna and commute to Newhalen. Some school positions are filled by Newhalen residents.

There are approximately fourteen commercial fishing permits held by Iliamna residents, nine of which are for drift netting and the other five for set netting. Trapping is done mostly by the young men of the community. The number of people participating and the income from trapping varies each year.

Personal Income. Tax records from the Alaska Department of Revenue show a combined average household income for Iliamna and Newhalen of $24,272. Although the average income for each community cannot be separated from this combined average, Iliamna's average household income is probably higher than that of Newhalen since Iliamna is the subregional center for the area, and there is more stable year-round employment in Iliamna than in Newhalen.

Average catch per boat with drift-net permit was about 45,000 pounds of fish, and average set-net catch was 22,000 pounds in 1980 according to Iliamna residents.

F. Building Stock Characteristics

There were 35 occupied residences in Iliamna at the time of the site visit in December 1981. Many of the houses were built in the 1970s, and one is currently under construction. According to the household survey, the average floor area of residences in Iliamna (and Newhalen) was 559 square feet, excluding the lodge residences.

There are approximately 23 commercial and government buildings in the community, some of which are combined businesses and residences. The largest buildings in this sector are the lodges and the airport warehouses. There are also several smaller shops in the community belonging to the state and federal governments. Average floor area of commercial/government buildings is 2,593 square feet.

Electricity Generation System. Iliamna electricity consumers are provided with power from a variety of small private generators. Some generators serve more than one home, and a few serve government or commercial buildings. One 7-kw generator provides power to seven homes as well as to the community hall, the clinic, a shop, and lights for a steam house.

Commercial and government generators in the village include seven lodge generators, a post office generator, and the Federal Aviation Administration generators. Five of the lodges also serve as residences. One of these includes an air taxi service and a store. The other store in the village is in the same building as the owner's residence and is supplied with power from the same generator as is the residence. Other commercial operations and community services which tie into residential generators are AERO Maintenance Service and the Baptist church.

The Federal Aviation Administration generator system is the largest system in Iliamna. The system's two 75-kw generators supply power to approximately fifteen federal- and state-owned buildings and privately owned commercial buildings, including six government-owned residences. The FAA generators also provide power for the airport runway lights, the telephone service, and Alascom.

Several residents in Iliamna are experimenting with wind power. There are currently two 4-kw wind generators in the community, both approximately three years old. Although they are both operable, neither one was in operation at the time of the site visit due to inverter problems.

Electricity Use Pattern. All residences, commercial buildings, and government and community services in Iliamna are supplied with electricity from private generators or the FAA system. Common electric appliances in Iliamna homes include refrigerators; freezers; various small kitchen appliances such as toasters, skillets, and coffeemakers; radios; tape decks; vacuum cleaners, and car plug-ins. Many residences also have video recorders and water pumps. There are several homes with electric ranges and microwave ovens although most residents use propane cook stoves.

Fuel Oil Supply Characteristics. Iliamna receives fuel for space heating and electricity generation each year from the Moody Sea Lighterage and Levelock Natives Limited barges. The barges make the trip from Naknek to the lake area in the summer and fall before freeze-up. The cost for fuel oil purchased from the Moody barge was $1.39 in 1980 and $1.50 in 1981. Levelock Natives Limited charged $1.30 in 1980 and $1.48 in 1981. A local fuel distributor delivers fuel from the barge to various commercial and residential customers.

Space Heating Pattern. The main source of space heating in Iliamna is fuel oil. Most residences are heated with oil stoves or oil heaters although a few are heated primarily with woodstoves.

Planned Development. Iliamna is scheduled to be tied into the Iliamna-Newhalen Electric Cooperative (I-NEC) system late in 1982 (see Newhalen community description). Managers for the new utility expect that all Iliamna electricity consumers will tie into the new system, as will consumers in Newhalen and Nondalton.

The Alaska Department of Transportation and Public Facilities has a number of projects scheduled for Iliamna, some currently funded and others proposed for fiscal year 1983-84. Currently funded projects are a dock study and the completion of the Nondalton-to-Iliamna road. Seven miles of the road have been constructed. The I-NEC utility will use the road to service the electricity line to Nondalton, which will be constructed parallel to the road.

Projects proposed for the 1983-84 fiscal year are runway extension and access road construction and construction of three bridges in the area. Other government funding for community projects includes a $100,000 legislative grant in fiscal year 1981 for the construction of bulk fuel storage facilities.

Land status is an important factor in Iliamna's future growth. The community is currently unincorporated, and the Natives in the community are interested in having it established as a traditional Native village while other residents would like to see Iliamna become an incorporated city. The outcome of the land issue will affect the availability of land for future commercial and residential use.

Summary of Distinguishing Characteristics. Iliamna is one of two communities in the study region where the number of resident non-Natives is larger than the number of resident Natives. The population is approximately 60 percent non-Native and 40 percent Native according to U.S. Census Bureau statistics for 1980.

Another distinguishing feature in the community is that its economy is not directly based on the commercial fishing industry. It functions as a regional center for the area, and the majority of Iliamna residents are involved in commercial enterprises or work for the government. There is a dichotomy in the community between Native and non-Native employment. Natives are involved in commercial fishing activities and government work but are not involved in Iliamna's commercial businesses. Non-Natives, on the other hand, are involved in commercial enterprises and government services but not in the commercial fishing industry.

The government sector of the community is large in proportion to the community's population. Iliamna serves as transportation center for the area, and some government services not present in other study region communities are tied to Iliamna's airport facilities. The Federal Aviation Administration has established a flight service station at the Iliamna airport. There is a VASI system at the station, and the runway is lighted. There are also state and federally owned shops at the airport and in the community, some of which house fire-fighting equipment.

Increases in electricity consumption in the residential and commercial sectors of the community will probably be gradual. There is already a high rate of appliance saturation in the residential sector of the community. Further increases in electricity consumption will be due mainly to an increase in the number of customers, as well as to an increase in average use per customer.

11. NEWHALEN

General Description. The village of Newhalen is located approximately five miles from Iliamna, at the outlet of the Newhalen River. The two communities are connected by road, and there is a great amount of interaction between them. Newhalen residents also have road access to the Iliamna airport where there are flights available on charter and scheduled air carriers.

Population. The U.S. Census Bureau reported 88 people living in Newhalen in 1970. The 1980 census reported 87 permanent residents in the community, living in 18 households. In 1980, 94.3 percent of the residents were Native according to census results. The village empties out in the summer, with 95 percent of the population involved in firefighting and commercial and subsistence fishing activities outside the village. Toward the end of July, approximately 80 percent of those who leave the village for the summer have returned. The last 20 percent return to the village in August and September.

Economic Base/Labor Force and Employment. Newhalen's economy is based primarily on the commercial fishing industry. There are between ten and fifteen drift-net permits and seven or eight set-net permits owned by Newhalen residents. Residents also work for the U.S. Bureau of Land Management as firefighters in May and early June before the commercial fishing season starts and then again in September after the fishing season is over. Employment in the community includes positions on the village council; employment with the Lake and Peninsula School District as cooks (two part-time positions), teacher's aides, and maintenance personnel; and work at the Iliamna airport for Wien Air Alaska. One Newhalen resident works in the post office in Iliamna. In general, Newhalen residents are not involved in the various commercial enterprises in the area such as Iliamna's lodges and stores.

Personal Income. Average household income information from the Alaska Department of Revenue for Newhalen is combined with that of Iliamna. Their combined average is $24,272 per household, and although it is impossible to separate the averages of the two villages, Newhalen average household income is probably less than that of Iliamna because of Newhalen's seasonal fishing industry employment and Iliamna's more stable year-round commercial and government services economy.

Building Stock Characteristics. In the fall of 1981, Newhalen had approximately twenty-one occupied residences, four commercial/ government buildings, and seven school buildings. The U.S. Department of Housing and Urban Development (HUD) is scheduled to build twelve houses in Newhalen the summer of 1982. Some of these new houses will be occupied by current residents while others will become housing for people moving into the community.

The non-school commercial/government sector of the community is made up of a store, a clinic, a Public Health Service washeteria, and a church. The city office is located in the same building as the clinic. The church is the largest building in this sector, with a floor area of approximately 1,100 square feet. It is used twice each week. The store, operated by the village mayor, is the smallest, with a floor area of 512 square feet. Average floor area for commercial/ government buildings is 739 square feet.

The Lake and Peninsula School District facilities in Newhalen provide primary and secondary education for the children of Newhalen and Iliamna. School facilities include a main school building; a high school building and a trailer, both used as classrooms; a multipurpose building; a small shop; one set of living quarters; and a power house for the school generators. Combined floor area for all school buildings is 9,600 square feet. Teachers at the Newhalen school live in Iliamna and commute to school.

In addition to these buildings, an office and a generator house are currently under construction for the new Iliamna-Newhalen Electric Cooperative (I-NEC). Transmission lines will provide power to Iliamna and Nondalton.

Electricity Generation System. Until the I-NEC utility system is on-line, Newhalen residents will continue to provide their own electricity from small, private generators. Results from a survey done for I-NEC in 1980 show a total of forty-nine private generators ranging in size from 4-to-15 kw and thirteen commercial generators ranging in size from 45-to-120 kw in the two communities of Newhalen and Iliamna.

Besides the school facilities, only the washeteria is supplied with electricity from its own generator. An 8-kw wind generator was built with state funds to provide electricity to the washeteria, but the wind generator is out of service due to wind damage. The washeteria currently receives power from its own 12-kw diesel generator. Other commercial/government buildings are tied into other power sources. The church receives its power from a 4.3-kw residential generator. The store is also tied into a residential generator. Electricity for the clinic is provided by the school's 125-kw, 75-kw, and 45-kw generators which also serve the school facilities. Generators are run 24 hours a day during the winter months. Most residential generators are shut down in the summer from June until sometime in August. Commercial/government generators are usually in operation year-round.

I-NEC is currently in the construction stage. The main power plant will be located in Newhalen and will include a generator house for the utility's three 330-kw generators and an office. The utility had originally planned to be on-line in 1981 with two smaller generators serving the three communities of Newhalen, Iliamna, and Nondalton. One generator would have been stationed in Nondalton and the other in Iliamna. The utility managers decided that this two-generator system would not be adequate to supply power to the three communities, so they shipped the generators back to Anchorage and developed the current plan for the system.

I-NEC hopes to have Newhalen on-line by the end of September, 1982. Iliamna will be tied-in next and finally, Nondalton will be supplied with power, probably several months later. Nondalton is approximately 25 miles from Newhalen and a transmission line and service road must be constructed between the communities.

The new utility expects to be serving 51 residences and 15 commercial enterprises in Iliamna and Newhalen, plus an unknown number of Nondalton consumers. Trig Olsen, I-NEC's General Manager, said that probably 100 percent of the electricity consumers who are currently using small private generators will switch over to using the utility system, once it is available. The utility is designed to tie-into a hydro-electric power source, should that source become available. Until that time, the utility will purchase fuel from the fuel barge services. Fuel storage facilities will be in conjunction with the Nondalton Village Corporation and Iliamna Natives Limited. There will be four tanks with a capacity of 125,000 gallons each.

Electricity Use Pattern. All Newhalen residences are provided with electricity either from their own generator plants or from tie-in lines to a neighbor's generator. Common electric appliances in village homes include lights; various kitchen appliances such as coffeemakers, skillets, and blenders; refrigerators; freezers; and tape decks. Other appliances that are less common include washers and dryers, television sets, and video recorders. A few residences have hot water heaters. Villagers get their water either from the school well or directly from the Newhalen River. Most cooking is done on propane cookstoves.

Fuel Oil Supply Characteristics. Fuel deliveries for use in generators and for space heating are made in the summer and in the fall before freeze-up. Moody Sea Lighterage and Levelock Natives, Limited, provide barge service for hauling fuel from Naknek to the Lake Iliamna area. The price per gallon for fuel delivered by Moody Sea Lighterage to Newhalen was $1.39 in 1980 and $1.50 in 1981. Levelock Natives, Limited, charged $1.30 per gallon in 1980 and $1.48 per gallon in 1981. Some residents buy their fuel from Chevron in Naknek and haul it to Newhalen on fishing boats.

Space Heating Pattern. Due to the high cost of stove oil and the greater availability of air-tight woodstoves, an increasing number of Newhalen residents are heating their homes with wood. Some homes are heated with a combination of woodstove and oil heater or oil stove. As is common in a number of the study region villages, there are almost as many steam houses as there are residences, mostly heated with wood. Buildings in the commercial/government sector of the village consume an average of 1,000 gallons of heating fuel per building each year.

Planned Development. The Iliamna-Newhalen Electric Cooperative is expected to be on-line the end of September 1982. One I-NEC management source said that probably 100 percent of Newhalen electricity consumers will switch from individual diesel generators to the new utility system. He felt that even if the cost per kilowatt hour of electricity provided by the utility is not less than that provided by individual generators, Newhalen consumers will still tie in because of the convenience and reliability of a central system.

Fuel storage is a problem in Newhalen. Bulk fuel storage facilities were installed in the village in the fall of 1981 through a $60,000 grant from the Alaska Department of Community and Regional Affairs. The bulk fuel tanks were not installed in time for the fuel barges to fill them in 1981, so the tanks were empty during winter, 1982. I-NEC plans to build bulk fuel storage facilities in Newhalen in conjunction with Nondalton Native Corporation and Levelock Natives, Limited. There will be four tanks, each with a 125,000 gallon capacity. The tanks will provide fuel both for the I-NEC power plant and for those residents in Iliamna and Newhalen who either cannot afford to pay for all their fuel when the barges come through, miss the barge visits, or for some other reason are unable to purchase their total year's supply of fuel oil in the summer or fall.

Other projects proposed for Newhalen include the construction of a dock supplement, construction of an experimental earth-shelter house and walk-in freezer, and the installation of a waste heat recovery system for the school generator plant. The dock supplement is planned by the Alaska Department of Transportation and Public Facilities for fiscal year 1983-84 and will be used for barge facilities. The city of Newhalen is currently applying for funds from the state for the earth-shelter projects.

12. NONDALTON

General Description. Nondalton is the northern-most community in the eighteen-community study region. It is situated on the western shore of Sixmile Lake which feeds into the Newhalen River. Nondalton's closest neighbor, Iliamna, is approximately twenty miles south of Nondalton, and though currently there is no road between the communities, the Alaska Department of Transportation and Public Facilities has funds allocated for the construction of a connecting road. Travel into and out of Nondalton is via plane and snow machine in winter and via plane and boat after spring breakup.

Population. The people of Nondalton are mainly of Athabaskan origin. According to the 1980 U.S. Census, 93.1 percent of the community's residents are of Native descent. In December 1981, Nondalton had 165 residents living in 32 households, for an average household size of 5.16 people. The population of the village has decreased in recent years, with 184 residents in the community in 1970 and 173 residents in 1980 according to the U.S. Census Bureau.

For two months of the year, usually June and July, 75 percent of the village residents leave for summer activities. Some residents leave for commercial and subsistence fishing the first part of June and return toward the end of July. Many residents leave in the summer to work for the U.S. Bureau of Land Management as firefighters, returning again sometime in August.

Economic Base/Labor Force and Employment. Before limited entry came into effect, the economy of Nondalton was based almost entirely on commercial fishing. Now there are approximately fifteen people who hold commercial fishing permits, five of the permits for set netting and ten for drift netting. Many residents move to fish camps during the summer months for subsistence fishing. Camps are located at each end of the village along the lake.

The main summer employment for Nondalton residents is firefighting. Both men and women participate in this occupation and are transported to different fire locations around the state. Many families divide the summer between fighting fires and fishing.

The school district provides a large number of jobs, employing five full-time teachers, three part-time teacher's aides, school maintenance personnel, two school cooks, and administrative personnel. These positions are seasonal, with most of the teachers leaving in the summer and returning in the fall.

Other occupations in the village include a part-time health aide, a postmistress, a police officer, four clerk positions in the village stores, a water and sewer maintenance person, and a person responsible for clearing the runway during the winter. Wood gathering is a source of income for several people, and a resident who owns one of the few trucks in the village hauls wood when there is no snow and the more numerous snow machines cannot be used for this purpose. Approximately ten people trap in the winter. There are also two lodges in the vicinity of Nondalton. Both lodges hire employees from outside the village for the May to November season.

Personal Income. According to tax return information from the Alaska Department of Revenue, average 1980 household income in Nondalton was $7,673. Residents estimated average catch for 1980 to be 25,000 to 30,000 pounds of fish per boat with drift-net permit and 22,000 pounds per commercial set-net operation. In this case, catch data implies a level of average household income roughly comparable with tax return data.

Building Stock Characteristics. In December 1981, there were 37 occupied residences, three occupied teachers' housing units, seven commercial/government buildings, and one elementary/secondary school in Nondalton. The residences include an assortment of building types and ages, ranging from old low-roofed log cabins to new prefabricated houses. Average area of the residences is 571 square feet. Besides the currently occupied houses in the village, there is one house under construction, and the village is expecting twenty Housing and Urban Development (HUD) houses to be built in the summer of 1982. Some residents feel Nondalton's population will increase in the near future, with former residents returning to the village and new residents moving in; and they expect the new housing to be used by some new residents as well as by current residents who will move out of their older homes.

There are three stores in Nondalton, one of which is a co-operative store, one a part of the village corporation building (also known as the "Pool Hall"), and one small store in a residence. The post office is located in the co-operative store building. There is a community hall in the village, a clinic, and a water and sewer maintenance building which provides the school with water. The elementary/secondary school, which serves a student body of about forty children, was built in 1978 after the previous school burned down. The village mission is located in a residence. The average floor area of non-school commercial/government buildings is 1,695 square feet. Total floor area for school facilities, including three teachers' quarters, is 21,720 square feet.

Electricity Generation System. Nondalton does not have a centralized electricity source. Individual generators provide electricity to private residences, commercial buildings, and the school. There are eight private generators in the residential sector of the community, six serving individual homes and two which serve two homes each, for a total of ten homes with electricity. Three of the generators are gasoline powered, and the rest are powered by diesel fuel. One residence which is served by a private generator also houses the village mission. Private residential generators range in size from 2.5 kw to 8 kw.

Generators in the commercial/government sector include a 7-kw generator which provides power to the corporation building and clinic;

a 30-kw generator serving the water and sewer maintenance building; a 12-kw generator which serves the cooperative store, post office, and community hall; and two generators serving the two lodges in the area, one a 12 kw and the other of an unknown size.

The Nondalton school, part of the Lake and Peninsula School District, receives electricity from two 75-kw and one 35-kw generators. Besides the main school building, these generators also supply power to a shop, the power house, and three teachers' residences.

Electricity Use Pattern. Electricity consumption in the residential sector of Nondalton was limited since only ten homes and three school residences were supplied with electricity. Each of the ten homes with electricity and the three school residences have electric lights, and most of these, if not all, have a freezer. Refrigerators are high on the list of most common appliances, as are stereo/tape decks and radios. Other appliances not so common in residences with electricity include coffeemakers, washers and dryers, mixers, toasters, and video recorders. Although most houses in Nondalton do not have electricity, all residences do have electric heat tape. Electricity for the heat tape is provided by a portable generator owned by the village. We estimate average annual consumption in the residential sector to be 922-kwh per user, the lowest of all 18 study-area communities. Generators are usually shut down for part of the summer when residents leave to go fishing or firefighting.

In addition to the private residential generators, there are five generators which supply power to seven commercial and government buildings and three generators which supply power to the school facilities and teachers' residences. Fuel sources and prices are generally the same as those discussed above.

One high school teacher intends to explore the feasibility of wind power generation in the area. He applied for and received a state grant to construct a 2-kw Aero Power wind generator to be used in teaching students about energy conversion. Construction of the generator should be completed by May 1982.

Fuel Oil Supply Characteristics. Fuel oil is transported to Nondalton by water and by air. Moody Sea Lighterage, the Chevron distributor, and Levelock Natives, Limited, barge fuel from Naknek to Iliamna twice each year in the summer and the fall. From there, the fuel is trucked to a portage point on the Newhalen River and then taken by skiff to Nondalton. The cost for transporting the fuel from Iliamna to Nondalton is added on to the price per gallon paid for fuel delivered to Iliamna.

Some Nondalton residents buy fuel in Iliamna, pay to have it trucked to the Newhalen portage point, and then haul it up the Newhalen River on their own private skiffs. One source quoted a cost of $8.00 per barrel charged for trucking fuel from Iliamna to the portage point and a charge of $5.00 per barrel for hauling empty barrels from the portage point to Iliamna to be refilled. These costs are in addition to the cost paid per gallon of fuel oil in Iliamna, giving a total cost of approximately $1.64 per gallon for fuel hauled by private skiff. The 1980 cost for fuel delivered to Iliamna by the Moody barge was $1.39 in 1980 and $1.50 in 1981. Fuel from the Levelock Natives, Limited, barge was $1.30 per gallon in 1980 and $1.48 in 1981.

Woods Air Fuel, based in Palmer, provides general and emergency air fuel delivery service directly to Nondalton. In 1981, there were a number of residents who, for various reasons, did not buy fuel when the fuel barges arrived in Iliamna and then had to have fuel flown in at a greater cost per gallon of fuel oil. Wood's Air Fuel charged $2.00 per gallon for air fuel deliveries in 1980 and $2.50 per gallon in 1981 according to one Nondalton resident. Those residents who were unable to buy their year's supply of fuel oil either from the barges or from Wood's Air Fuel got their fuel from the school supply.

Space Heating Pattern. The majority of Nondalton residents use wood as the primary fuel for heating their homes, burning an average of 16 cords of wood per year in barrel or air-tight woodstoves. According to the Nondalton household survey, 22 residences were heated primarily with wood, and ten were heated primarily with fuel oil in 1980. In some residences, oil stoves are used in conjunction with woodstoves as a secondary source of space heat. In other cases, the woodstove is the secondary source. An average of 990 gallons of fuel oil per year is consumed by residences heated primarily by stove oil. Rural Alaska Community Action Program (RurAL CAP) installed sixteen Waterford woodstoves in Nondalton in September and October 1981.

Besides its use in space heating, wood is also used to heat the more than twenty steamhouses in the village. An average of six cords per year is burned in each of the steamhouses.

Planned Development. Nondalton is scheduled to be tied in with the recently formed Iliamna-Newhalen Electric Cooperative (I-NEC) late in 1982. I-NEC originally planned to provide electricity to Iliamna, Newhalen, and Nondalton in 1981 through a system of two generator sets, one stationed in Iliamna and one in Nondalton. The utility revised its plans and now hopes to have Newhalen, the site of the utility's one large power plant, on-line in September 1982, with Iliamna and Nondalton on-line a few months later. The I-NEC system is constructed to switch from diesel generation to hydro generation should hydroelectricity power become available to the area. Nondalton also is interested in hydroelectric power, either from a large area-wide project or from a smaller local project, with enough power available to supply electricity to 100 residences.

The Alaska Department of Transportation and Public Facilities has funds allocated for and has begun construction of a connecting road between Nondalton and Iliamna. Currently, the only means of land travel between the communities is by a system of snow machine trails.

Besides regular passenger travel, the new road will also be used as a service road for the I-NEC utility transmission lines. An apron and access road for the airport are proposed for fiscal year 1983-84.

The city of Nondalton is also receiving government funds for the construction of bulk-fuel storage facilities. The Department of Housing and Urban Affairs plans to construct twenty new houses in the community in 1982. The Public Health Service is in the process of installing a water and sewer system to serve the new HUD houses as well as other residences in the community.

13. CLARKS POINT

General Discription. The village of Clarks Point is located on the eastern shore of Nushagak Bay approximately 16 air miles south of Dillingham. Travel via air from Clarks Point to Dillingham and the Nushagak River villages is very common. In the summer, Clarks Point is considered the crossroads of the Nushagak Bay fisheries. Alaska Packers Association operates a fish camp in the village.

Population. In 1981, 70 people of primarily Yupik descent lived year-round in 15 residences in Clarks Point. U.S. Census figures place the 1980 population at 79, 89 percent of which was Native (Table A.15). During the summer fishing season the population of the village swells to about 400, half of which live at the bunkhouse provided by the cannery. The number of occupied residences in summer is approximately 32 with additional wall tents set up as temporary residences.

TABLE A.15. POPULATION OF CLARKS POINT

Date	1930	40	50	60	70	80
Population	25	22	128	138	95	79

SOURCE: U.S. Bureau of the Census

Economic Base. Commercial fishing supports the economy of Clarks Point. Nearly every local year-round family fishes each summer, either with their own boat or on one leased from the cannery. Twenty-five drift-net salmon permits are held by residents.

Since 1952, the Clarks Point cannery has been run by Alaska Packers Association as a "fish camp" with minimal facilities for processing salmon roe (30 workers). Services offered by the fish camp include storage and maintenance of boats, bunkhouses, and board. Alaska Packers Association buys fish from the fishermen for processing on the Ultraprocessor anchored in the bay. This "floater" freezes the salmon before shipment to Japan.

Trapping for income adds very little to the economic base of Clarks Point. The scarcity of snow in recent years has made winter travel by snow machine or dogsled almost impossible, causing a decrease also in trapping for subsistence.

A general store serves the village during the summer season. A small store in a private home operates year-round, selling a very limited selection of food and merchandise and also filling special orders. Other government services and commercial buildings in Clarks Point include the health clinic, the school, a Catholic church, and three private warehouses.

Labor Force and Employment. Eleven year-round jobs are offered in the village: one health aide, six school employees, one janitor for the health clinic, one postmistress, one cannery watchman, and one airfield maintenance person.

In the summer fishing season, additional jobs are offered through the cannery (30) and the store (3). Since most of the year-round residents are fishing either on the beach or on boats in the summer, an itinerant labor force fills the seasonal job openings. Summer residents come from the Lower 48, other countries, other regions of Alaska and villages in the Bristol Bay region.

Personal Income. Gross income for permanent residents of Clarks Point with salmon permits ranged from $40,000 to $120,000. As is true in all commercial fishing economies, a large percentage (50-80 percent) of this income is used to cover fishing expenses before taxes. Information from 1978 tax records suggests that average household income in 1980 was $24,750.

Building Stock Characteristics. Residential buildings in Clarks Point can be divided into three housing stock types: permanent residences, summer residences, and HUD housing. Permanent residences are spread out along the beach and in a cluster at the south end of the village. They are typically 20 or more years old, and range from 250 to 1200 square feet. The houses along the beach are of the 250 to 400 square foot size, and are insulated only with grass and old nets in the wall unless recent weatherization improvements have been made. Retrofits in approximately four of these homes included two inches of styrofoam under the floor, thermopane windows, and four inches of fiberglass insulation in the walls. The larger permanent residences generally have four inches of insulation in the walls and ceiling.

Two households have been built since 1975 on the bluff above the south end of the village.

Summer residences are scattered along the entire length of the beach. Many structures are abandoned; many that are used consist only of a wood board shell covered with tarpaper. Average size is approximately 250 square feet.

Fifteen new HUD houses have been built on the bluff above the south end of the village. These houses should be occupied in early 1982 by current residents of permanent households. It is expected that eight of the old houses being moved out of will be made available for new families. Floor area for the HUD houses ranges from 756 to 1026 square feet. Houses are built with insulation values of R-38 in the ceiling and R-19 in the walls.

The health clinic building also houses the village and city council chambers. It is over ten years old and similar in construction to the larger permanent residences.

The Southwest Regional School District operates a school for elementary through high school ages at Clarks Point. The 4,362 square foot building, built in 1946, contains two classrooms for the ten students enrolled in 1981.

Alaska Packers Association cannery consists of six bunkhouses, the watchman's house, the superintendent's "white house," and the summer store. Only the cannery watchman's house is occupied year-round. The cannery was established in Clarks Point in 1888 by the Nushagak Packing Company. The two-line cannery and outbuildings were built in 1901.

Other structures found in Clarks Point include steam houses which residents use on a daily basis, and fish racks for summer drying of fish.

Severe erosion of the beach at Clarks Point has caused concern in the village for many years. In December of 1964, a tsunami alert in the middle of the night sent the entire population up to the top of the bluff to wait in the cold for the wave that never came. A freak flood at half-tide in August of 1981 inundated most of the village homes. Clarks Point has requested money to place a bulkhead along the entire shore from the cannery to the bluff, but no funding had been received as of late 1981. The construction of the HUD housing on the bluff signals a trend for the entire community to eventually move to higher ground. It is anticipated that a new school may eventually be constructed on the bluff.

<u>Electricity Generation Systems</u>. In the summer of 1981, the Southwest Regional School District upgraded their generating capacity at Clarks Point to two 75-kw diesel generators in an agreement to

supply the new HUD housing with electricity. In October and November they agreed to allow residents of Clarks Point to run their own lines and use the excess power generated by the new system. It is unclear as of this writing how many houses will eventually be supplied by the school power. Power may be provided to the connected houses on a year-round basis.

In addition, seven private 4-kw diesel generators are run continuously year-round supplying power to residences and the health clinic. When the move to the HUD housing is made in early 1982, four of these generators will be put on stand-by status. Each full-time 4-kw generator consumes about 1200 gallons of diesel annually. The ALaska Packers Association fish camp in Clarks Point maintains three 75-kw generators, normally operating two at any given time. A 30-kw generator at the cannery provides winter power to the caretaker's house, a cold storage, and lights for the cannery.

Five houses in Clarks Point presently have no source of electricity.

Electricity Use Pattern. Appliance use surveys and electricity generation information gathered in 1981 suggests an average annual use of 2,430 kwh by the nine residences with power in 1981. Freezers, clothes washers, radios, and refrigerators are the most commonly owned appliances in the village. No electricity use data is available for the Clarks Point commercial, government, and industrial sectors.

Fuel Oil Characteristics. Fuel oil is barged to Clarks Point from Dillingham by Alaska Packers Association (APA). In 1981, fuel deliveries by APA to residents were recorded in 142 individual accounts, including summer deliveries to seasonal residents. It is estimated by APA that 30,000 gallons of stove oil was sold to Clarks Point permanent residents in 1980.

In addition to fuel oil bought from APA, some residents bring their fuel supply from Dillingham in their own boats.

Space Heating Pattern. All but one of the buildings in Clarks Point use stove oil for space heating. Most residences have an oil cookstove which is used 24 hours a day to both heat and cook for at least nine months of the year. All of the stove oil is barged from Dillingham by the local cannery and trucked to individual residences by the cannery caretaker. In 1980, 30,000 gallons of stove oil was sold to permanent residents in this manner for heating.

Presently, two houses use wood as a secondary heat source and one house as a primary source. Clarks Point is located essentially in a wet tundra ecosystem. In the immediate vicinity only willow, alder, beach driftwood, and scraps salvaged from the cannery are available. These sources are tapped for the village's steams, but rarely used for heating of homes, and not at all for cooking. Residents with wood stoves use snow machines in the winter to harvest some birch and spruce from the tundra several miles east of the village to supplement the local wood source.

Planned Development. The Alaska Packers Association fish camp was for sale in late 1981. There is much speculation as to the eventual owners and plans for the processing facility, from fears of a complete shutdown to hopes for an increase in production capability.

The construction of the HUD housing on the bluff could signal the start of an eventual move of the village to higher ground. It is expected that several other new houses will be built on the bluff in the near future.

The village is currently soliciting funding for construction of a bulwark to deter further erosion of the beach on which the village is built.

14. EKUK

General Description. The village of Ekuk is located on a narrow gravel spit on the east side of Nushagak Bay, two miles south of Clarks Point and 18 air miles south of Dillingham.

Population. In recent decades, the population of Ekuk has dropped dramatically as residents followed game upriver or moved to villages with schools and a more stable shoreline. In 1981, Pete and Rose Heyano and their son were the only permanent residents of Ekuk. It is not expected that the permanent population will increase in the near future. The population of Ekuk swells to approximately 800 people during the summer fishing season.

Economic Base. The Colombia Ward Fisheries cannery in Ekuk is the economic base for the village. In 1980, the plant processed 700,000 pounds of frozen salmon, 4,836,000 pounds of canned salmon, and 330,000 pounds canned or boxed salmon roe. They are also set up for freezing herring. The camp at Ekuk is open from May 1 to mid-August, with a peak in operations at the end of June.

The seasonal nature of the Ekuk population does not encourage development of schools or other services which could provide an additional economic base.

Labor Force and Employment. Colombia Ward Fisheries employs one person year-round as cannery caretaker. All other employment in Ekuk is seasonal. During the 1980 fishing season, 325 people were employed as cannery workers and as crew of the eight drift-net boats owned by the cannery. About 40 percent of the employees of the cannery come from outside Alaska. Approximately 250 people from other villages also live in Ekuk in summer to fish set net sites. Most of these seasonal set netters return to Ekuk each year.

Personal Income. The income of the Heyano family, only permanent residents of Ekuk, is unknown.

Building Stock Characteristics. The cannery watchman's house is the only structure occupied year-round. It is an old, one-story building, approximately 600 square feet in size. All the other residences in Ekuk are occupied only in the summer. Most of these are uninsulated wood structures covered with tarpaper. Many summer residents also live in wall-tents set up along the beach.

In addition to the watchman's house, the cannery complex consists of 30,000 square feet of housing and office space and 28,000 square feet in the processing plant.

Electricity Generation System. The only operating power generation system in Ekuk is run by the cannery. In the winter months a 30-kw generator supplies power to the caretaker's house and the other cannery buildings for maintenance purposes. This generator is run 24 hours per day but usually at only half capacity. It uses approximately 1,000 gallons of diesel fuel per month, from September through May.

For 1980 summer operations, Colombia Ward Fisheries owned eight generators with a combined capacity of 1,277 kw. At peak operation in early July, a 400-kw plant and two 250-kw plants were in operation.

In the recent past, wind machines were used in Ekuk to power seasonal residences. Remnants of the machines remain, but there are no plans to repair or replace the equipment despite a promising wind regime.

Electricity Use Pattern. Approximately 600,000 kwh of electricity was used by Colombia Wards Fisheries in 1980. It is estimated that 25 percent of this total was used for freezing operations and 33 percent for canning operations. The remainder was consumed by fans, pumps, lights, conveyors, elevators, and the caretaker's house. In 1980, 60,000 gallons of fuel oil was used for electricity generation.

Some summer residents bring portable "light plants" with them to Ekuk. It is unknown how many of these plants are used in Ekuk or the electricity-use pattern of summer residents with power.

Fuel Oil Supply Characteristics. Colombia Wards Fisheries hauls fuel to Ekuk from Dillingham on their own barge and sometimes borrows a barge from Bumble Bee Seafoods for hauling. In 1980, the delivered price of fuel in Ekuk was $1.07/gallon. The company has a storage capacity of 154,000 gallons. Some fuel oil is sold to fishermen for transportation uses and for heating tents or camps. Gasoline is sold for three-wheelers and other transportation.

Space Heating Pattern. In 1980, 15,000 gallons of fuel oil was used to heat the cannery, housing, and office space, including the caretaker's house which uses about 1,800 gallons per year for space heating. The processing plant itself has no space heating needs.

Summer residents use stove oil and drift wood scrounged from the beach for space heating. In most cases, their oil is bought from the cannery.

Planned Development. No plans for development by the cannery or residents of Ekuk were not known at the time of this writing.

15. LEVELOCK

General Description. The village of Levelock is located on the Kvichak River about 40 air miles north of Naknek. Levelock is one of the older villages in the Bristol Bay region, with reports of a settlement prior to 1900. Levelock's closest neighbor is Igiugig, and there is good communication between the two village councils.

Population. In 1981, 79 people claimed Levelock as their permanent residence, 87 percent of them Native. According to the U.S. Bureau of the Census, the population has grown slightly in the past decades. There are currently 21 residences in the village, and the average household size is 3.76 persons. Fifteen HUD houses are scheduled to be built in Levelock soon. These units will be moved into by present Levelock residents, opening up currently occupied houses for in-migration. Residents expect the population to increase by about 50 persons with the new housing.

Economic Base. Commercial fishing and village government comprise the economic base of Levelock. For approximately one month at the height of the fishing season, all but 10 of the residents of Levelock go to the Naknek area to commercial or subsistence fish. Nine salmon drift-net permits are held in Levelock, and most adult residents have set-net permits. The income derived from commercial fishing varies greatly from year to year.

The local government in Levelock is very well organized and active. The village council employs a full-time grantwriter who has been very successful at bringing money to the community for electrification ($497,000), dock facilities ($55,000), and bulk fuel storage ($65,000). Levelock Natives, Limited also owns and manages a barge company which provides fuel and other goods to the Kvichak-River and Lake-Iliamna areas.

Labor Force and Employment. The primary employer in Levelock is the village council which offers eight full-time slots to residents. Other employment in the community includes the school (six full-time), post office (one part-time), and the health clinic (two full-time).

The grant monies brought into the community will provide seasonal employment in the coming years.

Personal Income. Except for those employed by the village council, personal income is dependent on commercial fishing success. Information from tax records suggests an average household income in 1980 of $6,155.

Building Stock Characteristics. The 37 residences in Levelock are spread along 1½ miles of the river front. Unlike most of the other villages in the study region, buildings in Levelock are separated by wide bands of trees. A road and trail system effectively provides access to all buildings.

Residential dwellings had an average floor area of 887 square feet. Most houses are frame with tarpaper, shingle or board siding. Almost half (48 percent) of the residences were built before 1945. Only three residences are less than 20 years old.

The largest commercial structure in Levelock is the school building. Built in 1941, the 3,400 square foot building contains classrooms for grades kindergarten through high school, and provides quarters for teachers. The Levelock school is presently administered by the Southwest Regional School District, but is interested in becoming part of the Lake and Peninsula School District, which serves the Lake-Iliamna and Alaskan-Peninsula areas.

The village council maintains two large buildings in Levelock. One building houses the health clinic, library and meeting room. The other houses village council offices as well as a combined community recreation hall/meeting hall. In the fall of 1981, both buildings were being renovated and weatherized.

Electricity Generation System. Nine private generators are operated in Levelock to serve 11 residences. All but one of the generators is diesel; average size is 4.5-kw. Eight of the 11 residences run their generators year-round. Residences without private generators go without electricity.

The Levelock school power comes from two 75-kw generators which were just reworked by the Southwest Regional School District. In addition to supplying the school, these generators supply power to the clinic and village council buildings.

Electricity Use Pattern. Six of the nine "light-plants" in use in Levelock are used year-round; the others are used from three to nine months. In houses with electricity, power consumption is high with each house owning one or more freezers and refrigerators, and a variety of smaller appliances. No typical use pattern emerges, however, with consumption ranging from a generator turned on only for a couple of hours twice a day to a 7.1-kw machine run 24 hours per day year-round.

In the fall of 1981, a household survey (of desired appliance ownership after electrification) was conducted by the Levelock village council. This survey shows that indoor and outdoor lights, freezers, refrigerators, television, and a stereo system are the appliances most desired by Levelock residents. A comparison with appliance use under the present private-generator system suggests that the number of hot water heaters, portable space heaters, circulating fans, and electric ranges would increase dramatically with village electrification.

Fuel Oil Supply Characteristics. Fuel oil is barged to Levelock by both the locally-owned Levelock Natives, Ltd. barge and by Moody Sea Lighterage. In 1981, the price per gallon was $1.486 from the

Levelock barge and $1.416 from the Moody barge. Levelock Natives, Ltd. brought in the fuel for the school in 1981 (30,000 gallons) for a total delivery of 58,264 gallons.

Space Heating Pattern. All of the buildings in Levelock use stove oil as their heat source. In 1980, residences on the average used 1,007 gallons of stove oil. The oil-drip stove was the most common residential heating system. On the average, the residences used 1.56 gallons per square foot of conditioned floor area for space heating.

The two village government buildings used 3,000 gallons of stove oil for heating in 1980, for a consumption of 0.84 gallons per square foot. As noted above, these buildings are undergoing renovation that may change their energy-use characteristics.

Planned Development. As mentioned above, 15 HUD houses are scheduled to be built in Levelock by 1984.

In 1981, the village of Levelock received a $450,000 legislative appropriation and $47,000 HUD block grant to study and ultimately electrify the entire village. Present plans are to install two 75-kw diesel generators and a 33-kw wind generator with these funds.

16. IGIUGIG

General Description. The village of Igiugig is located at the head of the Krichak River as it starts its course from Lake Iliamna to the Kuichak Bay. The nearest community is Levelock, 38 air miles south. An historical tie exists between Igiugig and Levelock, the ancestors of both villages sharing hunting, trapping, and seasonal residences in the Lake Kukaklek and Alagnak River areas. This tie is manifested in the present day by a close working relationship between the two village governments, by frequent travel between the communities, and by related families.

Igiugig is 59 air miles from Naknek and 48 air miles from Iliamna. Both of these communities as well as Dillingham are used as service centers by the residents of Igiugig.

Population. In 1981, 33 residents, all of Yubik Eskimo heritage, lived in ten households in Igiugig. The village is relatively new, becoming a permanent settlement of the Alagnak River and Lake Kukaklek Eskimo only around 1970. Since that time, the population has been stable.

Economic Base. As in most of the other Bristol Bay area villages, fishing activities provide the economic base for the village. Each summer, all but two families move to the Naknek area for the two-month fishing season although only four drift-net and two commercial set-net permits are held by the residents.

Living expenses are met with the aid of trapping in December and January. Predominant species taken include otter, lynx, beaver, mink, and fox. There is an awareness among the village elders of the importance of trapping to the village economy and lifestyle and an interest in teaching the younger generations the skills of trapping.

There is no store or lodging offered in Igiugig although there are eight hunting/fishing lodges in the immediate area. These lodges, however, add little, if anything, to the village economy.

The only state government presence in Igiugig is a summer fish-counting station operated by the Alaska Department of Fish and Game. The school and village council provide the only employment.

Labor Force and Employment. There are few employment options for Igiugig residents. The village government offers two full-time positions. The school, the largest employer, offers two full-time and three part-time slots.

Local summer employment includes 4-to-5 positions at the fish-counting station and employees at the local lodges. These summer positions usually do not employ local residents.

Personal Income. There was not any available information on personal income available for Igiugig. A comparison with villages with similar economies leads us to suggest an average household income of $12,000, coming primarily from commercial fishing activities.

Building Stock Characteristics. The residences in Igiugig are small and relatively new. Only three residences were built before 1960. These averaged 301 square feet of floor area and consumed 4.79 gallons of oil per square foot for space heating. The seven newer (post-1960) houses are better built, averaging 524 square feet in size and using 1.72 gallons per square foot. An awareness of conservation practices is evident in the thermal pane windows and six-inch-thick wall insultation of the newer houses.

There are three commercial buildings in Igiugig: the church, school, and village council building. Both the church and the council building are old and infrequently used. They average 976 square feet. The school is very new, built since 1978 in the style of other new schools in the study region.

Electricity Generating System. Four private generators serve nine residences in the village. One of these generators supplies six houses with power for lights. These private generators run 24 hours/day and average 6.6 kw in size.

The village council and church draw their electricity from a small village-owned generator which is used only as needed. This generator uses an average of one barrel of fuel oil every ten days.

The Lake and Peninsula School District maintains a 45-kw and a 35-kw generator at the school; only one generator is operated at a time. Consistent with school district policy, no other buildings are supplied with power from these generators. In 1980, 28,800 gallons of fuel were consumed by the school generators.

Fuel Oil Supply Characteristics. Fuel oil is delivered to Igiugig by both the Levelock Natives, Limited, barge and by Moody Sea Lighterage. In 1981, delivered price by the Levelock barge was $1.486 per gallon. In 1981, Moody delivered to Igiugig at $1.346 per gallon. In 1980, the school paid $1.67 per gallon for its delivered fuel.

Electricity Use Pattern. Freezers and stereos are the most common appliances in Igiugig. The large size of the private generators allows for high consumption in three of the village residences. In the other six residences, lights and basic appliances meet the generator capacity.

From the fuel consumption in the school generator and an assumed ratio of 7 kwh produced per gallon of fuel, it is estimated that the school used 201,600 kwh in 1980.

Space Heating Pattern. Nine of the ten residences in Iguigig use fuel oil for space heating; the tenth used wood. An average of 1,063 gallons per household was consumed in 1980 in the oil drip stoves used for space heating and cooking. There is no data on the quantity of wood consumed to heat the tenth residence.

The village council building and church burned a combined total of 1,500 gallons in 1980. This figure is low because of the intermittent use of both buildings.

Planned Development. In the fall of 1981, final decisions were being made on the location and ownership of five HUD houses to be built in Iguigig in 1982. The Public Health Service is investigating the potential development of a village water and sewer system. The village plans to provide central-station power by 1987.

Summary of Distinguishing Characteristics. Iguigig, like its neighbor Levelock, is a progressive village with an awareness of the necessity for planning and understanding of land claims and state government issues. There are plans for village electrification within five years. The location of the village at the outlet of Lake Iliamna places it in a desirable position for subsistence uses. Residents of Iguigig claim that only land status issues are hindering village growth. During the fall of 1981, the village was negotiating with the state for deed to additional village land. Without this land, residents claim, construction of any new housing beyond the planned five HUD houses is impossible.

APPENDIX B

METHODOLOGY FOR PROJECTING REGIONAL ECONOMIC ACTIVITY

B.1 General Model Description

The Institute of Social and Economic Research (ISER) has developed a model which projects population and employment levels at the census division level. SCIMP (Small Community Population Impact Model) was designed to estimate the impact of OCS (Outer Continental Shelf) petroleum development on rural census divisions in Alaska, and it has been used on several occasions (see references, Huskey 1980, Tuck 1981, Nebesky 1980). SCIMP has been used to project more than OCS development impacts; it was used quite recently in southwest Alaska to forecast growth (The Growth of the Nunam Kitlutsisti Region, Huskey, Nebesky and Kerr, July 1981). Other non-OCS applications include projections for Alaskan Community College Regions (unpublished projections made for community college planners, 1979).

