

ALASKA LEGISLATURE SPECIAL COMMITTEE / SUBJECT FILES 8672

992 SCOMM44: HOUSE POWER ALTERNATIVES STUDY COMM. 1979-80

Table 3
Average Annual Commercial-Industrial
Electricity Use Per Customer

Year	Southeast Commercial		Southeast Industrial		Southcentral Commercial/Industrial	
	Number of Customers	Average Annual MWH Usage per Customer	Number of Customers	Average Annual MWH Usage per Customer	Number of Customers	Average Annual MWH Usage per Customer
65	1,608	20.345	*	*	1,575	35.594
66	1,662	21.227	*	*	1,399	41.924
67	1,650	21.932	*	*	1,559	40.880
68	1,657	22.749	*	*	1,703	49.342
69	1,704	22.700	*	*	1,687	58.618
70	1,761	25.117	57	457.912	2,447	49.412
71	1,783	26.515	54	522.870	2,331	56.280
72	1,857	27.607	89	322.101	2,403	54.420
73	1,943	29.440	52	549.442	2,636	54.961
74	1,359	28.852	13	1,401.385	2,839	53.583

Year	Anchorage Commercial/Industrial		Fairbanks Commercial/Industrial	
	Number of Customers	Average Annual MWH Usage per Customer	Number of Customers	Average Annual MWH Usage per Customer
65	3,035	46.997	1,318	25.181
66	3,105	51.790	1,467	23.910
67	3,195	56.794	1,452	25.363
68	3,488	56.865	1,469	33.665
69	3,793	58.475	1,579	35.269
70	4,093	63.260	1,717	62.087
71	4,245	70.804	1,772	69.268
72	4,652	75.654	1,800	69.773
73	4,815	84.714	1,883	73.167
74	5,132	85.395	2,073	71.449

*No customer figures available.

along with two sets of assumptions (limited and accelerated petroleum development) was used to generate two projections of the future level of economic activity in the state. These are not predictions of the level of any particular variable, because future levels for the basic variables cannot be known with certainty. Rather, they are projections which describe the general expected levels of activity, if petroleum development and other basic activities take a certain course.

Results from the two cases are presented in Table 8. Two factors primarily account for the rapid growth observed in both cases. The first is the continued expansion of the petroleum industry, which has had an annual average increase in real gross

product of 17 percent since statehood. The second is the continuing important role of state and local government in the economy, stimulated by petroleum revenues.

In the limited case, annual population growth between 1974 and 1990 averages 3.8 percent, employment growth 4.3 percent, real wages and salaries 6.1 percent, and state and local government expenditures 12.2 percent. Accelerated development results in population growth of 4.8 percent, employment 5.2 percent, real wages and salaries 7.1 percent, and state and local government expenditures 13.7 percent.

Alaskan economic growth will be strong even in the limited development case, primarily because of

Table 4
1974 Residential Electricity Consumption by Region and Community

Map Region, Census Division	Utility Locations	(A) 1974 Residential Customers	(B) 1974 KWH Residential Sales by Utilities	(C) (B/A) Annual KWH Sales/Customers
Region I				
Northwest Alaska				
Barrow	Barrow	377	915,896	2,429
Kobuk	Kotzebue	369	1,553,676	4,210
Nome	Nome, Unalakleet	748	6,454,067	8,628
Region II				
Southwest Alaska				
Aleutian Islands		---	---	---
Bethel	Bethel	670	2,470,288	3,687
Bristol Bay Bor.	Naknek	190	980,821	5,162
Bristol Bay	Dillingham	301	1,200,571	3,989
Kuskokwim	McGrath	54	97,283	1,802
Wade Hampton		---	---	---
Region III				
Southeast Alaska				
Angoon		---	---	---
Haines	Haines	596	5,346,132	8,970
Juneau	Auke Bay, Juneau	5,266	35,392,244	6,721
Ketchikan	Ketchikan	3,569 ^a	30,957,853 ^a	8,674 ^a
Outer Ketchikan	Metlakatla	326	6,881,403	21,109
Prince of Wales	Craig, Hydaburg	b	742,597	b
Sitka	Sitka	1,666	11,656,608	6,997
Skagway- Yakutat	Pelican, Skagway	b	1,205,185	b
Wrangell- Petersburg	Wrangell, Petersburg	1,532	9,482,975	6,190
Region IV				
Southcentral Alaska				
Cordova- McCarthy	Cordova	534	3,159,042	5,916
Kenai-Cook Inlet	Homer	2,023	14,494,954	7,165
Kodiak	Kodiak	1,774	10,596,414	5,973
Matanuska- Susitna	Palmer	1,087	5,940,733	5,465
Seward	Seward	785	4,664,360	5,942

(Continued, next page)

Table 4 (Cont.)

Map Region, Census Division	Utility Locations	1974 Residential Customers	1974 KWH Residential Sales by Utilities	(B/A) Annual KWH Sales/Customers
Valdez- Chitina- Whittier	Valdez	935	3,750,993	4,012
Region V Anchorage				
Anchorage	Anchorage	43,456	395,854,136	9,109
Region VI Interior				
Upper Yukon	Ft. Yukon	130	179,650	1,381
Yukon- Koyukuk	Manley Hot Springs	9	48,764	5,418
Region VII Fairbanks				
Fairbanks	Fairbanks	13,261	153,781,613	11,597
Southeast Fairbanks	Dot Lake, Tok	b	674,870	b
TOTAL		79,062	700,514,344	8,860

SOURCE: FPC reports and Alaska Public Utilities Commission Annual Reports.

^a1973 figures^bConsumption figures not complete

the projected continued growth in the state and local government sectors. The two cases parallel one another closely until 1980, at which time the accelerated development case begins expanding much more rapidly.

Tables 9 and 10 present the projection results for population, employment, and real wages and salaries (which is closely related to personal income) on a regional basis for the two cases. The impact of development does not fall evenly across the regions of the state. A basic indicator of this is the difference in population growth rates among the regions and between cases as shown in Table 11.

In comparison with the projected rate of population increase in the United States of under 1 percent annually, these figures indicate significant population growth.

Electricity Demand Projection Results

Four different sets of electricity-use assumptions

(use-intensity scenarios) described in Appendix 2 were developed and combined with the two sets of economic projections (see Tables 9 and 10) to yield, for each region of the state, eight separate projections of utility electricity requirements through 1995. The different use-intensity scenarios reflect different assumptions regarding the future relative attractiveness of electricity as a source of energy. The highest and lowest of these projected requirements for each region were combined to yield the range of values for the state as a whole as shown in Table 12.

One can see in Table 12 that under the most restrictive assumptions regarding limited economic growth and electricity use, the long-run growth rate of electricity demand in Alaska is projected to exceed 8 percent. At the other extreme of accelerated economic development and continued historical rates of increase in electricity consumption, the long-run growth rate for electricity demand approaches 14 percent. Whatever the long-range growth rate actually turns out to be, Alaska requirements are expected to

be considerably higher than the historic national growth rate of 7 percent.

The larger component of variation among the different projections is in the intensity of electricity use rather than in the assumptions regarding economic growth. The long-run growth rate varies between 9.0 percent and 12.9 percent among the use-intensity scenarios within the accelerated economic development case, but only between 11.2 percent and 12.9 percent between economic development scenarios in the highest use-intensity case. The primary reason for this seems to be that the economic growth of the state is projected to largely depend upon state government activity which will grow steadily over the period under either economic growth assumption. This underscores the importance of the average consumption of electricity by the individual in the determination of total demand in a

rapidly growing region. Electricity consumption occurs through use of appliances, the purchase of which is a long-term investment. A rapidly growing population means a rapid growth in appliance stocks not only in the residential but the commercial and industrial sectors as well. Type of appliance (gas, oil, or electricity) decisions by these new customers will strongly influence the growth rate of electricity use.

A regional comparison of projected electricity requirements is shown in Table 13. This comparison shows that not only is present electricity consumption concentrated in the railbelt area of the state (Anchorage, Southcentral, and Fairbanks regions), but future growth will further concentrate electricity use in that part of the state.

Some indication of the magnitude of electricity requirements for the railbelt area is provided by a comparison of peak demand, measured in megawatts, with the installed capacity of 1,568 megawatts, which would be available from the Devil's Canyon Hydroelectric project proposed for the Susitna River by the Corps of Engineers. Total requirements in the railbelt would exceed this amount by 1995 in even the lowest growth case.

Growth of electricity requirements in Anchorage, which has the most diversified economy in the state, will be most rapid in the long run and relatively insensitive to the rate of economic development statewide. Southcentral growth will be most rapid in the short run and will moderate somewhat over the longer period. The projected range of variability for Fairbanks is larger due to the larger relative impact of direct petroleum-related activity in that community. By contrast, growth in the Southeast is the most stable in the state, showing little variation among projections. This stability largely arises from the lower population growth rate projected for that region. In the other regions of the state, projected growth rates are highly variable, but are below the statewide average, which is strongly influenced by Anchorage. Data for the utilities in these regions are sparse; some communities are still in the process of becoming electrified, so that the largest variation in projections is to be expected for those regions.

Detailed projections of sales and peak demand by region under each set of assumptions are presented in Tables 14 and 15. In addition, underlying assumptions regarding the ratio of consumers to population in each case as well as the average rate of consumption are presented in Table 16 for those regions where the data is available.

Analysis of Table 16 provides some additional insight into the plausibility of each set of projections.