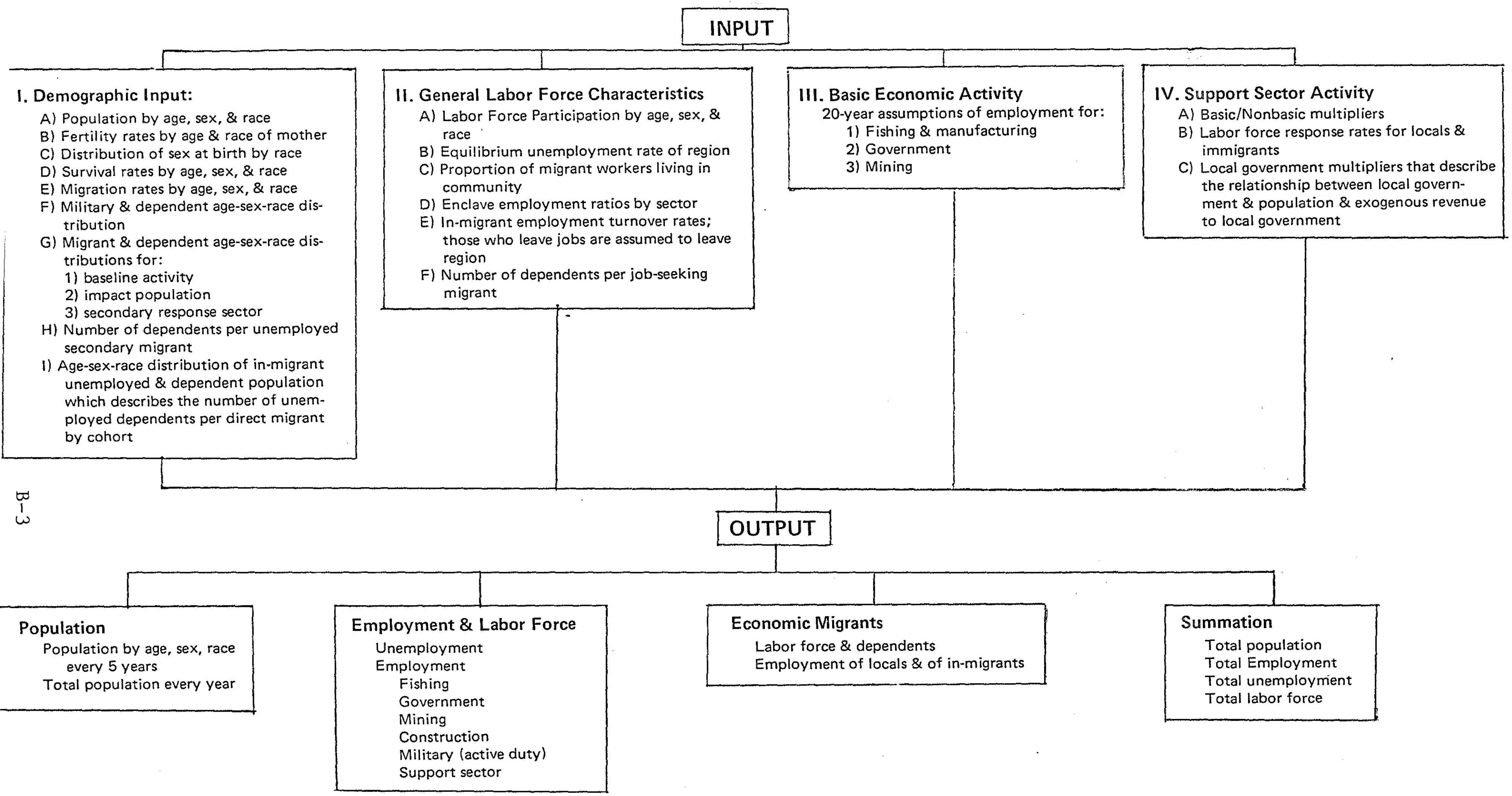
Typical rural Alaskan communities have small populations of which a large percent are Eskimo, Aleut or Indian. The indigenous labor force is mostly unskilled or semi-skilled. Labor force participation is usually lower than the state as a whole and urban areas in Alaska. In many cases, villagers receive government transfer payments and participate in subsistence hunting and fishing activities to supplement their incomes.

The principal component of economic growth is basic sector employment. Activities such as fish harvesting, manufacturing, special projects construction, mining, and exogenous government activity bring cash into the region that generates employment in the support sector industries such as construction, transportation, communications, utilities, trade, finance, services, and local government.

SCIMP is an accounting model that describes the process of growth in these rural Alaskan environments. It uses an age, sex, and race cohort advancement technique to project population and nonbasic to basic ratios to estimate support sector employment. The model output is based on assumptions of basic employment growth and the demographic structure of the regions. The projections are probabilistic and depend on the assumptions made. The projections are designed to help planners and policy makers understand the process and structure of growth in a given region.

Figure B-1 shows the basic inputs and outputs of SCIMP. It is presented to give an outline of the model's requirements and its output. It is followed by an outline of model input requirements and sources of data. Appendix C includes a detailed explanation of the input data and assumptions, and presents the major input data and assumptions.

Figure B-1



SCIMP Input and Output

B.2. Model Input Requirements and Sources for Data

1. Demographic Input

a. Population. Baseline population came from the 1980 census.

b. Fertility rates by age and race of mother are statewide rates based on the latest available census and Alaska Department of Health and Social Services data.

c. Distribution of sex at birth by race is based on the latest available Alaskan Department of Health and Social Services data. Rates are statewide by sex and race.

d. Age-sex-race survival rates are the proportions of each age-sex-race cohort expected to survive each year. Survival rates are calculated with 1960 and 1970 statewide census data combined with Health and Social Services data. New rates will be calculated as soon as 1980 census data is available.

e. Baseline migration rates by each age-sex-race cohort are the ratio of net migrants plus survived population in each cohort to the total survived population in each cohort. Migration rates were based on survey research done by Policy Analyists Limited (PAL) for the Nunam Kitlutsisti Report (see Huskey, Nebesky and Kerr, July 1981).

f. Military and dependent ratios are based on fourth count 1970 census data for the State of Alaska, or 1980 census data, if available, and estimates of military population.

g,h,i. Migrant and dependent age-sex-race distributions are expected to be different for baseline and economic impact migrant sectors of the population. Impact migrant and dependent data is from work done in the Nunam Kitlatsisti study (Huskey, Nebesky, Kerr, 1981).

2. Labor Force Characteristics

a. Labor force participation rates come from the Alaska Department of Labor (AK DOL). The age-sex-race distribution comes from the latest census data.

b. Unemployment rate comes from AK DOL.

c. Proportion of migrant workers living in community is estimated using previous BLM-OCS work, as well as discussions with local businessmen and residents.

d. Enclave employment ratios are ratios of workers employed in the basic sector who don't live in any of the census division communities. They usually live in company provided "enclaves" for weeks at a time and spend their off time somewhere outside the study region, such as Anchorage or Seattle. These ratios are based on work done in the Nunam Kitlutsisti report and interviews with employers within the study region.

e. The number of dependents per job seeking migrant is based on data from the Nunam Kitlutsisti report (Huskey, Nebesky, Kerr, 1981).

3. Basic Economic Activity.

a. Fishing and related manufacturing. This is the biggest of private industries in the region. It is very seasonal employment, but must be converted to annual average data for the model. Methodology for projections will be the same as that used in the Nunam Kitlutsisti report (Huskey, Nebesky, Kerr, July 1981). Projections are to be based primarily on the work done in OCS Technical Report #51 (Terry, et al., August 1980) and George Rodgers (1980) as well as any supplementary data supplied by contacting the processors in the region. Annual average and seasonal peak employment projections were made.

b. Government activity. Employment in this sector is a function of federal and state programs and revenues expected in the region. The 20-year projection is based on historical trends of civilian and military government employment (Source: AK DOL), and on public works projects or government programs that are ongoing or expected in the future. Projections of fiscal activity made by ISER's MAP model will be considered as well.

c. Except for oil and gas related activity, mining activity is based upon the latest geological maps and consulting with private geologists, such as CC Hawley and Associates.

Oil and gas related employment will be determined using the latest available* BLM-OCS and Alaska Department of Natural resources data.

4. Support Sector Activity

a. Basic/nonbasic multipliers describe the relationship between the aforementioned basic sector activities and support sector industry. These multipliers are based on historical rates and work done in the Nunam Kitlutsisti study (Huskey, Nebesky, Kerr, 1981).

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*Bureau of Land Management, Outer Continental Shelf oil impact socio-economic studies program.

b. Local government multipliers are ratios that describe the relationship between local government and population and exogenous revenue to local governments. These multipliers are based on previous BLM-OCS work.

Output includes employment by industrial sector, population by age, sex and race, as well as total enclave populations. Figure B.1 outlines the other aspects of the output.

B.3. General Model Structure

Figure B-2 is a flow chart that explains the steps the model uses to simulate population growth. Each age-sex-race cohort of population has deaths removed from it with a set of survival rates. A percentage of the females in each fertile age cohort adds births. Applying non-economic migration rates to this population, we find the number of migrants. Adding then to survived population gives us total population by age, sex, and race. Summing the cohorts gives total population which is multiplied by labor force participation rates and unemployment rates to find the total labor force, those not in the labor force and the total equilibrium unemployment.

Figure B-3 shows how growth in the basic sector affects the local labor force and population. The degree to which the local labor force

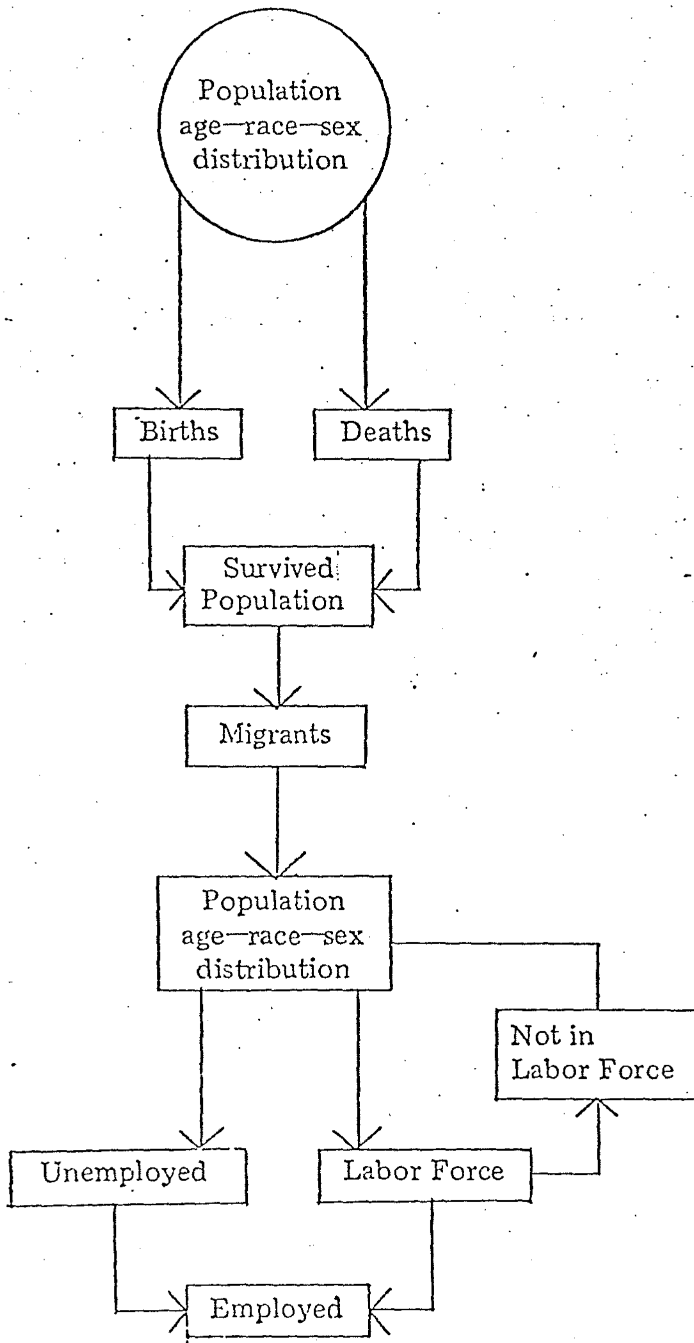

Figure B-2. Baseline Population Growth

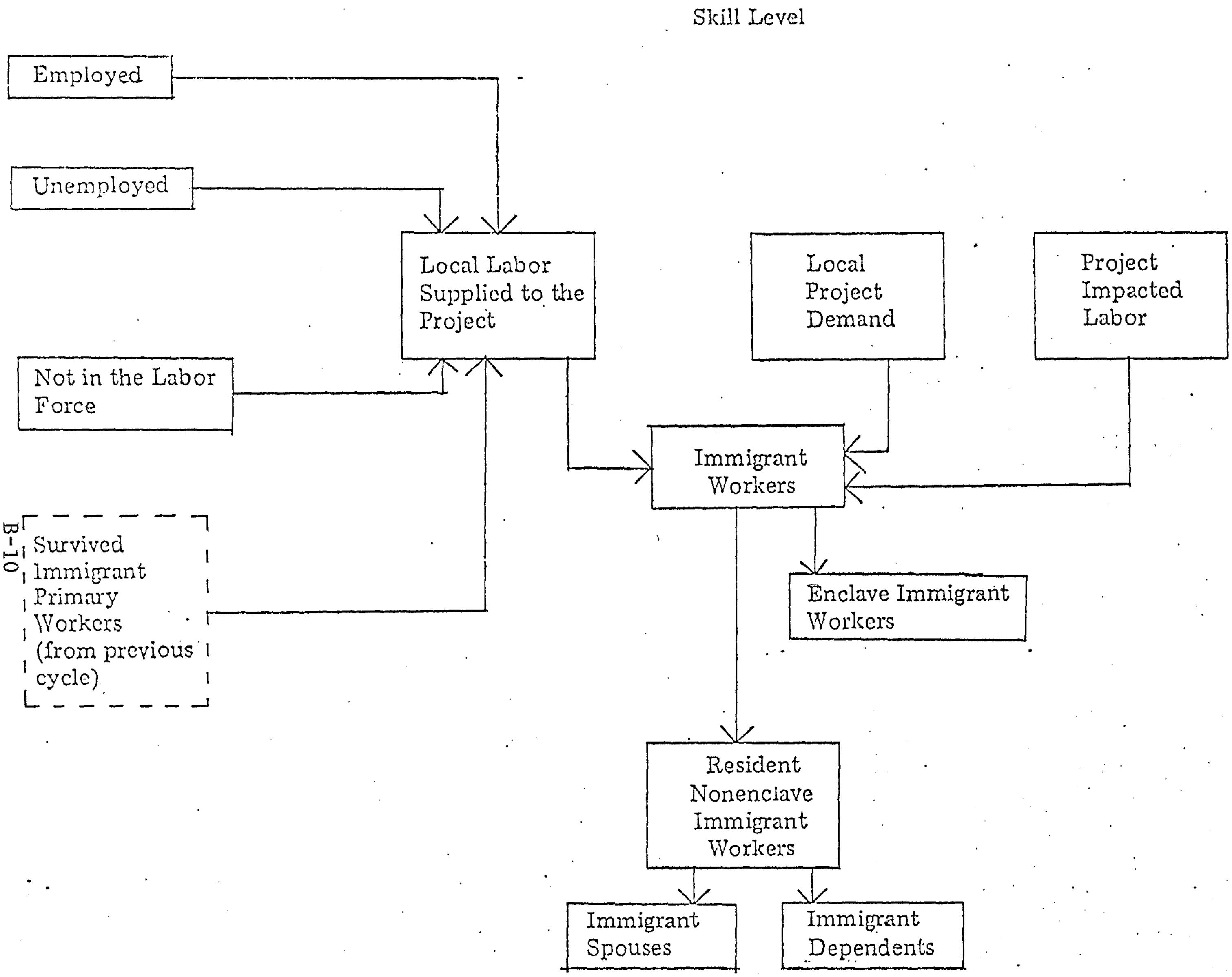

Figure B-3. Determination of Project Immigrants will supply employment to an exogenous project is a function of the skill level required by the exogenous project and the skill level of the local labor supply. In general, the local labor supply is unskilled or semi-skilled. This requires a large proportion of workers to inmigrate. Once the local project employment is determined, the number of inmigrant workers can be determined. Inmigrant labor force will include a proportion that live in the local community (of which some will be unemployed), and a percent that will live away from the local communities in company enclaves and have no impact on local population or local secondary support employment.

Figure B-4 shows how growth in support sector employment affects the labor force and population. Basically, secondary inmigration is a function of secondary employment demand needed to serve the impact population in a community. A certain amount of the local population will supply this and the rest will be imported.

In general, the model is written in a flexible computer language (fortran) and can be adapted very easily to several applications. For a thorough description of SCIMP and its development, see OCS Special Report No. 4 and OCS Technical Report No. 24. For a review of other projection models and their applicability to small Alaskan regions, see OCS Technical Report No. 24.

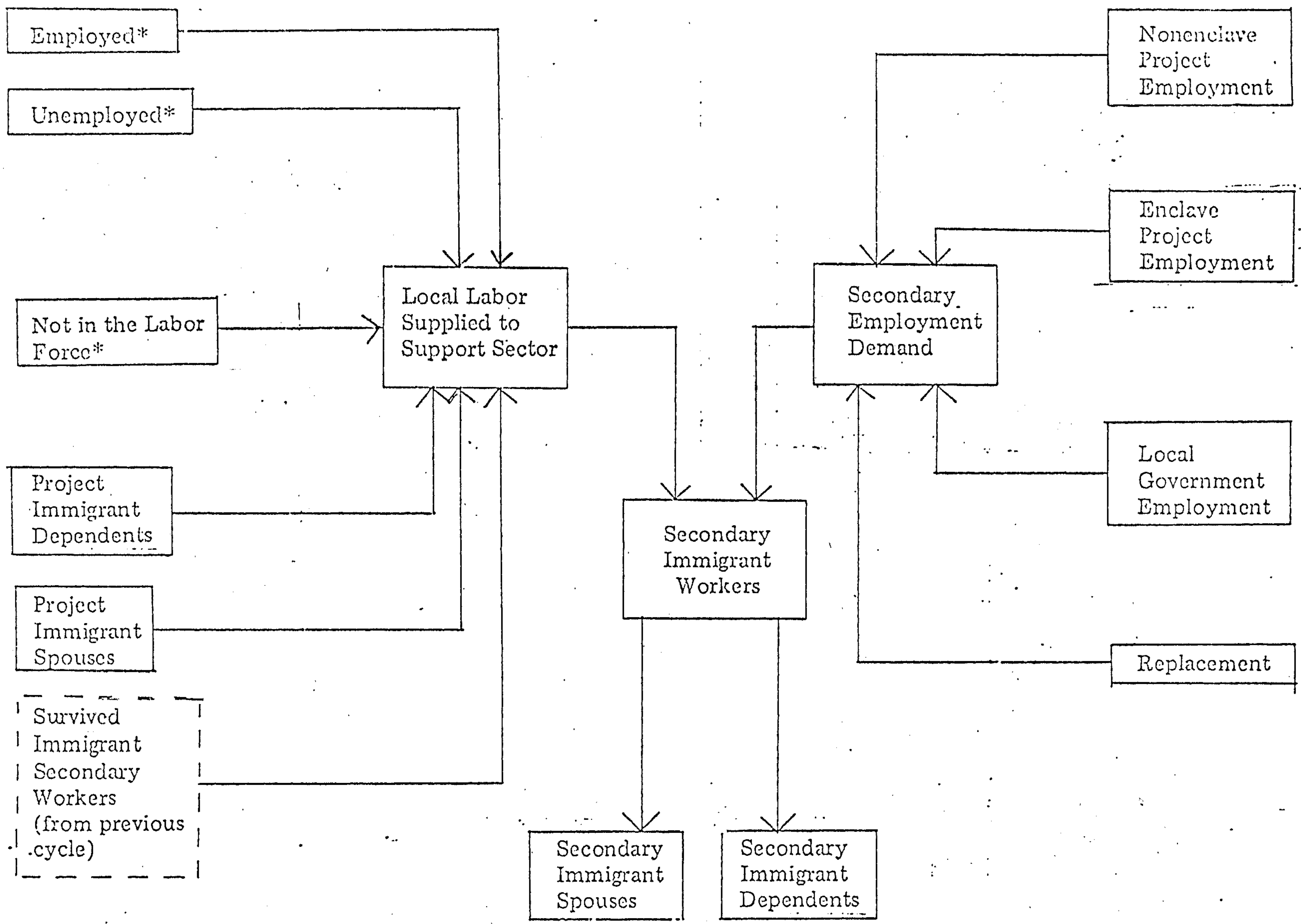

Figure B-4. Determination of Secondary Immigration

* Includes exogenous

APPENDIX C

BASELINE ECONOMIC DATA AND PROJECTION ASSUMPTIONS

C.1. Baseline Population

Initial 1980 baseline population was found in the 1980 Census. The census age and sex distributions were complete, but race was broken only into age cohorts less than 5, 5-17, 18-64, and over 65; race was not broken down by sex. So the age-sex distributions were applied to the age-race distribution to find the initial total baseline population by age, sex, and race. Next, the military was subtracted from the population by age, sex, and race, using the 1970 Census distribution of active duty military by age and sex.

Table C-1 shows the initial civilian population distribution that was used as the start-up population for the SCIMP model.

TABLE C-1. 1980 CIVILIAN POPULATION DISTRIBUTION

Age	Non-Native Male	Non-Native Female	Native Male	Native Female
< 15	162	158	646	613
15-19	72	112	231	219
20-24	115	105	223	186
25-29	89	90	216	169
30-44	152	176	388	310
45-64	144	105	246	215
65 +	21	15	99	59

C.2. Natural Population Increase

Natural increase in the population is traditionally defined as the excess of births over deaths. The other major component of population change is migration. Traditionally, migration is assumed to be related to economic growth. However, there are non-economic reasons for migration; these include education and the attraction of the "bright lights" of the bigger city. Because of this, we include a component of non-economic migration as part of natural population change.

Each of these components of natural increase is influenced by the demographic composition of the population. Two regions with the same total population will have a different natural increase if the demographic structure of the region differs. One obvious illustration is that the number of births depends on the number of females in the population.

The pattern of births, deaths, and non-economic migration is described by a series of cohort specific parameters which relate the specific demographic event to each age-sex-race cohort. These rates are as follows:

- Survival rates which describe the proportion of population in each cohort which survives to the next period.
- Fertility rates which illustrate the number of births expected per female in each cohort.
- Migration rates which show the proportion of population in each cohort assumed not to migrate for non-economic reasons in each year.

The survival and fertility rates used in this study are shown in Table C-2. Each of these sets was based on the 1970 Census statewide Native and non-Native population, births, and deaths. Statewide results were used to adjust for special circumstances which may be found in any region in one year. The rates were adjusted to reflect the 1977 Gross Rates presented by the Alaska Department of Health and Social Services, Alaska Vital Statistics, 1977.

TABLE C-2. SURVIVAL AND FERTILITY RATES

	Survival Rate			
	Non-Native		Native	
Age	Male	Female	Male	Female
0-14	.997	.998	.997	.998
15-19	.997	.999	.993	.997
20-24	.997	.999	.992	.997
25-29	.997	.999	.995	.996
30-44	.995	.998	.993	.990
45-64	.980	.990	.978	.980
65 +	.945	.961	.940	.962

	Fertility Rate			
	Non-Native		Native	
	Male	Female	Male	Female
0-14	-	.002	-	.004
15-19	-	.128	-	.114
20-24	-	.144	-	.204
25-29	-	.093	-	.143
30-44	-	.021	-	.050
45-64	-	0	-	0
65 +	-	0	-	0

SOURCE: Derived from U.S. Census and Alaska Vital Statistics. Statewide rates are developed.

Migration has always been an important component of population change in rural Alaska. Most experts expect this trend to continue (see Alonso and Rust, 1976). Changes in village life brought about by things such as schools and other services may support arguments that there will be less migration in the future than in the past. Counter-arguments could be made which hypothesize higher levels of migration in the future. The young age structure of the population may mean increased migration since the younger population is usually more mobile. In addition, as rural population becomes better educated and more informed about urban areas, the pull of the areas will increase. The growth of rural regional centers (such as Dillingham) may also lead to an increase in migration from rural villages since they present an area of opportunity which is less foreign than the urban areas of the state.

Since reasonable hypotheses can be developed which support both a decrease and increase in migration, we assume that the structure of Native migration remains the same as found bewteen 1970 and 1980. The structure as described by the cohort-specific migration rates is shown in Table C-3. This table indicates a propensity for all cohorts except the 65+ to move from the region and a propensity to move back in during retirement years. Change in migration, with this assumption, occurs because of changes in the age structure of the population. The rates in Table C-3 were found by comparing 1980 survived population with actual population for each cohort in each

TABLE C-3. NON-ECONOMIC NATIVE NET MIGRATION RATES[a,b]

Age	Migration Rate
0-14	.999
15-19	.992
20-24	.990
25-29	.990
30-44	.995
45-64	.995
65+	1.008

[a]Shows proportion of the population in each cohort remaining after one year.

[b]Assumes male and female rates are similar. Assumes non-Native migration occurs solely in response to economic factors.

SOURCE: Estimated by Policy Analysts Limited as reported in Huskey, Nebesky, & Kerr's, Growth of the Nunam Kitlutsisti Region, ISER, July 1981.

Nunam Kitlutsisti subregion[1] (as estimated by Policy Analysis Limited) in the Nunam Kitlutsisti study (Huskey, Nebesky and Kerr, 1981). The Nunam data was the most recent available data on southwestern Alaska migration, and that is why it was used. Unfortunately, no reliable non-Native non-economic migration rate data is available for these regions. Thus, all non-Native migration was assumed to be for economic reasons.

[1]These subregions are the Wade Hampton and Kuskokwim Census Divisions.

C.3. Economic Migration

Economic migration is the population change which results from a change in employment opportunities. In traditional analyses of regional growth, economic migration is found by subtracting the population in the labor force from the number of employment opportunities. If there are more jobs than available labor, in-migration occurs; if the opposite, out-migration occurs.

This pattern does not describe economic migration in rural Alaska. Although job opportunities (or the lack of them) influence migration in rural Alaska, three factors make the relationship less direct than usually assumed. The relation between economic migration, labor force, and jobs is affecetd by the determinants of labor force participation, the ability to commute to work, and the availability of required skills.

Participation in the labor force is usually defined as those employed or actively seeking work. Labor force is not a static concept; many factors influence the number of people in the labor force. The decision to participate is made based on a comparison of employment opportunities and wage rate with other uses of time and other sources of income. The availability of subsistence activity and transfer incomes reduces the labor force participation in rural Alaska. Given these other opportunities, residents of rural Alaska have another option to labor force participation which is withdrawing from the labor force. This is similar to the discouraged worker effect; when jobs are not available, people do not actively seek jobs, so they are by definition out of the labor force. This reduces the out-migration associated with a lack of employment opportunities. The discouraged worker effect was found high in the neighboring Wade Hampton and Kuskokwim Census Divisions; between 40-to-45 percent of the population over sixteen which was not in the labor force is estimated to be willing to work if work were available (PAL, 1981). Unfortunately, this data was not available for the Bristol Bay Census Divisions.

The second adjustment to a lack of jobs is commuting out of the community to work. Labor is one of the traditional export commodities of Alaska's rural villages (Alonso and Rust, 1976). When there are limited employment opportunities in the community, labor usually takes jobs outside the community for a few months to provide income. These laborers maintain residence in the community. Surveys indicate the extent of this effect; the 1980 WAATS survey found 29 percent of the households had members employed out of the village (PAL, 1981).

The importance of resource development in the region as a source of jobs also means the link between jobs, local labor force, and migration is less direct than usually assumed. The technical nature of many of the jobs in rural Alaska means that employees will be imported even though there are unemployed workers in the region. Additionally, since the majority of the capital available for resource development comes from outside the region, companies will import managers and engineers. Another example of this effect is the importation of teachers to staff the new village schools. Because of this, the creation of some jobs will lead directly to in-migration even though unemployed labor exists in the region.

One last factor is important for describing economic migration in rural Alaska--the seasonality of both labor supply and labor demand. Many jobs in rural Alaska are seasonal in nature, lasting only a few months. The seasonality is often determined by weather. Willingness to participate in wage employment may also be seasonally influenced by the subsistence cycles. The matching of these seasonal components also affects migration.

These factors are explicitly treated in the model both by the model structure and parameter assumptions. In the model used in this report, economic migration occurs for two reasons. First, a certain proportion of the employment growth is assumed to be imported; these migrants provide skills not available in the region. Secondly, economic migration does occur to bring labor force and job opportunities into equilibrium. This equilibrium takes into account the ability to commute to work.

This second component of economic migration is found as follows: The supply of labor from each region consists of two components, labor force and those out of the labor force who would work if jobs were available. Labor supply is calculated in terms of months to account for the seasonal component of labor supply. Labor supply is compared to total employment opportunities; the net excess labor is allocated between leaving the labor force and working as a commuter; the remainder migrates from the region. In all cases economic migration is assumed to be accompanied by dependents.

The following parameter assumptions describe the labor market interaction.

C.4. Labor Force Participation Rates

Labor force participation rates describe the proportion of each age-sex-race cohort in the labor force. In this study, we assume that historic rates would serve as starting rates. These rates are shown in Table C-4. These rates were derived from recent survey work in the coastal Nunam Kitlutsisti Region (see Huskey, Nebesky, Kerr, 1981).

The distribution of the rates was adjusted to reflect the 1980 labor force participation rate in the Bristol Bay region for 1980 as reported by the Alaska Department of Labor, and resident fish harvesting employment as estimated in the BLM-OCS Technical Report #51 (Terry, et al.).

TABLE C-4. LABOR FORCE PARTICIPATION RATES[a]

Age	Native Male	Native Female	Non-Native Male	Non-Native Female
0-14	-	-	-	-
15-19	.31	.31	.47	.38
20-24	.64	.50	.86	.84
25-29	.84	.54	.91	.74
30-44	.89	.54	.91	.67
45-64	.72	.27	.83	.72
65 +	.17	.08	.27	.08

[a]Shows proportion of cohort in the labor force.

SOURCE: PAL, 1981.
Alaska Department of Labor, special tabulations.
Terry (et al.), BLM-OCS Technical Report #51, August 1980.

COMMUTERS AND EQUILIBRIUM UNEMPLOYMENT

The equilibrium unemployment rate determines how many in the labor force without jobs remain in the region. Given our assumptions about the increasing importance of money income, we assume the ability to simply withdraw from the labor force diminishes. Because of this assumption, we use the historic unemployment rates to denote equilibrium levels. The rate used was 8.4 percent. This was determined using the 1976 to 1980 Alaska Department of Labor average for the two Bristol Bay Census Divisions.

DEPENDENTS

The migration of employees is accompanied by migration of dependents. Only migrants in construction, mining, and OCS industries were assumed to bring no dependents. Migrants in the other sectors of the economy were assumed to bring migrants at a ratio of .5 dependents per employee which was the ratio of non-Native dependents to labor force found in the Wade Hampton Census Division (PAL, 1981). Tables C-5 and C-6 show the age-sex-race distribution assumed for the migrants. Out-migrants are assumed to resemble the existing population in its distribution by age-sex-race. The model assumes two types of economic migrants, long-term migrants who bring dependents and short-term migrants who come to the region for the job and do not bring dependents.

The ratio of total military population to active duty military population was found to be 1.74. This is based on the fourth count 1970 Census tabulations.

TABLE C-5. LONG-TERM MIGRANT AGE-SEX-RACE DISTRIBUTION

	Employees				Dependents			
	Non-Native		Native		Non-Native		Native	
Age	Male	Female	Male	Female	Male	Female	Male	Female
0-14	-	-	-	-	.203	.171	.023	.019
15-19	.030	.030	.009	.008	.014	.014	.002	.002
20-24	.116	.068	.012	.010	-	.014	-	.002
25-29	.125	.093	.013	.012	-	.008	-	.001
30-44	.217	.068	.016	.014	-	.008	-	.001
45-64	.114	.038	.004	.003	-	.016	-	.002
65+	-	-	-	-	-	-	-	-

SOURCE: Based on Wade Hampton age-sex distribution for labor force and nonlabor force (PAL, 1981). Assumes racial distribution of migrants is .1 Native and .9 non-Native. Assumes no migrants over 65.

TABLE C-6. SHORT-TERM RESIDENT AGE-SEX-RACE DISTRIBUTION

	Employees			
	Non-Native		Native	
Age	Male	Female	Male	Female
0-14	-	-	-	-
15-19	.045	.015	.013	.004
20-24	.150	.036	.017	.004
25-29	.172	.044	.015	.006
30-44	.251	.034	.122	.006
45-66	.133	.019	.011	.003
65 +	-	-	-	-

SOURCE: Based on Wade Hampton labor force age-sex distribution (PAL, 1981). Assumes migrants distributed .9 non-Native and .1 Native. Assumes female migrants only one-half of labor force rates. Assumes no migrants over 65.

C.5. Support Sector Response

The local support sector consists of that portion of the local economy which provides goods and services to the local community. This sector consists of portions of the following industries: trade, service, finance, construction, transportation, communication, and utilities. The growth of this sector responds to the growth of the local community.

Traditional regional analysis treats the growth of this sector as responding in direct proportion to the growth of the basic sector. This simple description does not work well in rural Alaska, and a broader description of this response is needed. In reality, this sector grows as incomes are spent on local goods and services. Growth in local incomes is the real determinant of this response; incomes grow not just through wages, but also through increases in transfer payments.

The size of this sector is limited by the extent or size of the market. The size of the market is determined by the income available in the region. As income grows two changes in the local economy may take place. First, more of the goods and services available in the region will be sold. Secondly, more goods and services will be made available in the region. Each of these changes may increase employment in the region's support sector. The availability of goods and services in the region is influenced by the scale of the economy. As the size of the market increases, the costs of providing goods locally changes; and more goods are made available.

We assume that increasing incomes are the major determinant of the growth in the support sector. However, two other factors play an important part in that growth. First, a portion of the support sector is assumed to respond directly to the growth in government employment. That portion of this sector accounts for social service activities and construction sponsored by government. Secondly, those employees in the region for short-term employment (construction workers and petroleum industry employees) have a different impact on the support sector than full-time residents.

The following assumptions describe the support sector response.

INCOME GROWTH

Incomes grow because of increases in employment, increases in other sources of income, and increases in the real wage. We assume that the real wage rates in all sectors remain constant throughout the projection period. Table C-7 presents 1980 real wages.

TABLE C-7. ANNUAL WAGE RATES

Mining	43,774
Civilian Government	17,637
Military	14,361
Support Sector	12,820
Construction	29,750

Note: 1979 Wages inflated to 1980 using the BLS, Consumer Price Index average annual change for Anchorage (1979-1980).

SOURCES: Alaska Department of Labor Statistical Quarterly, 1979. U.S. Bureau of Labor Statistics.

Regression analysis was used to estimate an equation for determining support sector employment. The annual data used in the regression is presented in Table II-9 in Chapter II. Support employment (EMS) was the dependent variable and consisted of the total of the distribution industries in Table II-9 in Chapter II. The independent variables were total government (EMG), total fish harvesting and processing and mining combined (EMA + EMX). The years

1974 and 1975 were excluded from the analysis because of the exceptionally low fish harvesting and processing that took place then.

The regression was run on the following equation:

$$EMS = \alpha + \beta * EMG + \gamma * (EMA + EMX)$$

The results were:

α = -822	R^2 = .85
β = 1.032	F = 17.3
γ = .226	DF = 6

Support sector employment response to petroleum-related employment was determined using the ratio of support sector employment to basic employment activity in the years 1969 through 1979. The support sector employment is defined the same as nonpetroleum-related support. Basic is defined as total government plus total mining plus total fishing-related employment. The multipliers were applied to all resident support employees. To determine support response to nonresident petroleum-related activity, it was assumed that the support multiplier be one-fourth the resident multiplier. This assumption is based on work done for the Bureau of Land Management Outer-Continental Shelf (BLM-OCS) office's Technical Memorandum SG-4 (Tuck et al., September 1980).

Thus, the secondary support sector equation took the form:

$$SEMS = N15 * RPET + N16 * NRPET$$

RPET = Resident petroleum workers
NRPET = Nonresident petroleum workers
N15 = Resident multiplier (estimated as .2195)
N16 = Nonresident multiplier (estimated as .0549)

C.6. Government Employment Projections

Government employment is broken into three categories: state and local, federal-civilian, and active-duty military. Growth rates for total government employment were assumed to be the same as the total government growth rates projected by Goldsmith and Porter in the Alaska Economic Projections for Estimating Electricity Requirements for the Railbelt, October 1981 (the Railbelt study). In the mean case (SCIMP's control case), total government grew at 1.96 percent annually. Federal government growth was assumed to be zero. Thus, state and local government grew at 3.26 percent annually in the control case.

In SCIMP's two industrialization scenarios, the Railbelt study's high total government growth rates were used. In these two cases, however, the growth was allocated differently than the control case. Federal civilian growth was assumed at one percent annually, and military was assumed to grow at two percent annually. The residual of growth was allocated to state and local government and amounted to 4.59 percent annually.

Secondary state and local government response to petroleum-related activities was estimated using the ratio of state and local government to population lagged one year over the 1969-1979 period for state and local government and over the 1968-1978 period for population. This multiplier was estimated as .081 (see Table II-9 in Chapter II and the Alaska Department of Labor Current Population Estimates, various issues).

Support construction from nonpetroleum-related activities was estimated using the ratio of construction to basic employment (basic defined same as above) over the 1969-1979 period. This ratio was estimated as .0142. Petroleum-related activities were so small that no secondary construction was assumed to occur from it.

C.7. Residency Assumptions

Nonresident employment in the nonpetroleum-related industries was estimated using the following equation:

$$ENCLV = EMX * XR + EMFG * MFGA + CFISH * FADJ$$

Where: EMFG = Fish processing projections from BLM-OCS Technical Report 51.

MFGA = Residence adjustment for fish processors based on ISER (1981) interviews with major processors. This was found to be .83.

CFISH = Commercial fisherman employment based on BLM-OCS Technical Report 51. It is the sum of salmon and herring harvest employment presented in Table VIII-8.

FADJ = Residence adjustment based on 1979 residence of gear owner estimates in Table II-12 in Chapter II from the Alaska Department of Fish and Game. The year 1979 was used and equaled .468.

EMX = Mining and special exogenous projects.

XR = The ratio of nonresident employment to total employment. This was assumed by the author to be .5.

The proportion of migrant workers living in the community was estimated using previous BLM-OCS work as well as discussions with local businessmen and residents. A survey of the major fish processors in the region revealed that only approximately 17 percent of their employees were residents of the region; 46.8 percent of all fishermen were determined to be residents based on Table II-12.

Enclave employment ratios are ratios of workers employed in the basic sector who do not live in any of the census division communities. They usually live in company-provided "enclaves" for weeks at a time and spend their off-time somewhere outside the study region such as Anchorage. These ratios were determined through basic sector employers. For fish processors, they were 83 percent; for fish harvesting, they were 53.2 percent.

C.8. Basic Employment Assumptions

FISHING

Projections of fish harvesting and processing employment are derived from OCS Technical Report 51 (Tuck, et al.). Table C-8 breaks them down into annual average and peak employment projections. These projections assume that the 1978-1980 harvests (1979 is presented in Table II-10) are peak years and are not sustainable in the long run. Herring harvest and processing projections are based on very little historical data since there is a dearth of it. ISER's author assumes that herring processing will take place by the harvester or be processed outside of the region.

Despite the constancy of the harvest employment projections, the dollar value of the catch and the amount in tons are projected to increase over time. This increase in productivity can be attributed to enhanced technology, better fisheries management, decreases in foreign high seas salmon interceptions, and better market conditions[2] (see Tables C-8 and C-9).

The difference between seasonal peak employment and annual average employment is presented in Table C-8. The ratio of seasonal-to-annual average employment derived from Table II-9 in Chapter II was estimated to be 4.744. Most of the seasonal employment occurs in the

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[2]See Terry et al., August 1980.

TABLE C-8. FISHING EMPLOYMENT, 1980 - 2002
A COMPARISON OF PEAK AND ANNUAL AVERAGE EMPLOYMENT

PEAK EMPLOYMENT

	Harvesting		Processing		Total	
Year	Salmon	Herring	Low	High	Low	High
1980	4,320	1,789	962	1,006	7,071	7,115
1981	4,320	1,789	958	1,020	7,067	7,129
1982	4,320	1,789	953	1,039	7,062	7,148
1983	4,320	1,789	948	1,053	7,057	7,162
1984	4,320	1,789	944	1,072	7,053	7,181
1985	4,320	1,789	944	1,091	7,053	7,200
1986	4,320	1,789	944	1,110	7,053	7,219
1987	4,320	1,789	944	1,134	7,053	7,243
1988	4,320	1,789	944	1,153	7,053	7,262
1989	4,320	1,789	944	1,177	7,053	7,286
1990	4,320	1,789	944	1,200	7,053	7,309
1991	4,320	1,789	939	1,224	7,048	7,333
1992	4,320	1,789	939	1,248	7,048	7,357
1993	4,320	1,789	939	1,271	7,048	7,380
1994	4,320	1,789	939	1,300	7,048	7,409
1995	4,320	1,789	939	1,324	7,048	7,433
1996	4,320	1,789	939	1,352	7,048	7,461
1997	4,320	1,789	939	1,376	7,048	7,485
1998	4,320	1,789	939	1,404	7,048	7,513
1999	4,320	1,789	939	1,433	7,048	7,542
2000	4,320	1,789	934	1,461	7,043	7,570
2001	4,320	1,789	934	1,485	7,043	7,594
2002	4,320	1,789	934	1,518	7,043	7,627

ANNUAL AVG. FISHING EMPLOYMENT

	Harvesting All Scenarios		Processing		Total	
Year	Salmon	Herring	Low	High	Low	High
1980	720	297	203	212	1,220	1,229
1981	720	297	202	215	1,219	1,232
1982	720	297	202	219	1,219	1,236
1983	720	297	201	222	1,218	1,239
1984	720	297	200	226	1,217	1,243
1985	720	297	199	230	1,216	1,247
1986	720	297	199	234	1,216	1,251
1987	720	297	199	239	1,216	1,256
1988	720	297	199	243	1,216	1,260
1989	720	297	199	248	1,216	1,265
1990	720	297	199	253	1,216	1,270
1991	720	297	198	258	1,215	1,275
1992	720	297	198	263	1,215	1,280
1993	720	297	198	268	1,215	1,285
1994	720	297	198	274	1,215	1,291
1995	720	297	198	279	1,215	1,296
1996	720	297	198	285	1,215	1,302
1997	720	297	198	290	1,215	1,307
1998	720	297	198	296	1,215	1,313
1999	720	297	198	302	1,215	1,319
2000	720	297	197	308	1,214	1,325
2001	720	297	197	313	1,214	1,330
2002	720	297	197	320	1,214	1,337

SOURCE: Terry (et al.), BLM-OCS Technical Report #51, and Table I-9 in Chapter I (For Peak Processing Employment Ratios).

TABLE C-9.

Bristol Bay Salmon Fishery
Projected Harvesting Activity

1980-2000

Year	Catch: Weight: Pounds (millions)	Catch: Weight: Metric Tons	Catch: Value (millions)[1]: Nominal	Catch: Value (millions)[1]: Real
1980	54.2	24604	55.5	55.5
1981	55.1	25008	55.2	51.3
1982	56.0	25419	60.4	52.2
1983	57.0	25837	66.1	53.1
1984	57.9	26264	72.4	54.1
1985	58.9	26698	79.2	55.0
1986	60.0	27237	87.0	56.2
1987	61.2	27767	95.4	57.3
1988	62.4	28309	104.7	58.5
1989	63.6	28863	114.9	59.7
1990	64.9	29429	126.1	60.9
1991	66.2	30007	138.4	62.1
1992	67.5	30598	151.9	63.4
1993	68.8	31201	166.7	64.6
1994	70.1	31817	182.9	65.9
1995	71.5	32447	200.7	67.3
1996	72.9	33090	220.3	68.6
1997	74.4	33747	241.7	70.0
1998	75.9	34418	265.3	71.4
1999	77.4	35104	291.1	72.9
2000	78.9	35804	319.4	74.4

Bristol Bay Census Division
Projected Processing Plant Wages

1980-2000

High Projections: Wages: Nominal	High Projections: Wages: Real[1]	Low Projections: Wages: Nominal	Low Projections: Wages: Real
5513614	5513614	5295275	5295275
6057970	5632177	5701712	5300960
6656294	5753484	6139554	5306831
7313958	5877601	6611239	5312886
8036866	6004593	7119396	5319123
8831513	6134528	7666862	5325541
9739513	6289738	8286018	5351076
10733569	6444491	8949089	5373080
11829541	6603309	9665596	5395384
13037918	6766299	10439870	5417987
14370271	6933573	11276592	5440890
15839365	7105246	12180826	5464093
17459284	7281435	13158048	5487595
19245565	7462261	14214179	5511395
21215352	7647848	15355623	5535494
23387561	7838323	16589305	5559892
25783060	8033816	17922715	5584589
28424880	8234463	19363954	5609584
31338426	8440400	20921782	5634878
34551736	8651769	22605672	5660470
38095746	8868716	24425874	5686360

[1] The real values and prices were calculated using the U.S. CPI; 1980 is the base period.

Source: Terry et al BLM-OCS Technical Report 51 month of July. Most of the seasonal employment is nonresident. Using Table II-12 in Chapter II, 1979 ratio of resident gear owners to total gear owners as a proxy for residency ratio of fish harvesters, 46.8 percent of all harvesters were estimated to be resident. The remainder were assumed to be seasonal harvesters and have little impact on the local economy.

Based on a survey of eight of the major processors, it was estimated that only 17 percent of the labor supplied to fish processing originated from Bristol Bay.

MINING

Mining was broken down into petroleum and nonpetroleum. The petroleum scenarios were derived from the preliminary draft of the Prudhoe Bay Uplands Oil and Gas Lease Sale #34, prepared by Governor's Agency Advisory Committee on Leasing, State of Alaska, 9-81 (heretofore cited as "Sale #34"). The selection of this scenario was the result of conversations with officials at the State of Alaska, Department of Natural Resources (DNR), and a comparison of other scenarios around the state. It was generally agreed by the DNR experts that the minimum commercial discovery necessary to develop a field in Bristol Bay would be close to 100 million barrels (MMBBL) of oil. And since Sale #34 assumes 100 MMBL, it was chosen as a proxy scenario.

The assumptions used in developing the Prudhoe Bay Uplands scenario are reproduced from the Sale #34 report, and are presented within quotes and followed with comments on their application to Bristol Bay as follows:

1. "Industry interest and resource potential are generally low for the Prudhoe Bay Uplands sale with the exception of the eastern and northeastern portions of the sale area adjacent to the Canning River where interest and potential may be moderate. However, although specific tracts to be offered in the sale have not yet been selected, the overall sale area is very large, consisting of about 65 townships (about 1.5 million acres) in which few wells have been drilled. Two sub-economic gas fields, the Kemik and Kavik, have been discovered on existing leases."

Comment: Industry interest and resource potential are considered to be low to moderate in Bristol Bay. Very little exploration activity has yet to occur, and drilling in the past has not resulted in any significant finds. To quote the State of Alaska, Department of Natural Resources <u>Five Year Leasing Program</u>, January 1981 (hereafter referred to as the "Five Year Leasing Program Report"):

<u>"Southwest Bristol Bay Uplands (Sale 41)</u>

A Bristol Bay Uplands sale is scheduled for early 1984. State land holdings are currently limited with much land yet to be conveyed. Only onshore acreage is being considered for lease at this time with possible inclusion of submerged lands that could be drilled from onshore. AS 38.05.140(f) precludes the leasing of submerged lands in Bristol Bay east of 159°49' west longitude and north of 57°30' north longitude without the consent of the Legislature. Petroleum potential and industry interest in the area is low to moderate, since little exploration activity has occured, [sic] and drilling in the past has not resulted in any significant finds. Federal leasing in the area is also being considered."

It should also be noted that various tracts of Native corporation land are being considered for exploration as well.

"2. Assuming favorable reservoir characteristics, the minimum economic field size for oil fields adjacent to existing transportation infrastructure (e.g., Prudhoe Bay) in the nearshore Beaufort and North Slope is probably on the order of 100 million recoverable barrels (MMbbls) or perhaps lower (this reflects the doubling of oil prices that occurred in 1979-80).

"3. Assuming favorable reservoir characteristics, the minimum economic field size for gas fields adjacent to existing transportation infrastructure (e.g., Prudhoe Bay) in the nearshore Beaufort and on the North Slope is probably on the order of two or three trillion cubic feet (Tcf).