Table 5
Heating Degree Days for Alaskan Communities
20 Year Averages (1955-1974)

Heating Degree Days (Fahrenheit)	
Anchorage	10,960
Annette (S.E.)	7,054
Barrow	20,426
Barter Island (Int.)	20,197
Bethel	13,372
Bettles (Int.)	16,107
Cold Bay	9,885
Fairbanks	14,439
Gulkana	14,250
Homer	10,443
Juneau	9,184
King Salmon (S.W.)	11,701
Kodiak	8,890
Kotzebue (N.W.)	16,171
McGrath (S.W.)	14,667
Nome (N.W.)	14,512
St. Paul Island	11,205
Shemya (S.W.)	9,574
Summit (S.C.)	14,603
Talkeetna	12,024
Unalakleet (N.W.)	14,162
Yakutat (S.E.)	9,711

SOURCE: U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, Environmental Data Service, "Local Climatological Data," various issues, Asheville, N.C., 1974.

Table 6
Typical Monthly Bills for Residential Electricity

Map Region, Census Division	Utility Location	Minimum Bill (\$)	50 KWH Bill (\$)	Price per KWH (cents)	100 KWH Bill (\$)	Price per KWH (cents)	500 KWH Bill (\$)	Price per KWH (cents)
Region I								
Northwest Alaska								
Barrow	Barrow	10.00	10.00	20.0	15.00	15.0	66.00	13.2
Kobuk	Kotzebue	10.00	10.00	20.0	17.50	17.5	67.50	13.5
Nome	Nome	5.00	5.00	10.0	10.00	10.0	50.00	10.0
	Teller		10.00	20.0	20.00	20.0	100.00	20.0
	Unalakleet	10.00	12.00	24.0	18.00	18.0	54.00	10.8
Region II								
Southwest Alaska								
Aleutian Islands	Cold Bay	10.00	10.00	20.0	10.00	10.0	41.00	8.2
Bethel	Bethel	5.00	6.00	12.0	11.00	11.0	44.75	9.0
Bristol Bay	Dillingham	14.00	14.00	28.0	14.00	14.0	50.00	10.0
	Egegik	7.50	7.50	15.0	13.50	13.5	44.50	8.9
Bristol Bay	King Salmon	7.50	7.50	15.0	13.50	13.5	44.50	8.9
Borough	Naknek	7.50	7.50	15.0	13.50	13.5	44.50	8.9
Kuskokwim	Aniak	20.00	20.00	40.0	20.00	20.0	95.00	19.0
	McGrath	5.00	6.75	13.5	12.50	12.5	57.00	11.4
Region III								
Southeast Alaska								
Haines	Haines	5.50	5.50	11.0	7.50	7.5	23.50	4.7
Juneau	Auke Bay	10.00	10.00	20.0	10.00	10.0	35.00	7.0
	Juneau	4.00	4.00	8.0	5.00	5.0	20.80	4.2
Ketchikan	Ketchikan	4.50	6.00	12.0	7.50	7.5	18.25	3.7
Outer Ketchikan	Metlakatla*							
Prince of Wales	Craig	3.30	5.30	10.6	9.80	9.8	37.80	7.6
	Hydaburg	3.30	5.30	10.6	9.80	9.8	37.80	7.6
Sitka	Sitka	5.00	5.00	10.0	5.00	5.0	19.00	3.8
Skagway-	Hoonah	--	5.00	10.0	10.00	10.0	50.00	10.0
Yakutat	Pelican	2.50	3.75	7.5	6.00	6.0	26.00	5.2
	Skagway	3.50	5.00	10.0	10.00	10.0	31.50	6.3
	Yakutat	5.00	5.00	10.0	10.00	10.0	40.00	8.0
Wrangell-	Petersburg*							
Petersburg	Wrangell	5.50	5.50	11.0	9.35	9.4	24.75	5.0
Region IV								
Southcentral Alaska								
Cordova-McCarthy	Cordova	4.00	6.50	13.0	9.50	9.5	27.50	5.5
Kenai-Cook	Homer	7.50	7.50	15.0	8.00	8.0	25.00	5.0
Inlet	Kenai	5.00	5.00	10.0	7.50	7.5	23.50	4.7
	Port Graham*							
	Seldovia	7.50	7.50	15.0	11.50	11.5	33.50	6.7
	Soldotna	7.50	7.50	15.0	8.00	8.0	25.00	5.0
Kodiak	Kodiak	3.00	5.50	11.0	9.13	9.1	24.63	4.9
	Port Lions	9.00	7.00	14.0	14.00	14.0	44.00	8.8

(Continued, next page)

Table 6 (Cont.)

Map Region, Census Division	Utility Location	Minimum Bill (\$)	50 KWH Bill (\$)	Price per KWH (cents)	100 KWH Bill (\$)	Price per KWH (cents)	500 KWH Bill (\$)	Price per KWH (cents)
Matanuska-								
Susitna	Palmer	9.00	9.00	18.0	9.00	9.0	31.25	6.3
Seward	Seward	6.00	7.80	15.6	12.30	12.3	23.30	4.7
Valdez-Chitina-	Chitina	--	7.50	15.0	15.00	15.0	75.00	15.0
Whittier	Glennallen	7.50	8.00	16.0	13.50	13.5	45.50	9.1
	Valdez	5.00	5.00	10.0	9.75	9.8	41.75	8.4
	Paxson Lodge	5.00	8.00	16.0	13.50	13.5	53.50	10.7
Region V								
Anchorage								
Anchorage	Eagle River	9.00	9.00	18.0	9.00	9.0	31.25	6.3
	Municipal	2.00	2.75	5.5	4.25	4.3	13.00	2.6
	Chugach	2.00	2.75	5.5	4.25	4.3	13.75	2.8
Region VI								
Interior								
Upper Yukon	Deadhorse	--	13.20	26.4	26.39	26.4	131.94	26.4
	Fort Yukon	3.00	12.50	25.0	25.00	25.0	85.00	17.0
Yukon-Koyukuk	Bettles	--	12.00	24.0	24.00	24.0	120.00	24.0
	Manley Hot Springs	10.00	12.50	25.0	25.00	25.0	125.00	25.0
	Nenana	7.00	7.00	14.0	13.00	13.0	61.00	12.2
	Tanana	7.80	7.80	15.6	13.00	13.0	61.00	12.2
Region VII								
Fairbanks								
Fairbanks	Municipal	1.80	4.00	8.0	7.50	7.5	22.50	4.5
	Golden Valley	10.00	10.00	20.0	10.00	10.0	37.96	7.6
Southeast	Delta							
Fairbanks	Junction	10.00	10.00	20.0	10.00	10.0	30.38	6.1
	Dot Lake	--	7.50	15.0	15.00	15.0	63.00	12.6
	Northway	10.00	10.00	20.0	13.00	13.0	55.00	11.0
	Tok	7.50	7.50	15.0	13.00	13.0	53.50	10.7
Alaska Village								
Electric Cooperative (AVEC)		--	10.00	20.0	18.75	18.8	72.75	14.6

*Information not available.

SOURCE: Electric utility rate files, Alaska Public Utilities Commission, as of October 1975. These are the rates on file at the commission and do not include either interim rate increases or automatic fuel cost rate adjustments which increase actual prices paid. For utilities with more than one residential rate, the base rate without specific appliances was reported.

In particular, in the growth-as-usual use-intensity projections, the ratios of residential customers to population and average annual consumption continue to grow quite rapidly. The most striking example of this occurs in the Fairbanks region, where by 1990, assuming accelerated economic growth, average annual residential consumption exceeds 40,000 kwh per year. At present, the typical all-electric home in the Fairbanks area (including space heat) consumes

approximately 40,000 kwh. Thus, the unlikely assumption implied for Fairbanks in the growth-as-usual case is that the entire housing stock will, by 1990, convert to all-electric appliances. Also during this period, the ratio of residential customers to population is projected to increase from 28 to over 37 percent. This implies either a drastic reduction in average family size or a substantial increase in the incidence of second homes.

Neither of these implied assumptions appears likely to the author. It seems, therefore, that the growth-as-usual assumptions should not be seriously considered as a possible future growth pattern in electricity consumption.

CONCLUSION

This paper has attempted to delineate the possible range of growth of electricity requirements for the state. The range is wide, both because of the uncertainty surrounding economic growth and also the uncertainty of response by future customers to variables affecting consumption rates. Within the broad range of growth possibilities, however, the variation seems to be between rapid growth of requirements and very rapid growth. Clearly, to adequately respond to this growth with an efficient investment strategy to develop necessary additional capacity is a challenging prospect, given the many options available to the state.