"4. One small oil field (in the context of arctic economics) and one medium-sized natural gas field with recoverable reserves of 100 MMbbls and three Tcf, respectively, are discovered. The oil field is located in the eastern part of the sale area near the Canning River while the gas field is located in the foothills.

"5. The Point Thomson oil discovery will have been developed with a 50-mile pipeline to Pump Station No. 1 by the time production commences from any commercial discoveries in this lease sale area. This line has sufficient surplus capacity to accommodate the 29,000 Bbls/day peak production from the field and the line is operational when production commences.

"6. The oil field is developed with a 20-mile pipeline to Point Thomson where the crude enters a Point Thomson-Prudhoe Bay pipeline. A total of 20 producing wells are located on three pads (Table 1).

"7. The Alaska Natural Gas Transportation System (ANGTS) will have been completed by the time production commences from any commercial discoveries in this lease sale area. There is sufficient surplus capacity in the gas pipeline to accommodate the 425 MMcf/day peak production from this gas field.

"8. The gas field is developed with a 30-mile pipeline to the ANGTS terminal at Prudhoe Bay. A total of 30 production wells are located on four pads (Table 2)."

Comment: Since so little is known about what the Bristol Bay transportation infrastructure will be in the next 20 years, we have assumed that a similar infrastructure will exist in Bristol Bay as above in terms of the cost of getting the oil and gas to market. The location of the discoveries has not been assumed to be at any points on the map, although they will be assumed to be in the Bristol Bay region.

> "9. The development schedules indicate an elapsed time of about six to seven years from discovery to production (seven to eight years from the lease sale date) for small fields on the North Slope."

Comment: The time schedule for the development scenario is presented in Table C-12. The difference between Prudhoe Bay and Bristol Bay is that exploration is assumed to begin in 1982 in Prudhoe and in 1985 in Bristol Bay.

Tables C-10, C-11, and C-12 present the technical assumptions for the Prudhoe Bay scenario. The difference between these assumptions and their application to Bristol Bay is the location of the wells, pipelines, roads, and production systems.

The salient Bristol Bay petroleum development assumptions on employment demanded are summarized in Table C-13. The scheduling was derived from Table C-12 and Table D-4 in the Sale #34 report. For all employment except construction, employment demanded was estimated

TABLE C-10

PETROLEUM DEVELOPMENT SCENARIO - PRUDHOE BAY UPLANDS LEASE SALE - OIL

Field Size Oil (MMBBL)	Location	Reservoir Depth (Feet)	Production System	Number of Production Wells	Initial Well Productivity (B/D)	Peak Production Oil (MB/D)	Pipeline Distance to Terminal (Miles)	Trunk Pipeline Diameter (Inches) Oil	Terminal Location
100	Canning River	7,500	Pipeline to Pt. Thomson	20	1,500	28.8	20	8	Pt. Thomson

Note: This scenario assumes that the Point Thomson oil field will be developed with a pipeline constructed to Pump Station No. 1 at Prudhoe Bay. A small oil field is discovered near the Canning River south of Pt. Thomson. It is developed with a short pipeline to the pipeline terminal at Pt. Thomson where crude is piped to Prudhoe Bay in a trunk pipeline.

Source: Dames & Moore

As reported by the Governor's Agency Advisory Committee on Leasing, *A Social, Economic, and Environmental Analysis of the Proposed Prudhoe Bay Uplands Oil and Gold Lease Sale No. 34,* State of Alaska, Preliminary Draft, August 1981.

TABLE C-11

PETROLEUM DEVELOPMENT SCENARIO - PRUDHOE BAY UPLANDS LEASE SALE - NON-ASSOCIATED GAS

Field Size Oil (BCF)	Location	Reservoir Depth (Feet)	Production System	Number of Production Wells	Initial Well Productivity (MMCFD)	Peak Production Gas (MMCFD)	Pipeline Distance to Terminal (Miles)	Trunk Pipeline Diameter (Inches) Gas	Terminal Location
3,000	Foothills	10,000	Pipeline to ANGTS at Prudhoe Bay	30	15	425	30	20	Prudhoe Bay

NOTE: In addition to the Canning River oil field (Table 1), this scenario assumes discovery of a significant non-associated gas field in the Brooks Range foothills. It is developed with a 30-mile pipeline that takes the production to the ANGTS terminal at Prudhoe Bay (we have assumed that surplus capacity to accommodate the 400 mmcfd production from this field is available in the gas line).

Source: Dames & Moore

As reported by the Governor's Agency Advisory Committee on Leasing, *A Social, Economic, and Environmental Analysis of the Proposed Prudhoe Bay Uplands Oil and Gold Lease Sale No. 34,* State of Alaska, Preliminary Draft, August 1981.

TABLE C-12

PETROLEUM DEVELOPMENT SCENARIO - PRUDHOE BAY UPLANDS SALE(1)

Calendar Year: Prud-hoe*	Calendar Year: Bristol Bay*	Year After Lease Sale	Exploration and Delineation Wells(2): Exploration	Exploration and Delineation Wells(2): Delineation	Exploration Rigs Operating(2)	Commercial Discoveries: Oil	Commercial Discoveries: Gas	Well Pads(3): Oil	Well Pads(3): Gas	Development Wells(4): Oil	Development Wells(4): Gas	Road Construction (Miles per Year): Infield	Road Construction (Miles per Year): Haul	Trunk Pipeline Construction (Miles Per Year): Oil	Trunk Pipeline Construction (Miles Per Year): Gas	Production: Oil (MMBBL)(5)	Production: Gas (BCF)(5.6)
1982	1985	1	1		1												
1983	1986	2	1		1	1											
1984	1987	3	2	1	2		1										
1985	1988	4	1	2	2												
1986	1989	5	1	1	1												
1987	1990	6	1	1	1			3				4					
1988	1991	7	1						3	0	4	4	50	20			
1989	1992	8							1	8	12	3			35	6.3	
1990	1993	9								8	12					9.5	62
1991	1994	10									2					10.5	94
1992	1995	11														10.5	124
1993	1996	12														10.5	155
1994	1997	13														9.4	155
1995	1998	14														7.4	155
1996	1999	15														5.9	155
1997	2000	16														4.6	155
1998	2001	17														3.7	155
1999	2002	18														2.9	155
2000	2003	19														2.3	155
2001	2004	20														1.8	155
2002	2005	21														1.5	155
2003	2006	22														1.2	143
2004	2007	23														0.9	118
2005	2008	24														0.7	98
2006	2009	25															81
2007	2010	26															67
2008	2011	27															56
2009	2012	28															46
2010	2013	29															38
2011	2014	30															32
2012	2015	31															26
2013	2016	32															22
2014	2017	33															18
2015	2018	34															
2016	2019	35															
2017	2020	36															
TOTALS			8	5	8	1	1			24	30	11	50	20	35	89.6	2,575

Notes:
1. Also see Tables I-16 and I-17.
2. Drilled in winter using Arctic land rigs.
3. Gravel pads (1000 x 150' dx 5'.
4. Includes non-producing wells for water or gas injection at a ratio of 1:4 to producers.
5. This production profile reflects an economic limit which is assumed to be 100 B/D per well for oil and 1.5 MMCFD for gas.
6. Associated gas is assumed to be used as fuel for field facilities with the remainder reinjected into the reservoir.

Source: Dames & Moore
As reported by the Governor's Agency Advisory Committee on Leasing, *A Social, Economic, and Environmental Analysis of the Proposed Prudhoe Bay Uplands Oil and Gold Lease Sale No. 34,* State of Alaska, Preliminary Draft, August 1981.

*Exploration in Bristol Bay starts in 1985, as opposed to 1982, for the Prudhoe scenario.

TABLE C-13
DIRECT ANNUAL AVERAGE EMPLOYMENT DEMAND FROM ONSHORE PETROLEUM
DEVELOPMENT IN BRISTOL BAY REGION

Year	Construction		Oil and Gas		Geophysical (All (Import)	Exploration		Developmental		Operations		Total
	Local	Import	Local	Import		Local	Import	Local	Import	Local	Import	
1981 (Resident)						122	123	110	111	116	117	
1982												
1983												
1984 Year of Lease Sale												
1985	0		2	26	2	4	28					32
1986	0		2	26	2	4	28					32
1987	9	16	7	77	2	4	28	12	60			104
1988	79	148	7	77	2	4	28	84	199			315
1989	94	174	5	52	2	4	28	97	198			327
1990	0	0	5	51	2	4	28	0	0	3	25	60
1991	0	0	5	51	2	4	28	0	0	3	49	84
1992	0	0	3	34	0	0	0	0	0	3	34	37
1993	0	0	3	34	0	0	0	0	0	3	34	37
1994	0	0	2	17	0	0	0	0	0	2	17	19
1995-2002	0	0	2	17	0	0	0	0	0	2	17	19

SOURCE: State of Alaska, Governors Agency Advisory Committee on Leasing; A Social, Economic and Environmental Analysis of the Proposal Prudhoe Bay Uplands Oil and Gas Lease Sale No. 34, Preliminary Draft, Table D-4.

using Nebesky and Huskey's Patterns of Resident Employment in Alaska's OCS Industry (unpublished working paper prepared for the Alaska BLM-OCS office, November 1981).

Exploration is assumed to require 32 workers annually between 1985 and 1991 inclusive (see Table C-13).

The development phase requires a great deal of construction and will cause the greatest impact on the region. In the peak year (1989), the demand for development employees totals 295. Of these, 174 are assumed to be imported skilled trade construction workers; the other 94 construction workers are assumed to be local lower-skilled workers. The residency of construction workers is based on Sale #34's 65 percent skilled labor requirement for construction work assumption. A total of 327 direct employees will work in the peak year.

Operations start up in 1990 with 28 employees, increase to a peak of 52 in 1991, and finally level off at 19 during 1994 and remain at 19 through the projection period.

All of the imported workers in all phases of activities are assumed to live in company-created enclaves. Their effect on the local economy is assumed to be minimal. The secondary support employment created for each enclave worker is assumed to be one-fourth of what a resident creates. The impact of a marginal petroleum employee resident worker is the same as any imported resident worker.

Nonpetroleum-Related Mining

The manpower requirements for this scenario were based on Table II-13. Both high scenarios assumed three placer gold, one hard rock gold and precious metals, and one mercury. The manpower requirements are presented in Table C-14. They total to 52 workers annually. For SCIMP model purposes, we have assumed that half of the workers will live in enclaves.

TABLE C-14. MINING PROJECTIONS, 1983-2002

	Placer	Hard Rock	Mercury	Total Employment
Number of Mines	3	1	1	4
Annual Average Employment	14	25	13	52

SOURCE: Table I-13 and discussions with C.C. Hawley and Associates.

C.9. Resident Income and Wages and Salaries

For the purposes of this study, we wanted to look at total and per capita income changes over the projection period. To derive the total income of the region, the following equations were used in the model:

Total Income (Resident)

TYR = ((WST - WSFISH) * TYR) + (WFISHH * FHR) + (WSFP * FPR)

Where: WST = Total wages and salaries.

TYR = The historical ratio of total personal income to wages and salaries excluding fishing income. This was derived from Tables I5a and I5b and the Alaska Department of Labor's Statistical Quarterlies for 1979. TYR = .7188.

WSFISH = Total fish harvesting and processing wages and salaries.

WSFP = Wages and salaries of fish processors.

FPR = Ratio of resident fish processors to total; estimated to be .17 in 1981 based on an ISER survey of major processors.

FHR = ratio of resident to total fishermen; .468, based on Table I-12.

WSNRX = Total nonresident mining wages and salaries (including petroleum related).

Total Wages and Salaries

WST = WSG + WSS + WSFISHH + TWSFP + WSX

Where: WSG = Total government wages and salaries.

WSS = Total support sector employment wages and salaries.

WSFISHH = Fish harvesting income (presented in Table C-9).

WSFP = Fish processing wages and salaries (presented in Table C-9).

WSX = Total mining wages.

Government Wages and Salaries (annual)

WSG = (WRG * EMG) + (WRGM * EMM)

Where: WRG = Civilian government wage rate.

EMG = Civilian government employment.

WRGM = Military wage rate.

EMM = Military employment.

Support Sector Wages and Salaries

WSS = WRS * EMS + WRC * EMC

Where: WRS = Wage rate for support sector (transportation, communication, utilities, trade, finance, and services).

EMS = Employment in support sector.

WRC = Wage rate for construction.

EMC = Employment in construction.

The wage rates used in these projections are presented in Table C-7.

APPENDIX D

A REVIEW OF ENERGY DEMAND FORECAST METHODOLOGY FOR THREE STUDIES IN BRISTOL BAY

D.1. Introduction

As part of the overall energy demand analysis for the Bristol Bay Power Plan, the Alaska Power Authority asked the Institute of Social and Economic Research (ISER) to review the energy-demand forecast methodologies contained in an earlier series of reconnaissance reports. They are:

1. Bristol Bay Energy and Electric Power Potential by R.W. Retherford Associates for the Alaska Power Administration, 1979 (RWR79).

2. Reconnaissance Study of the Lake Elva and Other Hydro-Electric Power Potentials in the Dillingham Area by R.W. Retherford Associates for the Alaska Power Authority, 1980 (RWR80).

3. Lake Elva Project Detailed Feasibility Analysis by R.W. Beck and Associates, Inc., for the Alaska Power Authority, 1981 (RWB81).

The first report, abbreviated "RWR79," is a broad-based energy reconnaissance study that includes energy demand forecasts for thirty Bristol Bay communities shown in Figure D.1. The RWR79 report will be reviewed in detail since it covers all of the eighteen communities that comprise the revised study area for the Bristol Bay Regional Power Plan. In this review, considerable attention will be given to the electricity-demand forecasts in the eighteen-community subregion.

FIGURE D.1. BRISTOL BAY AREA[a]

X { Pilot Point/Ugashik
Port Heiden
Chignik
Chignik Lagoon
Chignik Lake
Ivanoff Bay
Port Moller
Perryville

[a]Villages with "X" are not included in 18-village subregion.

The other two reports (RWR80 and RWB81) will be given a less-detailed review since the forecast methodology in each is patterned after and, in some cases, borrows heavily from RWR79.

The RWR79 electric energy demand forecasts start from a base year of 1977 and end in the year 2000. The forecasts include a high and a low scenario. The low scenario forecasts electric energy use to grow at an average annual rate of 4.5 percent. Electricity demand in the high scenario increases at twice the rate of the low scenario. The RWR79 energy demand forecasts are reproduced in Table D.1.

Energy demand in the high and low scenarios consists essentially of the combined demand of three user categories: residential, commercial, and industrial (which includes schools, public buildings, and fish processing.) Population growth combined with assumptions about average household size are the chief determinants of energy demand in the residential and commercial sectors. While it is not clear exactly how historical patterns were used to forecast population growth in the high and the low scenarios, average household size was assumed to gradually decline from 5 persons to 4 persons over the projection period. Commercial energy users increase in "direct proportion" to the growth of residential users. Industrial users comprise schools, public buildings, and fish processors. Although fish processing operations are not expected to increase dramatically, RWR assumes that by the end of the forecast period, all processors will convert to central-station power from primarily individually owned diesel generators for peak season operations.

TABLE D.1

BRISTOL BAY ELECTRIC POWER REQUIREMENTS: 1977-2000

	1977		1980	1990	2000
POPULATION	4327	(high)	4572	5535	6548
		(low)	4431	4808	5225
(1) # of residential consumers	1131	(high)	1315	1938	2440
		(low)	1296	1828	2246
(2) average kWh/mo/ consumers (3)÷(1)÷12x1000	291	(high)	385	660	1364
		(low)	324	424	473
(3) MWh/year residential consumers	3951	(high)	6081	15338	39934
		(low)	5043	9298	12752
(4) # of small commercial consumers	233	(high)	275	419	532
		(low)	274	389	490
(5) average kWh/mo/ consumer (6)÷(4)÷12x1000	1553	(high)	1913	3034	6047
		(low)	1534	2155	2312
(6) MWh/year sm. com. cons.	4342	(high)	6313	15256	38604
		(low)	5045	10059	13597
(7) # of large cons. + public buildings	127	(high)	156	176	198
		(low)	156	170	177
(8) average kWh/mo/cons (9)÷(7)÷12x1000	8039	(high)	9800	22944	34590
		(low)	8640	10988	14786
(9) MWh/year LP's	12251	(high)	18345	48457	82185
		(low)	16175	22415	31405
(10) System MWh/year (3)+(6)+(9)	20544	(high)	30739	79051	160723
		(low)	26263	41772	57754
(11) System Load Factor	.45	(high)	.46	.48	.53
		(low)	.45	.46	.48
(12) System Demand kW (10)÷8760÷(11)x1000	5400	(high)	7600	18700	34500
		(low)	6600	10300	13500

Note: Totals and subtotals have been rounded off. Total and Subtotal MWH listed here represent the summation of usage by various consumer classifications from similar tables prepared for the individual communities.

The primary difference between the high and the low projections is the assumptions about consumers' responses to the cost of various forms of electricity supply. In the low scenario, the authors assume that electricity is provided by traditional diesel generators which require a rate of energy-price escalation that equals the prevailing historical rate (not specified). Total electricity demand would grow at an average annual rate of 4.5 percent -- "the lowest expected increase of electric energy use." Electricity demand was assumed to decrease from an average annual rate of 4.8 percent during the decade of the 1980s to 3.3 percent thereafter, due primarily to energy conservation.

The high scenario assumes a more "cost-stable" source of electric power such as a hydroelectric dam. Over time, the proportion of various electric appliances used in all three sectors (i.e., the appliance saturation rate) is assumed to increase. An increase is also assumed for the proportion of resident users that heat with electricity. The combination of rising electric appliance saturation and electric space heating affects the level of intensity of individual energy use. Energy conservation is not mentioned in the high scenario.

From the standpoint of economic activity, it is less clear how each scenario is distinguished. Although high-scenario population and number of users in each sector consistently grow faster than in the low scenario, the reasons why and the specific changes that are assumed are not made explicit in the narrative. In general, however, agriculture and fish processing are not assumed to increase dramatically, and oil and gas development is considered too uncertain and too controversial to be included in the analysis. (The authors do indicate that the high scenario is "conservative" if the fishery expands or oil and gas development takes place.) Mineral development is not discussed. Total electric energy demand in the high scenario is forecast to grow at an average annual rate of 9.4 percent from 1977 to 2000. Thus, a wide range of growth in energy demand--4.5-to-9.4 percent--is assumed for the thirty Bristol Bay communities.

D.2. Population Growth

Levels. The geographic area analyzed in RWR79 consists primarily of the Dillingham Census area and the Bristol Bay Borough (see Figure D.1). Civilian population in these two census areas has grown from 3,488 in 1960 to 5,335 in 1980. As shown in Table D.2, growth has averaged 2.1 percent per year over this historical period. The RWR79 high and low population forecasts for 1980 are also shown in Table D.2. According to the 1980 Census, the RWR79 study understates 1980 population for the overall Bristol Bay area by at least 14-to-19 percent.

If population in the smaller 18-community study area for the Bristol Bay Regional Power Plan is considered, then the discrepancy between the 1980 census count and the RWR79 forecast is somewhat less pronounced. As shown in Table D.3, RWR79 understates 1980 census population in the eighteen-village study area by about 14-to-17 percent.

TABLE D.2. POPULATION IN THE BRISTOL BAY AREA

	1960	1970	1980
Dillingham Census Area	NA	3,485	4,616
Bristol Bay Borough[a]	NA	708	719
Total	3,488	4,193	5,335

	1960–1970	1970–1980
Average Annual Growth (percent)	1.9	2.4
	2.1	

		1980	Percent of 1980 Census
RWR Projected	low	4,431	83
	high	4,572	86

[a]Excludes military population (1960: 536, 1970: 439, 1980: 375)

SOURCE: U.S. Department of Commerce, Bureau of the Census

TABLE D.3. POPULATION IN THE EIGHTEEN-VILLAGE STUDY AREA

	1 9 8 0			
			RWR79 Projection	
	Actual (Census)		Low	High
Dillingham	1,563	1,717	1,059	1,078
Aleknagik	154			
Naknek	318			
King Salmon	170	633[a]	517	526
South Naknek	145			
Iliamna	94			
Newhalen	87	354	402	409
Nondalton	173			
Clarks Point	79		62	72
Ekuk	7		59	60
Manokotak	294		304	347
Portage Creek	48		25	26
Ekwok	77		110	112
New Stuyahok	331		238	242
Koliganek	117		143	146
Levelock	79		96	98
Igivgig	33		40	41
Egegik	75		149	152
Total	3,844		3,204	3,309

[a]Population data do not include active duty military personnel at the King Salmon Air Force Base. Between 1977 and 1980, military personnel declined sharply from 428 to 375. A portion of the discrepancy between 1980 civilian population from the census and from the RWR79 projections could have occurred if the decline in military personnel was unforeseen by the RWR79 authors.

SOURCE: U.S. Department of Commerce, Bureau of the Census
RWR79

On a community-by-community basis, the RWR79 forecasts understate population in eight of the eighteen communities. However, the forecast error for this group -- averaging 31 percent -- occurred in the two largest population centers and was large enough to negatively bias the combined population projections for the overall study area. The understated communities included Dillingham, Aleknagik, Naknek, King Salmon, South Naknek, Clarks Point, Portage Creek, and New Stuyahok. They are varied in geographic location and economic structure such that no obvious pattern emerges in the discrepancy between census estimates and projected population. The remaining ten villages have an average positive forecast error of 20 percent. In only one case -- Manokotak -- was the absolute value of the forecast error less than 5 percent.

Growth. This reader was confused by the discussion of forecast methodology for population growth on page III-0. The authors suggest that they adjust historical trends in population growth to account for factors that may not have been present in the past or for expectations about the effects of possible economic development. There was no discussion of demographic change in population (through migration) and its possible effect on energy demand (e.g., changes in the proportion of non-Native inhabitants.)

Population in the overall Bristol Bay area was projected to grow at an average annual rate of 0.8 percent in the low scenario and 1.8 percent in the high scenario. As shown in Table D.4, population in the eighteen-community subregion was projected to grow more rapidly than in all thirty Bristol Bay communities combined.

TABLE D.4. PROJECTED POPULATION IN THE BRISTOL BAY AREA AND THE EIGHTEEN COMMUNITY STUDY AREAS

	Bristol Bay		Eighteen Communities	
	Low	High	Low	High
1977	4,327	4,327	3,122	3,122
1980	4,431	4,572	3,204	3,309
1990	4,808	5,535		
2000	5,225	6,548	5,030	6,142
Average Annual Growth (%) 1977 to 2000	0.8	1.8	2.1	3.0

SOURCE: RWR79

The projected concentration of regional population does not conform to historic trends. From the data in Table D.5, it is evident that as a porportion of total Bristol Bay Regional population, the eighteen-community subregion has been steady over the last 20 years. What is not apparent are possible underlying migration patterns. On the one hand, immigration could have offset population attributation to urban areas outside of the Bristol Bay region. On the other hand, population movement could have remained within the region itself. The distinction is important to forecasting. For example, if new migrants having different energy use characteristics are entering from outside

TABLE D.5. REGIONAL SHIFT OF BRISTOL BAY POPULATION

	(1) Bristol Bay Region	(2) 18-Community Subregion	(2)÷(1) Percent
1960	3,488	2,504	72
1970	4,193	2,985	71
1980	5,335	2,844	72

SOURCE: U.S. Department of Commerce, Bureau of the Census.

the region, then both the growth of energy users and intensity of energy use may change or depart from historic patterns.

Historical data on population growth from 1960 to 1980 in each study-area community is shown in Table D.6. Also shown are the high and low community-specific population growth rates assumed by RWR79 for 1980 to 2000. In only two cases -- Manokotak and Koliganek -- did the low and high projected rates encompass the actual rate of historical population growth. Clarks Point received the highest low-and-high scenario growth despite steady population attrition from 1960 to 1980. Over the twenty-year period between 1960 and 1980, seven out of eighteen communities experienced population decline; yet the growth rates assumed in RWR79 are positive in all communities. The population centers of Dillingham, Aleknagik, Naknek, King Salmon, and South Naknek have experienced strong overall growth of 3.1

TABLE D.6. PROJECTED AND HISTORICAL POPULATION GROWTH IN EIGHTEEN STUDY-AREA COMMUNITIES

	Population[a]			Average Annual Growth Rate (percent)				RWR79[b] Projected Population Growth (1980 to 2000)	
	1960	1970	1980	1960-1980		1970-1980		Low	High
Dillingham	424	914	1,563	6.7	4.9	5.5	5.1	1.1	1.7
Aleknagik	231	128	154	- 2.1		1.9			
Naknek	249	178	318	1.2		6.0			
King Salmon	227	202	170	- 1.5	0.1	- 1.7	1.7	1.1	1.7
South Naknek	142	154	147	0.1		- 0.6			
Iliamna	47	58	94	3.5		4.9			
Newhalen	63	88	87	1.6	0.6	- 0.1	2.8	1.1	1.7
Nondalton	205	184	173	- 0.9		- 0.6			
Clarks Point	138	95	79	- 2.8		- 1.9		0.2	3.7
Ekuk	40	51	7	- 9.1		-22.0		1.0	2.0
Manokotak	149	214	294	3.5		3.2		0.5	5.0
Portage Creek	Ø	Ø	48	NA		NA		0.6	1.1
Ekwok	106	103	77	- 1.6		- 3.0		0.2	1.0
New Stuyahok	145	216	331	4.2		4.4		1.1	1.7
Koliganek	100	142	117	0.8		- 2.0		0.2	1.0
Levelock	88	74	79	- 0.5		0.7		0.2	1.0
Igiugig	Ø	35	33	NA		- 0.9		0.2	1.0
Egegik	150	148	75	- 3.5		- 7.0		0.2	1.0
Total	2,504	2,985	3,844	2.2		2.6		0.9	1.9

[a] U.S. Department of Commerce, Bureau of the Census

[b] RWR79

percent, over two times faster than the combined high scenario population growth assumed for those communities. In some instances, RWR79 correctly identifies the occurrence of special development projects such as HUD housing or new fish processing facilities. However, the population growth rates assumed for each community differ significantly from historical growth over the past twenty years.

In general, population growth during the 1970s has retained the same pattern as population growth during the extended twenty-year historical period. Population growth or decline has generally accelerated in the latter ten-year historical period. In larger communities such as Dillingham-Aleknagik and Naknek-King Salmon, the rate of population growth increased. Similarly, steady population attrition in Nondalton, Clarks Point, and Ekwok intensified during the 1970s.

In only one village, Koliganek, did population growth reverse itself--in this case, from positive to declining growth. Despite evidence of historic continuity in the patterns of population growth, most Bristol Bay communities exhibited distinctly unique and varied patterns from each other. In view of this variability, the RWR79 authors appear to take a reasonable course of action in the selection of population growth rates. They appear to have applied a slow and fast rate to each of the low and high scenarios. These are reproduced in Table D.7.

TABLE D.7. POPULATION GROWTH RATE ASSUMPTIONS: RWR79

		Growth Rates	
		Slow	Fast
Scenario	High	1.0	1.7
	Low	0.2	1.1

In a few cases, they depart from this convention. The most significant departure is Manokotak, for which no explanation is given (pages 111-112).

In summary, two aspects of the RWR79 population forecasts have been evaluated: (1) the accuracy of the projected levels in 1980 and (2) the rate of population growth over the entire forecast interval -- 1977 to 2000. We have seen that projected total population for the eighteen-community subregion is understated by between 14 and 17 percent of the final 1980 census count. In addition to this, the average annual rates of projected population growth from 1980 to 2000 in both the low (0.9 percent) and the high (1.9 percent) scenarios are considerably less than historical population expansion from 1960 to 1980 (2.4 percent).

Of course, there may be several plausible reasons why future population may not grow at the same rate that occurred during the 1960s and 1970s in rural Alaska. The Bristol Bay fishery has been on the upswing for several years since 1973 and received a boost from the

200-mile limit and limited entry programs in 1977. A leveling of harvest intensity, which several fish biologists believe is likely, would transmit directly into a leveling of economic activity. Furthermore, the stimulative effects that the Alaska Native Claims Settlement Act (ANCSA) produced during the 1970s in the rural economy may be stabilizing and limited to occasional minor development programs over the next twenty years. Further growth may require the introduction into the region of larger-scale industry, which remains uncertain. Whatever reasons are used to explain a diminishing rate of future population growth relative to that of the past two decades, they were not identified in RWR79 to substantiate the growth rates assumed. Furthermore, it is not clear how the population projections relate to the energy consumption by various sectors of the economy.

D.3. Residential Consumers

Levels and Intensity of Use. The Retherford Methodology used to project residential consumers was not clearly stated in the discussions starting on page III-89. A precise definition of "residential consumer" was not given. The RWR79 authors do assume that average household size would gradually decline from five persons at the start of the projection period to four persons by the year 2000. However, the precise relationship between population and residential consumers was not given. As before, we can only comment on the results of the RWR79 forecasts and not on the methodology itself. Their own data (see Summary Table on page III-92) suggest that residential consumers are not the same as households. If they were the same, then as with population, the number of residential consumers would also be understated. This is particularly so under the assumption of an average household size of five at the start of the forecast period. According to census tabulations, average household size in Bristol Bay Borough and the Dillingham Census Area was between 3.07 and 3.80 persons, notably less than 5 (see Table D.8).

TABLE D.8. BRISTOL BAY AVERAGE HOUSEHOLD SIZE IN 1980

	Census
Bristol Bay Area	3.68
Dillingham	3.80
Bristol Bay Borough	3.07
18-Community Subregion	3.51

Thus, given that the RWR79 population projections were understated and that average household size was overestimated, it is remarkable that residential consumers, too, were not understated. Even by the year 2000, the RWR79 assumed average household size is larger than the level counted in the 1980 census. It is possible that RWR79 used data on residential consumers directly from the utilities for those communities with utilities.

Possibly, the RWR79 authors assumed an average household size of 5 in all of the rural villages except Dillingham, Naknek, and King Salmon. If this were the case, then average household size would have the following geographic distribution based on RWR population projections in 1980:

Dillingham, Naknek, King Salmon: 2.02

Remaining villages in 18-community study area: 5

Thus, in order to counterbalance the effect of overestimating average household size in rural areas, one would have to understate average household size in the more concentrated areas of population in Bristol Bay (i.e., Dillingham, Naknek, and King Salmon).

The number of residential consumers projected in RWR79 for 1980 is surprisingly close to on-site tabulations made by ISER study team members. As shown in Table D.9, RWR79 authors projected between 990 and 1,004 residential consumers in the eighteen-community study area in 1980. These low and high estimates exceed the ISER tabulations by only 3-to-4 percent, suggesting that the population error discussed earlier is not so serious unless there is significant unserved population.

The communities that RWR understated are Dillingham-Aleknagik, New Stuyahok, and Koliganek. Aside from their proximity on the Nushagak River, there is no discernible pattern to the discrepancy between RWR79 projections and actual site visit hookup counts.

Historically, the hookup saturation in the city of Dillingham exhibits a reverse pattern of what one would logically expect. While average household size declines from 3.84 in 1970 to 3.10 in 1980 (an

TABLE D.9. 1980 RESIDENTIAL CUSTOMERS IN BRISTOL BAY

	(1) Household (Census)		(2) Residential Customers (ISER)	(3) Hookup Saturation Rate (2)÷(1)		(4) RWR79 Residential Customers (Projected) Low	(5) High
Dillingham	467	505	443	.88		404	404
Aleknagik	38						
Naknek King Salmon South Naknek	221		241	1.09		258	258
Iliamna	22		21	.95			
Newhalen	18		18	1.00	.53	97	97
Nondalton	42		11	.26			
Clarks Point	22		10	.45		15	18
Ekuk	1		1	1.00		8	9
Manohotak	57		49	.86		43	50
Portage Creek	13		12	.92		11	11
Ekwok	20		20	1.00		26	27
New Stuyahok	65		54	.83		44	44
Koliganek	40		36 (est. 1981)	.90		21	21
Levelock	37		11	.30		29	30
Igiugig	9		7	.78		12	13
Egegik	32		23	.72		22	22
Total	1,104		957	.87		990	1,004

SOURCE: U.S. Department of Commerce, Bureau of the Census, 1980. RWR79 average rate of decline of -2.2 percent per year), residential hookups as a percent of households also decline from 97 percent in 1970 to 88 percent in 1980. Dave Bauker, general manager of Nushagak Electric Cooperative (NEC) attributed this to three factors. First, during the late 1960s and early 1970s, low-interest financing for appliance sales was available through the utility under Section 5 of the REA bylaws. According to Bauker, this program was responsible for a major upward shift in residential consumption from the early 1960s when NEC was formed to the early 1970s. Second, rising oil prices dramatically affected the cost of diesel electricity generation and could have encouraged electricity substitutes such as kerosene and propane. Third, NEC expanded its distribution network to include Aleknagik and points in-between Aleknagik and Dillingham. It is probable that a higher proportion of households in the outlying area still do not use electricity.

Although this historical saturation rate reflects a different pattern from that of a typical growing utility, it is a noteworthy pattern -- one that was not discussed in RWR79. In summary, it is not clear exactly what the RWR authors assumed regarding the proportion of households using electricity since according to their assumed average household size, there are fewer households than hookups (residential consumers) in the overall study region as well as in the eighteen-community subregion relevant to this demand analysis.

Appendix A of their report outlines the RWR79 assumptions on intensity of fuel and electricity consumption for residential users. These are compared in Table D.10 with actual data compiled from state energy audits performed by the Rural Alaska Community Action Program during 1981. On the whole, the RWR assumptions suggest better efficiency characteristics and less heat loss than that implied by the energy audit data for a comparable-size residential dwelling. A combination of lower finance efficiency and lower R-values (which measure a material's resistance to heat loss) would partially explain the discrepancy in heating fuel consumption (941 vs. 1033).

The RWR authors also assume that residential electricity consumption from central power stations (4,356 kwh) is over twice the average level calculated from audit data for homes that used electricity. Their assumption is based on an Alaska Public Utilities Commission (APUC) appliance-use survey conducted by AVEC in 1977. It matches closely with actual average residential electricity consumption in Dillingham for 1980 (4,860 kwh/year). Because of this, 4,356 kwh per household probably is not representative of electricity consumption in small villages that have central station power. More realistically, 4,356 kwh per household represents an upper limit that village resident users could approach under conditions of decreasing cost or expanding services. For example, average 1980 electricity use in New Stuyahok, where central-station power has been available for over a decade, was equal to 1968 kwh for 48 residential consumers -- nearly equal to average electricity consumption derived from residential energy audit data.

TABLE D.10. CHARACTERISTICS OF RESIDENTIAL ENERGY USE

	(1) RWR Appendix A	(2) State Energy Audit	$1 - \frac{(2)}{(1)}$ (percent)
Floor Area (Sq.Ft.)	600	612	2
Total Annual Heat Loss (BTU/HR/ΔT)	327	552	69
Conduction	260	402	55
Infiltration	67	150	124
Furnace Efficiency (%)	75	63	-.16
Heating Fuel Consumption (gallons)	941	1,033	10
Electricity Consumption (kwh)			
Central	4,356	1,969[a]	- 55
Noncentral	1,464	NA	NA
R-Values			
Wall	12.00	11.34	--
Ceiling	11.11	10.76	--
Floor	11.11	6.95	--

[a]The audit data may not be a valid comparison of electricity consumption. In many cases, annual electricity consumption was not known. This figure is from a sample of only 25 out of 142 energy audits.

SOURCES: Retherford, 1979
RURALCAP and Alaska Department of Commerce and Economic Development, Division of Energy and Power Development.

To summarize, the projected number of residential consumers asumed in RWR79 for 1980 is reasonably consistent with on-site data collected by ISER in all eighteen study-area communities. The specific methodology used to calculate residential consumers is not explained. The assumptions on intensity of use probably overstate average annual electricity consumption in 1980 for residential users having central station power. Their overall average rate of residential electricity use for the entire study area is comparable to that of Dillingham but over twice the level derived from residential energy audits as well as actual 1980 residential consumption in AVEC-powered New Stuyahok.

As a final note on residential users in 1980, the Dillingham-Aleknagik area supplied by NEC experienced a modest decline in the rate of growth of residential electricity use during the late 1970s. Between 1975 and 1980, average monthly consumption grew 2.4 percent, compared with 8.4 percent from 1970 to 1975. Consequently, RWR79 overstated actual residential use in 1980 in the high scenario projections for Dillingham-Aleknagik. However, the number of residential consumers in Dillingham-Aleknagik was understated, partially counterbalancing the overstated intensity-of-use assumption (see Table D.11).

TABLE D.11. 1980 RESIDENTIAL SECTOR ELECTRICITY USE: DILLINGHAM-ALEKNAGIK

	RWR Projection[a]		Actual[b]
	Low	High	
Number of Residential Consumers	404	404	443
Average Electricity Consumption (kwh/mo/consumer)	413	478	426
Total Residential Electricity Consumption (MWH/yr.)	2,002	2,317	2,267

[a]Retherford (1979)

[b]Nushagak Electric Cooperative

Growth. The growth of residential electricity demand equals a combination of growth in the number of residential users and growth in average residential consumption for each community. For the overall Bristol Bay area (thirty communities), residential electricity consumption is projected to grow at an average annual rate of 2.5 percent in the low scenario and 6.8 percent in the high scenario. These rates increase to 4.8 and 9.6 percent, respectively, in the eighteen-community study area, suggesting a concentration of expanding residential energy demand. The selection of growth rates in each community is based partially on an unknown relationship between population and residential consumers. The growth rates in average residential consumption for each community are also not explained. Our comments, therefore, pertain strictly to the merits of the results themselves.

Between 1980 and 2000, the projected average annual rate of growth in residential consumers would vary widely across communities for the high and low forecasts. In the low scenario, the average annual rate of growth in residential consumers ranges from zero in Portage Creek to 3.9 percent in Iliamna, Newhalen, and Nondalton. The Dillingham and Naknek areas each experience growth in excess of 3 percent per year, while the remaining villages range from 0.9-to-1.7 percent per year. The average annual growth in residential consumers for all eighteen villages between 1980 and 2000 equals 2.9 percent. This figure increases slightly to 3.3 percent in the high scenario. There, the average annual rate of growth in resident consumers ranges from 1.2 percent at Portage Creek to 4.5 percent at Clarks Point and Manokotak.

Table D.12 summarizes the RWR79 assumptions for low and high scenario growth in the eighteen-village study area. One is impressed by the large jump in the growth rate of average residential consumption from the low to the high scenario. According to RWR79, the difference between residential electricity demand in the low and high scenario is related partially to assumptions about conversion or adaptation to electric space heating. The high growth projection assumes that some homes will convert to electric space heating after

TABLE D.12. CHARACTERISTICS OF PROJECTED RESIDENTIAL ELECTRICITY DEMAND FOR THE EIGHTEEN-COMMUNITY STUDY AREA

	Low Scenario			High Scenario		
	(1) Consumers	(2) Average Consumption (kwh)	(3) Total MWH [(1)x(2)]	(4) Consumers	(5) Average Consumption	(6) Total MWH [(4)x(5)]
1980	990	4,544	4,499	1,004	5,331	5,352
2000	1,768	6,462	11,425	1,912	17,573	33,599
Average Annual Rate of Growth (percent)						
	2.9	1.8	4.8	3.3	6.1	9.6

SOURCE: RWR79

1990. In this case, average annual growth would be 9.6 percent. However, the authors do not explain the methodology underlying the mode split assumptions used in the high forecast. There is no opportunity for the reader to separate the effects of increasing space-heating electricity use from those of expanding appliance demand.

How do RWR79 projections compare to historical patterns of residential demand? Unfortunately, historical data on residential electricity demand is fragmented in Bristol Bay. The communities served by the electric utilities in Dillingham and in Naknek offer the only consistent source of historical data presently available.

Residential monthly electricity use in Dillingham is compared in Table D.13 to that of the United States as a whole. Except for a mutual halving of growth between the first and second half of the 1970s decade, the patterns are distinctly different. Residential electricity growth in Dillingham lagged behind the United States in the early period. After 1970, the reverse occurs. Note that the U.S. figures include shifts in space heating electricity demand not present in Dillingham which grow in response to appliance demand only.

The RWR79 low (4.8) and high (9.6) projected growth rates for the eighteen-village study area bracket the historical growth rate for residential consumption in Dillingham (6.2 percent). That growth in projected residential demand is less than Dillingham's historical rate

TABLE D.13. RESIDENTIAL MONTHLY ELECTRICITY USE IN DILLINGHAM/ ALEKNAGIK AND THE UNITED STATES

	Dillingham	United States
1963	154	370
1968	207	505
1970	240	589
1973	311	673
1975	359	681
1979	416	720
1980	426	NA

	Average Annual Growth Rate (percent)			
	1963-1970	1970-1975	1975-1980	1963-1980
Dillingham	6.5	8.4	3.5	6.2
United States	6.9	2.9	1.4[a]	4.2[a]

[a]End-year equals 1979.

SOURCE: Nushagak Electric Association and Electric World Magazine.

could reflect a downward influence of the smaller villages in the study area. That high scenario growth exceeds Dillingham's historical rate could reflect the effect of space heating demand, assumed exclusively in the high scenario.

Historical data on the components of residential demand from Nushagak Electric Cooperative (NEC) serving Dillingham and Aleknagik are shown in Table D.14. Growth in the number of consumers and in average electricity consumption was fairly balanced during the 1970s. Total residential electricity demand experiences strong growth of over 12 percent per year, which exceeds the RWR79 high scenario projections by several percentage points. Again, the historical data from NEC is free of any space heating electricity demand.

One is lead to believe that the RWR79 projections of residential use in both the low and the high scenarios are not excessive.

TABLE D.14. CHARACTERISTICS OF RESIDENTIAL ELECTRICITY CONSUMPTION IN DILLINGHAM/ALEKNAGIK: 1970 AND 1980

	1970	1980	Average Annual Rate of Growth (percent)
A. Residential Consumers	251	443	5.8
B. Average Residential Consumption (kwh)	2,880	5,117	5.9
C. Total MWH (A x B)	723	2,267	12.1

SOURCE: Nushagak Electric Cooperative.

Unfortunately, it is not possible to determine what proportion of total residential demand projected in the RWR79 high scenario is caused by a shift to electric space heating. However, it may be possible to identify the probable upper limit of the contribution made by electric space heating. Returning to Table D.12, one notes that total residential demand for electricity in any given year is the product of the projected number of users and of projected average consumption. If we assume, for a moment, that the difference between the rate of average annual growth of residential consumers in the low and high scenarios is not related to electric space heating, then the difference between the rates of growth in average consumption between the high and low scenarios represents the only remaining source of possible electric space heating demand. If, for example, we assume that the difference between low and high scenario average consumption growth results entirely from space heating demand, then 28 percent of average annual space heating requirements, as defined in Appendix A, were captured by electricity.[1]

---

[1]The difference between the high and low scenario average annual rate of growth equals 4.3 percent (6.1 - 1.8), or about 45 percent of the overall rate of high scenario residential electricity demand (4.3 ÷ 9.6). Forty-five percent of 33,599 MWH in the year 2000 equals 15,120 MWH. Divide this figure by 1,912 residential consumers in the year 2000 to derive 7,908 kwh per residential user per year. This represents the maximum possible space heating component of electricity demand. It is equal to 27 million BTUs per year, or about 28 percent of average residential space heating requirement as defined by RWR79 in Appendix A.

This represents an upper limit. It is likely that a portion of the growth in high scenario average annual consumption would be caused by the effects of increased appliance demand, thereby reducing the potential contribution of space heating to total residential electricity demand.

Electric space heating is not widespread in Alaska but is on the upswing in several Southeast communities which receive power from the Snettishan dam. In a report produced for the Glacier Highway Electric Association (GHEA, 1980), a "major shift" toward electric space heating is assumed to induce annual growth in total electricity consumption in three communities equal to 12.1 percent during the 1980s. This compares to 10.3 percent growth in total consumption assumed by RWR (combining growth in average use with growth in the number of users).

Given the relatively less-developed Bristol Bay area economy, the different social makeup of each region, and the uncertainty in relative energy prices, the more conservative RWR79 growth rates appear reasonable.

To summarize, the RWR79 forecast methodology for electricity demand in the residential sector appears reasonable from the standpoint of the compatibility with actual levels in 1980 and with historical rates of growth in the number of consumers and in average residential consumption.

The major shortcoming of the RWR residential demand projections involves the lack of explanation of the methodology itself. What is the relationship between population and residential consumers? How are the data in Appendix A incorporated into the demand projections? What proportion of total residential energy demand is accounted for by space heating? Without a clear picture of what the authors assume for these important relationships, the forecast methodology remains partially obscure, forcing the reader to evaluate the forecasts on only reasonableness of the results and not on the logic used to derive them. For example, the results of Appendix A would logically enter into assumptions about future conservation potential. The authors give no clue as to what they assume about conservation potential in the low scenario. There is also no explanation of why conservation potential is not analyzed in the high scenario. Furthermore, the electric space heating component of residential energy demand is probably the most critical aspect of the entire demand forecast. It has the potential to substantially alter the level of pure (appliance) electricity demand, and its impact on seasonal load is vital to the sizing question of a hydroelectric facility.

D.4. Commercial and Large Consumers

As discussed earlier, electricity demand in the commercial sector is tied directly to growth in the residential sector. This in itself is reasonable and plausible. Although never clearly stated in RWR79, we presume the commercial sector in the Dillingham and Naknek population centers includes the usual support-sector businesses such as real estate, banks, service stations, restaurants, retail stores, etc. In the smaller villages, the commercial sector would be the village store. Over the twenty-year forecast period, RWR79 projects electricity for small commercial users in the eighteen-community study area to grow at an average rate of 5.1 and 9.4 percent per year in the low and high scenarios, respectively. These rates are compatible with overall growth in residential electricity demand.

Space heat and electricity requirements for the typical village store are outlined in Part 5 of Appendix A. Heating requirements for a village store are assumed to be 41 percent greater than a comparable-sized residential dwelling due to higher air change assumptions. Similarly, additional freezer, refrigerator, and lighting is assumed to increase village store electrical use from that of the average residential user. Although these assumptions are reasonable, it is not known whether small commercial buildings contribute to electric space heating demand in either the low or the high scenario forecasts. Since small commercial demand is tied to residential demand, one would expect space heating electricity use to occur in the high scenario as well.

The third and final user category includes a combination of large consumers (mainly fish processors) and public buildings following the usual utility rate schedule breakdown. Total electricity demand in this sector was projected to grow at an average annual rate of between 2.9 and 6.9 percent, depending on the low or high scenario.

Fish Processing. Fish processing represents an important component of total electricity demand. According to the RWR79 compilation of energy use in 1977, processing accounted for 17 percent of total nontransportation energy use (electric and non-electric) in the eighteen-community study area. In one community, Egegik, two processing facilities accounted for over half of total energy use (see Table D.15).

TABLE D.15. ENERGY DEMAND BY THE PROCESSOR INDUSTRY IN 1977

	Proportion of Total Nontransportation Energy Demand
Dillingham	6
Naknek, South Naknek, King Salmon	24
Egegik	55
Eighteen-Community Study Area	17

In RWR79, thirteen processors consumed 2,800 MWH in 1977, or about 215 MWH per processor. Average 1977 production was assumed to be about 3-to-3.5 million pounds of salmon. Thus, on average, the processing industry was assumed to use about 7.2 kwh per pound of processed salmon. Average electricity use would depend mainly on the mix of freezing and canning activity that exists and is assumed to occur. In general, most processors are assumed to extend their operating season, diversify, and add freezing equipment. Over the forecast interval, only about two additional processors are expected to be established in the high scenario for the eighteen-community subregion. The authors also assume that by 2000, all processing facilities will shift to central station space heating.

On the whole, these assumptions appear reasonable. To date there are fourteen shore-based processors located in the eighteen-community study area. Their geographic distribution is shown in Table D.16. This does not include the host of buyers, fish camps, and floating processors that literally invade the study region each season. Average production per bona fide processor is presently about six million pounds of salmon (canned, frozen, or packed) per year -- roughly double the production level assumed by RWR.

TABLE D.16. GEOGRAPHIC DISTRIBUTION OF PROCESSORS IN EIGHTEEN-COMMUNITY STUDY AREA

Location	Number of Processors			
	Number of Processors			
	Canning	Freezing	Canning/ Freezing	Total
Dillingham	2	2		4
Naknek/King Salmon/ South Naknek	1		6	7
Ekuk			1	1
Egegik	1		1	2
Total	4	2	9	14

Out of seven fish processing companies that responded to ISER questionnaires, six ran their own generators for peak-month operations

operations, sometimes providing for total electricity requirements. The remaining processor received power from Naknek Electric Association. The large, upfront investment was the major deterent to shifting away from central station. Most processors also relied on the utilities to provide power for off-season and for office and bunk house electricity needs.

On average, processing facilities consumed about 423 MWH from their own generators plus 72 MWH each from utilities in 1980. Here, the relationship between fish production and energy consumption is about 8.3 kwh per pound. The total direct and indirect cost of energy varied from 3-to-15 percent of total operating costs, depending on the type and age of equipment, the type of production, and whether central or noncentral station power was used.

Recall that a basic premise of the RWR79 high forecast is the development of cost-stable hydro-electric. It is plausible that processors would convert to a reliable source of central station power priced to compete with fossil-fuel-generated electricity. However, from the standpoint of energy demand, this represents a shift from one supply source to another. The primary source of increased electricity consumption would, therefore, result from expanded freezing capacity, which RWR79 capture in their analysis. However, their assumption of extending the duration of seasonal operation seems contrary to the biological characteristics of both the salmon and herring fisheries. For this reason, it is possible that fish processor electricity demand is somewhat overstated.

Despite consistency in the relationship between production and electricity use, average salmon production and electricity consumption per processor in 1980 was over twice the 1977 level assumed by RWR79. It is possible that a recent increasing shift in freezing capacity would partially account for the dramatic increase suggested by RWR79 1977 data and ISER's 1980 data. Nevertheless, it is doubtful that RWR79 assumptions about expanded freezing capacity would account for all of the discrepancy in production and electricity demand described above. This suggests the RWR79 projections would understate projected energy demand in the processing industry.

Unfortunately, a breakdown of projected energy consumption in the processing industry was not given. It was, therefore, not possible to determine the pattern of energy growth or the production of total energy that would be demanded by the processor industry. It is also not possible to discern the combined effects on energy demand of overstating the duration of seasonal operations and understating the intensity of energy use per processing facility.

D.5. Conclusions

With the exception of population projections which do not enter directly into the energy demand forecasts, the levels and growth rates assumed in RWR79 for the three major sectors appear reasonable. They are neither excessive nor understated. The resulting overall growth in electricity demand bracketed by the high and low scenarios remains valid until further analysis can be performed on an updated, more comprehensive data base.

In many respects, the Retherford forecast methodology is very simple, which does not necessarily detract from its validity. A control-year level of electricity use is established for each sector in 1977 and is allowed to grow at an assumed rate over the duration of the forecast period. In certain sectors, projected energy use is a composite of several variables interacting together. For example, we have seen that energy demand in the residential sector reflects the combined effects of population growth, changes in household size, an unstated factor that converts from households into residential consumers, and use per customer. As discussed above, there were several discrepancies between the RWR 1980 projections and actual energy-use data collected on site by ISER study-team members. In some cases--notably residential consumption--the discrepancies "wash out" in the process of aggregation.

Small commercial energy use is assumed to experience a rate of growth equivalent to the residential sector. This is a neutral assumption insofar as the relationship between commercial and residential use is concerned. It is also plausible in an economy like Bristol Bay where commercial activity occurs essentially in the support sector which, by definition, experiences induced growth from population and residential expansion.

The RWR79 authors assume a rate of population growth based somewhat obscurely on historical population movement. However, there is not an economic model or underlying framework that systematically and consistently determines the expansion of economic variables including population. It is apparent to this reviewer that the growth rates selected for population in each of the study area communities were selected arbitrarily.

For the most part, the Retherford study team was unable to collect first-hand data from site visits to villages in Bristol Bay. Control-year assumptions were, therefore, estimated in many cases. For example, in the residential sector, the RWR authors constructed a hypothetical resident consumer structure with assumed heat loss and energy use characteristics. Similar energy-use assumptions were developed for other structures such as schools and village stores.

The major problem with the RWR79 projections concerns the degree to which the methodology itself is not clearly stated. This is particularly a problem with the methodology that underlies the mode split assumptions for electric space heating.

APPENDIX E

METHODOLOGY FOR PROJECTING NONSPACE HEATING ELECTRICITY USE IN THE REGION

E.1. Baseline Data Collection

Baseline data was collected from both primary and secondary sources. Primary sources refer to data obtained in the field during site visits to study area communities. The primary sources are:

(a) Knowledgeable informants;
(b) Household and commercial/government surveys;
(c) Bristol Bay electric utilities;
(d) Bristol Bay regional school districts;
(e) Alaska Village Electric Cooperative; and
(f) Fish processors.

Knowledgeable Informants. This category refers to village leaders and other Bristol Bay inhabitants knowledgeable about energy use. ISER study team members usually interviewed the village council president, the mayor, or the village administrator, to discuss the purpose of our study, and to learn of additional village information people, such as the generator maintenance person or the meter reader. In most cases, the village leader was best informed about village energy-use patterns and was our principle information source. Inquiries on the following subjects were made in each community:

- Electricity consumption and appliance use
- Space heating energy use
- Generator inventory
- Building stock characteristics
- Village economy and development plans

Surveys. Surveys were conducted on several levels. Households, commercial business, and government facilities were questioned on fuel consumption, electricity use, appliance ownership, household size, and building stock characteristics (e.g., age, floor area, and structure additions). In the smaller communities, we were usually able to arrange for a member of the community to conduct the household survey on a door-to-door basis. In larger communities (Dillingham and Naknek), a random sample of utility customers were interviewed over the phone by high school students, under the supervision of an academic advisor. Commercial/government facilities in Dillingham and Naknek were also issued one-page questionnaires that were later mailed or collected by ISER study-team members. Although these samples are neither random nor comprehensive, they provide valuable illustrations of variability in the pattern of electricity use by different types of C/G customers.

Electric Utilities. Nushagak Electric Cooperative (serving Dillingham and Aleknagik) and Naknek Electric Association (serving Naknek, King Salmon, South Naknek, and Egegik) were able to provide baseline and historical data on a level that was often more detailed than the information contained in Regional Electric Association (REA) documents. For example, the major utilities provided valuable assistance by isolating data on electricity use according to a consumer classification somewhat different than their own. Monthly meter records were also available from Manokotak City Electric and from AVEC, serving New Stuyahok.

Regional School Districts. Three of the 18 study area villages (Koliganek, Ekwok, and Portage Creek) received power from school generators in 1980. The school usually sells available electricity to the village council or other central village body, while the village assumes metering and distribution responsibilities. Thus, although individual customer meter records were not directly available, the Southwest Regional School District was able to separate school and village electricity consumption.

Fish Processors. Fish processors represent the single largest electricity consumer in the Bristol Bay study area, especially when viewed in terms of demand for capacity.

In order to obtain data on the relationships between energy use and fish production, an ISER study-team member personally interviewed the production superintendents of most of Bristol Bay's 13 larger shore-based processors. Base year inquiries were made of each member on the following subjects:

- Utility and self-generated electricity consumption
- Nonelectricity fuel consumption for processing boilers
- Electric space heating
- Electricity as a proportion of total operating cost
- Freezing technology
- Patterns of employment and production

Primary baseline data was collected to establish a 1980 starting point for forecasting electricity use in the Bristol Bay study area. We also obtained secondary data from several sources within and outside of Alaska to supplement primary baseline data, and to aid in our understanding of historical patterns of energy use that may apply to electricity consumption forecasts in Bristol Bay.

The U.S. Bureau of the Census was the main secondary data source for baseline and historical patterns in population growth and changes in household size. Other sources of secondary data included reports to government agencies that touch on the subjects of economic growth and energy-use in Bristol Bay. Examples are the Community Profiles and the Comprehensive Development Plans from the Department of Community and Regional Affairs, the Alaska Power Authority's reconnaissance studies in rural Alaska, the Bristol Bay Native Association Housing Survey of 1975, and the Department of Transportation and Public Facilities, Facilities Updates. We obtained data on energy use and housing stock characteristics from 142 energy audits performed by the Rural Alaska Community Action Program. We referenced national data on appliance ownership from the U.S. Department of Commerce, Statistical Abstract. The Alaska Public Utilities Commission provided historical data on electric price and consumption for Southwest Alaska Utilities outside the immediate Bristol Bay study area, as well as in other areas of Alaska.

E.2. Baseline Electricity Use

Introduction

The general forecast methodology used throughout this study is based on the following relationships:

$$\text{Annual Electricity Consumption} = \begin{matrix}\text{Number of}\\ \text{Customers}\end{matrix} \times \begin{matrix}\text{Electricity Use}\\ \text{Per Customer}\end{matrix}$$

Baseline estimates of customers and average use per customer were calculated for four broad consumer categories:

(a) Residential
(b) Commercial/government
(c) Industrial
(d) Military

In several study area communities, we were able to determine a baseline count of customers and electricity use per customer directly from utility records. However, in most communities, this information was not available. Seven of the 18 study area communities did not have central station utilities in 1980. In these "noncentral" communities, we relied upon site inspections, interviews, and household, business, and government surveys, discussed above. Sometimes we were able to check the accuracy of the data obtained from household surveys by comparing it to aggregate data obtained from the barge operators that deliver fuel for generators and space-heating furnaces.

Communities that did have central station generating facilities were often poorly endowed with baseline or historical data on household electricity use. When, for example, the generator belonged to the school district, individual customer sales were not monitored. Customer meter records that did exist were sometimes incomplete or poorly maintained. We encountered several instances when customers hooked into village electricity were not billed at all.

In only three communities outside the Dillingham and Naknek utility districts were reasonably accurate baseline data on electricity use available on a customer-by-customer basis.

Residential

Residential customers in this study are the same as the residential classifications used by electric utilities. For communities without utilities, residential customers are equal to the number of households that are hooked into village or school electricity, or that have their own generators. The general relationship between residential customers and households is:

Residential Customers = Households x Hookup Saturation Rate,

where the hookup saturation rate equals the proportion of households that are hooked up or that have their own generators. Baseline estimates of these variables are shown in Table E.2.1.

TABLE E.2.1. RESIDENTIAL CUSTOMERS BY COMMUNITY IN 1980

	1980 Households	Hookup[a] Saturation Rate	Residential Customers
Dillingham	467	.88	410
Aleknagik	38	.88	33
Naknek	75	1.09	82
King Salmon	103	1.09	112
South Naknek	43	1.09	47
Egegik	32	.72	23
Manokotak	57	.86	49
New Stuyahok	65	.83	54
Portage Creek	13	.92	12
Ekwok	20	1.00	20
Koliganek	40	.90	36
Iliamna	22	.95	21
Newhalen	18	1.00	18
Nondalton	42	.26	11
Clarks Point	22	.45	10
Ekuk	1	1.00	1
Levelock	37	.30	11
Igiugig	9	.78	7
Total Eighteen Communities			

---

[a]Equals the number of residential customers divided by households (census definition).

SOURCE: U. S. Department of Commerce, Bureau of the Census, 1980. ISER Field Survey.

Although we encountered discrepancies in the count of households and population from different sources, we used the 1980 U.S. Census count for baseline estimates because it offered a uniform data base across all 18 communities. The count of residential customers was made directly from utility data for central-station communities. For other communities, residential customers were derived from household surveys and interviews. In some cases, an estimate of 1981 hookup saturation was applied to the 1980 census count of households to derive a baseline estimate of residential customers.

Baseline electricity use per residential customer in most communities was obtained from the same sources as the number of customers: utility records, household surveys, and interviews with knowledgeable informants. These are shown in Table E.2.2. Electricity use per customer in noncentral villages was estimated from data on the average size of home generators, average home generator efficiency and fuel consumption and on common, self-generator, residential-electricity loads, calculated from interview data on appliance ownership and use- patterns. We estimated average annual electricity consumption to be 2,401 kwhs for self-generating, residential customers in noncentral communities. The variations around this figure shown in Table E.2.2 reflect observed differences in appliance ownership among noncentral communities.

The baseline composition of appliance ownership, measured as the proportion of households that own a given appliance, is shown in

TABLE E.2.2. RESIDENTIAL ELECTRICITY USE PER CUSTOMER IN 1980

	Annual Average Electricity Use Per Customer (kwh/Year)
Dillingham	5,112
Aleknagik	5,112
Naknek	5,328
King Salmon	5,328
South Naknek	5,328
Egegik	2,329
Manokotak	3,308
New Stuyahok	1,944
Portage Creek	1,536
Ekwok	1,536
Koliganek	1,104
Iliamna	3,149
Newhalen	2,847
Nondalton	922
Clarks Point	2,369
Ekuk[a]	NA
Levelock	1,381
Igiugig	2,549

[a]Included in industrial.

SOURCE: Nushagak Electric Cooperative, Naknek Electric Association, ISER Field Survey.

Table E.2.3, for each study area community. This 1981 data was obtained through ISER study team interviews with village informants in the smaller communities and through household surveys in the larger communities. Appliance ownership did not enter into the baseline calculations of residential electricity use per customer, except in noncentral-station communities. This data was used as the starting point for the analyses of future appliance ownership patterns (see Section E.3).

Commercial/Government

Commercial/Government (C/G) consumers encompass all other civilian electricity customers except those involved in seafood processing. Thus, our definition of C/G consumers includes both small commercial and large power (LP) customers under the conventional utility classification. The C/G classification used in this report covers a wide range of users having varied energy-use characteristics (e.g., schools versus the village store). To account for possibly significant differences, we have further divided C/G consumers into types having relatively uniform energy-use characteristics such as schools, village stores, and community centers. These are shown in Table E.2.4 for all communities except the utility district communities of Dillingham, Naknek and King Salmon, for whom a count of customers was available from utility records.

TABLE E.2.3. APPLIANCE OWNERSHIP IN BRISTOL BAY
(Measured as a Proportion to
Total Households)

Appliance	Aleknagik Dillingham	Clarks Point	Egegik	Ekwok	Igiugig	Iliamna	K. Salmon Naknek S. Naknek
Blender	67	0	90	75	0	100	90
Coffeemaker	4	0	95	NA	NA	NA	NA
Crockpot	69	NA	100	NA	NA	60	70
Dishwasher	4	0	NA	0	0	NA	NA
Dryer	64	20	40	0 (15)	58	15 (35)	50 (15)
Electric Skillet	73	53	75	0	50	100	80
Fan - Circulating	NA	0	NA	0	0	NA	NA
Freezer	90	NA	95	100	75	97	80
Hair Dryer	71	20	85	0	NA	100	65
Heat Tape	18	NA	5	NA	NA	40	25
Hot Water Heater	16	7	3 (27)	0	0	0 (70)	15 (40)
Iron	NA	NA	NA	NA	NA	NA	NA
Lights	88	67	100	100	75	100	100
Microwave	42	14	50	5	0	20	60
Mixer	82	0	100	100	0	100	95
Plug-in (car)	56	0	15	0	17	90	55
Pump	38	NA	70	0	0	NA	75
Radio	100	100	100	100	75	100	90
Range (cookstove)	69	0 (100)	0 (100)	0 (100)	0 (100)	5 (95)	70 (20)
Refrigerator	93	75	60	50	75	97	90
Sewing Machine	NA	NA	70	NA	NA	NA	NA
Stereo	82	47	70	50	33	60	60
Tape Deck	64	30	100	50	33	90	65
Television	93	53	100	0	42	90	100
Toaster	93	60	100	100	50	99	90
Vacuum Cleaner	13	NA	65	NA	NA	NA	NA
VHF Radio	20	NA	20	NA	NA	50	15

TABLE E.2.3. (CONTINUED)

Appliance	Aleknagik Dillingham	Clarks Point	Egegik	Ekwok	Igiugig	Iliamna	K. Salmon Naknek S. Naknek
Video Recorder	31	7	60	30	17	90	40
Washer	89	100	90	100	75	90	65
CB Radio	38	NA	100	NA	NA	30	45
Portable Space Heater	16	7	48 (32)	10	0	0 (35)	20 (10)
Steam House	NA	0	0 (70)	0	NA	0 (10)	5
Number Residences	540	15	22	20	12	35	246
Number Residences w/Elect.	475	10		20	9	21	241
% Residences w/Elect. (12 mos.)	88	67	100	100	75	60	98

NOTES: (a) Parentheses () indicate percentage of residences with appliance that uses non-electric fuel.

TABLE E.2.3 (CONTINUED) APPLIANCE SATURATION IN BRISTOL BAY
(Measured as a Proportion of Total Households)

Appliance	Koliganek	Levelock	Manokotak	New Stuyahok	Newhalen	Nondalton	Portage Creek
Blender	3	22	78	4	100	0	0
Coffeemaker	NA	NA	NA	NA	NA	8	NA
Crockpot	3	22	6	2	NA	0	NA
Dishwasher	NA	0	0	0	NA	0	0
Dryer	3	16	94	6	30	5	7
Electric Skillet	3	27	20	32	100	0	21
Fan - Circulating	NA	0	0	NA	NA	NA	0
Freezer	97	47	98	96	80	22	50
Hair Dryer	3	68	49	4	NA	NA	0
Heat Tape	NA	0	100	70	2	100	NA
Hot Water Heater	0 (15)	0	NA	0 (70)	0 (30)	0	0
Iron	NA	NA	NA	NA	NA	NA	7
Lights	100	30	100	100	100	22	100
Microwave	3	3	27	2	NA	0	0
Mixer	3	27	78	30	100	5	14
Plug-in (car)	NA	0	10	4	0	0	0
Pump	0	0	NA	NA	NA	NA	NA
Radio	60	19	100	100	100	100	50
Range (cookstove)	5 (95)	3 (97)	NA (100)	0 (100)	0 (100)	0 (100)	7 (93)
Refrigerator	3	35	96	11	80	22	43
Sewing Machine	30	NA	NA	NA	NA	NA	NA
Stereo	3	19	96	11	5	0	0
Tape Deck	35	65	100	70	80	24	0
Television	100	16	100	81	50	NA	71
Toaster	5	27	96	49	100	5	29
Vacuum Cleaner	NA	NA	NA	NA	NA	3	NA
VHF Radio	30	3	20	11	0	3	NA

TABLE E.2.3. (CONTINUED)

Appliance	Koliganek	Levelock	Manokotak	New Stuyahok	Newhalen	Nondalton	Portage Creek
Video Recorder	10	16	49	30	50	8	0
Washer	90	27	100	60	65	8	64
CB Radio	90	11	100	98	75	100	8
Portable Space Heater	1	0	29	0	0 (2)	3	NA
Steam House	0	0	NA	NA	0	NA	NA
Number Residences	30	37	51	47	18	37	14
Number Residences w/Elect.		11		44	18	9	
% Residences w/Elect. (12 mos.)		30		94	100	24	21
(9 mos.)							100

NOTE: (a) Parentheses () indicate percentage of residences with appliance that uses non-electric fuel.

TABLE E.2.4. COMMERCIAL BUILDING STOCK IN 1980

	Aleknagik	Clarks Point	Egegik	Ekuk	Ekwok	Igiugig	Iliamna	Koliganek	Levelock	Manokotak	New Stuyahok	Newhalen	Nondalton	Portage Creek	South Naknek
Commercial															
Store	0	2	2	1	1	0	2	2	0	2	2	1	2 (d)	0	1
Bar/Restaurant	0	0	1	0	0	0		0	0	0		0	0	0	1
Lodge		0	0	0	1	8	7	0	1	0	0	0	2	0	0
Other	2	0	1	0	0	1	3		0	0	0	0		0	
Government/Community															
Post Office	1	1	1	0	0	0	1	1	1		1 (c)	0	1 (b)	0	
Village Council/ City Office	1	1	1	0	0	1	0	1	1	1	1	0	0	0	1
Community Hall	0	0		0	0	0	1	0	0		0	0	1	0	0
Clinic		1	1	1	1	0	1	1	0		1	0	1	1	
Clinic/Comm. Hall		0		0	1	0		0	1	1	0	1		1	1
Fire Station	0	0	0	0	0	0	2	0	0		0	0	0	0	1
Water & Sewer Utility		0		0	0	0		1	0	1	1	0	1	0	
Electric Utility	0	0	1	0	1	0		1	0	1	1	1 (a,f)	1 (f)	0	0
Warehouse	1	0		0	0	0	2	1	1	1	1		0	0	
Hangar		0		0	0	0	2		1		0		0	0	
Airport Lights	0	0		0	0	0	1	0	0		0		0	0	
Church	3	1	1	1	2	1	1	1	2	1	1	1	1 (c)	1	
School Bldgs.	2	1	1	0	1	1	0	2	1	2	2	5	2	2	1
Teacher Housing			2	0	1	1	3	1		6	4		3	1	
Gymnasium		0		0	0	0	0	1	0	1	1				
RCA/Alascom							1				1				
Others							1					1	1 (e)		

NOTE: "0" indicates absence of facility known with certainty. A blank indicates absence of facility likely, but not known with certainty.

(a) Utility building under construction
(b) Same building as co-op store
(c) Residence in same building
(d) One store is in residence
(e) Corporation building
(f) School generator building
(g) Across river

SOURCE: ISER Field Survey

Annual electricity use per C/G customer was obtained directly from utility records for utility-district communities (Dillingham, Aleknagik, Naknek, King Salmon and South Naknek). For the remaining communities, we depended on the data obtained from surveys and site inspections. Data on floor area, electricity consumption and heating fuel consumption for C/G facilities in each community was pooled in order to derive estimates of average electricity consumption and heating-fuel consumption per square foot for a comprehensive set of C/G facility types. The resulting C/G energy consumption factors are shown in Table E.2.5. These were applied to existing facilities, for which we were unable to obtain complete baseline energy use data during our site visits. Thus, using a combination of actual data and the energy consumption factors shown in Table E.2.5, we were able to calculate baseline, average electricity use per C/G customer in all 18 study area villages. These baseline estimates are shown in Table E.2.6.

Industrial

Industrial activity in Bristol Bay is confined to seafood processors. In 1980, there were thirteen major shore-based processors operating in the Nushagak and Kvichak fisheries. There were also approximately 40 shore-based fish camps and fish buyers. Excluded from the forecast of industrial energy demand are the numerous off-shore processors and buyers which move freely about Bristol Bay, and do not directly contribute to electricity demand.

TABLE E.2.5. COMMERCIAL/GOVERNMENT ENERGY CONSUMPTION FACTORS

	Electricity Consumption Per Square Foot (kwy/Ft.^{2})	Heating Fuel Consumption Per Square Foot (gallons/Ft.^{2})
Commercial		
Store	2.43	1.26
Bar/Restaurant	5.91	0.94
Lodge	4.32	1.31
Other[a]	13.93	7.60
Government/Community		
Post Office	6.60	0.50
Village Council/City Office	2.29	1.37
Community Hall	1.52	1.37
Clinic	2.31	1.20
Clinic/Community Hall	12.11	1.82
Water/Sewer/Utility	6.43	∅
Warehouse	4.51	1.67
Hangar	5.37	1.67
Church	1.52	0.55
School: New	9.62	2.39
Old	1.53	2.39
Average	4.21	2.39

[a]Wien Air Alaska terminal building.

SOURCE: ISER Field Survey.

TABLE E.2.6. COMMERCIAL/GOVERNMENT ELECTRICITY USE PER CUSTOMER IN 1980

	Nonschool Customers	Use per Nonschool Customer	School Consumption (kwh/Year)	Total Commercial/ Government Consumption (mwh/Year)
Dillingham	184	24,610	NA	4,528
Aleknagik	10	24,610	NA	246
Naknek/King Salmon	130	20,538	NA	2,670
South Naknek	6	20,538	NA	123
Egegik	8	9,551	5,688	82
Manokotak	7	6,485	80,723	126
New Stuyahok	10	5,767	144,628	203
Portage Creek	5	2,931	66,227	81
Ekwok	5	7,795	46,555	86
Koliganek	7	9,189	51,115	115
Iliamna	31	20,636	NA	640
Newhalen	8	1,716	229,864	244
Nodalton	9	3,788	152,409	186
Clarks Point	5	4,326	48,000	70
Ekuk	NA[a]	NA	NA	NA
Levelock	8	6,711	72,000	126
Igiugig	3	7,294	115,200	137
Total Eighteen Communities	436			9,663

[a]Included in industrial.

SOURCE: Nushagak Electric Cooperative, Naknek Electric Association, ISER Field Survey.

Shore-Based Processors. ISER study team members surveyed all thirteen shore-based processors on baseline characteristics of electricity use. Many processors were not able to monitor how much of their fuel was used for electricity versus other requirements, nor did they know exactly what their electricity was used for, regardless of its source. The strategy used to fill missing baseline data gaps was similar to that used in the C/G sector. A proxy variable, such as fuel consumption or plant size, was used in conjunction with patterns observed in other processors to estimate electricity use for processors with incomplete baseline information.

From the standpoint of baseline data collection, the two key determinants of processor electricity use were method of electricity supply and processing technology.

The survey results pertaining to electricity supply are shown in Table E.2.7. They include electricity purchased from utilities and produced from processor-generating facilities. They cover all forms of processing - canning, freezing, and packing - and a variety of seafood types - salmon, salmon roe, and herring. The largest amount of electricity was furnished by self-generation. On average, processors used about 69 megawatt hours from utilities and 660 megawatt hours from their own generators. Most processors purchased electricity from utilities and used their own generators for peak summer months. Two Kvichak processors depended entirely on the electric utility.

TABLE E.2.7. CHARACTERISTICS OF ELECTRICITY CONSUMPTION BY BRISTOL BAY SEAFOOD PROCESSORS IN 1980

	Kvichak Fishery	Nushagak Fishery	Bristol Bay Study Region
Total Number of Processors	9	4	13
Self-Generating			
Number With Own Generator	7	4	11
Average MWH Produced/Year	913 (2)[a]	572 (2)	
Number Without	2	0	2
Average MWH Year/Proc.	710	572	660[b]
Utility Power			
Number Using	8	2	10
Average MWH Purchased/Year	97 (8)[a]	62 (2)[b]	
Number Not Using	1	2	3
Average MWH Year/Proc.	86	31	69

[a] Number in parentheses indicates number of processors for which data was available.

[b] Averages are weighted for number of processors in each fishery.

SOURCE: Naknek Electric Association, Nushagak Electric Cooperative, Inc., and data supplied by fish processors.

Table E.2.8 shows the allocation of total fuel consumption across major categories of use: electricity self generation, space heating, and processing boilers (canning).

In general, we were not successful in using data on total production as a proxy for electricity use because of considerable variability in both the amount of processed fish production and in the amount of electricity consumption. Production for 1980 data from ISER surveys and from ADFG are compared in Table E.2.9. Table E.2.10 summarizes the production data in Table E.2.9 for the "average" Bristol Bay processor engaged in freezing and canning operations.

Processing Technology. A recent shift toward freezing capacity is evident among Bristol Bay shore-based processors. In 1980, about ten out of fourteen processors have both canning and freezing facilities. Average electricity use per processor for this group was 583 mwh per year in 1980. Processors engaged only in canning used an average of 486 mwh in 1980. Thus, processors engaged in freezing used an average of 20 percent more electricity than those involved only in canning. The data in Table E.2.10 indicate that frozen salmon accounts for only 6.6 percent of average production. Although not conclusive, the evidence strongly suggests that compared with canning, freezing technology uses a disproportionately large amount of electricity per pound of processed fish.

TABLE E.2.8. FUEL OIL CONSUMPTION BY SELECTED BRISTOL BAY SEAFOOD PROCESSORS IN 1980

	Floor Area		Fuel Oil Consumption				Proportion of Total Fuel Oil Consumption (Percent)		
			Non-Space Heating[b]			Space Heating[c]			
Processor	Plant	Housing	Plant	Housing	Plant & Housing		Generator	Space Heating	Processing
Columbia Wards	28,000	30,000	NA	NA	60,000	NA	40	35	25
Red Salmon	151,000	55,000	NA	NA	64,767[a]	24,317[a]	40	(d)	60
Egegik Seafoods[g]	35,600	14,450	NA	NA	53,336[e]	Included in non-space heat	40	15	45
Bumble Bee	NA	NA	NA	NA	80,000	72,000	(f)	40	60
Whitney Fidalgo	8,100	32,100	20,785	NA	20,785	31,176	0	60	40
Peter Pan Seafoods	63,000	27,000	NA	NA	37,037	1,700	60	5	35
Nelbro Packing Co.	73,232	54,634	57,555	33,954	91,509	14,706	56	12	32

SOURCE: All data reported by Bristol Bay seafood processors, except as noted.

[a] Reported by Chevron for fuel sold between 9/30/80 and 9/30/81.
[b] In some cases, breakdown between plant and housing not available.
[c] Housing only.
[d] Included in processing.
[e] Includes space heating fuel.
[f] Included in space heating.
[g] 1981 data.

TABLE E.2.9. BRISTOL BAY SEAFOOD PROCESSORS 1980 PRODUCTION
(Pounds of Fish)

	Location	Canned	Frozen	Salmon Roe	Other	Total
REPORTED BY PROCESSOR						
Alaska Packers	S. Naknek	NA		NA		
Bumble Bee	Naknek					
Columbia Wards	Ekuk	4,836,000	700,000	330,000		5,866,000
Diamond E.	Egegik	NA	NA			
Red Salmon	Naknek	NA	NA			
Engstrom Bros.	Dillingham		NA			
Nelbro Packing	Naknek	3,211,941	38,696[a]	1,592,000[b]	3,194,245[a]	8,036,882
Pederson Pt. (Kodiak King Crab)	Naknek					
Peter Pan	Dillingham	6,500,000	NA	200,000		6,700,000
Queen Fisheries	Dillingham	NA				
Egegik Seafoods (Kodiak King Crab) (Egegik Packers)	Egegik	1,700,000		51,920		1,751,920
Whitney Fidalgo	Naknek	3,460,000			4,000,000[e]	7,460,000
Total		19,707,941	738,696	581,920	7,194,245	29,814,802
Average		3,941,588	369,348	193,973	3,597,122	5,962,960
REPORTED IN PACIFIC PACKERS' REPORT						
Alaska Packers	S. Naknek	3,429,648		132,235		3,561,883
Bumble Bee	Naknek	1,957,440	430,072			2,387,512
Columbia Wards	Ekuk	5,480,784	846,839			6,327,623
Diamond E.	Egegik	3,693,888	411,750			4,105,638
Red Salmon	Naknek	6,543,744[f]	430,072			6,973,816
Engstrom Bros.	Dillingham					
Nelbro Packing	Naknek	3,315,504	38,696	130,414	1,625,818[b]	5,110,432
Pederson Pt. (Kodiak King Crab)	Naknek					
Peter Pan	Dillingham	4,245,456	156,806[c]	200,204		4,602,466
Queen Fisheries	Dillingham	(d)				
Egegik Seafoods (Kodiak King Crab) (Egegik Packers)	Egegik	5,399,328[d]				5,399,328
Whitney Fidalgo	Naknek	(d)				
Total		34,065,792	2,314,235	462,853	1,625,818	38,468,698
Average		3,096,890	385,706	154,284	1,625,818	3,497,154

[a]Whole fish weight

[b]Herring roe-whole fish weight

[c]Includes salmon processed for fresh market

[d]Total for Queeen Fisheries, Egegik Packing Co., and Whitney Fidalgo

[e]Whole fish flown out

[f]Includes Columbia Wards pounds processed

TABLE E.2.10. AVERAGE SEAFOOD PROCESSOR[a] PRODUCTION IN 1980 (Pounds of Fish)

	Production
Salmon	
Frozen	295,000
Canned	2,839,000
Herring (packed)	158,000
Salmon Roe (boxed and salted)	127,000
Flown Out (processed elsewhere)	1,030,000[b]
Total	4,449,000

[a]Averages calculated for all processors including those that do not necessarily participate in a particular processing method.

[b]Estimated from incomplete data from Alaska Department of Fish and Game and the processors.

Because of the relevance to forecasting, we selected processing technology as the determinant of baseline industrial electricity use. Table E.2.11 shows the baseline estimates of industrial electricity consumption by study area community and by processing technique. In some instances, limited information compelled us to simply substitute average electricity use characteristics corresponding to the appropriate processing technique.

Fish Camps and Buy Stations. Average annual electricity consumption per user in this category (24 megawatt hours) was derived from 1980 data on annual consumption from ten buyers and fish camps in the study area. Actual consumption varies greatly since operations range in size from small offices to a bunk house, mess hall and ice facilities complex.

Military

The Alaskan Air Command (AAC) station at King Salmon is the only military presence in the study region. Prior to November 1981, when the military first tied into Naknek Electric Association (NEA), ACC generated their own power. In December 1981, the military bought 520,800 kwh from NEA. According to NEA manager Gordon McCormick, the utility contract with the military station calls for annual military electricity consumption of about 5,600 mwh.

TABLE E.2.11. TOTAL SEAFOOD PROCESSOR ELECTRICITY CONSUMPTION IN 1980 (kwh/Year)

Community	Canning Only	Freezing Only	Total
Dillingham			
Engstrom Bros.		86,240	86,240
Peter Pan		481,444	481,444
Dragnet Fisheries		Ø	Ø
Total		567,684	567,684
Naknek			
Alaska Far East		175,460	175,460
Nelbro Packing		892,081	892,081
Whitney-Fidalgo	295,166		295,166
Red Salmon		583,000	583,000
Pederson Point		583,000	583,000
Total	295,166	2,233,541	2,528,707
South Naknek			
Bumble Bee		1,003,300	1,003,300
Alaska Packers		583,000	583,000
Total		1,586,300	1,586,300
Ekuk			
Columbia Wards		700,000	700,000
Clarks Point			
Queen Fisheries	486,000		486,000
Egegik			
Egegik	486,000		486,000
Diamond "E"		583,000	583,000
Total	486,000	583,000	1,069,000
Total All Processors	1,267,166	5,670,525	6,937,691

SOURCE: Seafood Processors.

Electricity Prices

Bristol Bay electricity prices in 1980 varied widely across study area communities. There are three principle reasons for the non-uniform structure of electricity prices:

(a) Distance and method of diesel fuel shipment;

(b) Degree of electrification; and

(c) Power cost assistance.

Distance and Method of Shipment. Most diesel fuel is shipped upriver by barge several times each season. Excluding canneries, there were four barge companies operating on the Nushagak and Kvichak rivers. Outside of Naknek and Dillingham, the 1980 price charged by these carriers varied from $1.13 to $1.50 per gallon, depending on the receiving community. This implies a transportation surcharge of between 5 and 42 cents per gallon above the 1980, bulk-fuel, dock price of $1.08 per gallon. As shown in Table E.2.12, communities further away from the central distribution points of Dillingham and Naknek paid the most.

Diesel fuel is possibly the largest single contributor to the running cost of electricity. Surcharges of the dimension reported in Table E.2.12 are most certainly transmitted in electricity prices. In the extreme case, a surcharge of 42 cents per gallon would raise the price per kwh by 3-to-6 cents, depending on generator efficiency.

Degree of Electrification and Load Management. The degree of electrification pertains to economies of scale (i.e., savings in money

TABLE E.2.12. FUEL TRANSPORTATION SURCHARGES FOR SELECTED COMMUNITIES IN 1980

Community	Surcharge (¢/Gallon)	Carrier
Nushagak Area		
Aleknagik	25.4	Sorenson Lighterage
Manokotak	15.4	Smith Lighterage
Portage Creek	5.0	Sorenson Lighterage
Ekwok	5.0	Sorenson Lighterage
New Stuyahok	11.4	Smith Lighterage
Koliganek	33.4	Sorenson Lighterage[a]
Kvichak Area		
Egegik	24.4 - 42.4	Diamond "E"
Igiugig	27.0	Moody Sea Lighterage
Iliamna	31.4	Moody Sea Lighterage
	22.4	Levelock Natives Limited
Nondalton	27.0	Moody Sea Lighterage
	92.4	Woods Air Fuel Service

[a]1981.

SOURCE: ISER Field Survey

outlays due to efficiencies inherent in larger scale operations). In the base year, we observed five types of village electrification. They are:

(1) REA Cooperatives (Dillingham and Naknek utility districts)
(2) Municipal Utility Companies (Manokotak)
(3) AVEC Utilities (New Stuyahok)
(4) School generators (Koliganek, Ekwok and Portage Creek)
(5) Home self-generated electricity.

The central station utilities of Dillingham and Naknek have the largest power capacity in the study area; ranging from 2,600 kw at NEC to 6,200 kw at NEA. They could produce about 12 or 13 kwh per gallon of diesel fuel, at many times the efficiency of the smaller 500 kw village systems, or of the 3-to-5 kw, home generators used in noncentral station communities. Furthermore, the large central systems can distribute overhead and maintenance costs over more output than the smaller village systems, thereby reducing the contribution of overhead to the cost per kwh. In short, there are indisputable economies of scale that affect the consumer cost of electricity.

However, additional capacity is favorable only if the right amount can be used regularly. Unused capacity is costly from the standpoint of investment and operating efficiency. Generating capacity should be matched with the characteristics of the load to produce lowest cost electricity. The load factor depicts the relationship between the degree of electrification (peak demand in kw) and annual load (consumption in kwh) as shown below:

$$\text{Load Factor} = \frac{\text{Annual Consumption (kwh)}}{\text{Peak Demand (kw)} \times 8{,}760 \text{ Hours Per Year}}$$

A higher load factor suggests a more continuous load that is balanced with capacity. The load factor is a reasonable indicator of electricity cost at the plant as a function of load characteristics and capacity.

Representing one extreme, school generators (which range from 75-to-200 kw and experience considerable daily variation in load) display a load factor of about 0.35, according to an engineer knowledgeable about energy use in Bristol Bay. School generators typically produce about 4-to-7 kwh per gallon of diesel fuel. At the other extreme, the Alaska Air Command Station in King Salmon had 750 kw of generator capacity (prior to tying into NEA in December, 1981) and a steady load. It recorded a load factor of about 0.85. In 1980, the NEA and NEC utilities recorded factors of 0.72 and 0.69, respectively. As shown above, the ratio of output-to-fuel consumption at the utilities was two-to-three times that of the schools.

Power Cost Assistance. The Power Cost Assistance Program is designed to provide relief to customers of regulated electric utilities whose costs are inflated by their geographic or fuel supply situation. Application for assistance is made to the Alaska Public Utilities Commission (APUC) on a very detailed energy cost balance sheet. After the applicant verifies costs, the APUC establishes an assistance level. Requests for increases in cost assistance can be made at any time after initial award.

For residential and small commercial consumers, the Power Cost Assistance Program will cover 95 percent of the cost between 12¢ and 45¢ per kwh up to a limit of 600 kwh per month per customer. In addition, communities receive a credit of 55 kwh per month per resident for each community facility. An upper limit of 31.35¢ per kwh has been established for the assistance level of the program. In December 1981, utilities in Ruby and Bettles were awarded this maximum amount.

In the Bristol Bay study area, four utilities are receiving or have received power cost assistance under the present program and its predecessor, the Power Production Assistance Program. Levels of assistance for each utility are tabulated in Table E.2.13. The Alaska Village Electric Cooperative (AVEC) is currently applying for a rate increase under the Power Cost Asistance Program. Nushagak Electric Cooperative (NEC) is the only utility in the study area which has already shifted to this program. In January 1982, NEC will receive assistance of 7.03¢ per kwh.

Baseline electricity prices are summarized in Table E.2.14 for 1980 and 1981, with and without the Power Cost Assistance subsidy. Community-specific prices are weighted by total residential consumption in each community to derive average prices for the three village groupings.

TABLE E.2.13. POWER COST ASSISTANCE SUBSIDY IN BRISTOL BAY (¢/kwh)

		Nushagek Electric Cooperative	Naknek Electric Association		Alaska Village Electric Cooperative
			Naknek	Egegik	New Stuyahok
1980	Oct.				14.59
	Nov.				17.83
	Dec.				
1981	Jan.	5.00			
	Feb.	5.10	6.68	20.31	
	Mar.				
	Apr.	5.70			
	May				
	June				
	July				
	Aug.				
	Sept.		6.73	23.70	
	Oct.				
	Nov.		7.54		
	Dec.	5.83			26.93

TABLE E.2.14. BRISTOL BAY STUDY - AREA ELECTRICITY PRICES IN 1980 AND 1981

	1980		1981		Average Electricity Price 1980		Average Electricity Price 1981	
	Without Power Cost Assistance	With Power Cost Assistance	Without Power Cost Assistance	With Power Cost Assistance	Without Power Cost Assistance	With Power Cost Assistance	Without Power Cost Assistance	With Power Cost Assistance
Central Station Communities								
Dillingham Aleknagik	18.4	18.4	20.49	14.66				
Naknek King Salmon South Naknek	34.1	34.1	33.19	22.65	24.5	24.3	26.6	19.2
Egegik	34.1	34.1	37.18	14.87				
Manokotak	20.0	20.0	30.0	30.0				
New Stuyahok	42.0	27.4	48.27	21.34				
Seasonal-Central Station Communities								
Portage Creek	25.0	25.0	25.0	25.0				
Ekwok	30.0	30.0	30.0	30.0	26.8	26.8	26.8	26.8
Koliganek	25.0	25.0	25.0	25.0				
Noncentral Station[a] Communities	124.0	124.0	132.0	132.0	124.0	124.0	132.0	132.0

Note: The average electricity prices are printed beside a brace that groups all Central Station Communities (Dillingham through New Stuyahok), and beside a second brace that groups all Seasonal-Central Station Communities.

[a]Includes Iliamna, Newhalen, Nondalton, Clarks Point, Ekuk, Levelock, Igiugig.

SOURCE: Nushagak Electric Cooperative, Naknek Electric Association.

Capacity and Demand

In this analysis, we examine the monthly pattern of two forms of electricity consumption: monthly electricity output (kwh) and monthly electricity demand (kw). Data on monthly electricity use in the 18-community study area was available on a limited basis; primarily from the utilities in Dillingham, Naknek, and Egegik. Additional energy consumption data was collected from AVEC and directly from the shore-based fish processors.

In the analysis of capacity, fish processors represent a special consumer category for two reasons: First, they consume large quantities of electricity over a relatively short period. Second, a large portion of their total energy requirement is self-generated, creating special problems for measuring baseline capacity requirements. Our approach to measuring baseline capacity requirements incorporates these special considerations. Most fish processor activity is concentrated in the major utility districts of Dillingham, Naknek, and Egegik where baseline data is more plentiful.