* * * *

Table 7

Automatic Fuel Cost Rate Adjustment Clause Surcharges as of October 1, 1975

Utility	Surcharge in cents/KWH
Aniak Power Company	2.89
Craig (AP&T)	2.06
Egegik (Naknek Electric Association)	4.5
Fort Yukon Utilities	1.082
Golden Valley Electric Association	.5973
Haines Light & Power	1.33
Homer Electric Association	1.32
Hydaburg (AP&T)	2.49
Juneau (AELP)	.48
Kodiak Electric Association	1.34
Kotzebue Electric Association	1.518
Matanuska Electric Association	1.74
Naknek Electric Association	1.5
Northern Commercial Company	1.87
Northern Power and Engineering	1.76
Northway Power and Light	1.63
Nushagak Electric	1.502
Skagway (AP&T)	.35
Tok (AP&T)	1.96
Yakutat Power Company	1.604

SOURCE: Alaska Public Utilities Commission

Table 8

MAP Projection Results for Selected Variables

	Limited Development	Accelerated Development
1974		
Population (x 1000)	350.7	350.7
Employment (x 1000)	159.9	159.9
Wages and Salaries (real millions of 1967 \$)	973.9	973.9
Petroleum Production (thousand b/d)	200	200
State and Local Government Expenditures (nominal million \$)	793.2	793.2
1980		
Population (x 1000)	456.9	471.4
Employment (x 1000)	219.7	229.2
Wages and Salaries (real millions of 1967 \$)	1,506.9	1,586.3
Petroleum Production (thousand b/d)	2,066	2,066
State and Local Government Expenditures (nominal million \$)	1,973.3	2,058.1
1985		
Population (x 1000)	547.9	614.8
Employment (x 1000)	265.4	300.9
Wages and Salaries (real millions of 1967 \$)	1,970.0	2,260.8
Petroleum Production (thousand b/d)	3,033	4,930
State and Local Government Expenditures (nominal million \$)	3,408.8	4,084.4
1990		
Population (x 1000)	641.3	738.0
Employment (x 1000)	312.7	361.4
Wages and Salaries (real millions of 1967 \$)	2,506.2	2,919.2
Petroleum Production (thousand b/d)	3,597	7,299
State and Local Government Expenditures (nominal million \$)	5,026.1	6,197.1

Table 9
MAP Model Economic Projection Values for Limited Development Case

Population
 (Thousands of Persons)

Year	RGN 1	RGN 2	RGN 3	RGN 4	RGN 5	RGN 6	RGN 7	STATE
74	13.499	27.563	48.615	45.283	153.118	8.562	54.020	350.659
75	13.748	27.647	51.466	53.601	163.909	9.967	57.800	378.137
76	14.051	28.042	53.956	56.240	173.753	9.831	59.161	395.034
77	14.226	28.534	54.610	53.252	179.760	9.067	57.867	397.315
78	14.362	28.801	55.765	54.812	187.411	9.386	58.735	409.272
79	14.589	29.078	57.982	57.252	198.372	9.387	59.912	426.571
80	14.919	29.362	61.555	64.246	214.927	9.764	62.154	456.927
81	15.254	29.879	64.112	68.273	225.612	9.798	64.218	477.145
82	15.503	30.192	66.534	71.557	236.992	9.008	65.962	495.747
83	15.621	30.379	67.842	76.951	247.200	8.736	66.938	513.667
84	15.818	30.710	69.595	79.078	259.264	8.670	68.388	531.523
85	16.039	31.125	71.297	78.763	271.972	8.759	69.957	547.913
86	16.234	31.500	72.870	79.301	284.590	8.767	71.415	564.478
87	16.393	31.833	74.182	80.670	297.139	8.795	72.683	581.693
88	16.549	32.160	75.546	81.495	311.223	8.802	73.992	599.767
89	16.699	32.471	76.911	83.251	325.999	8.821	75.352	619.503
90	16.857	32.778	78.427	85.146	342.414	8.875	76.847	641.344

Employment
 (Thousands of Persons)

74	4.085	10.654	24.627	17.929	72.475	5.344	24.772	159.886
75	4.471	11.183	27.006	21.492	79.244	8.687	27.542	179.625
76	4.723	11.567	28.624	22.490	84.200	8.279	28.294	188.177
77	4.682	11.626	28.482	20.964	85.874	6.236	26.932	184.796
78	4.766	11.829	29.138	21.502	89.515	6.830	27.336	190.916
79	5.003	12.210	30.709	22.487	95.351	6.862	28.099	200.720
80	5.446	12.830	33.521	25.427	104.854	7.872	29.760	219.712
81	5.693	13.237	35.040	26.847	109.713	7.800	30.781	229.111
82	5.990	13.705	36.848	28.191	115.906	6.125	31.933	238.696
83	6.159	14.036	37.891	30.396	121.570	5.634	32.629	248.313
84	6.344	14.392	39.056	31.173	127.680	5.476	33.449	257.569
85	6.495	14.714	39.999	30.865	133.607	5.546	34.186	265.412
86	6.639	15.036	40.906	30.933	139.613	5.488	34.904	273.520
87	6.755	15.334	41.659	31.851	145.664	5.477	35.531	281.771
88	6.879	15.649	42.477	31.570	152.579	5.439	36.207	290.799
89	7.020	15.997	43.360	32.189	160.037	5.438	36.968	301.010
90	7.185	16.376	44.394	32.883	168.476	5.515	37.849	312.677

Real Wages and Salaries
 (Millions of Dollars)

74	24.9	56.5	150.5	102.5	441.1	48.1	150.2	973.9
75	27.7	60.9	168.8	130.3	493.5	82.5	174.9	1138.6
76	29.8	64.4	182.9	138.1	535.0	78.1	183.2	1211.5
77	30.2	66.0	185.9	128.1	556.1	54.4	175.1	1195.8
78	31.4	68.4	194.0	134.1	590.2	59.3	181.2	1258.5
79	33.5	72.1	208.7	142.9	640.0	59.4	190.0	1346.6
80	37.1	77.4	232.6	168.1	716.1	69.4	206.2	1506.9
81	39.5	81.5	247.9	180.6	761.6	69.2	218.0	1598.3
82	42.4	86.0	265.7	192.2	817.7	51.8	231.2	1687.0
83	44.4	89.7	278.4	212.7	871.1	47.2	241.1	1784.8
84	46.7	93.7	292.5	221.0	929.4	46.0	242.6	1881.9
85	48.8	97.6	305.3	220.3	987.2	47.2	263.6	1970.0
86	50.9	101.4	318.1	222.9	1046.8	47.0	274.7	2061.9
87	52.9	105.2	329.9	229.0	1107.9	47.5	285.4	2157.8
88	55.0	109.2	342.6	233.7	1176.7	47.6	296.7	2261.7
89	57.3	113.4	356.1	241.5	1251.0	48.2	309.1	2376.6
90	59.9	118.0	371.3	249.8	1334.6	49.5	323.1	2506.2

Table 10
MAP Model Economic Projection Values for Accelerated Development Case

Population
 (Thousands of Persons)

Year	RGN 1	RGN 2	RGN 3	RGN 4	RGN 5	RGN 6	RGN 7	STATE
74	13.499	27.563	48.615	45.283	153.118	8.562	54.020	350.659
75	13.748	27.647	51.466	53.601	163.909	9.967	57.800	378.137
76	14.051	27.042	53.956	56.240	173.753	9.831	59.161	395.034
77	14.387	28.483	53.738	55.478	186.201	9.035	59.081	409.402
78	14.357	28.710	56.059	58.860	190.077	9.352	58.948	416.363
79	14.632	29.040	58.654	61.233	202.266	9.257	60.115	435.196
80	16.055	29.550	62.410	69.002	221.208	10.172	63.032	471.429
81	18.138	30.278	65.145	78.349	236.062	11.291	66.297	505.560
82	20.409	31.006	69.286	88.024	257.630	12.058	70.672	549.083
83	20.601	31.625	72.957	94.871	278.020	11.778	73.391	583.243
84	19.079	32.419	76.424	91.155	294.060	10.166	74.951	598.253
85	18.881	33.225	78.392	89.892	307.794	10.035	76.592	614.811
86	18.610	33.912	80.392	89.975	323.307	9.851	78.212	634.258
87	18.867	34.602	82.150	91.668	340.177	10.031	79.950	657.445
88	19.177	35.267	84.073	93.211	359.740	10.191	81.827	683.484
89	19.289	35.660	86.067	95.613	379.584	10.233	83.718	710.163
90	19.414	35.911	88.027	98.147	400.593	10.305	85.607	738.004

Employment
 (Thousands of Persons)

74	4.085	10.654	24.627	17.929	72.475	5.344	24.772	159.886
75	4.471	11.183	27.006	21.492	79.244	6.687	27.542	179.625
76	4.723	11.567	28.624	22.490	84.200	8.279	28.294	188.177
77	5.009	11.995	30.439	22.119	90.473	6.408	28.133	194.575
78	4.835	11.906	29.547	23.213	91.439	6.868	27.660	195.467
79	5.114	12.336	31.373	24.169	97.903	6.682	28.403	205.981
80	6.743	13.147	34.226	27.378	108.429	8.935	30.392	229.249
81	9.326	13.746	35.777	30.844	115.221	11.838	32.079	248.830
82	13.009	14.590	38.613	34.597	126.224	14.241	34.710	275.983
83	13.358	15.430	41.278	37.319	136.987	13.274	36.429	294.075
84	10.514	16.289	43.509	35.614	144.590	8.455	37.114	296.114
85	9.845	16.871	44.248	34.670	149.853	7.845	37.586	300.916
86	9.242	17.526	45.288	34.444	156.764	7.273	38.252	308.797
87	9.470	18.274	46.233	34.896	164.570	7.542	39.062	320.047
88	9.811	19.080	47.393	35.344	174.012	7.804	40.037	333.481
89	9.906	19.558	48.695	36.172	183.844	7.838	41.096	347.108
90	10.031	19.838	49.998	37.061	194.348	7.948	42.176	361.399

Real Wages and Salaries
 (Millions of Dollars)