It is of some interest to note that until recently, the seafood processor's contributions to overall energy consumption (kwh) and demand (kw) was not as important. However, the rising salmon production since the late 70's, combined with a moderate shift toward freezing capacity has dramatically altered the complexion of energy use in the processing industry. Figures E.2.1 through E.2.4 indicate

FIGURE E.2.1. UTILITY MONTHLY OUTPUT
NUSHAGAK ELECTRIC COOPERATIVE, INC. (NEC)
(mwh)

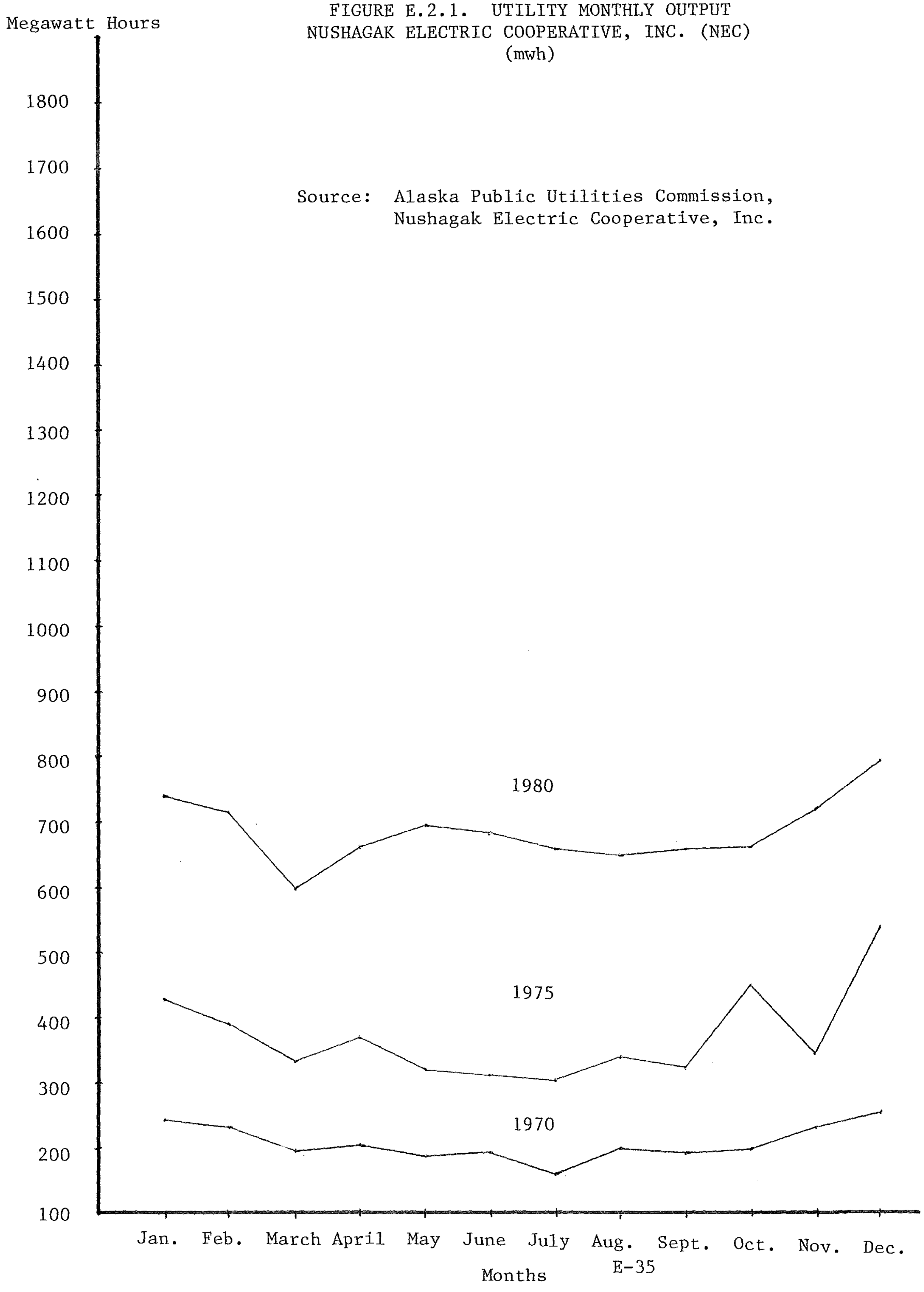


FIGURE E.2.2. UTILITY MONTHLY PEAK
NUSHAGAK ELECTRIC COOPERATIVE, INC. (NEC)
(kw)

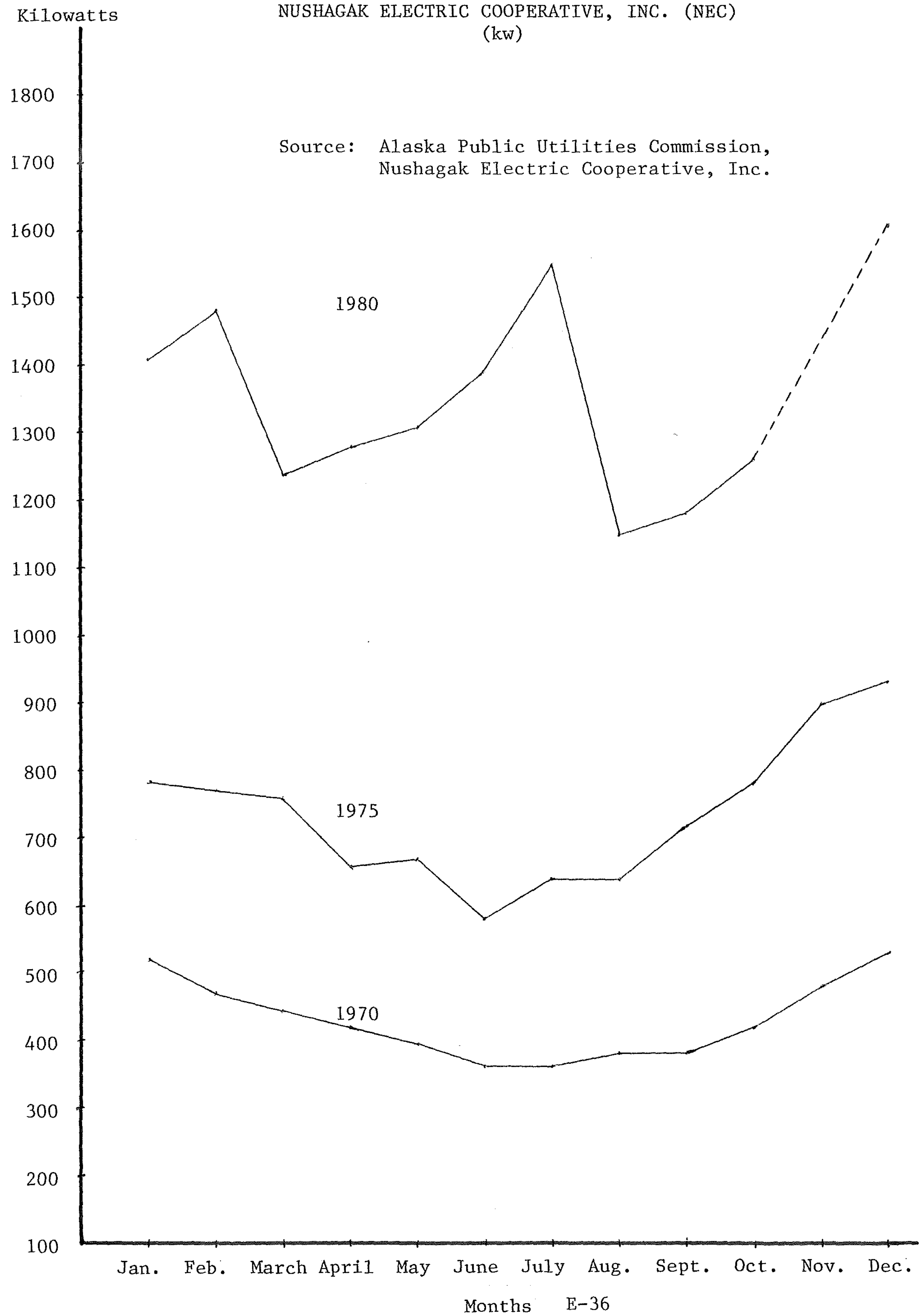


FIGURE E.2.3. UTILITY MONTHLY OUTPUT
NAKNEK ELECTRIC ASSOCIATION (NEA)
(mwh)

Source: Alaska Public Utilities Commission,
Naknek Electric Association

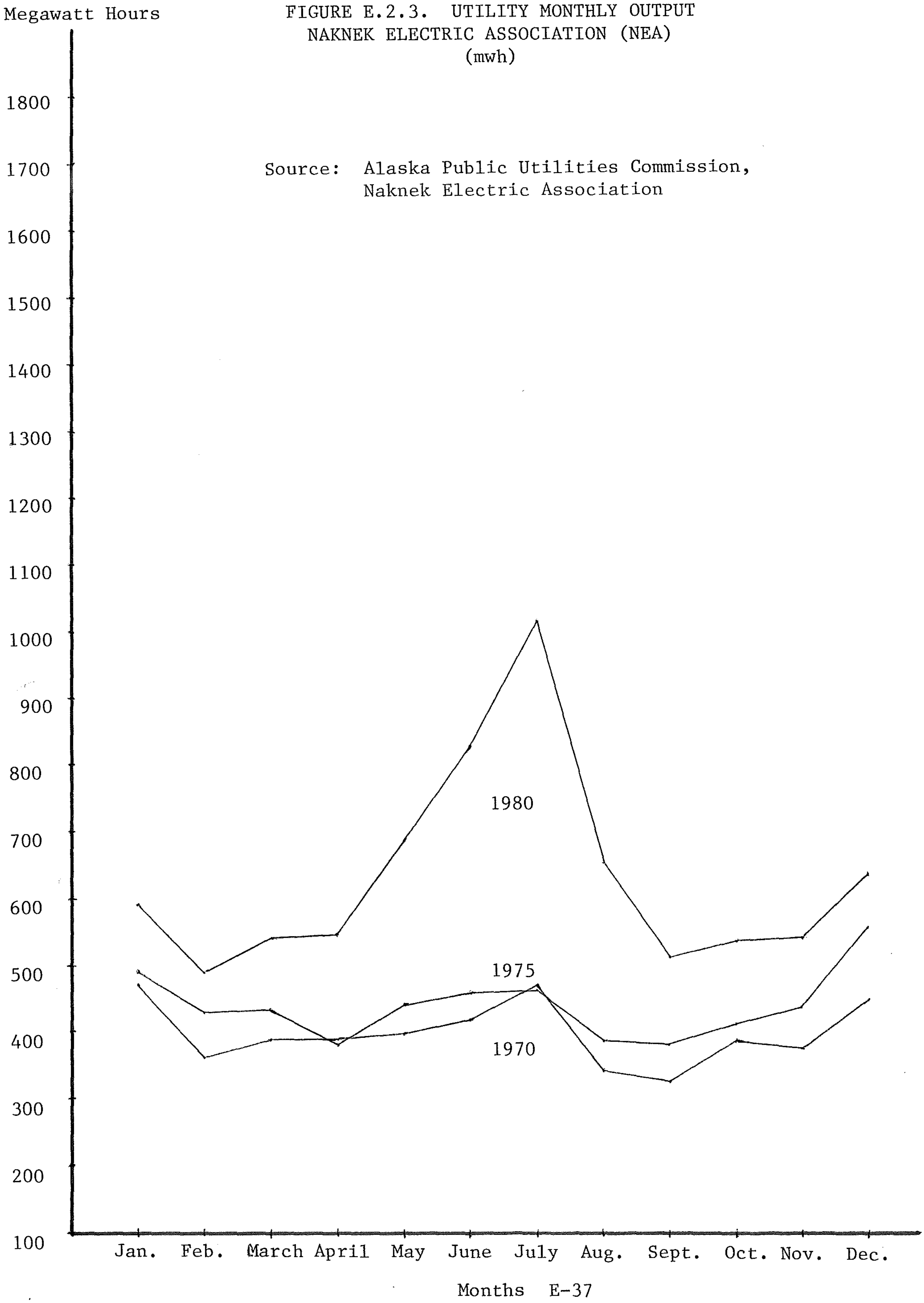
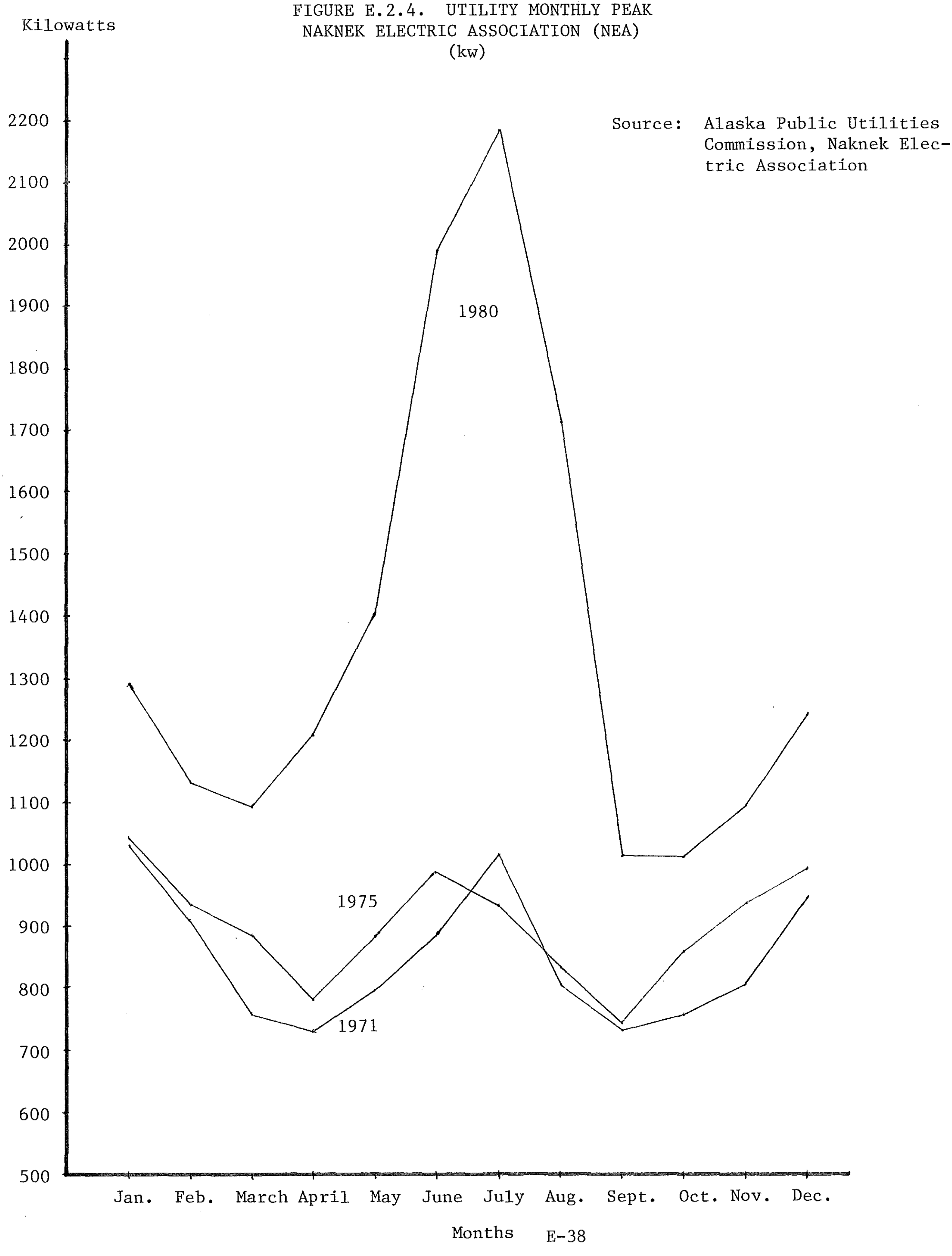


FIGURE E.2.4. UTILITY MONTHLY PEAK
NAKNEK ELECTRIC ASSOCIATION (NEA)
(kw)



that since 1970, summer output (kwh) and peak demand (kw) has been growing in both the Dillingham and Naknek Utility districts.

The basic approach used to derive baseline estimates of monthly output and electricity demand (kw) was first to segment capacity requirements into logical components. We begin by considering only central-station communities that also have shore-based processing facilities. These include the three major utility districts: Dillingham, Naknek, and Egegik. Next, we divide total monthly generation into its basic consumer categories. In the case of total monthly output, the utilities were able to furnish data by consumer classification: residential, commercial/government, and industrial. In the case of peak demand, the utilities were able only to furnish monthly data on total demand, except for a few processors that had three-phase meters.

Figures E.2.5, E.2.6 and E.2.7 show monthly output (kwh) by consumer classification and monthly total peak demand (kw) for respective utility districts.

As mentioned above, monthly output and demand at the utility reflect only a fraction of total study-area electricity requirements. A significant unmetered quantity of electricity is self-generated by the seafood processors. Of the 13 on-shore processors in the Bristol Bay study region, only two of those met their entire power needs with electricity bought from a central-station utility; the other ten either generated all their own power or a supplement to utility power.

FIGURE E.2.5. ELECTRICITY SALES BY CONSUMER CLASSIFICATION (mwh) AND PEAK DEMAND ALL CONSUMERS (kw) IN 1980

NUSHAGAK ELECTRIC COOPERATIVE, INC. (DILLINGHAM AND ALEKNAGIK)

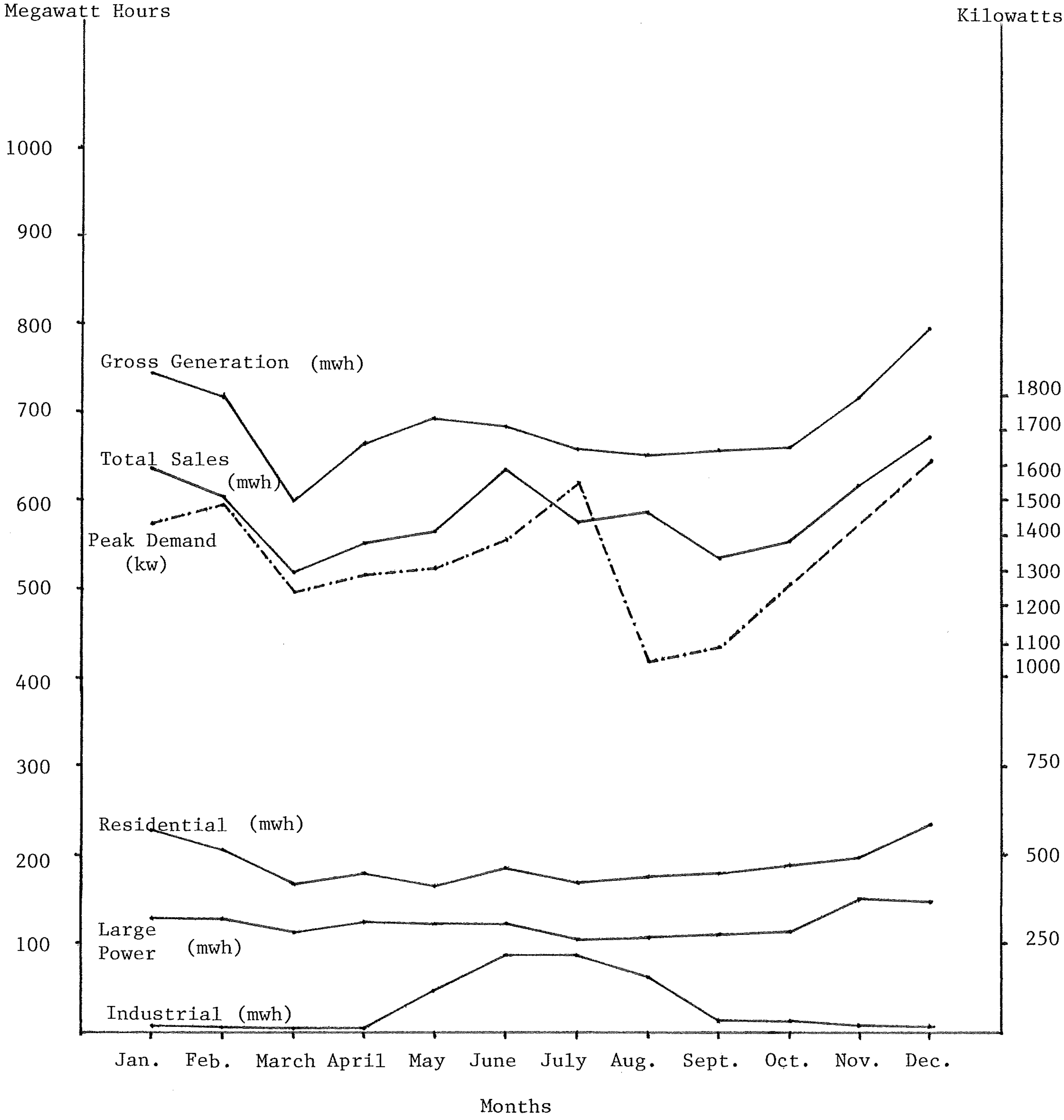


FIGURE E.2.6. ELECTRICITY SALES BY CONSUMER CLASSIFICATION (mwh) AND PEAK DEMAND ALL CONSUMERS (kw) IN 1980

NAKNEK ELECTRIC ASSOCIATION
(NAKNEK, SOUTH NAKNEK, AND KING SALMON)

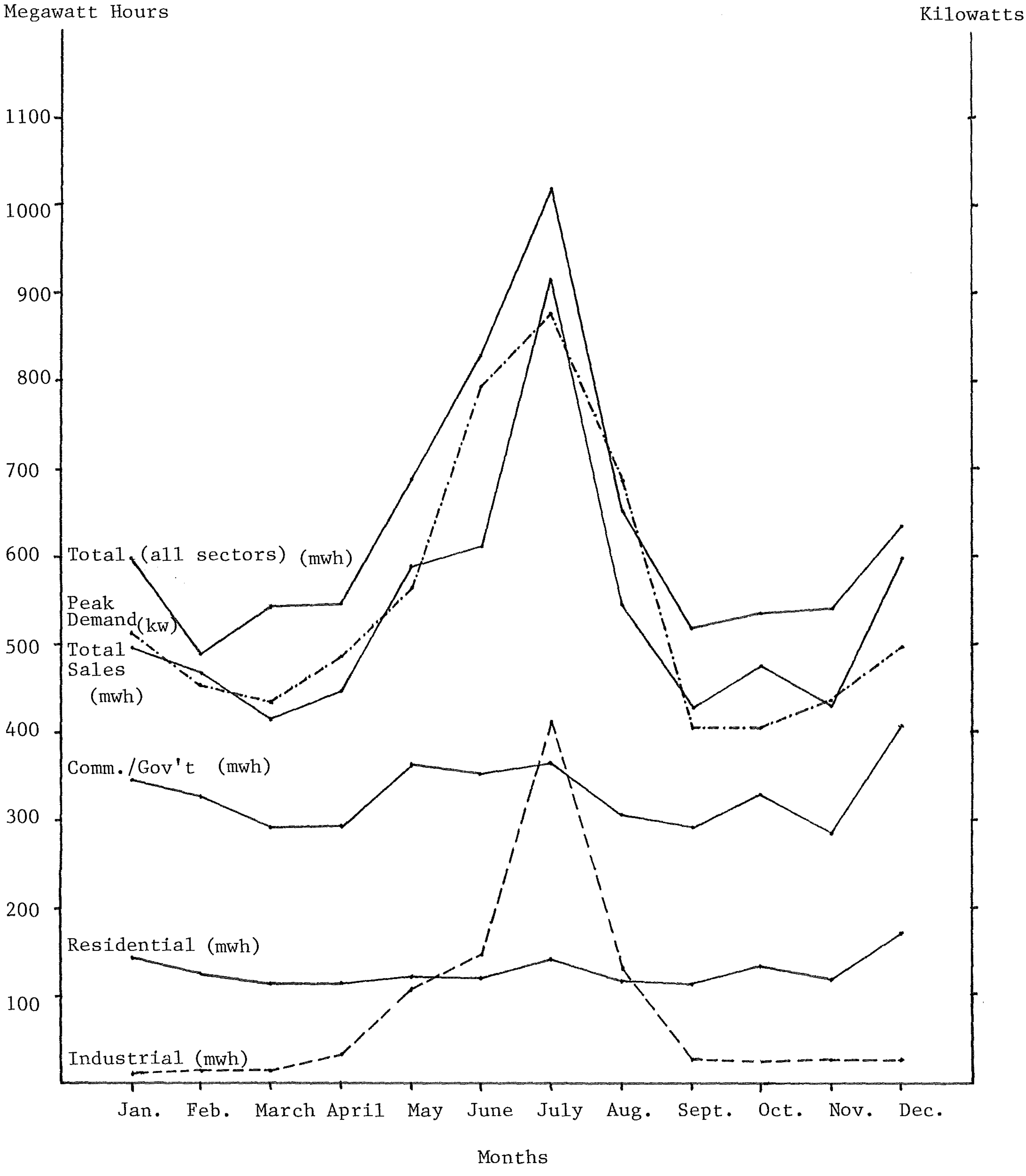
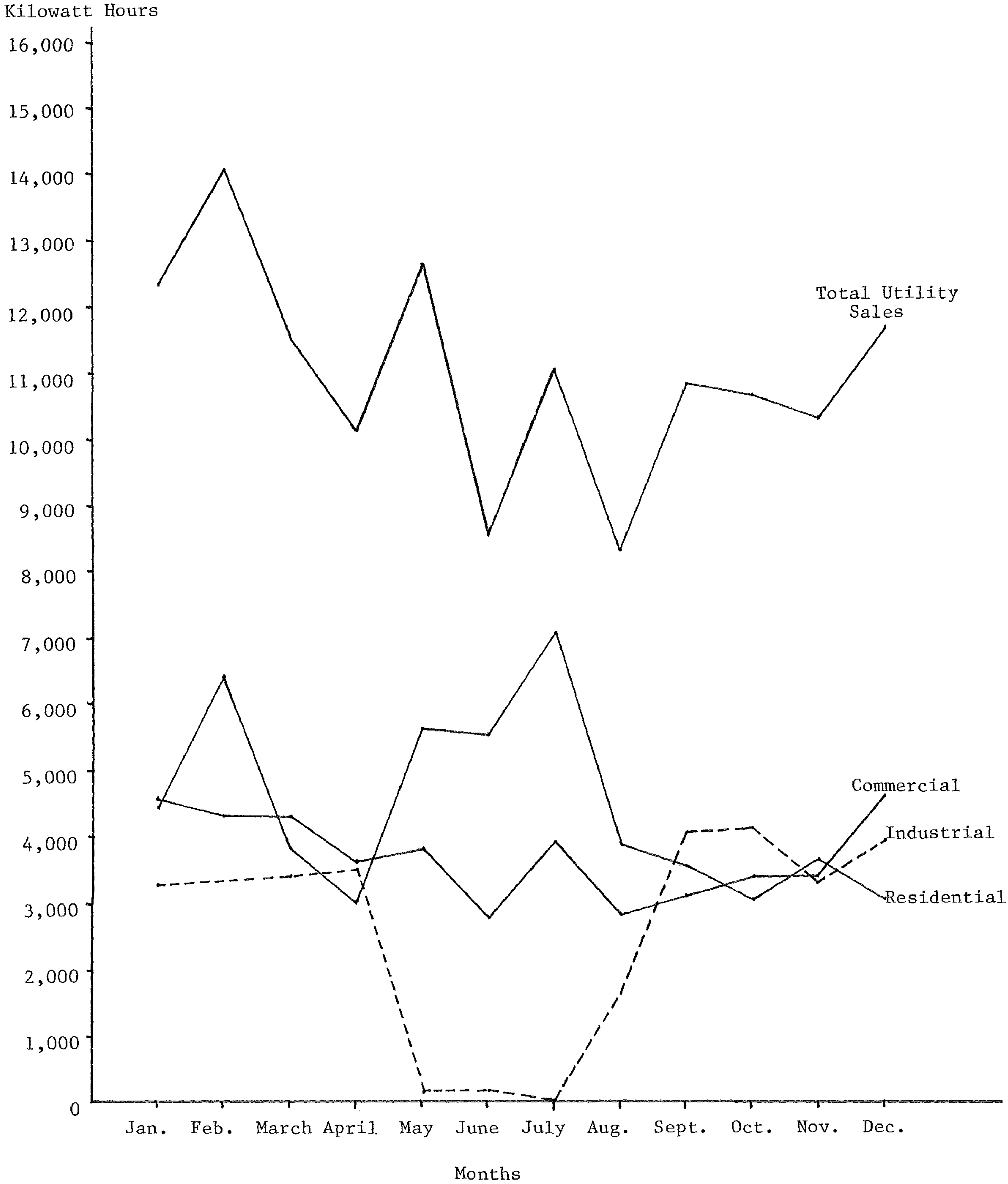


FIGURE E.2.7. ELECTRICITY SALES BY CONSUMER CLASSIFICATION IN 1980

NAKNEK ELECTRIC ASSOCIATION (Egegik)



In order to estimate the monthly distribution of unmetered, self-generated electricity, we analyzed utility data on monthly sales to seafood processors and derived a representative shape of the monthly output curve, where each month is assigned a proportion of total annual electricity generated in house by seafood processors. The monthly percentages of total annual self-generated output are shown in Table E.2.15. An estimate of the monthly distribution of total self-generated processor electricity consumption is derived by applying total annual output to the monthly percentages shown in Table E.2.15. These are shown for each utility district in Figure E.2.8, and compared with actual metered utility sales in Figures E.2.9, E.2.10 and E.2.11 for processors and their corresponding utility districts.

Thus far, we have identified the distribution of 1980 monthly output by consumer classification at the utility and added to that the monthly distribution of seafood-processor self-generated electricity, to derive a monthly output curve for total metered and unmetered electricity consumption.

We have also obtained records of monthly total peak demand at the utility for the three utility districts. Missing is an estimate of monthly self-generated peak demand by seafood processors.

In order to estimate monthly peak demand for all processors by district, we analyzed data on fish processor electricity use from

TABLE E.2.15. MONTHLY DISTRIBUTIONS OF ANNUAL PROCESSOR ELECTRICITY CONSUMPTION AT THE UTILITY

Month	Proportion of Annual Output (Percent)
January	Ø
February	0.5
March	0.5
April	2.5
May	11.5
June	18.5
July	53.0
August	11.5
September	0.5
October	1.0
November	1.5
December	Ø

SOURCE: Nushagak Electric Cooperative and Naknek Electric Association.

FIGURE E.2.8. SEAFOOD PROCESSOR SELF-GENERATED ELECTRICITY IN 1980 (mwh)

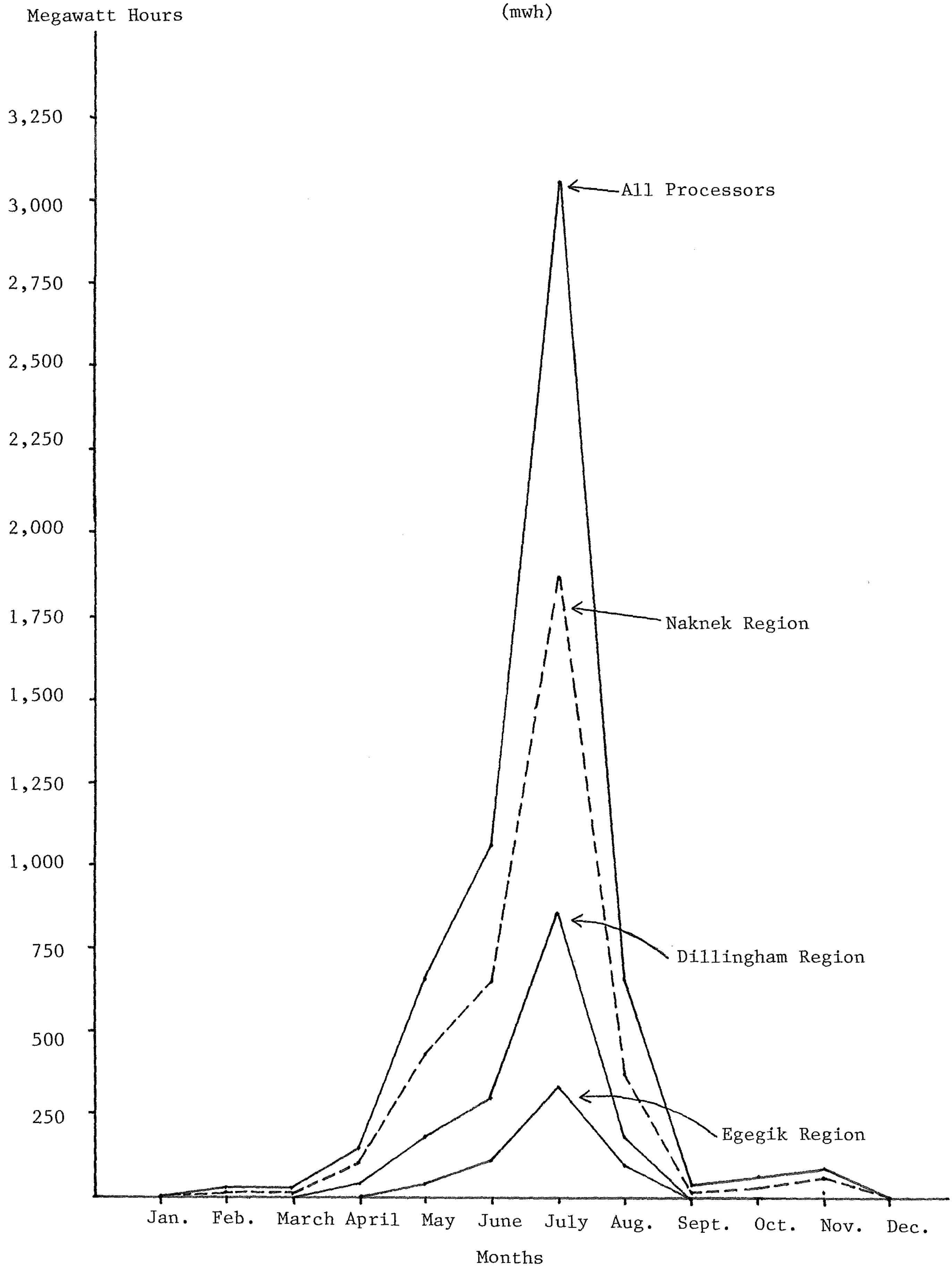
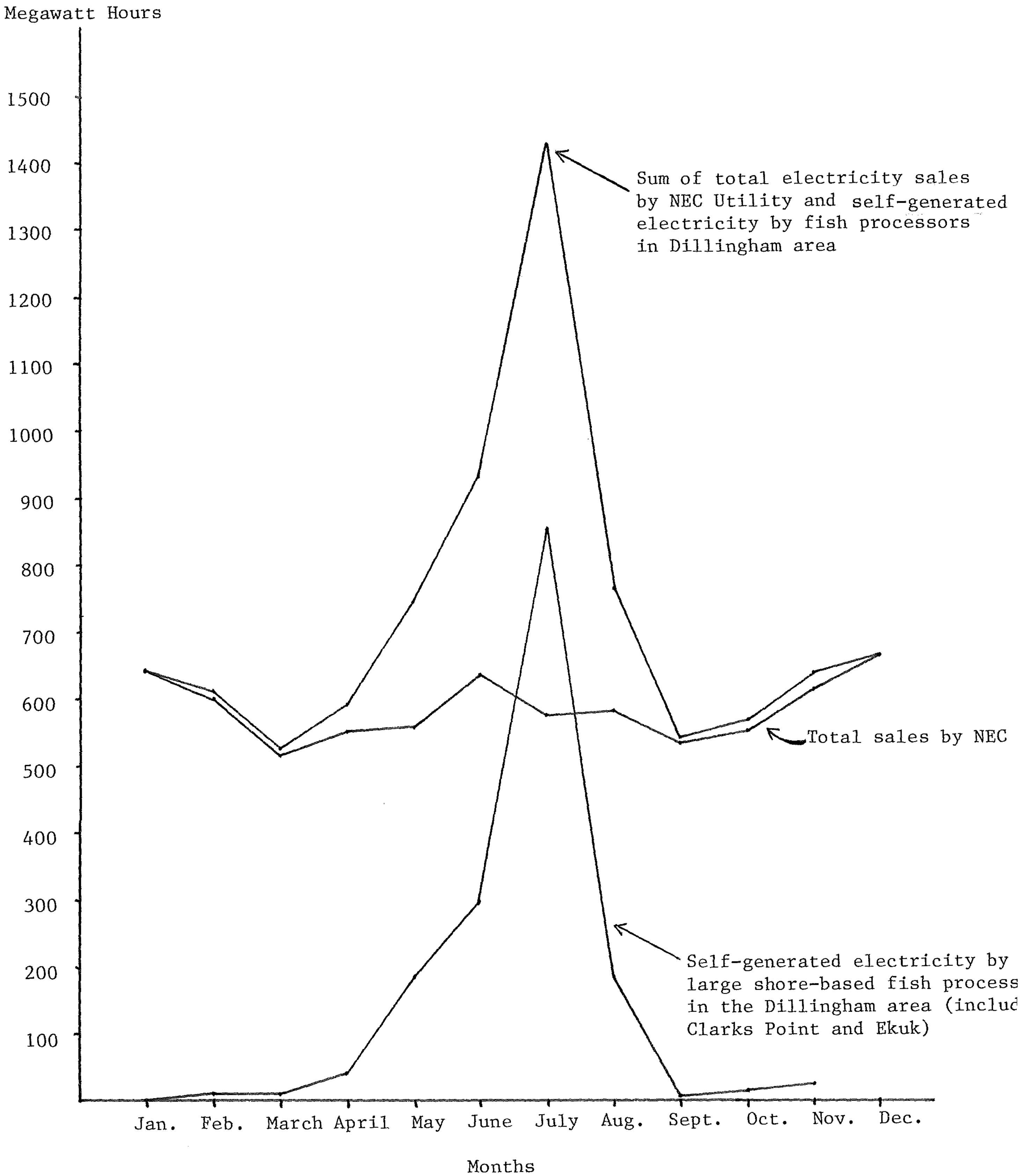


FIGURE E.2.9. TOTAL UTILITY AND NON-UTILITY ELECTRICITY CONSUMPTION IN THE DILLINGHAM DISTRICT IN 1980 (mwh)



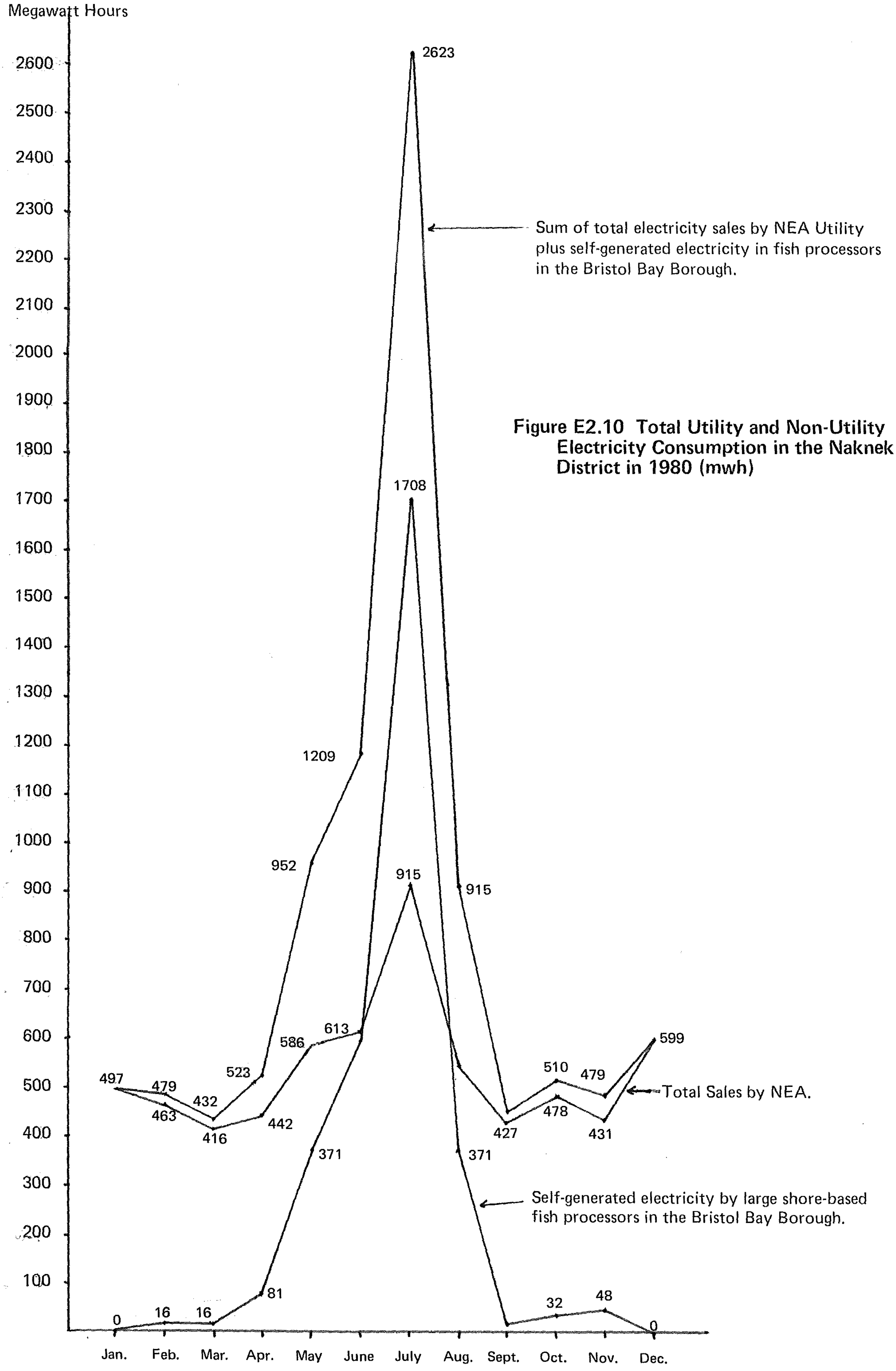
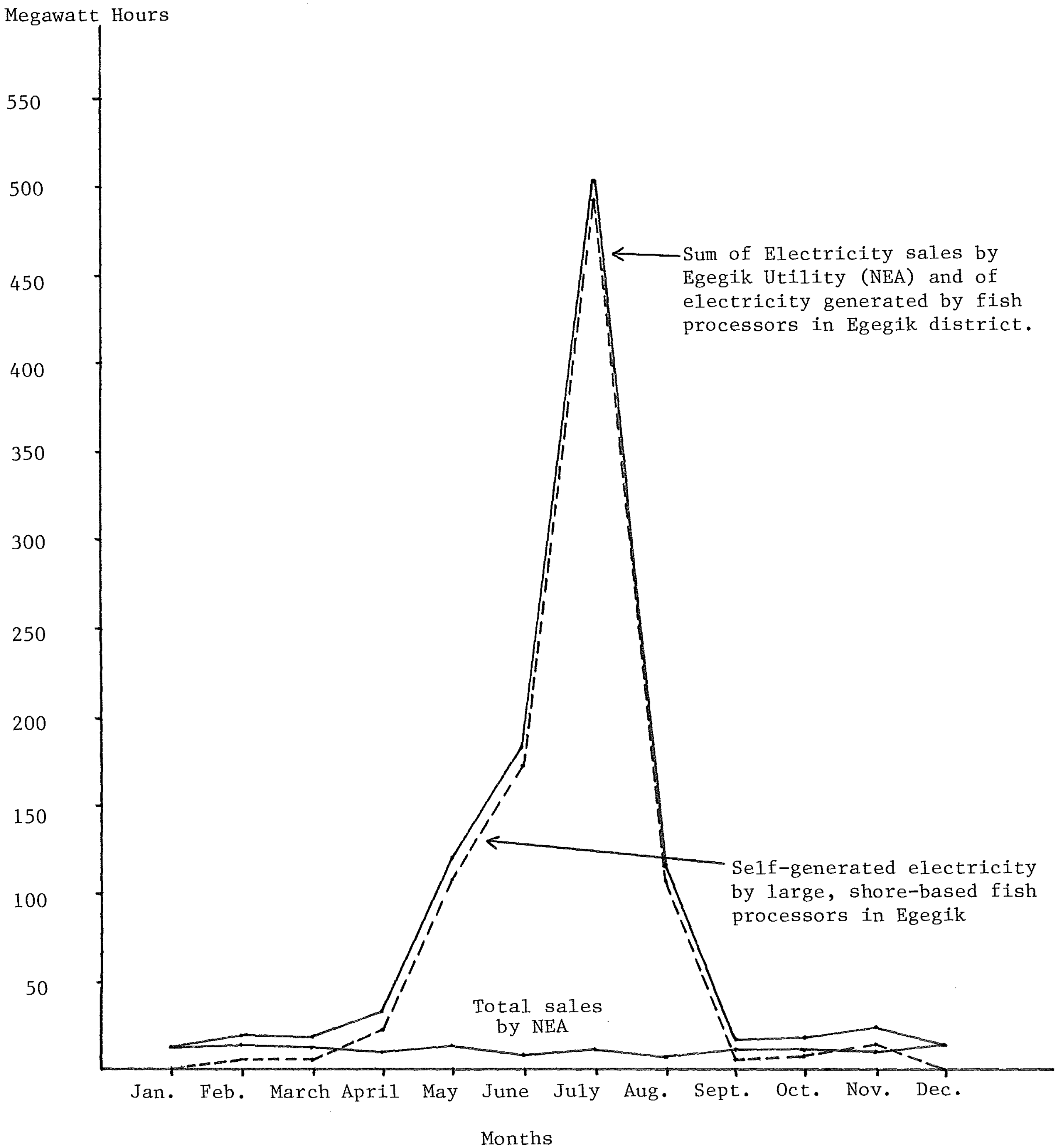


Figure E2.10 Total Utility and Non-Utility Electricity Consumption in the Naknek District in 1980 (mwh)

FIGURE E.2.11. TOTAL UTILITY AND NONUTILITY ELECTRICITY CONSUMPTION IN EGEGIK DISTRICT IN 1980 (mwh)



processor surveys and from the NEA utility. Data from the fish processor survey suggests that, on average, processor peak demand from their own generators was 69 percent of processor generator capacity. Furthermore, on average, peak demand (kw) was equal to the product of annual output (mwh) and a factor of 1.66. These relationships were assumed to be stable and were applied to processors for which data on peak demand was not available. The data in Table E.2.16 reflects a combination of actual data and estimates to derive an estimate of overall peak demand by district from processors' own generating systems. Processor self-generated peak demand is adjusted downward by an 80 percent diversity factor. Monthly peak demand curves were calculated by assuming a seasonable distribution comparable to that observed from actual data for two NEA processors. These are shown in Figure E.2.12.

Except for fish processors, there were no other large electricity users that would increase peak demand above the monthly levels actually serviced by the utility. It is, therefore, possible to construct a total peak-demand curve, for each district, that captures actual peak demand at the utility, as well as the additional component of peak demand from processors' own generators that occurs outside of the utility, but nevertheless remains important to regional peak demand forecasting. Figures E.2.13, E.2.14, and E.2.15 show the theoretic total peak demand in each utility district by combining monthly peak demand from utilities with monthly peak demand from processor in-house generation.

TABLE E.2.16. GENERATION CAPACITY, PEAK DEMAND, AND 1980 IN-HOUSE ELECTRICITY PRODUCTION BY BRISTOL BAY SEAFOOD PROCESSORS

	Generator Capacity (kw)	Peak Demand (kw)	Self-Generated Electricity (kwh)
Dillingham			
Engstrom Bros.	207[a]	143[b]	86,240[b]
Peter Pan	905	650	392,000[b]
Dragnet	0	0	0
		793	478,240
Naknek			
Alaska Far East	256[a]	177[b]	106,460[c]
Nelbro	1,885	1,500	866,735
Whitney Fidalgo	0	0	0
Red Salmon	1,225	600[b]	361,000[d]
Peterson Pt.	1,119[a]	772[b]	465,000[d]
		3,049	1,799,195
Ekuk			
Columbia Wards	1,277	1,000	700,000
Clarks Point			
Queens	915	631[a]	380,000[b]
Egegik			
Egegik Seafood	460	317[a]	191,000
Diamond E	25	17[a]	9,450
		334	200,450
South Naknek			
Bumble Bee	2,360	1,815[a]	1,003,300
Alaska Packers	1,119[a]	772[b]	465,000
		2,587	1,468,300
Total All Processors		6,715 kw[e] Total Peak Demand	5,026,185 kwh

[a]Assume peak demand = 69 percent of generator capacity.

[b]Assume peak demand (kw) = annual output x 1.66.

[c]Derived by subtracting utility-generated output (69,000 kwh) from total output reported by Alaska for East (175,640 kwh).

[d]Equals average processor consumption from own generator.

[e]Based on a diversity factor of 0.80.

Figure E2.12 Seafood Processor Self-generated Peak Demand in 1980

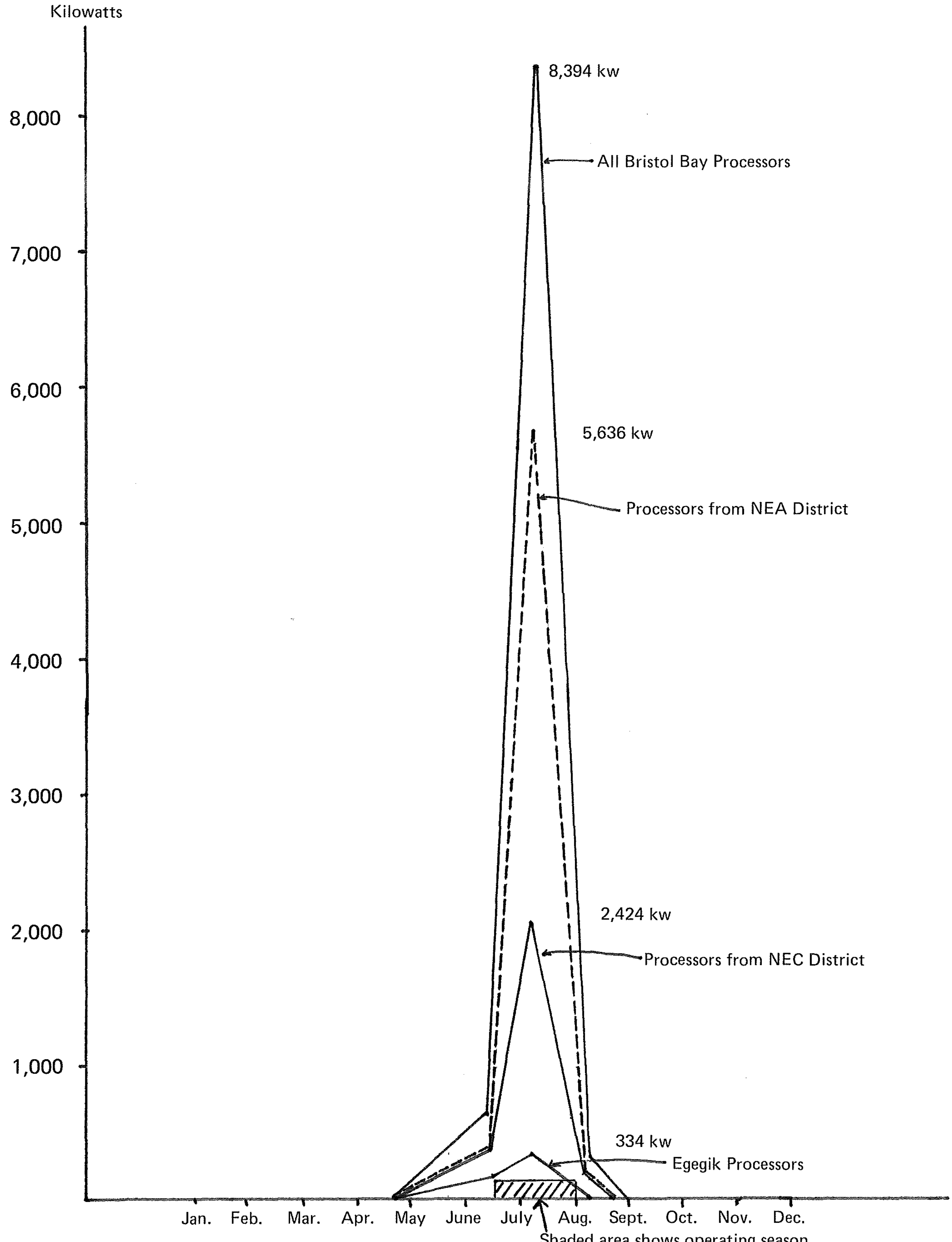


FIGURE E.2.13. PEAK DEMAND BY MONTH IN 1980
FOR THE DILLINGHAM DISTRICT (NEC)

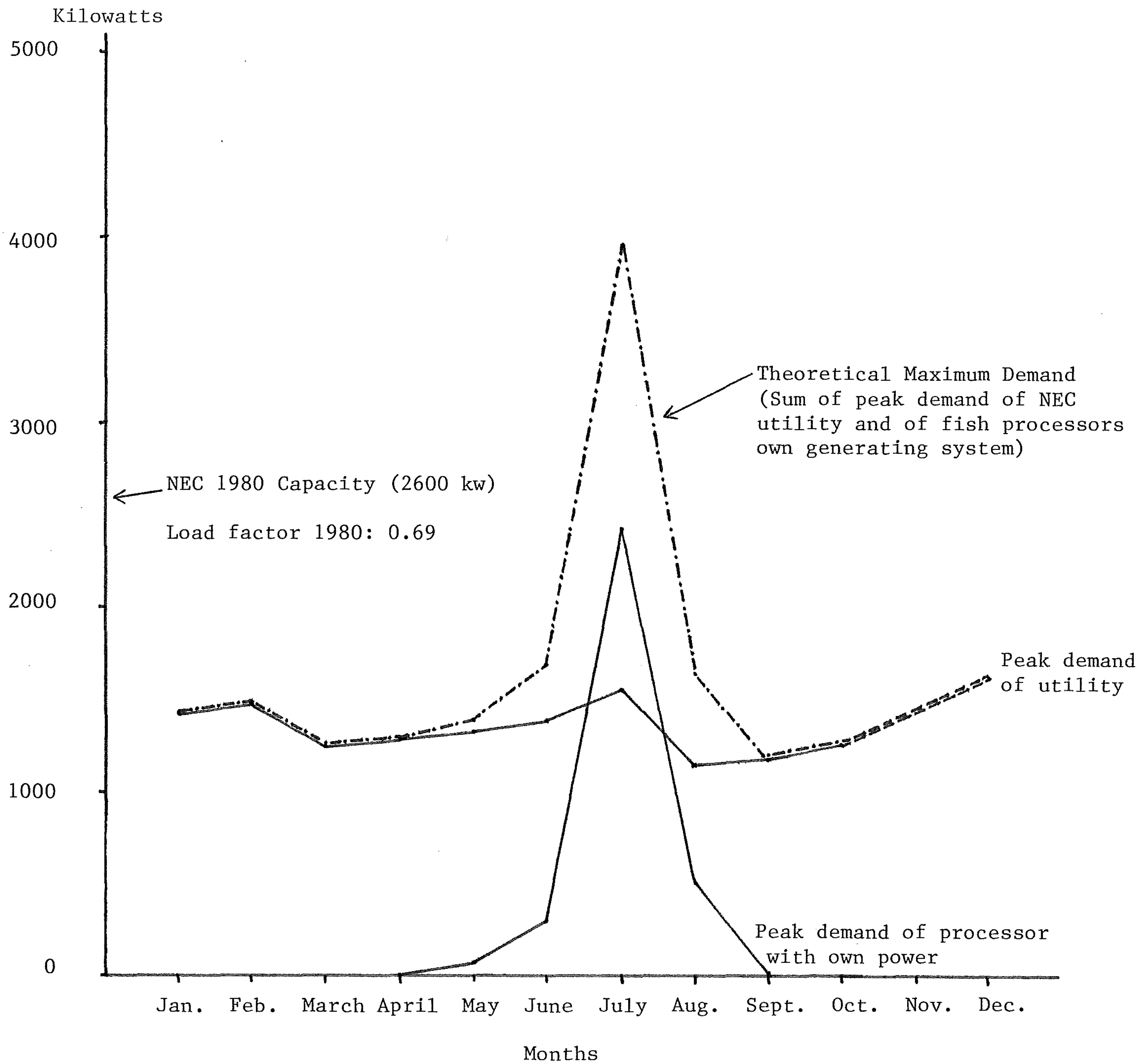


FIGURE E.2.14. PEAK DEMAND BY MONTH IN 1980 FOR THE NAKNEK DISTRICT (NEA) (kw)

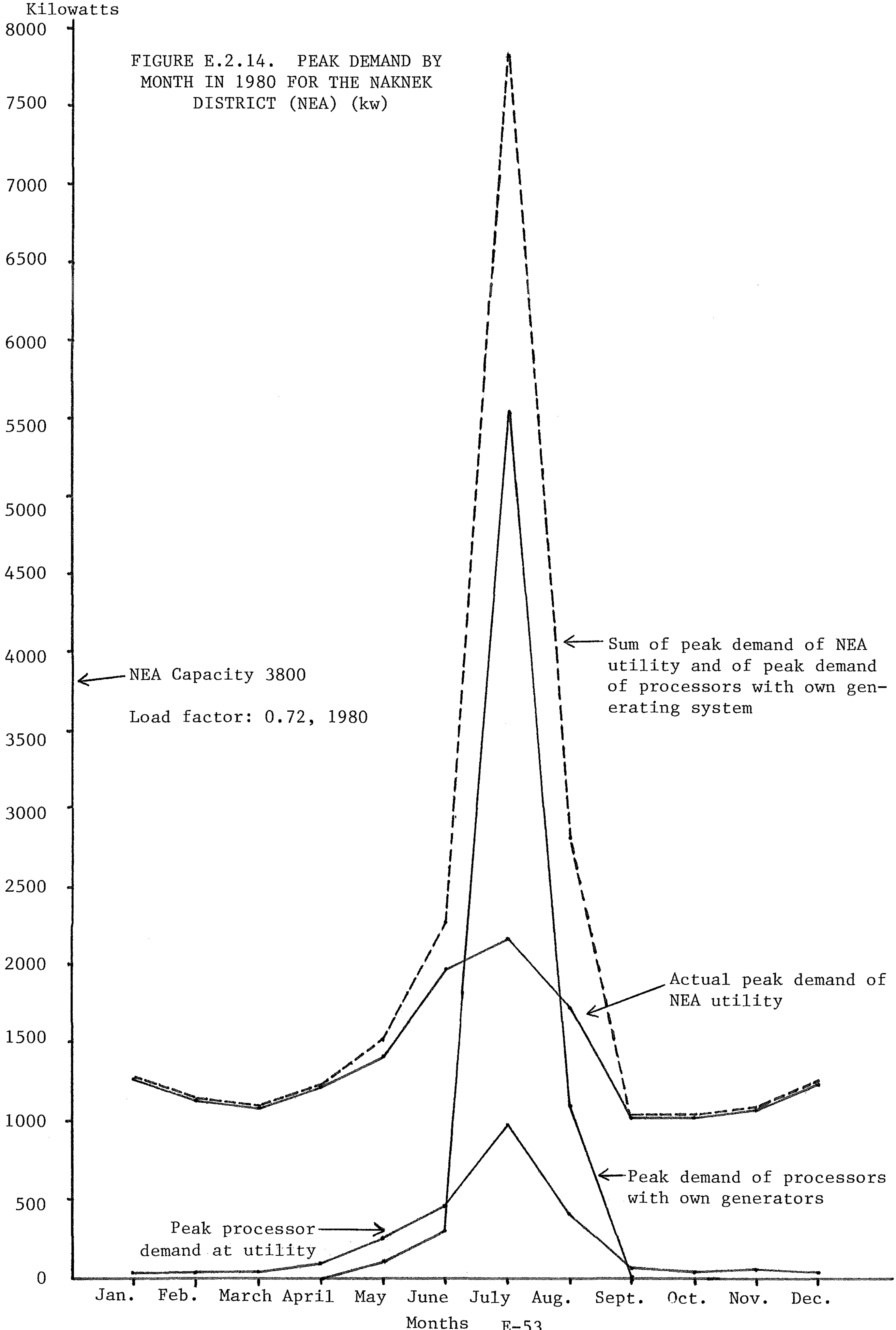
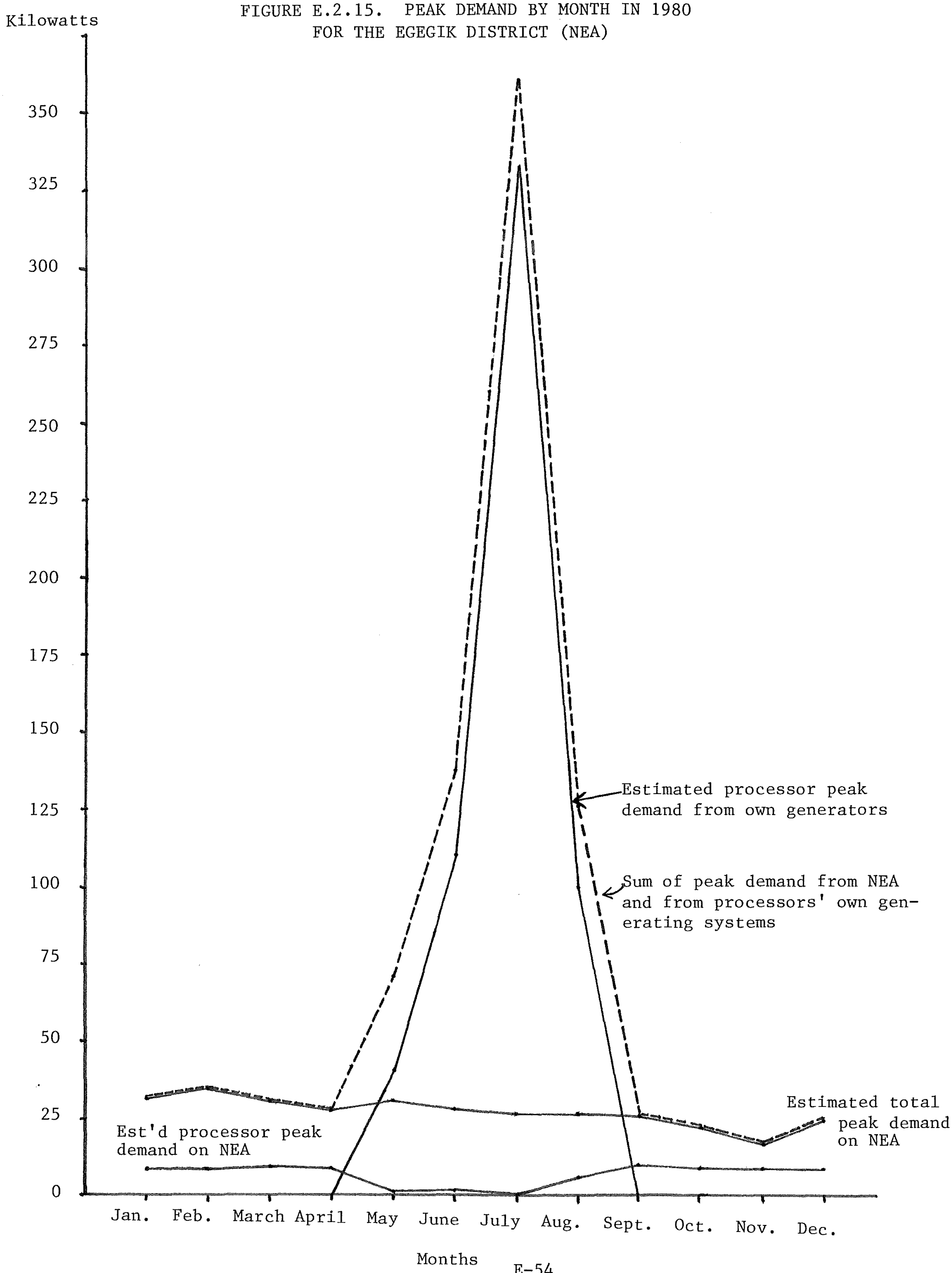


FIGURE E.2.15. PEAK DEMAND BY MONTH IN 1980
FOR THE EGEGIK DISTRICT (NEA)



Baseline data on annual electricity output and peak demand in Bristal Bay's three major utility districts is summarized in Table E.2.17.

The remaining communities reflect a varied mix of industry and electrification. Clarks Point and Ekuk are situated near seafood processors, but do not have central station electricity. Because of their proximity to Dillingham, we have included these processor loads into the previous analysis of the Dillingham utility district industrial load. Manokotak, Portage Creek, Ekwok, New Stuyahok, and Koliganek have central-station electricity without any industry. Iliamna, Newhalen, Nondalton, Levelock, and Igiugig have neither central-station power nor industrial consumers.

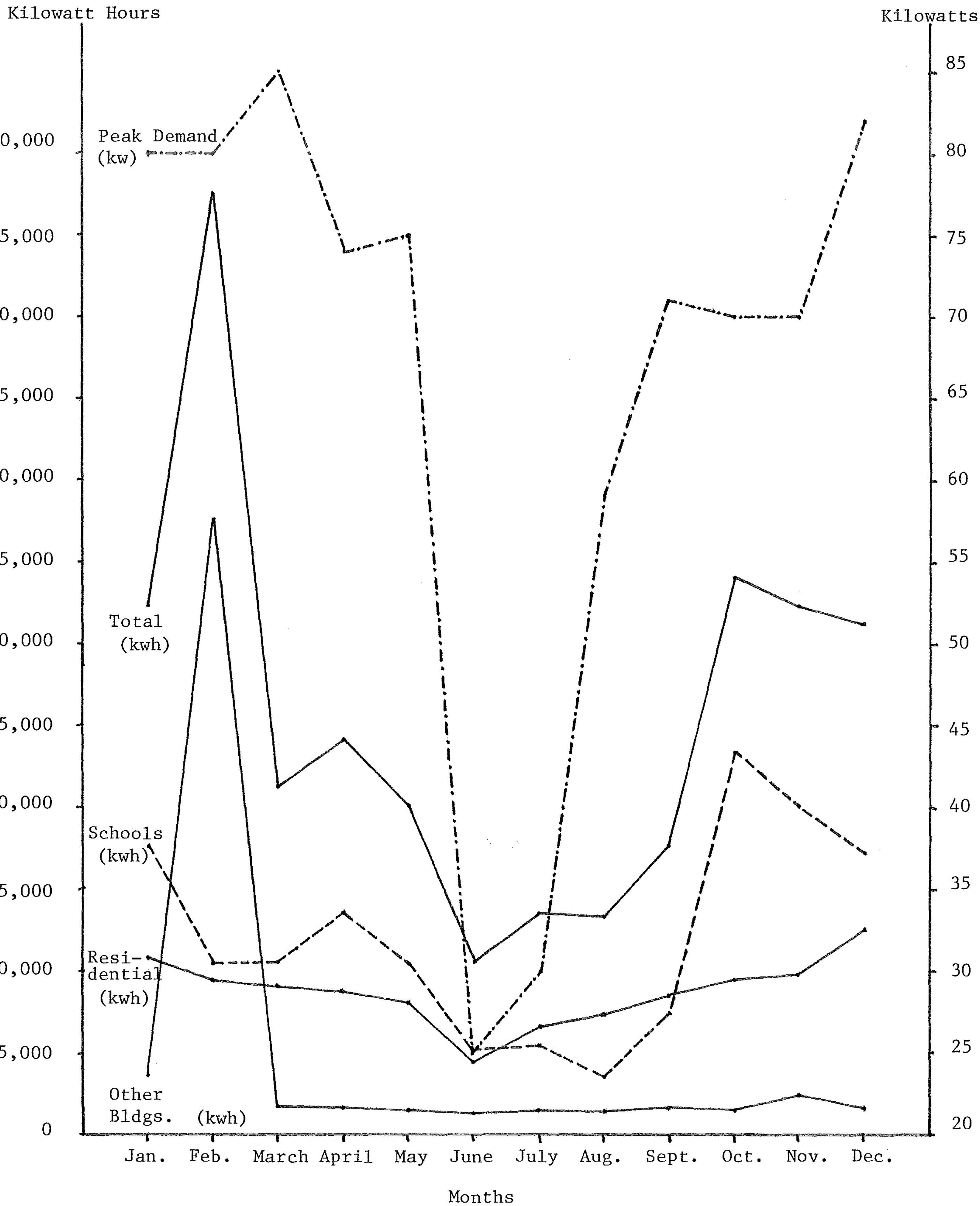
In most cases, monthly data on electricity use is not available for the remaining, nonutility district communities. New Stuyahok was an exception. Monthly data on output (kwh) by consumer classification and on peak demand (kw) was available from Alaska Village Electric Cooperative records. These are shown in Figure E.2.16. Note the distinct winter peak in both output and capacity; a familiar pattern for villages that experienced summer school closure and seasonal outmigration. Peak demand in 1980 was 86 kw. Annual electricity output was 307 mwh, yielding a ratio of kw demand to mwh output of 0.28. This ratio was assumed to be representative of other villages and was used to estimate peak demand from data on annual total ouput. These baseline estimates are shown along with actual estimate of

TABLE E.2.17. SUMMARY TABLE OF 1980 ANNUAL OUTPUT AND PEAK DEMAND FOR THE MAJOR UTILITY DISTRICTS

	Utility Districts							
	Naknek		Dillingham		Egegik		Combined	
	Jan.	July	Jan.	July	Jan.	July	Jan.	July
Annual Output	(MWH)							
1. Utility Sales to Seafood Processors	12	413	NA	NA	3	Ø	12	413
2. Processor Self-Generated	Ø	1,708	Ø	Ø	Ø	493	Ø	3,054
3. Utility Total Sales	497	915	638	575	12	11	1,147	1,501
4. Total Metered and Self-Generated (2+3)	497	2,623	638	1,428	12	504	1,147	4,555
Peak Demand	(KW)							
1. Total Utility	1,287	2,184	1,410	1,550	32	26	2,729	3,760
2. Processor Self-Generated[a]	Ø	4,509	Ø	1,939	Ø	267	Ø	6,715
Total Metered and Self-Generated (1+2)	1,287	6,693	1,410	3,489	32	293	2,729	10,475

[a] Adjusted for 80 percent diversity.

FIGURE E.2.16. 1980 TOTAL MONTHLY ELECTRICITY USE BY CONSUMER CLASSIFICATION AND MONTHLY PEAK ELECTRICITY DEMAND IN NEW STUYAHOK



village capacity in Table E.2.18. An alternative demand-to-output ratio of 0.30 was applied to Portage Creek and Koliganek where there is no source of electricity in summer months. The Iliamna, Newhalen, and Nondalton grouping was assigned a ratio of 0.29 to reflect the balance of summer out-migration to fish camps and in-migration to lodges.

TABLE E.2.18. BASELINE ESTIMATES OF CAPACITY AND DEMAND (KW) IN NONUTILITY DISTRICT COMMUNITIES

	Annual Total Output (mwh)	Estimated Peak Demand (kw)	Generator[a] Capacity (kw)
Manokotak	162	45	600
New Stuyahok	307	86	285
Portage Creek	66	20	107
Ekwok	117	33	190
Koliganek	155	47	200[c]
Iliamna, Newhalen, Nondalton	1200	348	1000[c]
Clarks Point	580	103[b]	103
Ekwok	NA	NA	NA
Levelock	142	40	141
Igiugig	166	46	100[c]

[a]Includes school, residential, and commercial.

[b]Peak demand reaches capacity.

[c]Some unknown residential capacity not included.

E.3. Projection of Electricity Consumption

Introduction

The methodology used to project electricity consumption classifies electricity consumers from each community into groups having uniform energy-use characteristics. The groupings reflect those used throughout the analysis: residential, commercial/ government, industrial, and military. Total electricity consumption in each group (C_t) is equal to the product of the projected number of customers (N_t) and projected average electricity use per customer (U_t) for each time period (t). Thus:

$$C_t = N_t \times U_t$$

by community for each grouping.

The bulk of Section E.3 is pertinent to the analysis of factors that influence the growth of N_t and U_t. The most important of these factors are:

- Fuel and electricity prices
- Household Income
- Appliance ownership
- Consumption per appliance
- Village electrification
- Population and employment
- Household composition
- Consumer responsiveness to prices
- Industrial activity.

Our approach to projecting electricity consumption was to establish a base-case scenario that represents a reasonable extrapolation of recent historical trends in economic development and electricity consumption.

The base-case scenario is labeled: Business As Usual (BAU), reflecting the broad assumptions that projected economic activity, electricity consumption, and electricity prices do not depart significantly from recent historical patterns. A key assumption is that electricity use by residential and commercial/government consumers was assumed to increase despite escalating real electricity prices.[1]

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[1]This assumption is reasonable. Note that the Anchorage consumer price index, a proxy for overall Alaska inflation, grew at an average annual rate of 7.5 percent between 1970 and 1980. Electricity prices at Nushagak Electric Cooperative (NEC) grew at the same rate over the same period. Yet, average residential consumption at NEC grew by 6 percent per year from 1970 to 1980. Electricity prices at Naknek Electric Association (NEA) increased at 14.4 percent over the same period, nearly twice the rate of inflation. Still, average use per NEA residential customer increased at 1.3 percent per year over the same ten-year period. In general, the historical data suggests that electricity use per customer would increase under conditions of rising real electricity prices.

The BAU scenario also functions as a frame of reference to gauge the effects of different electricity prices on total electricity consumption. In this study, two alternatives to the BAU scenario were analyzed: Regional Diesel (Part IV) and Newhalen Regional (Part V). The major distinction between each projection scenario is the nature of electricity supply and its effect on consumption, as transmitted through price. The specific methodology used to treat alternative price-escalation assumptions is discussed in Section E.5. The remainder of Section E.3 deals with methods and assumptions about how the number of customers (N_t) and electricity use per customer (U_t) grow in the BAU scenario.

Residential

Residential energy consumption is based on several important factors. They are:

1. Population growth.
2. Concentration of census division population in the 18-community study area.
3. Saturation of electric hookups.
4. Changes in household size.
5. Village electrification.
7. Household income.
8. Ownership of electric appliances.
9. Conservation potential.

Although to some extent the above factors are interdependent, the first four factors strongly relate to the number of residential customers. The remaining factors pertain more closely to the question of average electricity use per customer. Conservation potential applies primarily to electric space heat, which we assume does not occur in the BAU scenario.

Number of Customers

The number of residential customers was calculated using a three-step procedure beginning with the determination of (1) the growth and distribution of study-area population, (2) changes in average household size, and (3) changes in the proportion of households that are hooked up to some form of electricity.

Population Growth and Distribution. According to U.S. Census data shown in Table E.3.1, total study-area population has remained a constant proportion of total population in the Bristol Bay Borough and Dillingham census divisions. We assume that this relationship holds throughout the forecast period. Furthermore, we assume that overall population growth in the 18-community study area will equal 1.9 percent per year. This is less than the historical rate of 2.4-to-2.5 percent shown in Table E.3.2. The historical rate reflects in part, the effects of rapid economic growth from fisheries expansion in the latter 1970s. We assume that the fish economy will stabilize at a maximum sustainable yield comparable to actual harvest levels recorded over the past few years.

The distribution of projected population across the eighteen communities was based on both historical patterns and on probable growth. The data in Table E.3.3 indicates how each community's share

TABLE E.3.1. DISTRIBUTION OF TOTAL STUDY-AREA POPULATION 1960 TO 1980

	(1) Total Population in Bristol Bay Borough and Dillingham Census District	(2) Total Population in the 18-Community Study Area	Proportion of Total Study Area Population in the Combined Census Divisions (2) ÷ (1) (Percent)
1960	3,488	2,504	72
1970	4,193	2,985	71
1980	5,335	3,844	72

SOURCE: U. S. Department of Commerce, Bureau of the Census.

TABLE E.3.2. HISTORICAL POPULATION GROWTH IN THE EIGHTEEN STUDY-AREA COMMUNITIES

	Civilian Population			Average Annual Growth Rate (Percent)	
	1960	1970	1980	1960-1980	1970-1980
Central Station					
Dillingham	424	914	1,563	6.7	5.5
Aleknagik	231	128	154	-2.1	1.9
Naknek	249	178	318	1.2	6.0
King Salmon	227	202	170	-1.5	- 1.7
South Naknek	142	154	145	0.1	- 0.6
Egegik	150	148	75	-3.5	- 7.0
Manokotak	149	214	294	3.5	3.2
New Stuyahok	145	216	331	4.2	4.4
All Villages	1,717	2,154	3,050	2.9	3.5
Seasonal-Central Station					
Portage Creek	0	0	48	NA	NA
Ekwok	106	103	77	-1.6	- 3.0
Koliganek	100	142	117	0.8	- 2.0
All Villages	206	245	242	0.8	- 0.1
Noncentral Station					
Iliamna	47	58	94	3.5	5.0
Newhalen	63	88	87	1.6	- 0.1
Nondalton	205	184	173	-0.9	- 0.6
Clarks Point	138	95	79	-2.8	- 1.9
Ekuk	40	51	7	-9.1	-22.0
Levelock	88	74	79	-0.5	0.7
Igiugig	0	35	33	NA	- 0.9
All Villages	581	586	552	-0.3	- 0.6
Total All Villages	2,504	2,985	3,844	2.2	2.6

SOURCE: U. S. Department of Commerce, Bureau of the Census, 1980.

TABLE E.3.3. PROPORTION OF TOTAL STUDY-AREA POPULATION WITHIN EACH COMMUNITY

Community	1960	1970	1980
Dillingham	16.9	30.6	40.7
Aleknagik	9.2	4.3	4.0
Naknek	9.9	6.0	8.3
King Salmon	9.1	6.8	4.4
South Naknek	5.7	5.2	3.8
Egegik	6.0	5.0	2.0
Manokotak	6.0	7.2	7.6
New Stuyahok	5.8	7.2	8.6
Ekwok	4.2	3.5	2.0
Koliganek	4.0	4.8	3.0
Portage Creek	∅	∅	1.2
Clarks Point	5.5	3.2	2.1
Ekuk	1.6	1.7	0.2
Igiugig	∅	1.2	0.9
Iliamna	1.9	1.9	2.4
Newhalen	2.5	2.9	2.3
Nondalton	8.2	6.2	4.5
Levelock	3.5	2.5	2.1
Total	100.0	100.0	100.0

SOURCE: U. S. Department of Commerce, Census Bureau.

of total study-area population has changed over time. Dillingham, Manokotak, New Stuyahok, and Iliamna were the only communities to capture a larger proportion of total study-area population. The dramatic concentration of population in Dillingham, coupled with moderate reductions in most other villages, suggests that in addition to in-migration from outside the study area, there were regional population shifts from smaller, outlying communities to large communities, especially the Dillingham regional center.

We assume that this trend continues with Dillingham population increasing to 46 percent of total study-area population by 2002. Population growth was distributed across all eighteen communities so that the overall average rate of growth was preserved. The population growth rates for 1980 to 2002 that were assigned to each community are shown in Table E.3.4. Population in each community was ranked according to two criteria:

1. Whether we expect the rate of population growth to be strong, moderate, or low.

2. Whether we expect a community's share of total study-area population to be increasing, stable or declining.

Dillingham, Naknek, and Iliamna were assigned strong growth and an increasing share in accordance with historic patterns. Aleknagik, Newhalen, and Portage Creek were assigned rates of population growth equal to the regional average (1.9 percent per year) because of the

TABLE E.3.4. DISTRIBUTION OF POPULATION GROWTH

Expected Proportion of Total Study-Area Population		Strong	Moderate	Low
	Increasing	Dillingham Naknek Iliamna (2.45)		
	Stable	Aleknagik Newhalen Portage Creek (1.9)	Manokotak New Stuyahok Koliganek (1.5)	
	Declining		Levelock Igiugig Ekwok Clarks Point South Naknek (1.0)	Egegik King Salmon Nondalton Ekuk (0.5)

Average Annual Rates of Population Growth for 1980-2002 are shown in parentheses.

likelihood of spillover growth due to their respective proximity to Dillingham and Iliamna. Despite their strong historical patterns, Manokotak and New Stuyahok were assigned moderate growth rates in response to our assumption that village population would level off at around 500-to-600 persons, with Dillingham absorbing most additional population pressure. The remaining villages were assigned growth rates primarily according to historic patterns.

Population projections for each village are shown in Table E.3.5.

Household Size. The relationship between population growth and household growth is a function of changes in the number of persons per household (average household size). As shown in Table E.3.6, average household size declined dramatically between 1970 and 1980, with an average rate of decline equal to 3 percent per year for all eighteen communities. There are several reasons for this decline. First, population expansion was due partly to non-Native immigration which placed downward pressure on average household size. Second, the improving fishing economy has increased household income, which has enabled families to split into smaller units. Third, government homes have further contributed to smaller family units by creating net additions to village housing. Fourth, secular trends in the age distribution of population have produced a growing segment of young adults, which traditionally have smaller families than populations with a more advanced age distribution.

TABLE E.3.5. POPULATION PROJECTIONS BY COMMUNITY - 1980-2002

Community	Average Annual Growth Rate (%)	1980	1981	1982	1987	1992	1997	2002	% Total 2002 Population
Dillingham	2.45	1,563	1,601	1,641	1,852	2,090	2,359	2,662	46
Aleknagik	1.9	154	157	160	176	193	212	233	4
Naknek	2.45	318	326	334	377	425	480	542	9
King Solomon	0.5	170	171	172	176	180	185	190	3
South Naknek	1.0	145	146	148	156	163	172	180	3
Egegik	0.5	75	75	76	78	80	82	84	1
Manokotak	1.5	294	298	303	326	352	379	408	7
New Stuyahok	1.5	331	336	341	367	396	426	459	8
		3,050	3,110	3,175	3,508	3,879	4,295	4,758	82
Portage Creek	1.9	48	49	50	55	60	66	73	1
Ekwok	1.0	77	78	79	83	87	91	96	2
Koliganek	1.5	117	119	121	130	140	151	162	3
		242	246	250	268	287	308	331	6
Iliamna	2.45	94	96	99	111	126	142	160	3
Newhalen	1.9	87	89	90	99	109	120	132	2
Nondalton	0.5	173	174	175	179	184	188	193	3
Clarks Point	1.0	79	80	81	85	89	94	98	2
Ekuk	0.5	7	7	7	7	7	8	8	<0.1
Levelock	1.0	79	80	81	85	89	94	98	2
Igiugig	1.0	33	33	34	35	37	39	41	1
		552	559	567	601	641	685	730	13
Total	1.9	3,844	3,915	3,992	4,377	4,807	5,288	5,819	100

TABLE E.3.6. POPULATION AND HOUSEHOLDS IN THE BRISTOL BAY STUDY AREA

Central Station	1970 Pop	1970 HH	1980 Pop	1980 HH	Rate of Decline in Avg. Household Size (percent/yr.)
Dillingham	914	238	1,563	467	1.4
Aleknagik	128	22	154	38	3.7
Naknek	178	45	318	103	2.5
King Salmon	202	62	170	75	3.7
South Naknek	154	34	145	43	3.0
Egegik	148	35	75	32	6.1
Manokotak	214	37	294	57	1.2
New Stuyahok	215	32	331	65	2.9
Total	2,154	505	3,050	880	2.1
Avg. Household Size	4.27		3.47		2.1
Seasonal-Central Station					
Portage Creek	NA	NA	48	13	NA
Ekwok	103	24	77	20	1.1
Koliganek	142	19	117	40	9.8
Total	245	43	242	73	5.6
Avg. Household Size	5.70		3.32		5.6
Non-Central Station					
Iliamna	58	15	94	22	-1.0
Newhalen	88	14	87	18	2.7
Nondalton	184	29	173	42	4.4
Clarks Point	95	16	79	22	5.2
Ekuk	51	8	7	1	-0.9
Levelock	74	14	79	37	9.5
Igiugig	36	8	33	9	2.1
Total	586	104	552	151	4.4
Avg. Household Size	5.63		3.66		4.4
All Eighteen Communities Average Household Size	4.58		3.48		2.8

SOURCE: U. S. Department of Commerce, Bureau of the Census 1970, 1980.

We assume that all of these factors continue to reduce average household size at a uniform rate of 1 percent per year across all communities, over the 20-year projection period.

The baseline number of households in each community was assumed to grow at a rate equal to the product of their corresponding population growth rate and the declining-household-size factor of 1.01.

Hookup Saturation. Residential customers are equal to the proportion of households that either hook into utility or school electricity or self-generate their own. We assume that residential customers are most strongly influenced by the degree of electrification and its effect on availability. In the BAU scenario, we assume that future patterns of hookup saturation are tied to the baseline electrification groupings to which each community was assigned: central, seasonal/central, and noncentral-station electricity. General patterns of hookup saturation are listed below:

1. For central-station communities, excluding Naknek, South Naknek, and King Salmon, but including Levelock and Igiugig, we assume that the 1980 baseline hookup saturation rate is the same in 1981 and 1982. The 1982 hookup-saturation gap (i.e. the difference between 100 percent and hookup saturation in 1982) halves by 1987; halves again in 1992, and closes (becomes 100 percent) by 1997 (Table E.3.7A).

TABLE E.3.7A. PROJECTED HOUSEHOLDS AND RESIDENTIAL CUSTOMERS
BUSINESS AS USUAL

	Dillingham			Aleknagik			Manokotak			New Stuyahok			Levelock			Igiugig		
	HH	HUSR	RC	HH	HUSR	RC	HH	HUSR	RC	HH	HUSR	RC	HH	HUSR	RC	HH	HUSR	RC
1980	467	.88	410	38	.88	33	57	.86	49	65	.83	54	37	.30	11	9	.78	7
1982	500	.88	440	40	.88	35	60	.86	52	68	.83	56	39	.30	12	9	.78	7
1987	593	.94	557	46	.94	43	68	.93	63	77	.915	70	43	.65	28	10	.89	9
1992	704	.97	683	54	.97	52	77	.965	74	88	.9575	84	47	.825	39	11	.945	10
1997	835	1.00	835	62	1.00	62	87	1.00	87	99	1.00	99	52	1.00	52	13	1.00	13
2002	990	1.00	990	72	1.00	72	98	1.00	98	112	1.00	112	57	1.00	57	14	1.00	14

NOTE: HH = Households
HUSR = Hookup Saturation Rate
RC = Residential Customers

2. For noncentral-station communities, excluding Levelock and Igiugig, we assume that the hookup saturation gap halves by 1987 and closes by 1992 (Table E.3.7B).

3. For seasonal/central-station communities and for Naknek, South Naknek, and King Salmon, the base year hookup saturation rate is constant over the entire projection period (Table E.3.7C).

Electricity Use Per Customer

The projection of annual electricity use per residential customer is based on an analysis of appliance ownership patterns and of consumption per appliance. Historically, residential electric space heating in the Bristol Bay study area was negligible. In the BAU scenario, the base-year relative price of electricity and fuel oil remain constant, so that electricity would continue to be uneconomic for space heating. Therefore, future residential electricity consumption reflects only ownership and use of appliances.

Appliance Ownership. In this study, appliance ownership is viewed in terms of the proportion of total residential customers in a particular village that own one or more of a given appliance, at a certain point in time. Under this interpretation, appliance ownership is synonomous with the term "appliance saturation," where 100 percent is the maximum possible saturation rate for a given appliance.

TABLE E.3.7B. PROJECTED HOUSEHOLDS AND RESIDENTIAL CUSTOMERS
BUSINESS AS USUAL

	Iliamna			Newhalen			Nondalton			Clarks Point		
	HH	HUSR	RC	HH	HUSR	RC	HH	HUSR	RC	HH	HUSR	RC
1980	22	.95	21	18	1.00	18	42	.26	11	22	.45	10
1982	24	.95	23	19	1.00	19	43	.26	11	23	.45	10
1987	28	.975	27	22	1.00	22	47	.63	30	25	.725	18
1992	33	1.00	33	25	1.00	25	50	1.00	50	28	1.00	28
1997	39	1.00	39	29	1.00	29	54	1.00	54	31	1.00	31
2002	47	1.00	47	34	1.00	34	58	1.00	58	34	1.00	34

NOTE: HH = Households
HUSR = Hookup Saturation Rate
RC = Residential Customers

TABLE E.3.7C. PROJECTED HOUSEHOLDS AND RESIDENTIAL CUSTOMERS
BUSINESS AS USUAL

	Portage Creek			Ekwok			Koliganek			Naknek			South Naknek			King Salmon			Ekuk		
	HH	HUSR	RC	HH	HUSR	RC	HH	HUSR	RC	HH	HUSR	RC	HH	HUSR	RC	HH	HUSR	RC	HH	HUSR	RC
1980	13	.92	12	20	1.00	20	40	.90	36	75	1.09	82	43	1.09	47	103	1.09	112	1	1.00	1
1982	14	.92	13	21	1.00	21	42	.90	38	80	1.09	87	45	1.09	49	106	1.09	116	1	1.00	1
1987	16	.92	15	23	1.00	23	48	.90	43	95	1.09	104	49	1.09	53	114	1.09	124	1	1.00	1
1992	18	.92	17	25	1.00	25	54	.90	49	113	1.09	123	55	1.09	60	123	1.09	134	1	1.00	1
1997	21	.92	19	28	1.00	28	61	.90	55	134	1.09	146	60	1.09	65	133	1.09	145	1	1.00	1
2002	24	.92	22	31	1.00	31	69	.90	62	159	1.09	173	67	1.09	73	143	1.09	156	1	1.00	1

NOTE: HH = Households
HUSR = Hookup Saturation Rate
RC = Residential Customers

We derived appliance saturation levels for 1981 primarily from interviews and surveys in each village. We then projected appliance saturation for each of 14 appliances having the greatest annual electricity use. Appliance saturation curves were constructed for each appliance in the village for the 20-year projection period.[1] Construction of the curves was based on (1) historical and present use patterns in the Bristol Bay region, in other rural areas in Alaska, and in each village; (2) present conditions and expected changes in village electrifications, (3) the expressed desire for particular appliances in each village; and (4) specific plans for future development, such as installtion of a satellite television station or a village water system.

Historic time series data on appliance saturation from other areas of Alaska and from national data were important ingrediants in this analysis. For example, historical saturation curves for freezers are shown for several Alaska communities, for Alaska as a whole, and for the United States in Figure E.3.1. The curves to the left in Figure E.3.1 reflect a variety of historical patterns in freezer ownership. In general, the proportion of residents that own freezers stabilizes after 1970. In several cases, the initial upward trend in

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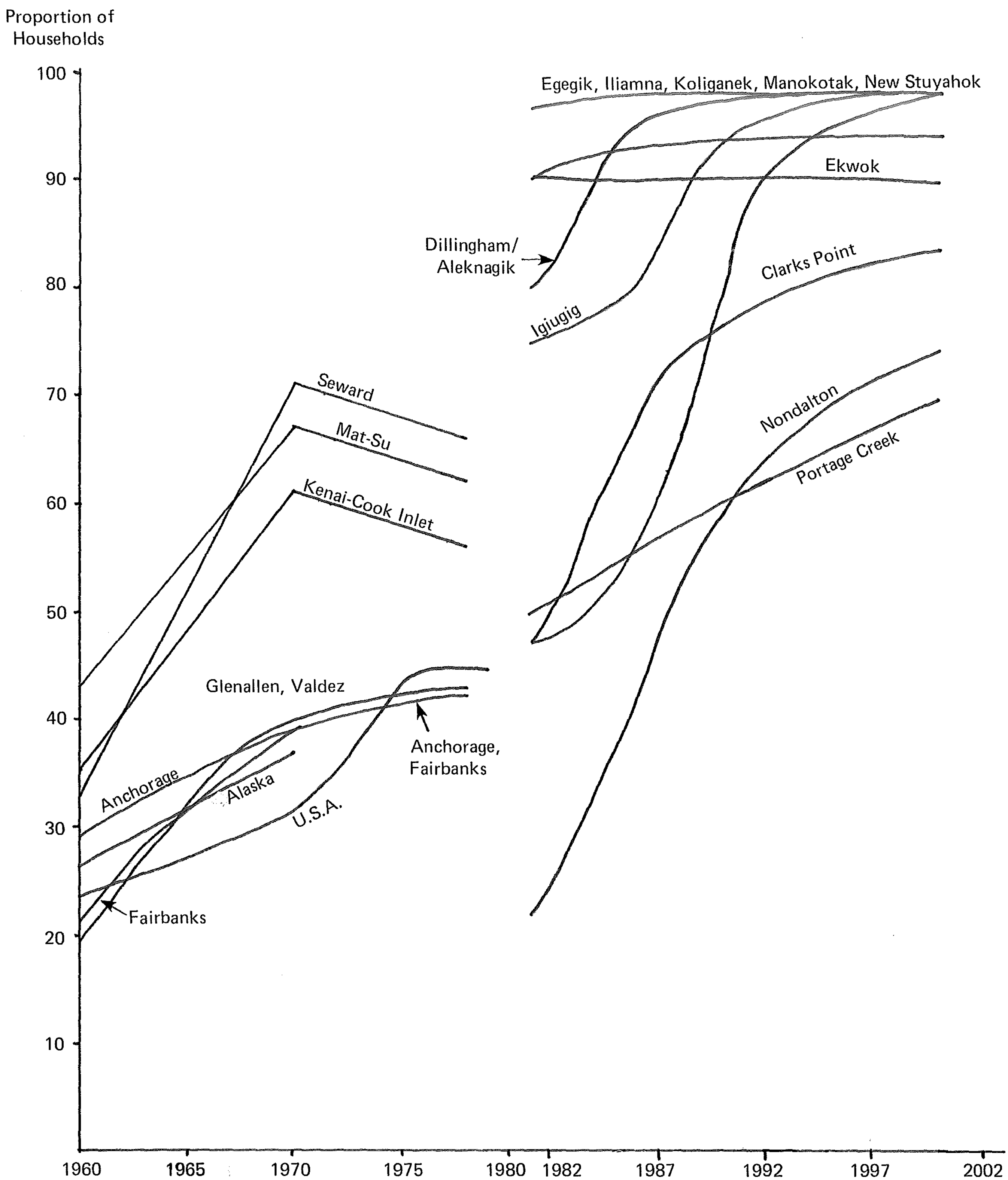
[1]Appliances used for the analysis include home freezers, dishwashers, electric ranges, clothes washers, clothes dryers, televisions, refrigerators, lights, electric water heaters, radios, stereos, tapedecks, headbolt heaters, and miscellaneous small appliances.

Figure E3.1 Historical and Projected Home Freezer Saturation Rates



freezer saturation reverses itself during the 1970's. Freezer saturation in the United States is characterized by a logistics curve, where freezer ownership increases move rapidly about 1975, after which, increases in ownership decline and eventually level off.

The curves to the right in Figure E.3.1. represent hypothetical rates of freezer saturation in Bristol Bay. In general, most Bristol Bay communities have higher levels of base-year freezer ownership than that reflected in the historic curves shown to the left. Villages that we assume would electrify by 1987 (Iliamna, Newhalen, Nondalton, Clarks Point, Ekuk, Levelock, and Igiugig) were represented by a logistics curve, reflecting rapid increases at the time electrification occurs, followed by a leveling of growth in freezer ownership. Communities with 1981 freezer saturation above 88 percent were assumed to experience gradual increases thereafter. Portage Creek is expected to have linear growth in freezer ownership at about the same rate as Alaska as a whole.

The proportion of households projected to own freezers in each community were then derived from the freezer saturation curve for five-year intervals from 1982 to 2002.

A similar analysis was performed on the other 13 appliances across all communities. The determination of the shape of the curve is subjective. However, it enables the analyst to use a significant quantity of primary data on appliance ownership collected during site visits to the communities. The bulk of the baseline (1981) data on appliance ownership is reproduced in Table E.2.3. in the previous section on baseline electricity use.

The analysis was performed on individual communities and incorporated community-specific features pertaining to appliance ownership, to economic development, and to village electrification.

We assume that all the communities will get central station utility electricity within the forecast period. At present, several of the villages in the Bristol Bay study area have plans for village electrification. In late 1982, the Iliamna-Newhalen Electric Cooperative will go on line to serve residents of Iliamna, Newhalen and Nondalton. Private generators currently supply power in these villages, with 1981 hookup saturation rates of 60 percent, 100 percent, and 26 percent respectively. It is expected that both Levelock and Igiugig will install village generators by 1986. In 1981, Levelock was appropriated $450,000 for electrification. Currently, 30 percent and 75 percent of the residences in Levelock and Igiugig respectively, obtain power from private generators.

A brief discussion of the factors involved in projections for each appliance are included to aid the reader unfamiliar with appliance ownership and use patterns in the study area.

Home Freezer. Freezers are an important appliance for the modern villager living a subsistence lifestyle. The proportion of rural

Alaska households with freezers is much greater than larger cities with food processing, storage, and distribution facilities. Saturation rates will grow the least for villages who already have reliable, constant electricity; growth will be greatest in those villages where the high cost of home generation is the limiting factor and where village electrification is expected to occur. The 1981 average of one freezer per residence is expected to grow to one and one half freezers per residence by the year 2002 (see below page E-87.

Dishwasher. Dishwashers are an uncommon appliance in Dillingham and unknown in the smaller villages where the availability of water and power is usually limited. A growth rate paralleling that of Glennallen-Valdez is used for the appliance saturation curve.

Electric Range. There is presently little incentive to cook with electricity in Bristol Bay since electricity is expensive and/or in limited supply. The proportion of residences using electric ranges will decrease in Dillingham, similar to the historic Glennallen-Valdez trend. In the smaller villages, however, it is expected that a small number of residences will install electric ranges within the forecast period as stove oil prices increase and electricity supply increases.

Clothes Washer. Clothes washers are desired appliances. In some villages, washers are owned in houses without electricity and brought to a neighbor's electrified house on wash day. Saturation rates for washers are dependent on the present electricity supply in the village future electrification, and the availability of a laundramat either in the village (Newhalen) or in a neighboring village (e.g. Dillingham for Portage Creek residents).

In the study region washers are used an average of 52 hours per year. Both automatic and wringer-type washers are present in the central utility villages. We assume that the popularity and use of automatic washers will increase through the year 2002.