74	24.9	56.5	150.5	102.5	441.1	48.1	150.2	973.9
75	27.7	60.9	168.8	130.3	493.5	82.5	174.9	1138.6
76	29.8	64.4	182.9	138.1	535.0	78.1	183.2	1211.5
77	32.2	68.3	198.8	135.3	586.6	55.3	183.7	1260.1
78	31.8	68.9	196.8	149.8	603.2	59.5	183.6	1293.6
79	34.3	72.9	213.3	158.3	657.4	57.2	192.2	1385.5
80	51.8	79.7	237.5	186.2	740.9	78.8	211.3	1586.3
81	82.7	85.3	253.2	216.6	800.3	107.8	229.1	1775.1
82	125.8	92.8	278.7	247.4	890.9	129.7	255.9	2020.3
83	129.2	100.4	303.9	270.9	982.0	121.4	273.5	2181.2
84	94.5	108.5	326.8	256.6	1052.5	75.3	283.8	2197.8
85	87.1	114.7	338.6	251.0	1107.3	69.4	292.8	2260.8
86	80.3	121.5	353.1	251.7	1175.1	63.7	303.9	2349.4
87	83.8	129.3	367.3	258.2	1251.0	67.0	316.7	2473.3
88	88.9	137.7	383.6	265.2	1231.0	70.2	331.3	2617.9
89	90.7	143.4	401.5	274.8	1435.4	71.2	347.1	2764.0
90	93.0	147.5	419.9	285.2	1537.2	72.9	363.5	2919.2

Table 11

Projected Average Annual Population Growth Rates

	North-west	South-west	South-east	South-central	Anchorage	Interior	Fairbanks	State
Limited Development	1.4	1.1	3.0	4.0	5.2	.0	2.2	3.8
Accelerated Development	2.3	1.7	3.8	5.0	6.2	1.2	2.9	4.8

Table 12

State Electricity Demand Projections Summary

Year	Thousands of MWH Demanded				Annual Growth Rates Calculated from 1974 (%)				MW Peak Capacity @ 50% Load			
	Limited Economic Development		Accelerated Economic Development		Limited Economic Development		Accelerated Economic Development					
	Highest	Lowest	Highest	Lowest	Highest	Lowest	Highest	Lowest				
1974	1,715	1,715	1,715	1,715	--	--	--	--	392	392	392	392
1980	3,909	2,830	4,286	2,941	14.7	8.7	16.5	9.4	892	646	979	671
1985	6,581	4,147	8,358	4,712	13.0	8.4	15.5	9.6	1,503	947	1,908	1,076
1990	10,158	5,975	13,450	6,961	11.8	8.1	13.7	9.2	2,319	1,364	3,071	1,589
1995	15,799	8,765	21,929	10,524	11.2	8.1	12.9	9.0	3,607	2,001	5,007	2,403

Table 13
Summary of the Range of Alaska Electricity
Demand Projections, 1985 and 1995

Region		Peak Demand (MW)			Total Energy Sales (Thousand MWH)			Average Annual Growth Rates		
		1974 (actual)	1985	1995	1974 (actual)	1985	1995	1975 to 1980	1975 to 1985	1975 to 1995
Anchorage (v)	Lowest	199	538	1300	867	2347	5679	9.9	9.4	9.4
	Highest	199	1104	3515	867	4822	15350	17.5	16.9	14.7
Southcentral (except Anchorage) (iv)	Lowest	62	164	372	282	748	1325	10.1	9.2	7.6
	Highest	62	290	611	282	1701	2791	21.9	17.7	11.5
Anchorage, Southcentral	Lowest	261	702	1672	1149	3095	7004	9.9	9.4	9.0
	Highest	261	1394	4126	1149	6523	18141	18.7	17.1	14.0
Fairbanks (vii)	Lowest	76	144	260	319	602	1088	5.8	5.9	6.0
	Highest	76	297	677	319	1244	2843	12.8	13.2	11.0
Anchorage, Southcentral, and Fairbanks	Lowest	337	846	1932	1468	3697	8092	9.1	8.8	8.5
	Highest	337	1691	4803	1468	7787	20984	17.6	16.4	13.5
Southeast (iii)	Lowest	48	93	141	215	417	634	6.7	6.2	5.3
	Highest	48	112	184	215	505	827	8.7	8.1	6.6
Northwest plus Southwest (i & ii)	Lowest	8	9	10	31	36	44	2.0	1.3	1.6
	Highest	8	21	31	31	86	127	9.7	9.7	6.9
Alaska Statewide	Lowest	393	948	2083	1715	4147	8765	8.6	8.4	8.1
	Highest	393	1824	5018	1715	8358	21938	16.5	15.5	12.5

Note: There are no significant electric utilities in the Interior Region.

Table 14
Projected Net Sales of Electric Utilities to Final Consumers (Thousand MWH)
 Electricity Use Intensity Scenario

Electricity Intensity Scenario	Case 1		Case 2		Case 3		Case 4	
	Growth As Usual		Moderate Residential Electrification Commercial/Industrial Growth As Usual		Low Residential Electrification Commercial/Industrial Minimum Electrification		Minimum Growth	
	Limited Growth	Accelerated Growth	Limited Growth	Accelerated Growth	Limited Growth	Accelerated Growth	Limited Growth	Accelerated Growth
Northwest^a								
1974 (Actual)	15.178	15.178					15.178	15.178
1980	20	24					17	18
1985	24	34					17	21
1990	27	36					19	22
1995	30	37					20	23
Southwest^b								
1974 (Actual)	16.615	16.615					16.615	16.615
1980	28	30					18	18
1985	40	52					19	21
1990	51	69					20	23
1995	63	90					22	25
Southeast^c								
1974 (Actual)	215.088	215.088	215.088	215.088	215.088	215.088	215.088	215.088
1980	328	338	344	355	340	350	318	326
1985	432	487	443	505	449	502	417	465
1990	529	611	527	617	561	639	523	594
1995	656	777	634	763	713	827	667	768
Southcentral^d								
1974 (Actual)	282.417	282.417	282.417	282.417	282.417	282.417	282.417	282.417
1980	762	933	717	849	563	612	503	544
1985	1,302	1,701	1,131	1,432	835	966	748	857
1990	1,659	2,178	1,390	1,774	1,087	1,267	987	1,142
1995	2,114	2,791	1,716	2,205	1,436	1,686	1,323	1,545
Anchorage								
1974 (Actual)	867.132	867.132	867.132	867.132	867.132	867.132	867.132	867.132
1980	2,124	2,286	2,012	2,147	1,664	1,723	1,529	1,580
1985	3,734	4,822	3,245	4,076	2,550	2,924	2,347	2,679
1990	6,326	8,637	5,096	6,749	3,910	4,628	3,625	4,273
1995	10,633	15,350	7,982	11,154	6,071	7,416	5,679	6,918
Fairbanks								
1974 (Actual)	318.751	318.751	318.751	318.751	318.751	318.751	318.751	318.751
1980	631	658	558	616	485	495	446	455
1985	1,032	1,244	833	950	650	727	602	669
1990	1,534	1,891	1,090	1,256	861	977	803	907
1995	2,247	2,834	1,410	1,640	1,157	1,334	1,088	1,250

^aIncludes utilities at Kotzebue, Nome, and Unalakleet.

^bBethel, McGrath, Naknek, and Nushagak.

^cJuneau, Ketchikan, Metlakatla, Petersburg, Sitka, and Wrangell.

^dIncludes Cordova, Glennallen, Homer, Kenai, Kodiak, Palmer, Seldovia, Seward, Talkeetna, and Valdez.

Table 15
Projected Electricity Peak Demand (MW)

Electricity Intensity Scenario	Case 1		Case 2		Case 3		Case 4	
	Growth As Usual		Moderate Residential Electrification Commercial/Industrial Growth As Usual		Low Residential Electrification Commercial/Industrial Minimum Electrification		Minimum Growth	
Economic Scenario	Limited Growth	Accelerated Growth	Limited Growth	Accelerated Growth	Limited Growth	Accelerated Growth	Limited Growth	Accelerated Growth
<u>Northwest</u>								
1974	3.6	3.6					3.6	3.6
1980	4.8	5.7					4.0	4.3
1985	5.7	8.1					4.0	5.0
1990	6.4	8.6					4.5	5.2
1995	7.1	8.8					4.8	5.5
<u>Southwest</u>								
1974	4.1	4.2					4.1	4.1
1980	7.0	7.5					4.5	4.5
1985	10.0	12.9					4.7	5.2
1990	12.7	17.2					5.0	5.7
1995	15.7	22.4					5.5	6.2
<u>Southeast</u>								
1974	48.0	48.0	48.0	48.0	48.0	48.0	48.0	48.0
1980	73.1	75.4	76.7	79.2	75.8	78.1	70.9	72.7
1985	96.3	108.6	98.8	112.6	100.1	111.9	93.0	103.7
1990	118.0	136.3	117.5	137.6	125.1	142.5	116.6	132.5
1995	146.3	173.3	141.4	170.1	159.0	184.4	148.7	171.3
<u>Southcentral</u>								
1974	61.8	61.8	61.8	61.8	61.8	61.8	61.8	61.8
1980	166.9	204.3	157.0	185.9	123.3	134.0	110.2	119.1
1985	285.1	372.5	247.7	313.6	182.9	211.6	163.8	187.7
1990	363.3	477.0	304.4	388.5	238.1	277.5	216.2	250.1
1995	463.0	611.2	375.8	482.9	314.5	369.2	289.7	338.4
<u>Anchorage</u>								
1974	198.6	198.6	198.6	198.6	198.6	198.6	198.6	198.6
1980	486.4	523.5	460.7	491.7	381.1	394.6	350.1	361.8
1985	855.1	1,104.2	743.1	933.4	584.0	669.6	537.5	613.5
1990	1,448.7	1,977.9	1,167.0	1,545.5	895.4	1,059.8	830.1	978.5
1995	2,435.0	3,515.2	1,827.9	2,554.3	1,390.3	1,698.3	1,300.5	1,584.2
<u>Fairbanks</u>								
1974	76.2	76.2	76.2	76.2	76.2	76.2	76.2	76.2
1980	150.8	157.3	142.9	147.2	115.9	118.3	106.6	108.7
1985	246.6	297.3	199.1	227.1	155.4	173.8	143.9	159.9
1990	366.6	451.9	260.5	300.2	205.8	233.5	191.9	216.8
1995	537.0	677.3	337.0	392.0	276.5	318.8	260.0	298.8

Load factor: Northwest .53, Southwest .51, Southeast .56, Southcentral .56, Anchorage .55, Fairbanks .53.