Clothes Dryer. In most of the smaller Bristol Bay villages, less than 50 percent of the residences own a clothes dryer. In 1981, most of the dryers that were owned were combination propane/electric appliances. Ownership projections depend primarily on the future availability of electricity with an upper limit established below the non-Bristol Bay, urban areas. The growth rate for villages with laundramats is less than that of villages with similar power supplies and no laundry facilities.

Television. The growth of saturation rates for television is very dependent upon present facilities for television reception in each village. The military brought television into King Salmon in the early 1970's with an extensive translater system which supplied most of the Bristol Bay villages with one station. By the middle of the decade, however, most of the translaters had fallen into disrepair. The reintroduction of satellite television reception is very recent; in the second half of 1981, instructional television was brought into

New Stuyahok, Egegik, Aleknagik, and Nondalton. The only study-area village without any television reception is Ekwok, although television sets are owned for use with video recorders.

Saturation rates for future television ownership reflect the newness of the appliance in villages with recent increases in electricity availability and television reception.

Refrigerator. Saturation rates for refrigerators appear to be determined by the number of residences with electricity and by summer migration patterns. In the villages of Koliganek and New Stuyahok, electricity is available 12 months and the number of families in the village in the summer is small. In both these villages, a low percentage of residences own refrigerators. In the village of Levelock, however, all residences with electricity have a refrigerator and it is assumed that village electrification will dramatically increase ownership of this appliance. Only in Igiugig, Newhalen, Iliamna, Manokotak, and Dillingham are the saturation rates expected to approach 100 percent.

Lights. Every house supplied with electricity will have lights, and therefore the saturation rate for lights equals the current and projected hookup saturation rate. In all the study area villages, the hookup saturation rate is expected to increase within the projection period. The historical trend for Dillingham is a decrease in hookup saturation, but we expect this trend to reverse itself as new subdivisions are developed within the Dillingham/Aleknagik area.

Electric Water Heater. In 1981, the communities of Nondalton, Naknek, King Salmon, Manokotak, and Dillingham had village piped water systems. The Public Health Service (PHS) works in conjunction with the United States Department of Housing and Urban Development (HUD) to provide a water system in villages as they get HUD housing. At this time, PHS is planning new systems in Iliamna/Newhalen and in Igiugig and plans to extend the systems in Nondalton, Dillingham, and Manokotak, to install a system for the HUD houses in Clarks Point and to install a system for the entire village of South Naknek. It is not known whether new systems will be simply a village watering point or piped water and sewer. Future HUD housing and PHS water systems will be introduced to Aleknagik and Egegik by 1983 and to the Nushagak River villages in the mid-1980's. Ekwok is currently on the state's priority list for a Village Safe Water Project.

Electric water heater saturation projections depend primarily on the availability and reliability of a water and electric supply. The saturation rates in all villages are expected to increase very slowly over the projection period. Hot water heaters which have an electric ignition system but are fired by another fuel such as oil or propane are not included in the saturation rate.

Radio. Nearly 100 percent of Bristol Bay residences own a radio. The radio is an important communications link to other Bristol Bay communities. In villages with limited or seasonal electricity, these radios are often battery-powered. With predictable year-round electricity, the saturation rate will approach 100 percent in all of the study area villages.

Stereo and Tapedeck. The growth in ownership of stereos and tapedecks is based on the present proportion of houses that have electricity and own stereos or tapedecks. As the number of electrified homes approaches 100 percent, the saturation rate is expected to decline. There was not any historical data on saturation rates for stereos and tapedecks.

Headbolt Heaters. Headbolt heaters or vehicle plug-ins are used to aid starting and to reduce vehicle engine wear in cold temperatures. These heaters draw an average of 1,175 watts. We assume that passenger vehicles would use 705 kwh/yr. (1,175 w x 600 hrs.). In 1980, Dillingham had 1.15 registered passenger cars and pickups per household and Naknek had 0.99. For the purposes of this analysis, we assumed an average of one vehicle per residence throughout the study period, a 1980 headbolt heater saturation rate of 50 percent in Dillingham and Naknek, and a rate of 5 percent in the smaller communities. Saturation rates will increase at an annual rate of 1 percent in the central utility villages and 3 percent in the other villages.

Miscellaneous Small Appliances. Miscellaneous small appliances include kitchen appliances such as a mixer, toaster, coffeemaker, and electric skillet, other household items such as a vacuum, iron and hair dryer, and shop tools. A previous appliance survey in rural

Alaska (Retherford, 1975) indicates that the average number of small appliances per residence is 2.78. We assume this average of 2.78 for all villages in 1980 and increase it to an average of 5.0 in 2002. The average annual consumption for miscellaneous small appliances is assumed to be constant over the study period at 50 kwh per year per small appliance.

CB Radio. There was diversity in the present popularity of CB radios in the Bristol Bay area. In some villages, every residence had a CB Radio which is turned on most of the time; in other villages only one or two residences have a CB radio which is used primarily for contacting air taxi operators or other villages. Projection of CB radio saturation rates has not been attempted because of the unpredictable nature of ownership. Determining factors include the use of VHF radio, telephone availability, and distance to neighboring villages.

Consumption Per Appliance. The analysis of appliance ownership produced an estimate of the proportion of households that would use a given appliance over time. This is equivalent to an estimate of the probability of a household owning a given appliance. In order to project total household electric appliance consumption, we need an estimate of annual household electricity consumption per appliance. Estimates of annual consumption per appliance from several areas of Alaska and the United States are shown in Table E.3.8 for a variety of appliances. These were used as guidelines for estimating consumption

TABLE E.3.8. ANNUAL ELECTRICITY CONSUMPTION PER APPLIANCE
(kwh/Year)

Appliance	Rural Alaska[a]	Portage Creek[b]	Kuskokwin[c]	Kobuk[d]	Southeast[e]	United States[f]
Lights	480	720	300-600	1,000	1,200	
Range		1,200	1,400		1,200	700
Refrigerator		1,248-2,184	400	1,350	1,800	1,217 (frostless)
Freezer	704	1,260-2,340	1,200	780	1,560	1,761 (frostless)
Hot Water Heater		4,212			4,800-9,600(a)	4,811 (quick recovery
Dishwasher			30		360	363
Clothes Washer	108	108	40		1,440b)	76 (non-automatic)
Clothes Dryer		1,080	1,200			993
TV		660	300	600	600	320 (solid state, color)
Space Heater		1,080	240-360			176
Water Pump			180			
Radio	84	84-144	100			86
CB Radio	84	84				
Frying Pan		180				100
Hot Plate		120				90
Coffee Maker		120				140
Toaster		160				39
Microwave		192				190
Blender						1
Sewing Machine						
Hair Dryer						25
Iron			100			60

(a) Includes Washer
(b) Washer/Dryer

SOURCE:
[a] R. W. Retherford (1981)
[b] Marks Engineering (1981)
[c] R. W. Retherford (1975)
[d] Wind Systems Engineering (1980)
[e] R. W. Beck (1975)
[f] Edison Electric Institute

per appliance for Bristol Bay households, as summarized in Table E.3.9. Except for freezers which are assumed to gradually increase by 50 percent over the forecast period, we assume that annual appliance use remains constant over time.

Correction for Seasonality. In the Bristol Bay study-area communities, a significant percentage of households are vacated for the summer fishing season. The 1981 consumption values derived from the appliance saturation analysis were corrected for this seasonality to reflect the decreased consumption of electricity during the two or three summer months in which either the village received no power or the village residents were gone. The seasonality corrections are depicted in Figure E.3.2, where the shaded area represents the effect of seasonal resident patterns on annual electricity use.

Residential electricity use per customer in each community was derived by finding the product of annual consumption per appliance and the proportion of households that would use a given appliance over time, and summing overall appliances. Symbolically:

$$U_{ti} = \sum_{j} (H_{tij} \times A_{tj}) \times S_j \qquad \text{where,}$$

U_{ti} = Electricity Use Per Customer in village (i) at time period (t).

H_{tij} = The proportion of village (i) households that own appliance (j) in time period (t).

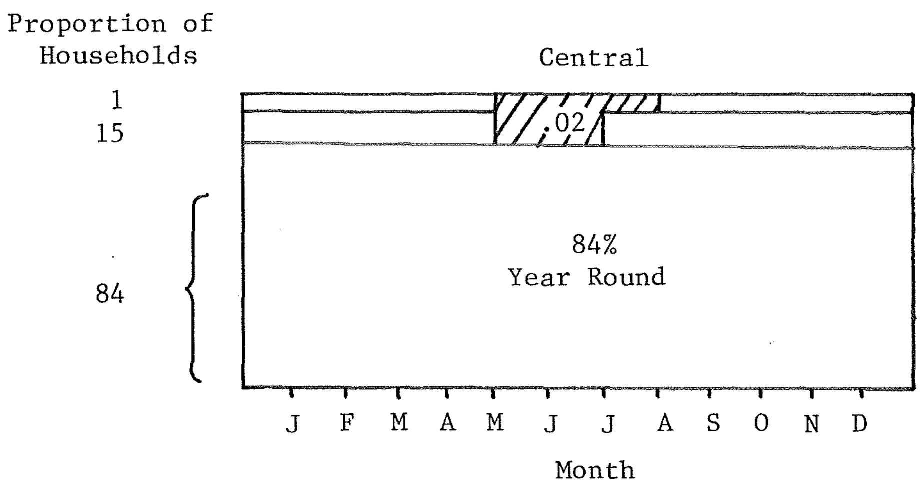
A_{tj} = Annual Consumption Per Appliance (j) in time period (t). This is the same for all villages.

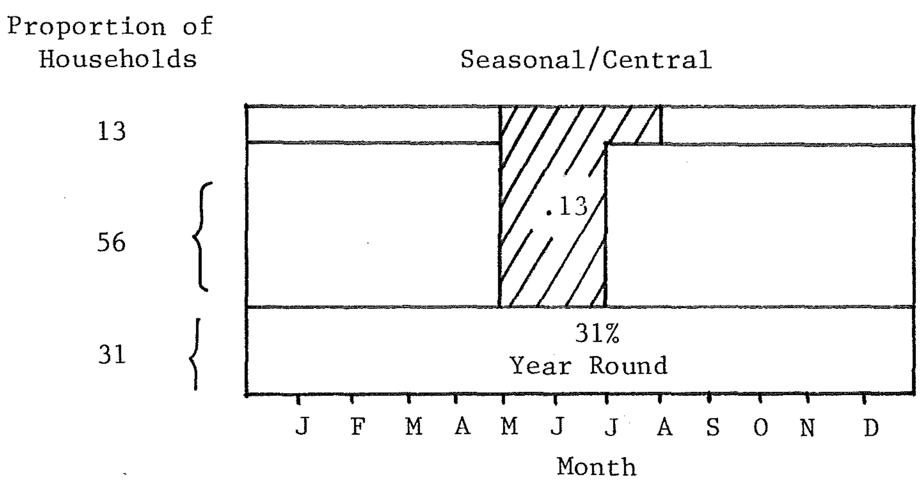
TABLE E.3.9. ANNUAL ELECTRICITY USE FOR SELECTED APPLIANCES

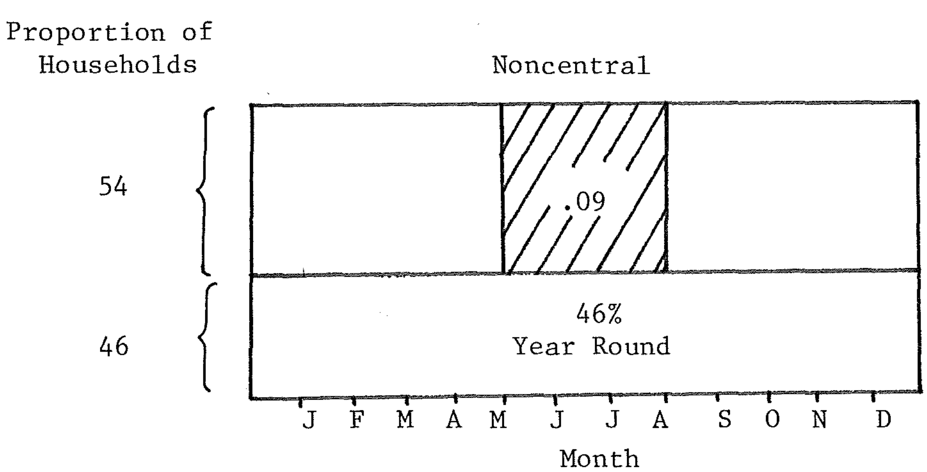
Electric Appliance	Annual Electricity Use (kwh/Year)
Freezer	1801-2702[a]
Dishwasher	363
Range	700
Clothes Washer	7 (wringer) 27 (automatic)
Clothes Dryer	350
Television	212
Refrigerator	1,213
Radio	259
Lights	1,000
Stereo	199
Tapedeck	199
Water Heater	4,811
Headbolt Heater	705
Miscellaneous Small Appliances	139

[a]Increases over the forecast period to reflect average ownership of more than one freezer by 2002.

FIGURE E.3.2. SEASONALITY ADJUSTMENT







S_j = Seasonality Adjustment

$\sum_j$ = To sum over all applianes; j = 1,..., 14.

The projections of electricity use per customer (U_{ti}) by community, in each time period are shown in Table E.3.10.

The appliance saturation analysis produced a significantly higher level of average consumption in 1981 than our field survey estimate for 1980. There are several possible reasons for this discrepancy. First, the baseline data could be incorrect. The 1980 estimates of electricity use per customer in the seasonal/central and noncentral communities shown in Table E.3.10, are less reliable than those obtained from utilities. In several cases, meter records were not complete or not available at all. We were forced on several occasions to exercise judgment in the determination of use per customer.

The data on appliance ownership could also contain errors. In the smaller villages, we resorted to interviews with persons we believed to be knowledgeable about electricity use patterns, rather than using formal survey methods such as those applied in the Dillingham and Naknek utility districts.

Second, the methods used to calculate appliance ownership and electricity consumption per appliance could be incorrect. However, the selection of electric-appliance consumption rates (kwh/year) were

TABLE E.3.10. ELECTRICITY USE PER RESIDENTIAL CUSTOMER IN THE BUSINESS AS USUAL SCENARIO (Kwh/Customer/Year)

	1980	1981	1982	1987	1992	2002
Dillingham	5,112	6,243	6,383	6,703	7,049	7,708
Aleknagik	5,112	6,243	6,383	6,703	7,049	7,708
Naknek, King Salmon, South Naknek	5,328	6,341	6,472	6,771	7,088	7,717
Egegik	2,329	4,615	4,718	5,073	5,438	6,129
Manokotak	3,308	5,113	5,278	5,544	5,798	6,474
New Stuyahok	1,944	3,477	3,627	4,012	4,386	5,244
Ekwok	1,536	3,389	3,471	3,767	4,133	4,854
Koligonek	1,104	2,990	3,098	3,443	3,838	4,670
Portage Creek	1,536	2,509	2,592	2,938	3,335	4,113
Iliamna	3,149	3,200	3,324	3,916	3,997	4,479
Newhalen	2,847	2,903	2,977	3,556	3,868	4,373
Nondalton	922	981	1,089	1,948	2,744	3,617
Clarks Point	2,369	2,430	2,564	3,189	3,583	4,148
Ekuk	NA	NA	NA	NA	NA	NA
Levelock	1,381	1,453	1,488	2,002	3,200	4,197
Iguigig	2,549	2,613	2,678	3,180	3,787	4,412

based on a careful analysis of existing data from other parts of Alaska with adjustments to reflect use patterns pertinent to Bristol Bay electricity consumers. The seasonality adjustment reduces further the potential for overstating residential electricity consumption.

We chose to use the higher figure derived from the appliance ownership analysis for forecasting purposes. The discrepancy is largest for communities whose small relative size would tend to minimize the probability of overstating residential consumption.

Residential Energy Costs as a Proportion of Income. To illustrate the implications of our analysis of residential electricity demand, we constructed several tables that compare future residential energy costs with future household income. The analysis is based on electricity prices adjusted to incorporate the subsidy implied by the Power Cost Assistance program, administered by the Alaska Power Authority (see Section E.2.).

The overall effect of Power Cost Assistance in the eighteen study-area communities is shown in Table E.3.11 for each village grouping.

We allow the base year price of heating fuel and electricity (subsidy and nonsubsidy) to grow at an average annual inflation-adjusted rate of 2.6 percent per year. This is illustrated graphically in Figures E.3.3 and E.3.4.

TABLE E.3.11. BASE YEAR ELECTRICITY PRICES WITH AND WITHOUT THE POWER COST ASSISTANCE SUBSIDY (¢/kwh)

	1980		1981	
Village Category[a]	Nonsubsidy	Subsidy	Nonsubsidy	Subsidy
Central	24.5	24.3	26.6	19.6
Seasonal-Central	26.8	26.8	26.8	26.8
Noncentral[b]	124.0	124.0	132.0	132.0

[a] Village prices weighted by total 1980 residential electricity consumption to derive average price (¢/kwh) for village groups.

[b] Noncentral station prices are based on the following assumptions:

1.	919 gallons/year x $1.20/gallon	=	$1,103
2.	Operation and maintenance	=	200
3.	Depreciation ($5,000, 3-year life)	=	1,666
4.	Labor: 40 hrs/year @ $8.00/hr.	=	320
			$3,289
5.	Average annual electricity consumption	=	2,401 kwh
6.	Average cost equals: $3,289 ÷ 2,401	=	$1.37/kwh

7. Since labor has an implicit wage that does not appear in household income, the labor cost is excluded from noncentral prices used in this analysis.

FIGURE E.3.3. PROJECTED REAL ELECTRICITY PRICES IN BRISTOL BAY

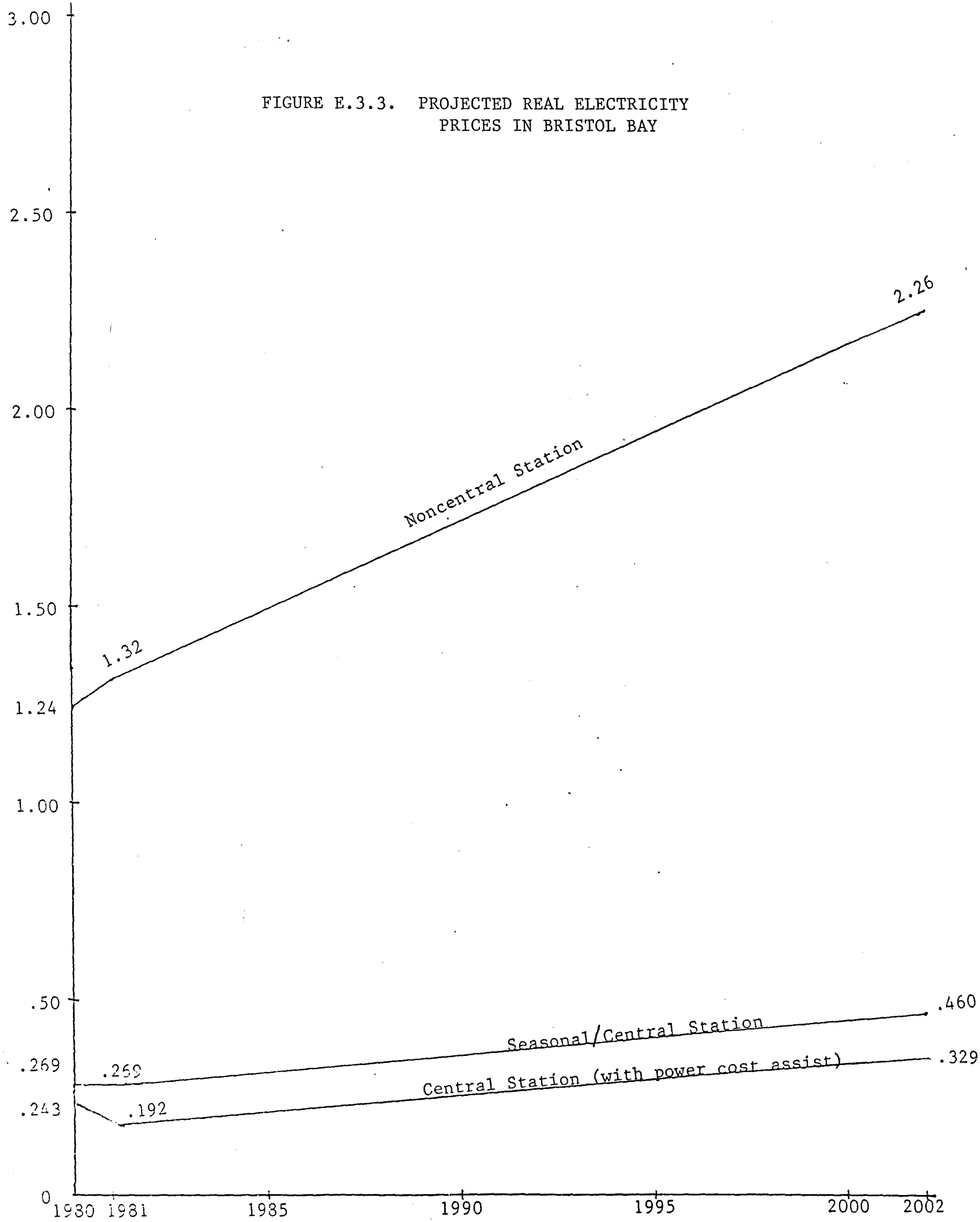
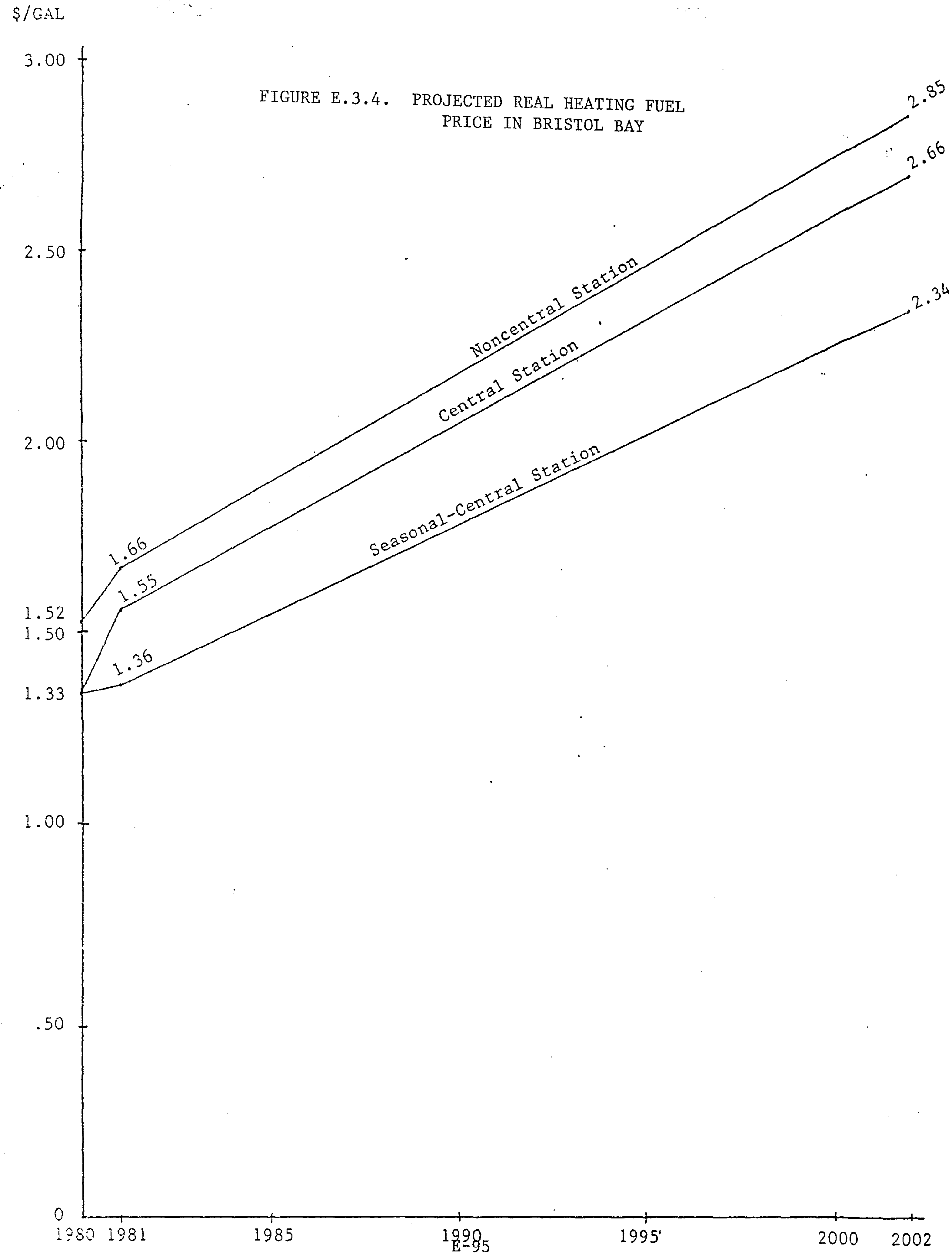


FIGURE E.3.4. PROJECTED REAL HEATING FUEL PRICE IN BRISTOL BAY



Average household income was calculated for each study area village as shown in Table E.3.12. Household income was assumed to grow at 1 percent per year over inflation in each village category. This assumption captures the dampening effect of decreasing average household size on average household income. As average household size declines, personal income is distributed over more households having fewer income-earning members than under conditions of stable or increasing household size.

The results of our assumptions on the level and growth of energy price, household income, and on average residential heating fuel and electricity consumption are brought together in Tables E.3.13, E.3.14 and E.3.15 for respective village groupings.

These calculations were performed to compare our assumptions on future energy prices and on future energy consumption to reasonable estimates of average household income. Figures E.3.5, E.3.6. and E.3.7 graphically illustrate the comparisons shown in Tables E.3.13, E.3.14 and E.3.15, respectively.

The analysis of the cost of residential electricity consumption as a proportion of income was conducted under the business as usual scenario. The key assumptions are reviewed below:

1. Electricity production remains regionally decentralized so that rising fuel prices are not offset by economies of scale

TABLE E.3.12. 1980 AVERAGE HOUSEHOLD INCOME IN THE EIGHTEEN BRISTOL BAY COMMUNITIES

	1980 Est. Personal Income ($)[a]	Number of Households	Average Household Income ($/HH)
Dillingham	15,679,040	480	32,665
Aleknagik	822,587	38	21,647
Naknek King Salmon South Naknek	9,467,772	261	36,275
Egegik	201,683	23	8,769
Manokotak	987,500	57	17,325
New Stuyahok	1,090,908	65	16,784
Total	28,249,550	924	30,573
Portage Creek[b]	NA	NA	NA
Ekwok	214,291	20	10,715
Koliganek	381,422	40	9,536
Total	595,714	60	9,929
Iliamna		35	
Newhalen	1,286,416	18	24,272
Nondalton	322,257	42	7,673
Clarks Point		22	
Ekuk	569,239	1	24,750
Levelock	172,326	28	6,155
Igiugig[c]	NA	NA	NA
Total	2,350,238	146	16,098
All Communities	31,195,441	1,130	27,607

SOURCE: Alaska Department of Revenue, "Individual Income Tax Paid in 1978 by Alaskan Communities."

U. S. Department of Commerce, Bureau of the Census, 1980.

NOTES: On following page.

NOTES: TABLE E.3.12

[a]Personal income in 1980 is estimated from 1978 taxable income using the following adjustment from U. S. income statistics:

1. $$\frac{\text{Taxable Income (U. S.)}}{\text{Adjusted Gross Income (U. S.)}} = \frac{1063.3}{1304.2} = .815$$

(1978 Statistics of Income)

2. $$\frac{\text{Adjusted Gross Income (U. S.)}}{\text{Personal Income (U. S.)}} = \frac{1406.0}{1721.8} = .817$$

(BEC Survey of current business, November 1981, Pg. 24)

3. $$\frac{\text{Personal Income}}{\text{Taxable Income}} = \frac{1}{.817} \times \frac{1}{.815} = 1.224 \times 1.227 = 1.502$$

4. Thus, 1978 taxable income by village was multiplied by 1.502 to derive an estimate of personal income in 1978.

5. To calculate personal income in 1980, we multiplied 1978 income by 20 percent growth from 1978 to 1979 based upon BEA income data and by half that growth rate from 1979 to 1980.

[b]Included in Dillingham figures.

[c]Included in King Salmon figures.

TABLE E.3.13. PROJECTED HOUSEHOLD INCOME AND RESIDENTIAL ENERGY CONSUMPTION FOR CENTRAL-STATION COMMUNITIES[a]

Year	Average Household Income ($/HH)	Average Household Electricity Consumption (kwy/HH)	Average Electricity Price ($/kwh)	Average Household Electricity Expenditures ($/HH)	Average Household Heating Fuel Consump. (gal./HH)	Average Heating Fuel Price ($/gal.)	Average Household Heating Expenditures ($/HH)	Proportion of Household Income Spent on Electricity	Proportion of Household Income Spent on Heating Fuel	Electricity and Heating Fuel
1980	$30,573	4,777	$.243	$1,161	1,082	$1.33	$1,439	3.8%	4.7%	8.5
1981	30,879	5,974	.192	1,147	1,093	1.55	1,694	3.7	5.5	9.2
1982	31,188	6,116	.197	1,205	1,104	1.59	1,755	3.9	5.6	9.5
1987	32,778	6,420	.224	1,438	1,160	1.81	2,100	4.4	6.4	10.8
1992	34,450	6,760	.255	1,724	1,219	2.06	2,511	5.0	7.3	12.3
2002	38,055	7,439	.329	2,447	1,347	2.66	3,583	6.4	9.4	15.8

aDillingham, Aleknagik, Naknek, King Salmon, South Naknek, Egegik, Manokotak, and New Stuyahok.

TABLE E.3.14. PROJECTED HOUSEHOLD INCOME AND RESIDENTIAL ENERGY CONSUMPTION FOR CENTRAL-STATION COMMUNITIES[a]

Year	Average Household Income ($/HH)	Average Household Electricity Consumption (kwy/HH)	Average Electricity Price ($/kwh)	Average Household Electricity Expenditures ($/HH)	Average Household Heating Fuel Consump. (gal./HH)	Average Heating Fuel Price ($/gal.)	Average Household Heating Expenditures ($/HH)	Proportion of Household Income Spent on Electricity	Proportion of Household Income Spent on Heating Fuel	Electricity and Heating Fuel
1980	$ 9,929	1,307	$.269	$ 352	991	$1.33	$1,318	3.5%	13.3%	16.8%
1981	10,028	3,022	.269	813	1,001	1.36	1,361	8.1	13.6	21.7
1982	10,129	3,115	.276	860	1,011	1.40	1,415	8.5	14.0	22.5
1987	10,645	3,441	.314	1,080	1,062	1.59	1,689	10.1	15.9	26.0
1992	11,188	3,825	.357	1,366	1,117	1.81	2,022	12.2	18.1	30.3
2002	12,359	4,613	.461	2,127	1,234	2.34	2,888	17.2	23.4	40.6

[a]Portage Creek, Ekwok, and Koliganek.

TABLE E.3.15. PROJECTED HOUSEHOLD INCOME AND RESIDENTIAL ENERGY CONSUMPTION FOR CENTRAL-STATION COMMUNITIES[a]

Year	Average Household Income ($/HH)	Average Household Electricity Consumption (kwy/HH)	Average Electricity Price ($/kwh)	Average Household Electricity Expenditures ($/HH)	Average Household Heating Fuel Consump. (gal./HH)	Average Heating Fuel Price ($/gal.)	Average Household Heating Expenditures ($/HH)	Proportion of Household Income Spent on Electricity	Proportion of Household Income Spent on Heating Fuel	Electricity and Heating Fuel
1980	$16,098	2,401	1.24	$2,977	1,257	$1.52	$1,911	18.5%	11.9%	30.4%
1981	16,259	2,437	1.32	3,217	1,270	1.66	2,108	19.8	13.0	32.8
1982	16,442	2,527	1.36	3,437	1,282	1.70	2,179	20.9	13.3	34.2
1987	17,253	2,869	1.54	4,418	1,348	1.94	2,615	25.6	15.2	40.8
1992	18,140	3,399	0.357[b]	1,213	1,416	2.20	3,115	6.7	17.2	23.9
2002	20,037	4,143	0.461	1,910	1,565	2.85	4,460	9.5	22.3	31.8

[a]Iliamna, Nondalton, Newhalen, Igiugig, Levelock, Ekuk, and Clarks Point.

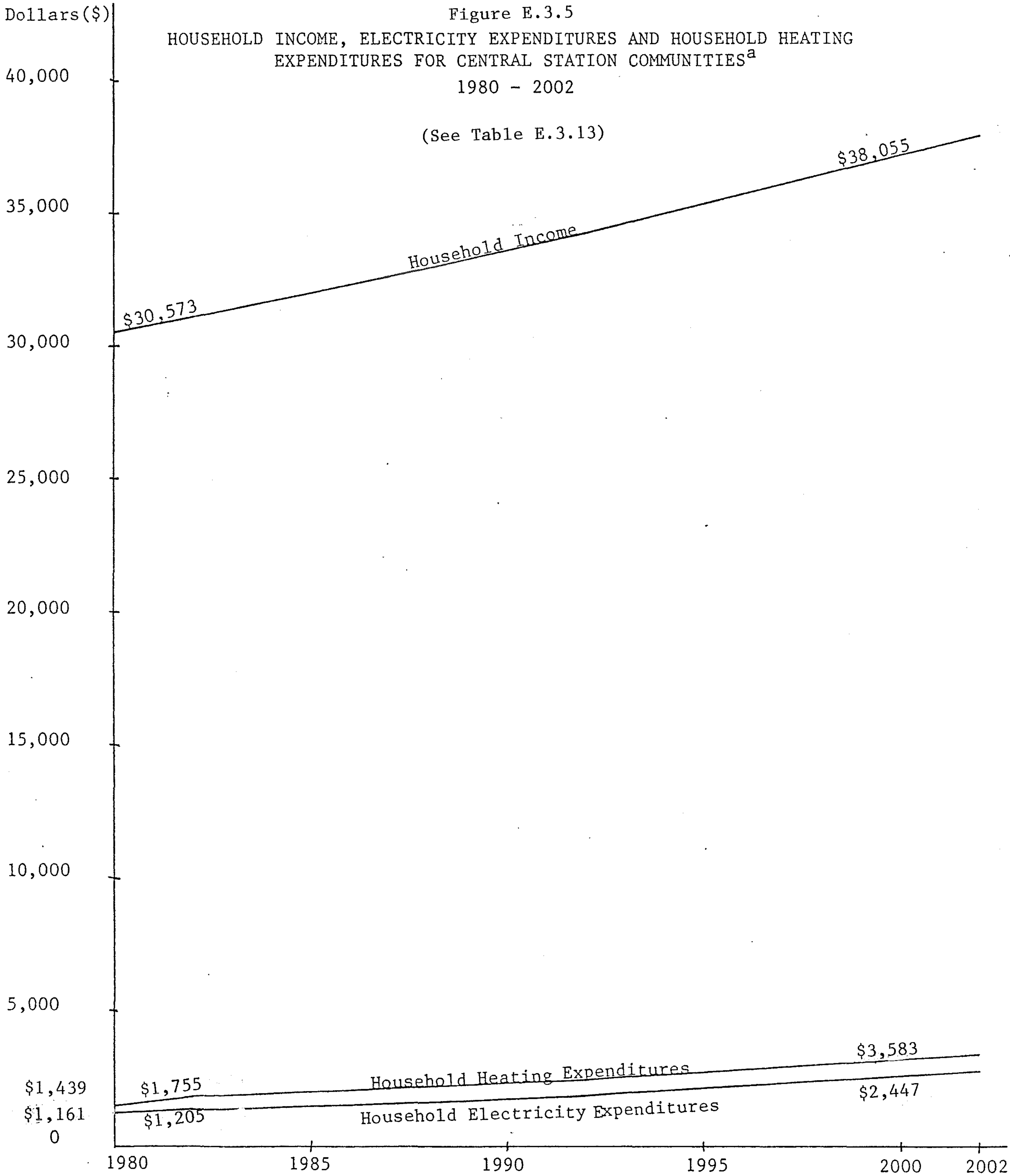
[b]Noncentral-station communities adopt seasonal/central-station electricity prices after 1987, when all noncentral communities are assumed to be fully electrified.

Figure E.3.5

HOUSEHOLD INCOME, ELECTRICITY EXPENDITURES AND HOUSEHOLD HEATING EXPENDITURES FOR CENTRAL STATION COMMUNITIES[a]

1980 - 2002

(See Table E.3.13)



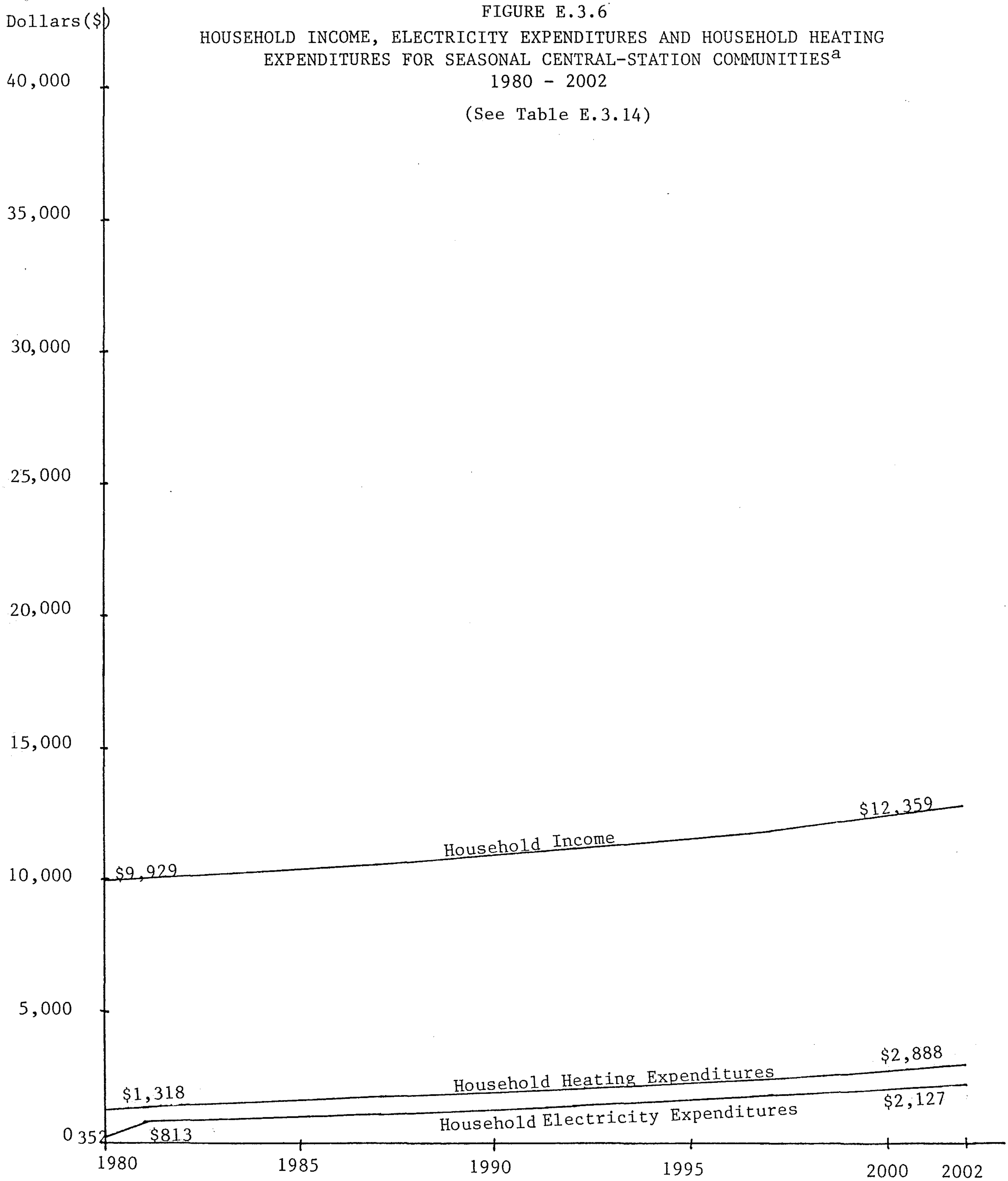
[a]Dillingham, Aleknagik, Naknek, King Salmon, South Naknek, Egegik, Manokotak, and New Stuyahok.

FIGURE E.3.6

HOUSEHOLD INCOME, ELECTRICITY EXPENDITURES AND HOUSEHOLD HEATING EXPENDITURES FOR SEASONAL CENTRAL-STATION COMMUNITIES[a]

1980 - 2002

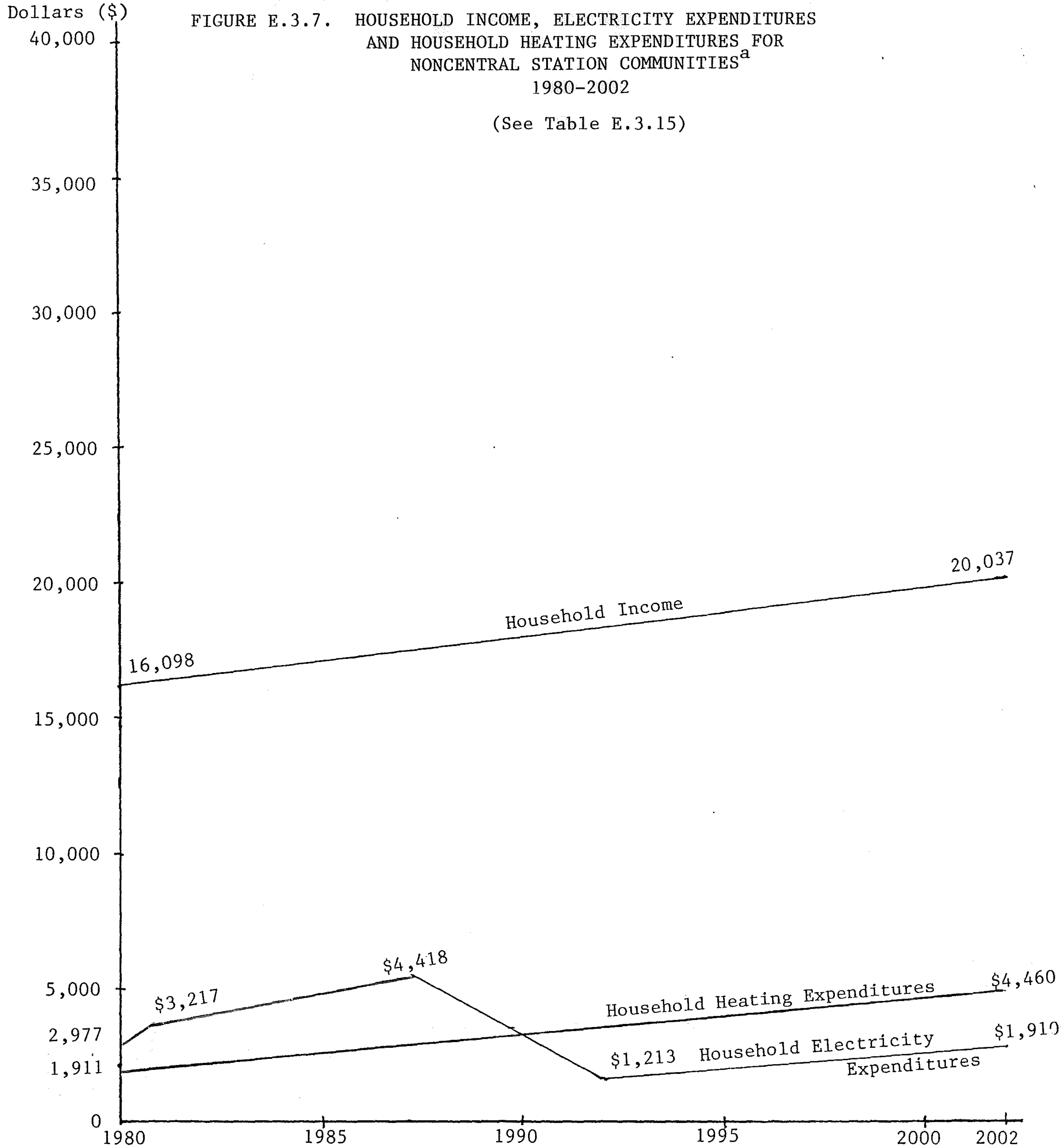
(See Table E.3.14)



[a]Ekwok, Koliganek, Portage Creek.

FIGURE E.3.7. HOUSEHOLD INCOME, ELECTRICITY EXPENDITURES AND HOUSEHOLD HEATING EXPENDITURES FOR NONCENTRAL STATION COMMUNITIES[a] 1980-2002

(See Table E.3.15)



[a]Iliamna, Nondalton, Newhalen, Igiugig, Levelock, Ekuk, Clark's Point

in electricity generation. Fuel and electricity prices escalate at a rate 2.6 percent higher than the general rate of inflation.

2. Inflation adjusted household income rises, but not as fast as energy prices.

3. Future residential energy-use patterns do not depart significantly from historical trends. That is, despite rising real energy prices, consumption per residential customer increases.

4. The future impact on electricity prices of state intervention is comparable to the effect of the Power Cost Assistance program in 1981.

The combined effect of these assumptions suggests that the proportion of household income spent on electricity rises over the forecast period. The exact proportion of income spent on electricity depends on the community's economic outlook, reflected in average household income, and on the degree of electrification. Electricity expenditures were projected to be consistently less than heating fuel expenditures in all three community groups. Central-station communities would pay proportionately less for electricity than either seasonal/central or noncentral communities in spite of higher average household electricity consumption. The relatively low household income for seasonal/central-station communities reflects the single-resource, fishing economies. The higher average household income of central- and noncentral-station community groups reflects economic opportunities from government services and recreation demand in addition to fishing.

As noted in Table E.3.14, we assume noncentral-station communities adopt seasonal/central-station prices after 1987, by which time they would be all electrified.

Commercial/Government

The projection of commercial/government (C/G) electricity consumption is based on an analysis of several key factors:

- Population and Household Growth
- Distribution of Economic Activity
- Historical Patterns of Electricity Consumption

As in the residential sector, we project growth in the number of C/G customers and in electricity use per customer independently, by community. Electricity consumption in each period equals the product of the number of customers and use per customer.

Number of Customers. The baseline estimates of the number of commercial/government customers reflects a recent period of rapid growth from fisheries activity and from public spending. It would be unrealistic to extrapolate future commercial/government growth from historical patterns characterized by short-term upswings. Most villages have in place a services infra-structure covering utilities, health, education, and village administration. Some villages have much more. We expect more growth in the commercial/government sector over the next 20 years. However, our assumptions about growth were tempered to reflect long-run possibilities under a scenario of moderate economic development.

The number of school facilities is assumed to remain constant over the projection period. Thus, the following analysis pertains only to noneducation, C/G customers.

The distribution of population growth assumed for residential customers was also applied to C/G customers. Table E.3.16 reproduces the allocation of communities according to probable growth and to their proportion of projected total study-area population. Communities in boxes A, B, and C are expected to grow fastest and to absorb an increasing share of total study-area population. For these communities, the population growth rate was increased by an parameter reflecting the historical difference between growth in residential and commercial customers for Bristol Bay utilities.

As shown in Table E.3.17, the average annual rate of growth of commercial customers has historically exceeded that of residential customers by a factor of 1.2 to 1.4 per year, depending on geographic

TABLE E.3.16. DISTRIBUTION OF GROWTH OF COMMERCIAL/ GOVERNMENT CUSTOMERS IN THE BUSINESS AS USUAL SCENARIO

		Population Growth		
		Strong	Moderate	Low
	Increasing	A Dillingham Naknek/King Salmon Iliamna (1.0397)		
Proportion of Regional Population	Constant	B Aleknagik Newhalen Portage Creek (1.0330)	C Manokotak New Stuyahok Koliganek (1.0282)	
	Decreasing		D Levelock Igiugig Ekwok Clarks Point South Naknek (1.0201)	E Egegik Nondalton Ekuk (1.0151)

Figures in parenthesis equal the average annual projected growth rates for C/G customers.

TABLE E.3.17. AVERAGE ANNUAL RATE OF GROWTH IN RESIDENTIAL AND COMMERCIAL CUSTOMERS: UNITED STATES, ALASKA, AND BRISTOL BAY UTILITIES
(percent/year)

	United States	Alaska	Bristol Bay
	(1960-1979)		(1970-1980)
Residential	4.5	4.9	6.1
Commercial	6.2	7.1	7.3
Ratio of Commercial to Residential Growth Rates	1.4	1.4	1.2

SOURCE: Statistical Abstract, 1980
Alaska Public Utilities Commission

area. Population growth for communities in boxes A, B, and C was multiplied by the difference reflected in Bristol Bay utilities (1.2 percent) and then adjusted for the effect of a gradual decline in average household size. Thus,

$$(1 + r_{C/G}) = \left[1 + \frac{r_{pop} \times 1.2}{100} \right] \times 1.01 \qquad \text{where,}$$

$r_{C/G}$ = Projected average annual rate of growth of commercial/ government customers.

r_{pop} = Projected average annual population growth from Table E.3.4.

1.2 = A parameter that reflects the historical difference in growth between C/G and residential customers in Bristol Bay.

1.01 = The effect of declining household size.

Although King Salmon is not expected to experience strong population growth, we assume that its C/G sector will expand at a higher rate comparable to that of Naknek.

Communities in boxes D and E are expected to experience relatively modest population growth and to decline as a proportion of total study area population. For these communities, we do not permit the historical difference in growth between commercial and residential users to influence C/G customers. Commercial/government customers were assumed to grow at the same rate as households were projected to grow. Thus,

$$(1 + r_{C/G}) = [1 + r_{pop}] \times 1.01$$

The growth rates for C/G customers corresponding to each community are shown in parenthesis in Table E.3.16.

Use Per Customer. Average electricity use per customer in the commercial/government sector was assumed to grow at 2.4 percent per year for central-station communities. This assumption is based on the historical pattern of nonresidential electricity consumption in several southwest Alaska utilities shown in Figures E.3.8 and E.3.9. Although use per nonresidential customer varied dramatically across utilities, the pattern of growth does exhibit a stabilizing trend toward a slower, more uniform average rate in the latter 1970's. As shown in Table E.3.18, the average growth in use per customer in four utilities falls to 2.4 percent per year from 1976 to 1980, from 5.9 percent over an extended historical period.

We assumed that use per customer in the seasonal-central station and noncentral station villages equaled the growth rate derived from the appliance saturation analysis for residential use per customer in the seasonal-central station villages (2.03 percent). The commercial/government sector exhibits similar characteristics in these two village groups despite important differences in the degree of electrification. Furthermore, the noncentral commercial users already have relatively large generating facilities and are not expected to respond dramatically to electrification.

In many of the study-area communities, electricity consumption by the school and related facilities was significantly greater than the

FIGURE E.3.8. NONRESIDENTIAL ELECTRICITY CONSUMPTION PER CUSTOMER FOR SELECTED SOUTHWEST ALASKA UTILITIES

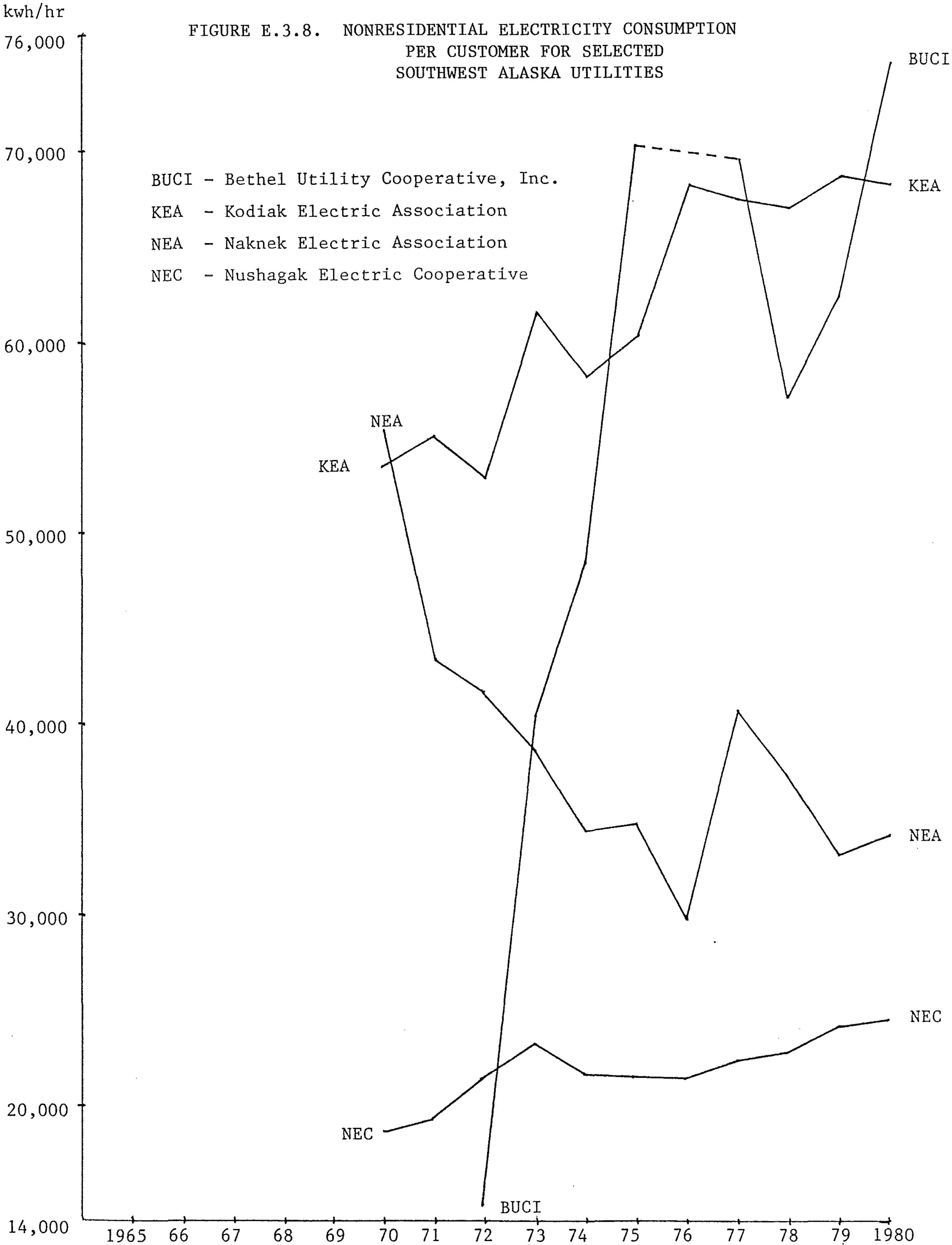


FIGURE E.3.9. NONRESIDENTIAL ELECTRICITY CONSUMPTION PER CUSTOMER FOR SELECTED ALASKA UTILITIES IN THE RAILBELT REGION

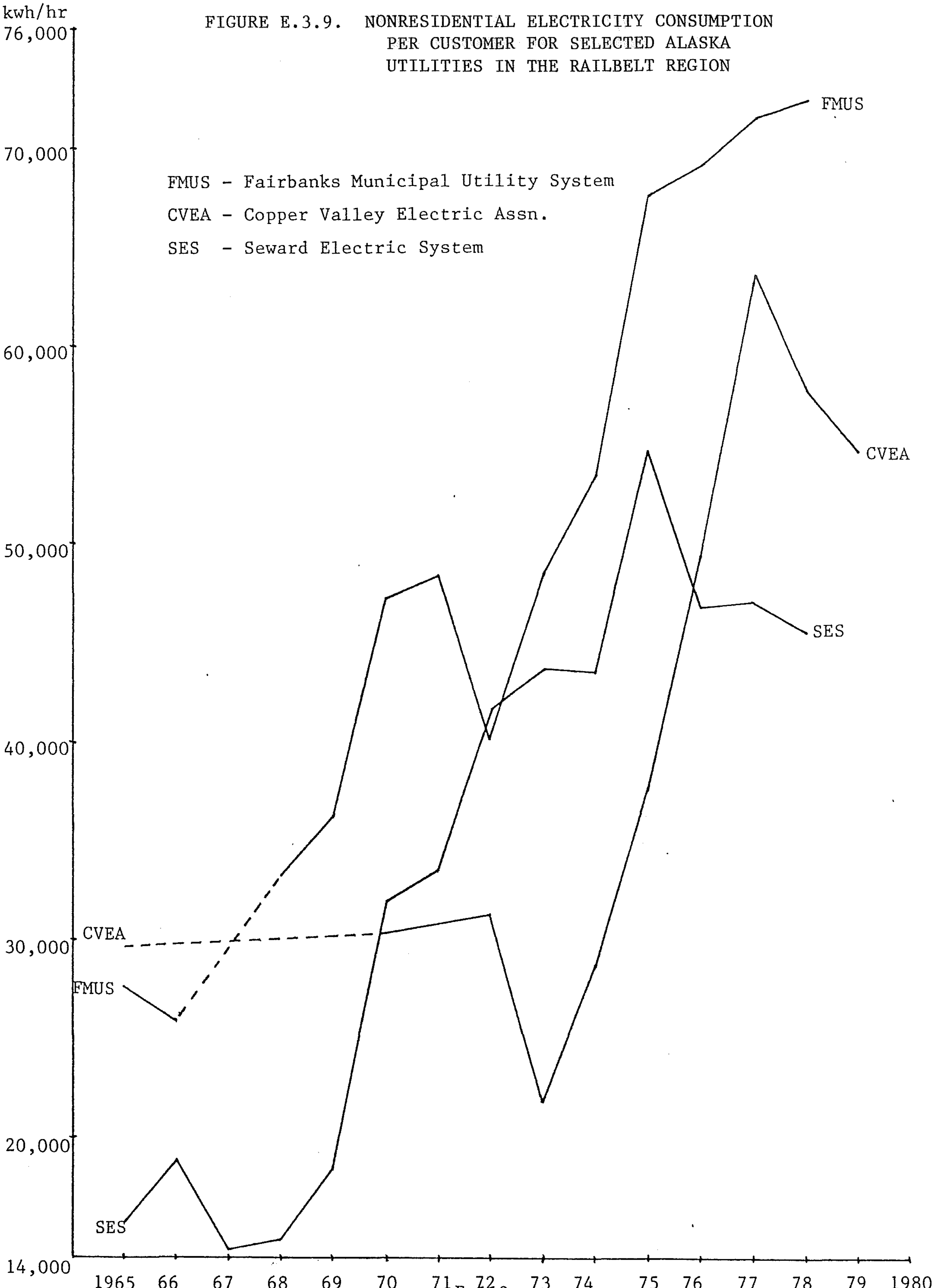


TABLE E.3.18. HISTORIC GROWTH IN ELECTRICITY USE PER CUSTOMER FOR SELECTED UTILITIES (percent/year)

	1970-1980	1976-1980
NEC	2.8	3.6
NEA	- 5.0	3.3
BUCI	23.0	2.4 (1977-1980)
KEA	2.7	0.4
Average	5.9	2.4

average consumption of all other C/G customers. In the projections, we assume that annual consumption by the schools would remain constant over the study period except in the villages of Portage Creek, Clarks Point, and Levelock. In each of these three communities, we assume the existing old school will be replaced by larger improved facilities by 1992. The average consumption of the modern school facilities in other villages was assigned to the Portage Creek, Clarks Point, and Levelock schools in 1992 and 2002.

Government Income Check

State and local government, which represents an increasing share of total government activity in Bristol Bay, receives all of its income from the state for operation and maintenance (O&M) of its facilities. A reduction of public income could affect electricity consumption in the C/G sector. For example, C/G electricity expenditures in 1980 amounted to about $2.5 million at 25 cents per kwh. State and local government represents over half of this figure. Although only a fraction of the total O&M budget, any curtailment of state O&M support could result in facility closure and thereby reduce electricity consumption. This contingency becomes more important as the C/G sector grows from one third to over half of the overall electricity consumption over the forecast interval.

Industrial

The projection of industrial electricity consumption is not tied to growth in population or income. It is driven primarily by exogenous market activity and by biological factors that are not directly influenced by Bristol Bay's economy.

Number of Consumers. We assume that Bristol Bay's seafood-processing industry has attained a long run equilibrium. With the exception of one additional processor coming on line in 1982, the number of processors and the general level of fish harvesting activity remains constant at the 1980-81 levels. Therefore, we do not anticipate any new entrants after 1982. This assumption is based on two premises. First, any increases in seasonal catch beyond the 1980-81 levels would possibly conflict with the biological limits of the Bristol Bay salmon fishery. The strong salmon runs in the late 1970's and early 1980's resulted from a combination of factors, including:

1. Mild winters in the early 1970's,
2. The introduction of the federal 200 mile limit and the state limited entry program in 1977, and
3. Successful ADFG escapement policies.

If these factors continue to positively influence survival, return, and escapement, then the 1980-81 harvest levels reflect the average sustainable yield that would be attainable in future years.

The 1981 wholesale cannery price of red salmon ($.75/pound of whole fish) stabilized at, roughly, the mid-point of the price range determined in the previous two seasons. We interpret this stabilizing trend to reflect equilibrium conditions in Japanese and United States markets and we assume that, despite inevitable cyclical variation in the quantity demanded and harvested, equilibrium market conditions will prevail at roughly 1981 levels over the forecast period.

Use Per Customer. We assume that over the projected period, processors with strictly canning operations will eventually convert to a combination of canning and freezing. Except for the additional processor in 1982, this shift toward a more energy-intensive technology would be the only source of increased electricity demand per processor in the industrial sector.

Thus, the primary source of increased energy demand in the seafood processing industrial sector is that resulting from a continued expansion of relatively electricity-intensive freezing capacity.

Electricity consumption projections for the major shore-based processors are shown in Table E.3.19. We implicitly assume in these projections that the Power Cost Assistance subsidy is relatively unimportant. Future electricity prices are, therefore, close to the real marginal cost of oil.

TABLE E.3.19. PROJECTED ELECTRICITY CONSUMPTION BY SHORE-BASED SEAFOOD PROCESSORS (kwh/year)

	Dillingham		Naknek		South Naknek		Ekuk		Clarks Point		Egegik		All Processors		
	F	C	F	C	F	C	F	C	F	C	F	C	F	C	Both
1980	(2) 567,684	Ø	(4) 2,233,540	(1) 295,166	(2) 1,586,300	Ø	(1) 700,000	Ø	Ø	(1) 486,000	(1) 583,000	(1) 486,000	5,670,524	1,267,166	6,937,690
1982	(3) 1,150,684	Ø	2,233,540	295,166	1,586,300	Ø	700,000	Ø	Ø	486,000	583,000	486,000	6,253,524	1,267,166	7,520,690
1987	1,150,684	Ø	(5) 2,816,540	Ø	1,586,300	Ø	700,000	Ø	Ø	486,000	583,000	486,000	6,836,524	972,000	7,808,524
1992	1,150,684	Ø	2,816,540	Ø	1,586,300	Ø	700,000	Ø	Ø	486,000	(2) 1,166,000	Ø	7,419,524	486,000	7,905,524
2002	1,150,684	Ø	2,816,540	Ø	1,586,300	Ø	700,000	Ø	(1) 583,000	Ø	1,166,000	Ø	8,002,524	Ø	8,002,524

SOURCE: See Text.

NOTES: F = Freezing and Canning
C = Canning Only

The base-year levels of consumption in each district are assumed to change only in the event of a new processor beginning operations (Dillingham in 1982) or of a shift from canning-only to freezing-and-canning operations (Naknek in 1987, Egegik in 1992, and Clarks Point after 1992).

Fish Camps and Buy Stations. We assume that the number of customers and average electricity use per customer remains constant at base-year levels throughout the forecast interval. Based on the assumption of 24 mwh per customer, the regional distribution of annual electricity consumption by fish camps and buy stations is shown in Table E.3.20.

TABLE E.3.20. PROJECTED ELECTRICITY CONSUMPTION BY FISH CAMPS AND BUY STATIONS

	Number of Customers	Total Electricity Consumption (mwh)
Dillingham	10	240
Naknek	1	24
South Naknek	6	144
Ekuk	8	192
Clarks Point	8	192
Egegik	7	168
Total	40	960

Military. The Alaska Air Command Public Information Office projects no significant damages in the King Salmon station or the Bristol Bay region that would affect military electricity consumption. Therefore, we assume constant annual consumption of 5600 mwh throughout the projection period.

E.4. Projection of Capacity

General Method

The general method used to project peak demand by community was to assume a stable relationship over time between peak demand (kw) and annual output (mwh) observed in the base year. The ratio of base year peak demand to annual output was multiplied by projected annual output in 2002, to derive an estimate of peak demand in 2002. We do not project the shape of the annual load curve in future years.

Over time, we expect industrial load (kw) at the utilities to decline as a proportion of total utility demand, as residential and commercial/government consumption increases in relative size. The effect of a gradual decline in the proportion of total demand captured by industrial consumers would probably reduce the industrial sector's contribution to summer peak demand. Furthermore, we assume that any increases in industrial demand resulting from new entrants, or from additions to freezing capacity, would be fully absorbed by processor inhouse, generating capacity. Recall from the analysis of baseline capacity that processor self-generation captures the bulk of seasonal peak demand. In many cases, industrial electricity consumption at the utility diminishes or shuts off completely during summer months when processors rely on their own generators. Thus, although we anticipate a relative decline in industrial peak demand at the utility, we remind the reader that, in this forecast, a substantial and increasing portion of industrial demand would be present, although not serviced by the utility.

The Dillingham, Naknek and Egegik utility districts all have an industrial component. For communities in these districts, we separate processor baseload peak demand from processor seasonal peak demand at the utility. Industrial self-generated peak demand is also projected by assuming that it increases in direct proportion to projected increases in self-generated output (mwh).

Projections of peak demand are shown by utility district in Tables E.4.1 and E.4.2 for central and noncentral station communities with fish processors. Peak demand (kw), shown in 1980 and 2002, was divided into four classifications:

1. Appliance Demand (Residential and C/G)
2. Processor Baseload Demand at the Utility
3. Processor Seasonal Demand at the Utility
4. Processor Self-generated Demand.

Projections of peak demand for the remaining central and noncentral station communities are shown in Tables E.4.3 and E.4.4.

TABLE E.4.1. PEAK DEMAND FOR CENTRAL STATION COMMUNITIES WITH FISH PROCESSORS

	Nushagak Electric Cooperative (Dillingham and Aleknagik)		Naknek Electric Assoc. (Naknek, South Naknek and King Salmon)		Naknek Electric Association (Egegik)	
	1980	2002	1980	2002	1980	2002
1. Peak Demand[a] at Utility (kw)	1,610	6,306	2,184	5,168	34	381
2. Utility Sales (mwh)[b]	7,041	27,419	6,411	22,470	133	1,466
3. Ratio of Peak Utility Demand (kw) and Utility Sales (mwh) (1) ÷ (2)	.23	.23	.34	.23[c]	.26	.26
4. Utility Appliance Peak Demand (kw) (Excluding Processors	1,606	6,145	1,582	4,332	34	373
5. Processor Base Demand at Utility (kw)	40	40	58	58	10	10
6. Processor Summer Demand at Utility (kw)	162	162	987	987	0	0
7. Processor Self-generated Peak Demand (kw)	793	1,607	5,636	6,276	334	364

[a] Peak demand at utility does not equal the sum of columns 4, 5, and 6 because demand is noncoincident.

[b] Utility sales include all residential, commercial/government and fishing industry sales by the central utility for the given year.

[c] The factor for NEA/Bristol Bay Borough decreases because of the addition of the stable load from the military station at King Salmon in 1981.

TABLE E.4.2. PEAK DEMAND FOR NONCENTRAL-STATION COMMUNITIES WITH FISH PROCESSORS

	Clarks Point		Ekuk	
	1980	2002	1980	2002
(1) Village Peak Demand Excluding Processors (kw)	116	258[a]	0	0
(2) Processor Base Demand (kw)	15	15	15	15
(3) Processor Seasonal Peak Demand (kw)	631[b]	757	1,000	1,000
(4) Total Peak Demand (kw) (1) + (2) + (3)	762	1,030	1,015	1,015
(5) Total Village and Processor Electricity Output (mwh)	1,066	1,502	700	700
(6) Ratio of Total Peak Demand (kw) and Total Village Electricity Output (mwh) (4) ÷ (5)	.71	.69	1.45	1.45

NOTES: [a]We assume that the ratio of peak demand and annual output increases to 0.26, reflecting additions to school and possibly home generating capacity.

[b]631 kw = .69 x Processor Generator Capacity.

TABLE E.4.3. PEAK DEMAND FOR CENTRAL-STATION COMMUNITIES WITHOUT FISH PROCESSORS

	(1) Peak Demand at Utility (kw)		(2) Utility Sales (mwh)		(3) Ratio of Utility Peak Demand (kw) to Sales (mwh) (1) ÷ (2)	
	1980	2002	1980	2002	1980	2002
Manokotak	81	240	288	857	0.28	0.28
New Stuyahok	86	254	308	907	0.28	0.28
Ekwok	33	82	117	294	0.28	0.28
Koliganek	47	158	155	527	0.30	0.30
Portage Creek	30	76	99	253	0.30	0.30

TABLE E.4.4. PEAK DEMAND FOR NONCENTRAL STATION COMMUNITIES WITHOUT FISH PROCESSORS

	(1) Village Peak Demand (kw)		(2) Village Total Electricity Consumption (mwh)		(3) Ratio of Village Real Demand (kw) to Total Electricity Consumption (mwh) (1) ÷ (2)	
	1980	2002	1980	2002	1980	2002
Iliamna Newhalen Nondalton	347	991	1,197	3,416	0.29	0.29
Igiugig	43	66	155	234	0.28	0.28
Levelock	39	135	141	481	0.28	0.28

Total peak demand in all study area communities in 2002 is summarized in Table E.4.5, which distinguishes between peak demand at the utility and self-generated peak demand by fish processors. In both cases, a diversity factor of 80 percent was applied to account for non-coincident peaks.

Peak demand at the utility is projected to grow at an average annual rate of 4.6 percent due to expanding appliance demand. Processor self-generated peak demand is projected to grow more slowly, at 1.3 percent per year. The self-generated industrial peak ultimately falls below the level of peak demand at the utility, from nearly twice the level of utility demand in the base year.

TABLE E.4.5. TOTAL STUDY-AREA CAPACITY REQUIREMENT
(kw)

	1980	2002	Average Annual Rate of Growth 1980 - 2002 (Percent)
Utility[a]			
(1) Appliance Demand	4,404	13,110	5.5
(2) Processor Base Demand	108	108	Ø
(3) Processor Seasonal Demand	1,149	1,149	Ø
(4) Total Utility Demand	5,301	14,367	
(5) Correction for Diversity[b]	4,241	11,494	4.6
Self-Generated			
(6) Processor	8,394	10,004	
(7) Correction for Diversity[b]	6,715	8,003	0.8
(8) Utility and Self-Generated Demand (5 + 7)	10,956	19,497	2.7

[a]Includes appliance demand at noncentral-station communities.

[b]80 percent of lines (4) and (6).

E.5. Responsiveness to Price, Income, and Electricity Availability

There are three electricity consumption scenarios in this report. They are:

- Business As Usual
- Regional Diesel
- Newhalen Regional

Each scenario is distinguished by assumptions about how electricity would be supplied, the timing and extent of village electrification, and corresponding assumptions about electricity prices.

The Business As Usual (BAU) scenario is based on a continuation of regionally-decentralized, diesel-powered electricity. Total study-area electricity is supplied from a mix of utility configurations which vary in degree of electrification from central station (REA Co-operatives Association) to totally noncentral, individual home generators. By 1987, all communities are assumed to become electrified, meaning they receive central-station power, at least on a seasonal basis. Economies of scale are not assumed to offset the rising price of diesel fuel. Electricity prices increase from base-year levels at the same rate as fuel oil prices--2.6 percent per year, over the 20-year forecast period. The effect of state intervention to lower consumer electricity prices continues throughout the forecast period and is consistent with levels experienced in 1981.

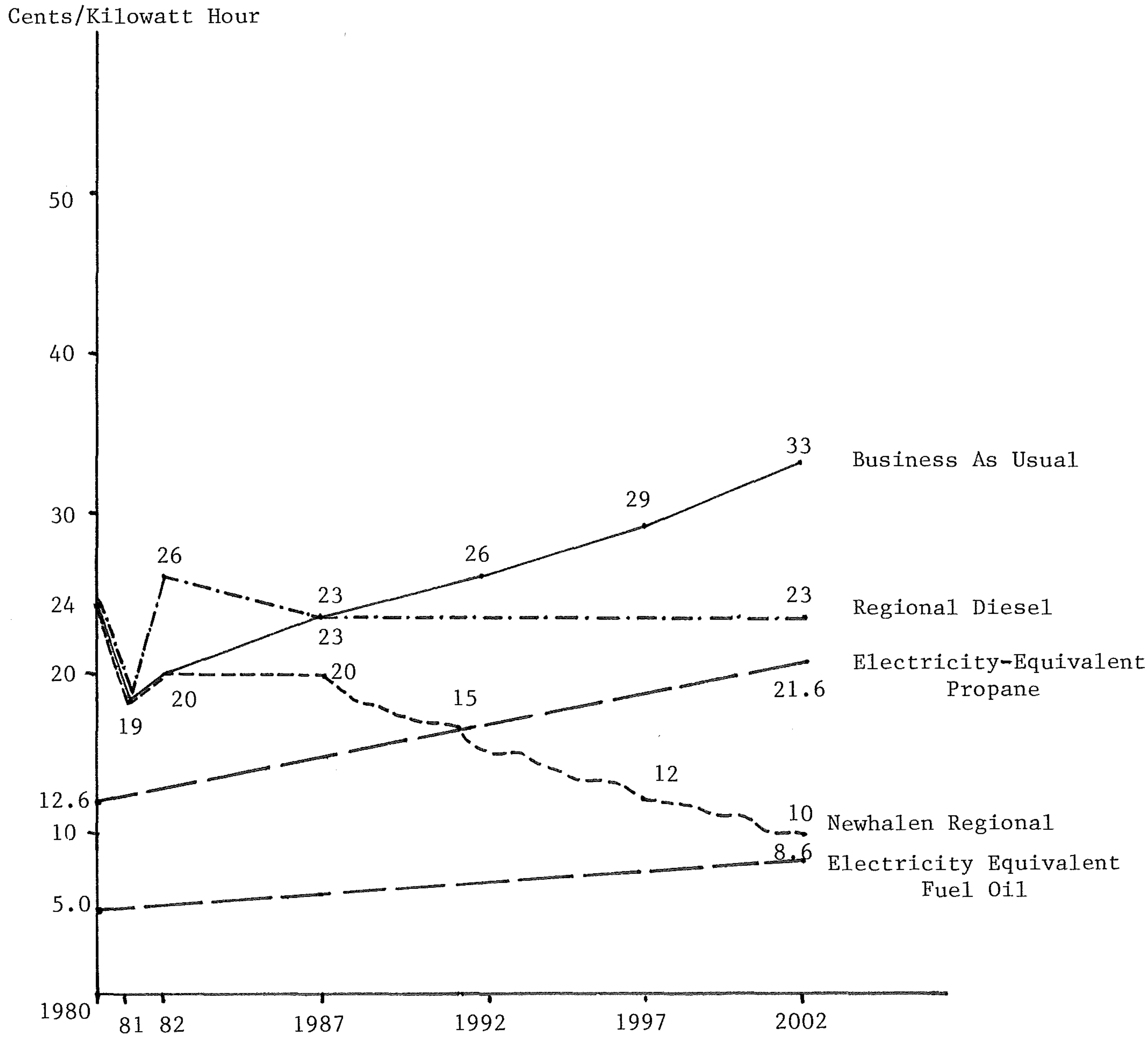
Electricity prices from community-to-community retain the same degree of nonuniformity observed in the base year.

By comparison, the Regional Diesel Scenario (RD) calls for a regional transmission intertie connecting all 18 communities to the two main utilities in Dillingham (NEC) and Naknek (NEA). Electricity will remain diesel powered, but prices will be uniform across all 18 communities. Furthermore, economies of scale from regional centralization and from growing demand offset transmission line costs and rising fuel prices, such that real electricity prices eventually stabilize. The effect of state intervention to lower the consumer cost of electricity continues as before.

The Newhalen Regional scenario calls for a sixteen-megawatt hydroelectric facility on the Newhalen River. Prior to 1988, when the hydro facility becomes operable, this scenario is identical to the BAU. A regional transmission line interconnects all communities in 1988. Electricity prices become uniform in 1988 and decline steadily in real terms throughout the 20-year forecast period. State intervention to lower electricity prices is consistent with the relative effects experienced in 1981.

The projected price streams corresponding to each scenario are shown graphically in Figure E.5.1. All prices are expressed in constant 1982 dollars and are adjusted for a subsidy comparative to the effect of Power Cost Assistance in 1981 (see Section E.3). The BAU prices reflect a weighted average of base-year levels from

FIGURE E.5.1. PRICES CORRESPONDING TO ALTERNATE ENERGY SCENARIOS (CONSTANT 1982 DOLLARS)



communities with either seasonal or year-round, central-station electricity. Base-year prices for noncentral-station electricity were excluded. The effect of noncentral-station prices on average BAU prices is negligible because of the small quantity of electricity consumed by noncentral communities relative to overall study-area consumption. Also shown in Figure E.5.1 are the electricity equivalent prices of propane and fuel oil. These are calculated by applying base-year and projected market prices of propane and fuel oil to an equivalent quantity of energy expressed in kwh of electricity, after adjusting for seasonal efficiency (propane - 85 percent, fuel oil - 72 percent). The price of both propane and fuel oil were projected to increase at 2.6 percent per year from base-year levels. Their importance is discussed below in connection with projections of consumption per customer in the Newhalen Regional scenario.

In general, after 1987, alternative scenarios represent a fairly comprehensive set of price patterns; they escalate in the BAU, remain constant in the Regional Diesel, and decline in the Newhalen Regional scenarios.

The basic differences between the alternate scenarios then is the rate and timing of electricity-price changes and whether or not electricity prices are uniform over all study-area communities. The question of uniformity is particularly important to the effects on aggregate consumption during the transition to regionally uniform prices. Assumptions about how electricity consumers respond to price and income changes over time, as well as broader assumptions about economic growth remain the same. Difference consumption patterns, therefore, occur as a direct result of different patterns of projected prices, transmitted through a consistent set of assumptions regarding the consumer's response to price changes.

Assumptions regarding the consumer's response to changing prices and income are conveniently made in connection with price and income elasticities of demand. Price and income elasticities are parameters that describe how responsive consumer behavior is to changes in a commodity's price or to the consumer's income. For example, if the price elasticity of electricity demand was greater than one, then the household is considered somewhat price-responsive. In this case, a 10 percent price increase would be offset by a greater than 10 percent reduction in the quantity of household electricity consumption. As a result, the total amount spent under the higher price and lower consumption pattern would be less than what it was before the price increase. Goods that are considered necessities typically have low price elasticities, indicating that it is difficult for the consumer to find substitutes or otherwise change consumption patterns when price changes.

The same concepts apply to household income. If, for example, a household has an income elasticity of electricity demand equal to one, then a 10 percent rise in income a certain period, would be met by a 10 percent rise in the quantity of electricity consumed over the same period, whatever the price of electricity might be at the time.

Occasionally, economists are able to measure price and income elasticities for specific commodities and for specific groups of consumers based on the history of household income, of prices, and of quantities consumed at those prices. Under the present circumstances, this was not possible. In order to forecast electricity consumption patterns in the alternate scenarios, however, we have used a set of implicit price and income elasticity assumptions from the BAU scenario. These are shown in Table E.5.1.

TABLE E.5.1. PRICE AND INCOME ELASTICITIES FOR ELECTRICITY DEMAND
(no units)

	Price	Income
Elasticity Factor	-0.10	1.80

In reality, there were numerous combinations of price and income elasticities implicit in the BAU case. This set was selected as most reasonable. The price elasticity of -0.10 indicates that a change in electricity prices would be met by a proportionately smaller change in consumption in the opposite direction of the price change (i.e. negative sign). It suggests a moderate consumer response to changing electricity prices. The income elasticity of 1.80 indicates a relatively strong, positive relationship between household income and electricity use. Because price is the only variable that differs between scenarios, the income elasticity was not directly drawn on to calculate alternate consumption patterns. It was, nevertheless, implicit in the consumption patterns derived from all scenarios.

In this analysis, a change in price has two channels of effect on consumption: the income effect and the substitution effect. When the price of electricity drops, the consumer's real income rises and he purchases more appliances and consumes more electricity per appliance. This is the income effect. The relatively large proportion of household income spent on electricity, discussed above in Section E.3 suggests that changing electricity prices can have an important effect on real household income. Here the income effect is not to be confused with the income elasticity of demand, which measures the effect on consumption of a direct change in income, rather than an indirect change caused by a change in price.

The substitution effect refers to the increase in consumption resulting from a switch to electric appliances from other goods as the price of electricity falls. This may occur if the electricity equivalent price of a substitute fuel becomes greater or equal to the price of electricity or simply because electricity use is viewed as more of a "bargain" at a lower price.

The BAU scenario was used as a frame of reference to measure the effects on electricity use patterns resulting from different electricity prices, corresponding to the Regional Diesel (RD) and Newhalen Regional (NR) scenarios. The approach is similar to that commonly used in sensitivity analysis. Electricity use patterns in the BAU scenario correspond to specific assumptions about availability of electricity, electricity prices, household income, and consumer responsiveness to these and other variables. We hold everything constant, including parameters depicting consumer responsiveness, and change only price. We then calculate how these changes affect electricity consumption.

The price elasticity of demand was the instrument used to transmit the effect of a price change and to derive new consumption patterns for the RD and NR scenarios. We assume that nominal household income in the BAU scenario is the same in the RD and NR scenarios. We isolated the effect of the price elasticity of demand in the BAU case for residential demand and calculated comparable effects using the price patterns in the alternate scenarios.

A similar method was used to incorporate the income effect of alternate price streams to adjust use per customer in the C/G sector. In this case, the adjustments to C/G use per customer in the BAU scenario were performed on average use per customer for central, seasonal/central, and noncentral-station communities, and then applied directly to communities in corresponding groupings.

This method of analyzing the sensitivity of electricity consumption to price of electricity is deficient because it reflects the historical relationship among fuel prices during which time electricity was not price competitive with propane or fuel oil for those uses for which either fuel could be used. To correct this problem, we specifically added to the NR scenario an analysis to capture the additional electricity demand which would result if consumers began switching from propane to electric appliances due to a fall in the relative price of electricity. The energy characteristics and 1981 prices of propane, fuel oil, and wood are compared to electricity in Table E.5.2. Prices in 1981 and 2002, expressed as an electricity equivalent, indicate that oil and wood would be considerably cheaper than electricity in most cases. Given the price escalation assumptions in Table E.5.2, propane's competitive advantage diminishes over time. The figures suggest that compared with wood and oil, propane appliances are the most likely candidates for replacement by electric appliances if the price of electricity were to fall. In all scenarios, the price of propane is assumed to escalate at 2.6 percent per year as shown in Table E.5.2. In the NR scenarios, electricity prices would decline to about $.10 per kwh by 2002 and match the electricity-equivalent price of propane in 1991.

Four major appliances were evaluated for their electric substitution potential. As shown in Table E.5.3, they all use at least one type of fuel in addition to electricity. Table E.5.3 compares their fuel and electricity costs based on estimates of average annual energy requirements for each appliance.

TABLE E.5.2. COMPARISON OF ENERGY AND PRICE CHARACTERISTICS OF FUEL AND ELECTRICITY

Fuel Type or Electricity	Units of Measure	1981[a] Price ($/unit)	Energy Content (BTU/unit)	Seasonal[b] Efficiency (percent)	Electricity Equivalent Price[c] 1981 (¢/kwh)	Electricity Equivalent Price[c] 2002[d] (¢/kwh)
Propane	Gallon	$ 2.89	92,000/Gal.	85	12.6¢	21.6¢
Oil	Gallon	1.42	138,000/Gal.	70	5.0	8.6
Wood	Cord	150.00	13.5x106/Cord	50	7.6	13.0
Electricity	kwh	0.27	3413/kwh	100	27.0	10.0-33.0[e]

NOTES: [a]Prices are representative of average levels for Bristol Bay study area.

[b]Includes adjustment to steady-state efficiency to account for seasonal use patterns.

[c]Convert 1981 and 2002 price of non-electric fuel into kwh-equivalent price.

[d]All fuels increase at 2.6 percent per year.

[e]Electricity varies from 10 to 33¢/kwh depending on electricity projection scenario.

TABLE E.5.3. FUEL AND ELECTRICITY USE COMPARISON FOR MAJOR APPLIANCES

Appliance	Average Annual Energy Requirement (BTU/Yr)	1981 Annual Energy Consumption and Cost							
		Propane		Oil		Wood		Electric	
		Gal.	$	Gal.	$	Cords	$	kwh	$
Dryer	3.4 Million[a]	43	$125	NA		NA		996	$269
Refrigerator	2.5 Million[a]	32	92	NA		NA		732	198
Range	3.6 Million[b]	46	133	41	59	0.53	80	1,054	285
Water Heater	10.0 Million[c]	128	370	103	147	1.48	222	2,930	791

[a] Chugach Electric, "Energy Demands of Household Appliances."

[b] Adjustment of 1.5 to Chugach data to reflect large range size.

[c] Based on 10 gallons hot water per person per day and 4 persons per household. Using HUD rule of thumb, 40 gal/day requires 10 million btu/yr.

The water heater and refrigerator were rejected as candidates for electricity substitution. Electric water heaters were not common among Bristol Bay residential customers. More importantly, oil-fired water heaters were considerably more economic than electric or propane models. The economics of electric water heating were regarded as comparable to electric space heating which was assumed not to occur in any of these projection scenarios.

The analysis of appliance ownership indicated that propane refrigerators were not marketed regularily nor commonly used in Bristol Bay. They occur primarily in mobile homes and recreation vehicles. We assume propane refrigerators represent a negligible component of overall propane use throughout the forecast period.

Even though oil and wood are more economical than propane or electricity for cooking, we included the propane ranges as a candidate for electricity substitution because of their convenience and high occurrence among residential customers.

The only alternative to propane dryers are electrically-heated dryers. Propane dryers were the most common type found in many communities and represent a potentially significant source of electricity substitution among residential customers.

The propensity to switch from propane to electric dryers and ranges and its effect on total residential electricity consumption was incorporated in the NR scenario through two effects -- first time purchases and conversions.

First-Time Purchases. First-time purchases (FTPs) of dryers and ranges in newly formed households were assumed to begin when electricity became less expensive than propane.

The proportion of newly formed households who would normally buy these appliances choosing electric dryers and rangers was assumed to grow over time as follows:

	Proportion of Newly-Formed Households Using Appliance j that Switch to Electric Version of Appliance
(Year)	(Percent)
1992	25
1997	33
2002	50

Thus, the number of new residential customers that purchase electric dryers and ranges in any period is the product of the additions to households times the proportion of new households normally purchasing dryers and ranges times the switch parameters listed above.

Conversions. Conversions are the replacement of one appliance for another which performs the same function but uses a different fuel. Unlike FTPs, conversions imply additional owner costs that would probably delay this effect until some time after propane and electricity prices intersect when the relative price of electricity reduces further. We, therefore, assume conversions do not occur before 1997.

The derivation of the addition to electricity use from conversions is similar to that of FTP's, except that total residential customers (less those that made conversions in the previous period) replaced newly-formed residential customers in the calculation. We assume that the proportion of residential customers using propane appliances that convert to electric increases from 25 to 33 percent between 1997 and 2002.

The overall effect equals the sum of the conversion and FTP effects, and amounts to about 4 percent of total residential consumption in the NR scenario. This effect was added to total residential electricity consumption by community, as shown in the community-specific projections for the NR scenario in Chapter V.

Data on appliance ownership in the C/G sector was not obtained in a form as complete or comprehensive as in the residential sector. However, our observations suggest that an effect similar to that of appliance substitution in the residential sector is likely to occur in the C/G sector, especially among schools that use relatively large amounts of propane. To account for C/G appliance substitution, we apply the same percentage increase derived by community in the residential sector to total projected electricity used in the C/G sector from 1992 to 2002.

We assume that appliance use in the industry and military sectors is based more strongly on factors other than relative prices and is not subject to this type of adjustment.

Availability. Availability refers to the timing and extent of village electrification. The degree of electrification ranges from totally non-electrified villages that receive power only from home generators to regional electrification through transmission-line interties.

The effects of changing electricity availability were transmitted through changes in the hookup-saturation rate. In general, changes in hookup saturation were assumed to occur uniformly for communities grouped according to their base year electrification:

- Central Station
- Seasonal/Central Station
- Noncentral station.

Hookup saturation was assumed to vary over the forecast period according to the extent and timing of electrification in each scenario. The effects of changes in electrification were reflected in adjustments in the gap between 100 percent hookup saturation (where all households are residential customers) and the level assumed in a given period, as described in Table E.5.4.

TABLE E.5.4. EFFECT OF ELECTRICITY AVAILABILITY ON HOOKUP SATURATION

Scenario	Communities	Hookup Saturation Gap
Business As Usual	Central Station, plus Levelock Igiugig	Equal to base-year saturation through 1982. Gap halves by 1987, halves again by 1992, and closes by 1997.
	Iliamna Newhalen Nondalton Clarks Point	Equal to base-year saturation through 1982. Gap halves by 1987 and closes by 1992.
	Seasonal/Central Station	Equal to base-year saturation for entire forecast period.
Regional Diesel	All Communities	Equal to base-year saturation through 1981. Gap halves by 1982 and closes completely by 1987.
Newhalen Regional	Central Station Seasonal/Central Station Levelock Igiugig	Equal to base-year saturation until 1992 when gap closes completely.
	Iliamna Newhalen Nondalton Clarks Point	(These villages electrify prior to regional intertie.) Equal to base-year saturation through 1982. Gap halves by 1987 and closes completely by 1992.

NOTES:

(1) Central Station communities include: Dillingham, Aleknagik, Naknek, South Naknek, King Salmon, Egegik, Manokotak, and New Stuyahok.

Seasonal/Central-Station communities include: Ekwok, Portage Creek, and Koliganek.

Noncentral-Station Communities include: Iliamna, Newhalen, Nondalton, Clarks Point, Ekuk, Levelock, and Igiugig.

(2) Ekuk hookup saturation equals 100 percent in all scenarios.

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Personal Contacts

Aleknagik

Peter Andrews, Sr. - Mayor
Mildred Shephard - City Manager
Don Shephard - Public Safety Officer
Okalena Offt - Post Mistress
Roland Moody - Moody Sea Lighterage
Sherb & Shirley Smith - Smith Lighterage

Anchorage

Craig Valentine - Alaska Air Command
Georgia Feusi - Alaska Village Electric Co-operative
Bruce Wood - Alaska Department of Transportation and Public Facilities
Frank Tyler - Alaska Department of Natural Resources
Karen Saunders - Alaska Department of Fish and Game
Ken Flourey - Alaska Department of Fish and Game
Dan Huttunen - Alaska Department of Fish and Game
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Dora Gropp - Retherford Associates
Craig Thompson - Retherford Associates
Don Anderson - Lake and Peninsula School District
Charlie Bunch - Bureau of Indian Affairs
Roberta Goldman - DOWL Engineers
Allan Yost - Regional Electric Association
Midge Clouse - Alaska Department of Community and Regional Affairs
Heinz Noonan - Alaska Power Authority (Power Cost Assistance)
Bob Dryden - Dryden & LaRue

Clarks Point

Joseph Clark - President of Village Council

Dillingham

Dave Bouker - Nushagak Electric Cooperative
Gerry Nelson - Nushagak Electric Cooperative
Laura Schroeder - City of Dillingham
Kay Larson - Bristol Bay Native Association
Andy Golia - Bristol Bay Native Association
William Johnson - Bristol Bay Native Corporation
Judy Nelson - Choggiung Limited
Tom Hawkins - Choggiung Limited
Jim Gardiner - Southwest Regional School District
Tom Ward, Jr. - Chevron
Mike Nelson - Alaska Department of Fish and Game
Don Sagemoen - Dillingham City Schools
Jim Timmerman - Bristol Bay Housing Authority
Truman Emberg - Western Alaska Cooperative Marketing Association
Jim Bingman - Rowls Oil
Mark Siegers (formerly Bristol Bay Native Association)

Egegik

Charlie Kelly - Ex-President of Village Council
Shirley Kelly - Ex-Secretary of Village Council
Lee Leonard - Egegik Light and Power
Dicky Day - Vice President of Village Council
Don and Mary Albright - Residents

Ekuk

Pete Heyano - President of Village Council

Ekwok

Luki Akelkuk - Ex-President of Village Council
Philip Akelkuk - President of Village Council

Igiugig

Marianne Olympic - President of Igiugig Natives, Limited
Tim Nickoli - Village Planner
Dave McClure - Village Council Employee

Iliamna

Gerald Anelon - Vice President of Iliamna Natives Limited
Myrtle Anelon - President of Iliamna Natives Limited
Trig Olsen - Iliamna-Newhalen Electric Cooperative

King Salmon

Jim Huff - Bristol Bay Borough School District
LaVerne Shawback - Bristol Bay Contractors
Don Bill - Alaska Department of Fish and Game

Koliganek

C. T. Seidl - Village Administrator
Charles Nelson - President of Koliganek Natives Limited
Veronica McCarr - Meter Reader

Levelock

Peter Apokedak - Member of Village Council
Dave McClure - Village Council Employee
James Woods, Sr. - President of Village Council

Manokotak

Moses Toyukak - Mayor
Nels Franklin - President of Manokotak Natives Limited

Naknek

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Tony Littau - Bristol Bay Borough School District
Jim Huff - Bristol Bay Borough School District
Ralph Mancuso - Paug-Vik Incorporated, Limited

Newhalen

Wassie Balluta, Sr. - Mayor

New Stuyahok

Duwayne Johnson - Mayor
Sacally Wanhola - School Generator Maintenance Man
Peter Christopher - Village Council Member

Nondalton

Jim Lewis - Mayor
Benny Trefon - Member of Village Council

Portage Creek

Nick Dancer - President of Village Council
Natalia Wassily - Health Aide

South Naknek

Ralph Angasan - President of Alaska Peninsula Corporation