System losses: Northwest 10.5%, Southwest 11.6%, Southeast 9.2%, Southcentral 7.4%, Anchorage 10.4%, Fairbanks 11.0%.

Table 16
Projected Residential Consumption Parameters

Electricity Intensity Use Scenario

Economic Scenario	Growth as Usual				Moderate Electrification				Low Electrification			
	Limited Growth		Accelerated Growth		Limited Growth		Accelerated Growth		Limited Growth		Accelerated Growth	
	hookup saturation	kwh/ consumer	hookup saturation	kwh/ consumer	hookup saturation	kwh/ consumer	hookup saturation	kwh/ consumer	hookup saturation	kwh/ consumer	hookup saturation	kwh/ consumer
Southeast												
1974	24.9%	7,623	24.9%	7,623	24.9%	7,623	24.9%	7,623	24.9%	7,623	24.9%	7,623
1980	24.5	8,520	25.9	8,555	27.0	9,137	27.0	9,232	27.0	8,394	27.0	8,422
1985	26.9	9,181	26.7	9,226	27.0	9,690	27.0	10,009	27.0	8,675	27.0	8,808
1990	27.9	9,776	27.7	9,818	27.0	10,008	27.0	10,340	27.0	8,837	27.0	8,972
1995	29.1	10,435	28.8	10,472	27.0	10,296	27.0	10,635	27.0	8,983	27.0	9,118
Southcentral												
1974	32.7%	8,026	32.7%	8,026	32.7%	8,026	32.7%	8,026	32.7%	8,026	32.7%	8,026
1980	37.4	12,896	38.3	14,240	37.0	11,076	37.0	11,422	37.0	9,639	37.0	9,822
1985	40.0	16,771	40.1	19,050	37.0	11,999	37.0	12,502	37.0	10,127	37.0	10,394
1990	40.8	18,961	41.2	21,589	37.0	12,304	37.0	12,801	37.0	10,289	37.0	10,552
1995	42.1	21,448	42.3	24,477	37.0	12,585	37.0	13,075	37.0	10,438	37.0	10,696
Anchorage												
1974	31.1%	9,106	31.1%	9,106	31.1%	9,106	31.1%	9,106	31.1%	9,106	31.1%	9,106
1980	35.8	12,614	36.1	12,931	35.0	11,317	35.0	11,425	35.0	10,010	35.0	10,054
1985	38.1	16,073	39.1	17,605	35.0	12,102	35.0	12,439	35.0	10,331	35.0	10,469
1990	39.9	20,505	40.9	23,090	35.0	12,695	35.0	13,023	35.0	10,573	35.0	10,707
1995	41.3	26,498	42.2	30,704	35.0	13,162	35.0	13,466	35.0	10,794	35.0	10,888
Fairbanks												
1974	28.0%	11,597	28.0%	11,597	28.0%	11,597	28.0%	11,597	28.0%	11,597	28.0%	11,597
1980	31.5	19,112	31.8	19,797	32.0	16,987	32.0	17,235	32.0	12,310	32.0	12,343
1985	34.3	26,816	34.9	30,735	32.0	18,952	32.0	20,278	32.0	12,509	32.0	12,746
1990	36.9	34,801	37.3	40,223	32.0	20,324	32.0	21,723	32.0	12,752	32.0	12,937
1995	39.6	44,585	40.0	52,006	32.0	21,561	32.0	23,002	32.0	12,916	32.0	13,107

Note: The no-growth case assumes no change over time in either hookup saturation or average KWH consumption per customer and is, therefore, omitted.
Hookup saturation is defined as residential customers/civilian population.

APPENDIX 1. THE MAP ECONOMIC MODEL

Growth in electricity requirements will closely follow growth in the state's economy. Projections of the state's future economic growth are provided by the Man-in-the-Arctic Program (MAP) regional econometric model of the state.

Model Description

The MAP model¹ allows the researcher to develop projections of key economic and demographic variables for seven regions of Alaska (Figure 1), based upon a set of assumptions about factors outside state control but impacting the state economy. Researchers constructed the model using multiple linear regression techniques with historic Alaskan data covering the period 1961 to the present.

Treatment of individual industries in the model depends upon whether the industry is basic or nonbasic. A basic industry is one in which the level of economic activity (as measured by employment, wages and salaries, and gross product) is determined by forces outside the Alaskan private economy. The basic determinants of activity in these industries are national and international markets, the physical availability of resources, and federal government policies impacting the state. Industries which fall into this category are mining (including petroleum), agriculture, forestry and fisheries, and manufacturing. Construction industry activity is partially determined by forces external to the Alaska economy and partially by instate economic activity.

The level of activity in nonbasic industries is essentially a function of the amount of income generated instate by both the basic and nonbasic industries. This category includes services, trade, finance, transportation, communications, and public utilities.

Government activity at the federal level is determined by forces outside state control, but state and local government revenues and expenditures are a function of Alaska economic conditions. State population is related not only to employment but also to relative disposable income in the state.

Development Scenarios

In order to project annual economic values using the MAP model, a set of assumptions must first be provided which indicates levels of expected activity

within the basic industry sectors. Most important within this set are the assumptions of the petroleum industry, because activity in this industry will have the most impact on economic growth in the state during the next 20 years. This impact will occur both through employment in the petroleum and related industries (such as construction) and through state revenues generated by petroleum exploration, development, and production.

In developing the electric power requirements, two different sets of assumptions were used regarding petroleum industry activities within the state. Each is a consistent scenario describing the level and pace of new discoveries. The average wellhead price of new oil discoveries is assumed to be \$5 per barrel in either case. The two cases are known as limited development and accelerated development.

Limited Development. This case represents the minimum expected level of petroleum leasing activity between the present and 1990. In addition to Cook Inlet and Prudhoe Bay, the federal government leases in Lower Cook Inlet and the Gulf of Alaska. In leasing the Outer Continental Shelf (OCS), the federal government effectively determines where state and private, primarily Native, development can occur. Thus, these parties are assumed to develop adjacent areas, and along the route of the oil pipeline. In addition, a gas line from Prudhoe Bay through Canada via the McKenzie Valley is constructed with minimum instate impact. In this scenario, petroleum production increases to 2 million barrels per day (mbd) in 1980 and 3.6 mbd in 1990.

Accelerated Development. This case incorporates all limited development activities. In addition, National Petroleum Reserve Alaska and several other OCS areas are developed through federal initiative. State and private development again follows the geographic lead of these activities. Petroleum development in this case increases more rapidly after 1980 and reaches 7.3 mbd by 1990. The OCS leasing schedule in this scenario is rapid but does not correspond to the schedule of leasing proposed as a part of Project Independence, nor does it include all OCS provinces identified and included in that schedule.

In addition to petroleum development assumptions, assumptions must be made regarding other basic industries. These other industries are assumed to experience mild growth, which does not vary between cases. This does not imply that

¹See box on page 1.

nonpetroleum basic industries are not important to the future of the state or that there will not be future growth in these industries. Developments in other basic industries will be of central importance, particularly on a community level. However, on a statewide and regional basis, the activities associated with petroleum development will be greater than those of other industries by an order of magnitude—thus, the choice to concentrate on petroleum development.

Finally, policy decisions by the state regarding the disposition of the revenues generated by petroleum development will affect the level of economic activity in the state. State government is assumed to place in a permanent fund 25 percent of recurrent and 50 percent of nonrecurrent petroleum revenues in both the limited and accelerated cases. This reflects the effect which the permanent fund will have on the level of expenditures.

APPENDIX 2. ELECTRICITY USE PROJECTION METHODOLOGY

The level of electricity requirements in future years will depend both upon the number of customers and the intensity of use per customer. These factors will in turn be related to the price of electricity, alternative types of energy available, and the level of income of the potential consumers. In Alaska, as elsewhere, there is evidence of a negative consumption response to price increases and a positive response to income increases. Although the relationship observed is only for one time period and only for the residential type of consumer, it is reasonable to expect that the same qualitative relationship will exist in other years and among other consumer types.¹

The MAP econometric model projects increases in real wages and salaries (closely related to personal income) but does not provide estimates of the future prices of electricity and other fuels. This is because these prices will increasingly be determined by national and international, as opposed to purely local, market conditions.

Because of this uncertainty both in price and in consumers' response to price as it affects consumption, several sets of projections must be made, each corresponding to a different set of assumptions regarding these variables. Since each set of assumptions is essentially independent of the growth rate of the economy, each of the projections of electricity use is linked to both sets of economic projections (slow growth and accelerated growth). In this way, the projections cover the likely range of requirements for electricity.

The four sets of assumptions are: (1) *no growth*, (2) *low electrification*, (3) *moderate electrification*, and (4) *growth as usual*. Each is

briefly described in the remainder of this section.

No-growth. This assumption provides the lowest estimate of future electricity use. The ratio of new residential customers to new population is assumed to be equal to the present ratio in each region. The average annual rate of consumption of existing customers is unchanged and new customers consume at the average rate of old customers. In the commercial and industrial sectors, new customers are projected at the same ratio to new population as existing customers. However, annual average consumption is allowed to grow at 5.8 percent, which was the national rate for the decade 1962-1972. These assumptions correspond to a very restrictive climate for electricity demand increase. Such a climate could result from substantial and continuing relative price increases for electricity, as well as from restrictions on electricity use, which would hold down or reduce consumer use.

Low-electrification. This case allows a gradual increase in the ratio of residential customers to population. Present customers will continue to consume at existing average rates, while consumption by new customers will be determined by the mix of appliances they choose and the average consumption rate of those appliances. New customers in each region are assumed to acquire major electric appliances (space heaters, water heaters, and stoves) in the same ratio as existing customers in that region. Other appliances in new households are all electric. The average consumption for a new customer will thus vary among regions, based not only upon differences in the existing ratio of particular electric appliances to consumers in the region, but also upon implicit regional differences in the average consumption rate of electricity in the different appliances. The commercial and industrial sectors are, because of scarcity of data, projected using the same methodology as in the *no-growth* case. However, the rationale behind this set of assumptions is a

¹A detailed analysis of this relationship is presented in Scott Goldsmith, "Future Electricity Requirements in Alaska," paper presented at the Western Economic Association Annual Meeting, San Francisco, June 17, 1976.

somewhat less restrictive atmosphere for the development of increased electricity demand than the *no-growth* case.

National average electricity requirements for the most common household appliances used in the

development of these projections are shown in Table 2-1. Data on the percentage of households with major electric appliances is shown in Table 2-2.

Moderate electrification. This case differs from low electrification in two respects. First, all new consumers in the residential sector acquire electric water heaters and stoves. Second, the projections of both commercial and industrial customers, as well as average consumption level per customer, are based upon regression analysis employing historical time series data for the individual region. This case reflects an atmosphere more conducive to electricity consumption growth than the former cases.

Growth-as-Usual. Finally, this case is based entirely upon regression analysis using observed historical relationships between the demographic and economic variables of the economic model and electric power consumed through utilities. Implicit in this case is the assumption of a continuing reduction in the relative price of electricity within Alaska.

Table 2-1

Household Appliance Electricity Consumption

Major Appliances	Average Wattage	Estimated Annual KWH Use
Dishwasher	1,201	100
Range (with oven)	12,200	1,175
Range (self-cleaning)	12,200	1,205
Freezer (15 cu. ft.)	341	1,195
Freezer (Frostless, 15 cu. ft.)	440	1,761
Refrigerator (12 cu. ft.)	241	728
Refrigerator (Frostless, 12 cu. ft.)	321	1,217
Clothes dryer	4,856	993
Water heater	2,475	4,219
Water heater (quick-recovery)	4,474	4,811
Air conditioner (room)	860	860
Dehumidifier	257	377
TV (black & white, tube)	160	350
TV (black & white, solid st.)	55	120
TV (Color, tube)	300	660
TV (color, solid st.)	200	440
Other Common Appliances		
Broiler	1,436	100
Coffee maker	894	106
Deep fryer	1,448	83
Frying pan	1,196	186
Hot plate	1,257	90
Oven (microwave)	1,450	190
Roaster	1,333	205
Toaster	1,146	39
Trash compactor	400	50
Iron (hand)	1,008	144
Wash machine (automatic)	512	103
Wash machine (nonautomatic)	286	76
Bed covering	177	147
Heater (portable)	1,322	176
Humidifier	177	163
Hair dryer	381	14
Heat lamp (infrared)	250	13
Radio	71	86
Clock	2	17
Sewing machine	75	11
Vacuum cleaner	630	46
Toothbrush	7	1/2

SOURCE: Electric Energy Association.

Table 2-2
Percentages of Households With Selected Appliances — 1970

CENSUS DIVISION	Number of Occupied Housing Units	Percent Modern Space Heat	Percent Electric Space Heat	Percent Modern Water Heat	Percent Electric Water Heat	Percent Modern Cooking Fuel	Percent Electric Cooking Fuel	Percent Clothes Dryers	Percent Electric Clothes Dryers	Percent Dish- washers	Percent Clothes Washing Machines	Percent Freezers	Percent Television Sets
ANCHORAGE REGION													
Anchorage	35,021	94.9	6.4	95.6	34.6	99.4	64.5	59.4	54.2	29.0	63.2	39.1	94.6
SOUTHCENTRAL REGION													
Cordova-McCarthy	563	100.0	0.0	90.4	11.5	100.0	51.9	49.2	34.3	10.8	48.3	68.7	62.5
Kenai-Cook Inlet	3,881	90.8	3.6	86.1	33.0	97.4	23.6	54.6	42.8	17.4	61.6	50.8	70.5
Kodiak	2,535	96.1	0.8	93.1	21.9	100.0	54.7	66.8	61.9	12.9	78.3	51.5	80.7
Matanuska-Susitna	1,797	68.8	1.1	63.2	31.3	82.1	44.0	47.5	44.0	19.3	47.3	66.5	75.0
Seward	534	95.5	3.9	87.5	30.9	100.0	47.0	53.0	36.9	26.2	75.3	71.3	90.6
Valdez-Chitina-Whittier	1,017	78.9	0.9	56.5	20.2	93.6	17.9	35.0	17.5	5.5	30.5	40.0	36.0
INTERIOR REGION													
Upper Yukon	3,65	36.7	0.0	0.0	0.0	38.1	0.0	0.0	0.0	0.0	12.1	27.1	14.0
Yukon-Koyukuk	1,030	73.6	5.9	48.5	28.0	81.8	35.2	32.6	30.8	3.7	47.9	42.3	50.1
FAIRBANKS REGION													
Fairbanks	11,630	72.6	6.9	75.8	33.7	98.9	77.7	47.6	46.5	21.7	56.7	38.5	91.4
Southeast Fairbanks	982	73.1	6.2	83.0	45.8	92.4	59.0	54.7	54.7	17.1	60.9	45.9	67.9
SOUTHEAST REGION													
Angoon	116	79.3	0.0	15.5	0.0	79.3	0.0	0.0	0.0	0.0	0.0	15.5	0.0
Haines	362	92.5	0.0	72.1	26.2	92.5	48.9	56.9	56.9	13.0	69.1	52.5	41.4
Juneau	4,293	99.0	0.6	98.2	27.5	97.7	79.6	57.4	57.0	24.2	59.4	38.5	81.6
Ketchikan	2,820	99.3	3.5	98.7	66.4	100.0	87.8	64.3	64.3	21.8	63.2	40.6	78.3
Outer Ketchikan	412	100.0	16.9	100.0	83.5	100.0	89.1	74.0	74.0	11.7	94.9	69.7	88.8
Prince of Wales	528	96.4	0.0	79.0	7.4	93.4	6.6	31.6	13.8	7.0	64.8	43.4	16.3
Sitka	1,873	100.0	0.0	97.0	42.3	100.0	59.7	62.1	59.2	20.1	71.1	48.6	83.0
Skagway-Yakutat	626	90.7	3.6	87.6	20.5	90.7	34.8	33.7	24.3	7.0	40.9	47.1	24.3
Wrangell-Petersburg	1,395	96.5	3.4	86.5	51.0	90.6	60.9	45.4	45.4	19.6	64.2	53.8	66.8
NORTHWEST REGION (Rural)													
Barrow	513	100.0	0.0	25.0	0.0	95.9	7.6	21.6	18.1	0.0	17.5	14.6	28.1
Kobuk	955	81.4	2.2	19.3	6.6	74.9	17.6	19.3	19.3	4.6	15.6	30.2	4.5
Nome	1,238	85.5	1.8	34.0	5.6	87.6	9.5	12.6	11.1	5.1	15.1	12.9	1.4
SOUTHWEST REGION													
Aleutian Islands	1,192	88.3	5.7	82.8	52.3	100.0	62.2	66.1	62.8	15.0	73.2	45.7	53.9
Bethel	1,439	86.7	0.0	19.7	2.6	81.8	13.1	9.1	8.1	1.5	25.6	28.1	0.0
Bristol Bay	655	89.9	0.0	37.3	3.5	93.1	18.5	18.2	18.2	3.4	34.4	37.9	0.0
Bristol Bay Borough	213	100.0	0.0	72.3	29.1	100.0	38.0	84.5	48.4	17.8	56.8	82.1	93.4
Kuskokwim	401	29.9	0.0	24.4	9.5	39.7	14.0	14.7	14.7	0.0	24.4	24.4	14.9
Wade-Hampton	773	46.2	0.0	5.8	0.0	46.6	6.2	8.9	8.9	0.0	21.2	9.4	6.2
TOTAL	79,059	89.0	4.8	83.6	32.5	96.2	58.9	52.5	48.3	21.9	58.5	41.3	78.9

SOURCE: U.S. Bureau of the Census, Department of Commerce, 1970 Census of Housing.

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New Factors in Utility Load Forecasting

By ROBERT W. SHAW, JR.

LOAD forecasting is the cornerstone of all utility planning. To provide useful input to facility and financial planning, utility load forecasters must be able to project electric energy sales and peak loads fifteen or twenty years into the future. Yet load forecasting has become an increasingly difficult challenge as social, economic, demographic, and political forces converge to form an ever-changing pattern of complexity. The relatively primitive trend line forecasting methods of past decades — which were adequate in their time — are now being replaced with more sophisticated approaches needed to cope with the "new factors" which the forecaster must address.

Two general load forecasting approaches are currently in widespread use in the utility industry: (1) econometric models, and (2) end-use (or engineering) models. Econometric models rely on historical data and statistical techniques to forecast future use of electric energy — in the aggregate for a service area or by customer class — as a function of the price of electricity, price of alternate energy sources, population,

personal income, and other economic-demographic variables. These models are based on the assumption that customer response to changes in these variables will be the same in the future as it was in the past. They cannot deal explicitly with factors such as technological change or regulatory initiatives other than those affecting prices.

The author suggests that the deficiencies in two existing general approaches to utility load forecasting — econometric models and end-use engineering models — may be corrected through a combination of the best features of both. The utility load forecaster would, as one result, be given greater flexibility in assessing the many factors with which he is confronted. This article identifies many of those factors — which constitute a changing forecast environment — and provides a schematic description of the kind of econometric end-use forecasting approach proposed by the author.



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End-use models build a forecast on detailed information regarding the way electric energy is used in each consuming sector of the utility's service area. Although these models frequently suffer from a severe lack of data, they do provide a way to deal with the multitude of factors which can cause end-use patterns to change. These models have a serious drawback, however, in that they usually do not explicitly consider the effect of price on the consumption of electricity. This is not an essential flaw in the model structure, but merely an indication that forecasters have not yet pushed the modeling art far enough.

Econometric End-use Forecasting Models

To correct the deficiencies in both general approaches and give the utility forecaster greater flexibility in addressing the new factors he must consider, a forecasting approach which combines the most important features of both econometric and end-use models has been suggested. The basic elements of the method are shown in Figure 1 (this page). In simplified terms, the forecast of electric energy consumed during a particular year is the product of the number of utility customers (disaggregated into categories such as residential, commercial, industrial, etc.), the number of electricity-consuming devices that each customer has connected to the grid, and the amount of electricity consumed by each device during the year. Econometric relations are developed to describe the projected change in these three basic components as a function of price and other economic and demographic variables. This type of "econometric end-use models" has recently been used by several utilities to improve their forecasting capability.

The econometric end-use model is simple to describe in concept but much more difficult to execute in practice, because it requires an extensive data base defining the structure of end-use patterns in detail. Very few utilities have such a data base at their disposal. The first and most challenging task in the forecasting effort is to assemble and refine the necessary data over a period of years.

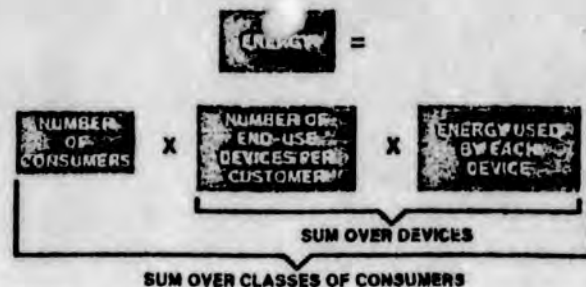
Once the end-use data have been assembled, price and income effects are built into the model — as indicated schematically in Figure 2 (page 21). The econometric methods used in the analysis are essentially identical to those used in market-penetration models. The models describe how the number of different devices used by customers in each sector depends on: price of electricity, prices of alternative fuels that could operate comparable devices, marketplace price of the devices, income (personal or corporate), and characteristics of the sector; i.e., for the residential sector, number of persons per household.

The final step is to develop models such as those illustrated in Figure 3 (page 22) which link the amount of energy consumed by typical devices with:

- The price of the electricity used to run them
- The income of the user
- The efficiency of the device
- The characteristics of present or planned load management programs
- Other socioeconomic and technical variables.

This schematic and highly simplified description of the econometric end-use forecasting approach masks the complexity of the models involved and gives little indication of the extraordinary level of effort required to assemble the necessary data base. To overcome these problems in the early stages of forecast development, the level of disaggregation used in the models can be tailored to fit the data base available. In later years, as

FIGURE 1
AN ECONOMETRIC
END-USE MODEL COMBINES
THE BEST FEATURES OF BOTH



the data base expands, the level of disaggregation can be increased.

The Changing Forecast Environment

The econometric end-use approach to utility load forecasting has the capability to deal with the changing social and economic environment which influences load growth. The "new factors" which characterize this uncertain environment were of little importance in the past, but they must now be taken into account if forecasts of electric energy consumption and peak demand are to be useful in utility decision making. These new factors fall into three generic groups: policy-regulatory factors, technical factors, and economic-demographic factors.

Policy-regulatory factors include fuel price and use controls, efficiency standards, mandatory conservation regulations, load management programs, incentives to adoption of alternative technologies, and changes in rate structure. Changes in policies and regulations can occur at almost any time, taking the forecaster by surprise, and sometimes causing an immediate impact on load growth.

Technical factors, on the other hand, are easier to deal with because changes in technology typically do not penetrate the market very rapidly. Technical factors important to load forecasting include: new end-use devices, improved efficiency of traditional devices, dispersed energy supply technologies (such as solar heating or cogeneration), and new systems for load control and management.

Sometimes these first two categories overlap. For instance, technical advances in solar heating may occur over time, but the use of solar heating may be accelerated by economic incentive mechanisms and government-supported research and development. A similar relationship exists with technical achievements in appliance efficiency, and government-imposed efficiency standards.

Economic-demographic factors also are important to accurate load forecasting. Like technical and policy developments, regional economic and demographic characteristics are changing more rapidly than they did in the past. These factors can best be addressed by constructing a regional economic-demographic model of

a utility's service territory, accounting for population shifts, employment, personal and corporate income, etc. Such models are difficult to create and specify, but they have been built and they work reasonably well.

New Factors Affecting Residential Load Growth

For the remainder of this discussion, we shall assume that a state of the art regional model exists and produces acceptable forecasts of population, employment, and so on in the utility's service area. Our major concern will be to examine specific new factors in the areas of policy regulation and technology as they impact the residential, commercial, and industrial components of a utility's load and energy sales.

There are many new factors which could affect residential load growth over the rest of this century, including improvements in the efficiency of buildings and appliances, greater use of solar heating systems, load management programs, and new energy-consuming devices.

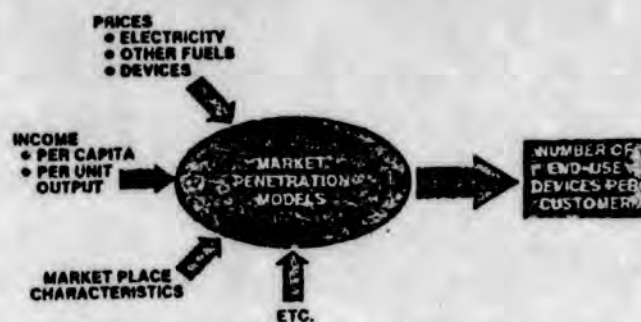
Building Shell Efficiency Improvements. The recently legislated National Energy Act (NEA) requires utilities to help home owners install improved attic and wall insulation, caulking, weather stripping, etc., to decrease heat loss from their homes. Technically it is feasible to make the typical residential building far more efficient than it currently is — reductions in energy use by factors of two or three are possible. The economics of various levels of improvements are the subject of much debate. The results depend strongly on regional differences and on assumptions regarding fuel price increases. It is generally accepted that a modest investment in ceiling insulation, for example, can lead to a significant energy savings (up to 25 per cent of the heating load) and pay off in a year or two.

These NEA provisions could lead to a substantial near-term reduction in utilities' electric heating loads — though perhaps less than has been suggested because electric homes are typically quite efficient already. To account for this effect in its forecast, the utility would have to monitor the number of retrofit installations in its service area, conduct measurements to determine the average reduction in energy use per building, and project the eventual saturation level of retrofit installations. It also would be desirable to obtain data on the energy efficiency of new homes in the service area.

Appliance Efficiency. Appliances are a major component of residential electric load. The NEA mandates improvements in the efficiency of major appliances, but the standards will not become effective for several years. To account for these future appliance efficiency improvements, the utility forecaster must differentiate between old and new appliances after the early 1980's, and develop new data on electric consumption levels for the new appliances which enter the market.

Although the use of more efficient appliances will tend to decrease energy consumption, net energy use will increase if people continue to buy more and more electricity-consuming devices. The introduction of

FIGURE 2
MARKET MODELS CAN BE USED
TO PROJECT HOW MANY END-USE
DEVICES THERE WILL BE



entirely new devices — such as electric vehicles — could also result in sharp growth of electric energy sales. The consequences of an increasingly electrified economy must be accounted for in the load forecast, as new electricity-consuming devices enter the marketplace over the next few decades.

Solar Heating Systems. Another factor of concern to utility forecasters is the market penetration of solar heating systems. Although solar heating currently is not economical in most parts of the country, it is possible that the NEA's solar incentives coupled with rising fuel prices could cause significant market penetration of solar heating systems within the next decade. In many cases the backup for solar heating systems will be electric. As a result, it is conceivable that increased use of solar systems could reduce electric energy consumption on an annual basis, but exacerbate the peak-load problems.

To account for increased use of solar heating systems, the forecaster must use market models to predict how rapidly solar technology will penetrate the service area, as a function of various price and policy factors. Measurements must be made to determine the annual electric energy consumption — and the impact at peak — of solar systems with electric backup. A similar approach can be used to account for the possible introduction of passive solar designs in new homes.

Load Management. While increased use of solar heating systems may be detrimental to utilities' load factors, improved load management programs will likely offset these effects and benefit the entire utility industry. A variety of schemes has been recommended to help flatten the load duration curve, ranging from ripple controls on water heaters to time-of-day rates. Many of these schemes are being tested now, and there is already evidence that poorly designed load management programs can have adverse effects on load shape. For example, time-of-day rates can lead to a new and even higher peak in the hour after the peak rate ends, if there is no "shoulder" rate.

Dealing with load management options in the forecast is extremely difficult, because little data are available to help predict how customers will respond to load management efforts. It is important, therefore, for utilities to gather and disseminate data from the

experiments which are now being conducted. These data will help predict the average usage rate per controlled appliances; the impact of storage, feedback meters, etc., on usage levels; and response of customers to various rate structures.

In principle, the econometric end-use forecasting model has the flexibility to deal with both rate changes and engineering-oriented load management options. The problem is lack of data; but this problem should be resolved as the results of ongoing experiments are disseminated, and new experiments are initiated. The importance of load management cannot be overstated. Improved load management means more efficient use of the industry's capital stock — its generating plants and transmission lines — and that is good business.

New Factors Affecting Commercial Load Growth

The nonmanufacturing or commercial sector often represents the fastest-growing component of load in a utility's service area. Yet it is the most difficult component to deal with in forecasting, because it includes a broad spectrum of customers — ranging from restaurants, to shopping centers, to high-rise office buildings — using energy in a variety of ways.

The new factors which could have a major impact on commercial sector load growth include building efficiency standards, dispersed energy sources, and improved equipment efficiency.

Building Efficiency. Among the conservation-related provisions of the National Energy Act are standards to improve the energy efficiency of commercial buildings. These standards, which are not expected to be in place until the mid-1980's, will not have an immediate effect because the building stock turns over slowly. In the long run, however, the impact of these standards on load growth may be substantial, reducing the energy consumption of new office buildings by a factor of two or more. Even now, many states are in the process of adopting the voluntary ASHRAE 90-75 standard, and advanced building-design concepts are being developed with the aim of attaining even greater reductions in the energy consumption of new buildings.

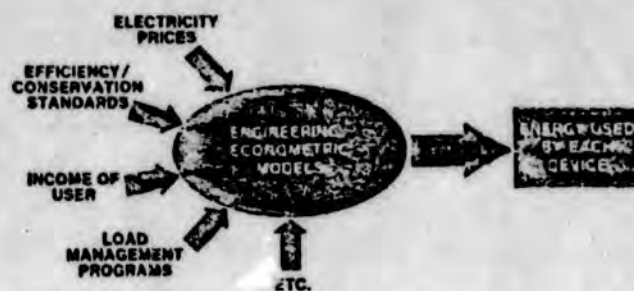
Dispersed Energy Sources. Not only are commercial buildings the prime targets of new energy-efficiency standards, they are also attractive candidates for pioneering the use of dispersed energy sources, including solar heating and cooling, total energy systems, and fuel cells. These innovations may penetrate the market rapidly, particularly if the commercial sector becomes subject to interruptible service as part of state or federal load management policies. There are two crucial issues which the forecaster must address in dealing with these new sources:

- The penetration rate of each type of device on a standard industrial code specific basis.
- The impact of each device on the utility's load, particularly at the peak.

To account for the possible introduction of dispersed

FIGURE 3

ENGINEERING/ECONOMETRIC MODELS CAN BE DEVELOPED TO PROJECT CHANGES IN CONSUMPTION OF VARIOUS DEVICES



energy sources, the utility load forecaster must construct market models to estimate penetration rates, based on historical experience with similar new technologies (such as central air conditioning). Load profiles for the new devices will have to be established through field measurements of early users.

Equipment Efficiency. A third factor important in forecasting commercial sector load is the improved efficiency of lighting, office machines, compressors, pumps, commercial ranges and ovens, and other equipment. The approach used in dealing with these efficiency improvements is similar to forecasting the impact of appliance efficiency improvements in the residential sector, but is complicated by the heterogeneity of commercial sector users.

The commercial sector will also be influenced — perhaps more strongly than the residential sector — by changes in the way electricity is priced, and by the prices of competing energy sources. Econometric models which incorporate price explicitly into the penetration and consumption models — for both current and future end uses — are of particular importance in the commercial sector. The same point holds true for the industrial sector.

New Factors Affecting Industrial Load Growth

Projecting load growth in the industrial sector is complicated by three factors. When a new industrial facility locates in the service territory, or leaves it, the load can change by a large increment at one time. Also of importance is the fact that industrial energy use is strongly dependent on the health of the national economy — it was the industrial load that dropped most sharply in the recession that followed the 1973 oil embargo. A third factor is that fuel shifting and process changes, initiated for economic or regulatory reasons, can create large new loads in a short time period.

In order to understand better their industrial load, most utilities are moving toward highly disaggregated industry (or plant) specific forecasting techniques. These techniques address end uses at the process level, and account for industrial output in the service territory as a function of national as well as regional economic

indicators. Once these models are in place, it is a relatively straightforward task to deal with new factors such as energy conservation standards, process efficiency improvements, regulations constraining the use of oil and gas, and alternative energy sources.

Energy Conservation Standards. Although the federal government has promulgated a set of energy-efficiency targets for the ten most energy-intensive industries, compliance is still voluntary, and may remain so. Industry's primary concern is not the cost of energy, but the certainty of supply — the efficiency of end use is of secondary importance. Thus in order to pursue conservation targets, industries may switch to electricity-based processes, shifting the burden of inefficient fossil fuel conversion to the utility.

Process Efficiency. Improvements in process efficiency, although part of the overall conservation effort, warrant special attention because they are the focus for substantial research and development effort on the part of both industry and the federal government. Dealing with process efficiency improvements is not much different, in principle, than examining the efficiency of specific appliances in the residential sector. Because there is so much room for process efficiency improvements in most industries, it behooves the utility forecaster to disaggregate his models to the point where these improvements can be captured when there is evidence that they are occurring.

Coal Conversion. A highly disaggregate model is also desirable in order to capture the influences of new NEA-mandated regulations providing for industrial use of coal instead of oil or gas. In many cases, industrial users may choose to convert to electric energy rather than cope with the problems inherent with coal use, including environmental effects and supply uncertainties. As with process efficiency improvements, a highly disaggregated end-use model is essential if the effects are to be addressed correctly in the forecast.

Alternative Sources. The NEA also provides incentives for industrial use of cogeneration, as well as for the use of solar energy, geothermal resources, and other advanced technologies. Increased use of such technologies could reduce electric energy sales to the industrial sector significantly. Again, detailed end-use models — reflecting specifically the potential for use of alternative sources in industrial process applications — will be necessary to account for switchovers in the load forecast.

Limitations of Models

This discussion has stressed the use of analytical models to address the new factors affecting electric load growth. It is important, however, to remember that models are only a tool. They are intrinsically:

- Nothing more than a systematic way to structure the available data and information about a situation. They can in no way transcend the data used to create them, although they may occasionally help the forecaster to discover relationships which were not intuitively evident.

- Limited by the "boundaries of the modeler's understanding"* of what is happening in the world around him. If he does not know, for example, how customers will respond to changes in regulation or technology based on past experience, then models cannot help the forecaster out of the bind imposed by his ignorance.

The art and science of load forecasting will have taken a major step forward when it progresses to the point where accounting — in an explicit way — for the types of factors discussed here is truly feasible. But the challenge of trying to foresee what new factors — beyond those we already envision — will emerge in the years ahead is even more forbidding. Unfortunately, anticipating basic changes in the course of society is something that no utility forecaster will ever be able to do. The tool of sensitivity analysis, which can help him address the "what-if" questions, is perhaps the most effective way of assessing the potential impacts of events such as new regulations or potential technological breakthroughs on load growth.

Dealing with the new factors affecting load growth requires a commitment on the part of utility managers to the development of analytical tools and the data necessary to understand what is going on in the service territory, and to specify the forecasting models. It is legitimate to ask if the investment in data and models is worth the return. There is no simple answer to this question. The returns from improved forecasting come both in reduced levels of uncertainty and in a better understanding of the potential impacts which various futures could have on the utility. Only senior management can decide when an incremental improvement in its perspective on the future is outweighed by the marginal cost of achieving it.

*"Electric Load Forecasting: Probing the Issues with Models," EMF Report 3, Vol. 1, Energy Modeling Forum, Stanford University, Stanford, California, April, 1979, p. 7. EMF is sponsored by the Electric Power Research Institute.

Telecommunications Policy Conference: Call for Papers

The eighth annual Telecommunications Policy Research Conference (scheduled for spring, 1980) will provide a forum for analysis and discussion of important telecommunications policy issues. Participants will include researchers and policymakers from academia, government, and industry. Those engaged in research which has implications for telecommunications policy are invited to submit abstracts (500 words or less) by December 1, 1979. Authors of papers selected for presentation at the conference will be reimbursed for travel and conference living expenses if no alternative source of funding is available. Please send abstracts to: TPRC Organizing Committee, c/o Robert Dansby, American Telephone and Telegraph Company, 195 Broadway, Room 1942B, New York, N. Y. 10007.

Agenda

1. Introduction & Reasons for Meeting
 - a. discussion of model structure
 - b. develop probability distributions for key scenarios items
2. Critical elements in long run model structure and testing model
 - a. employment/population ratio
 - b. real income growth (disposable)
 - c. structural change
 - d. specification of government

Critical elements in long run model scenarios

- a. growth of government
- b. exogenous construction and resource development employment (Oil)

Methods of prediction and their shortcomings

- a. extrapolation - changing ^{problem} conditions
- b. scenario building - ^{problem} myopic

3. Technique of assigning probabilities - example

1st determination of year 2000 probability distributions for exogenous employment, government spending, and population

2nd round determination of probability distributions with ISER inputs

HISTORICAL INDICATORS

ALASKAN ECONOMY

AVERAGE ANNUAL GROWTH

	1960	1970	1980	60-70	70-80	60-80
<u>EMPLOYMENT</u>						
NON-AG W&S	56.9	92.5	168.2 ^A	5.0	6.2	5.6
GOVT (NON-MIL)	22.7	35.6	54.6 ^A	4.6	4.4	4.5
CONSTRUCTION	5.9	6.9	11.1 ^A	1.6	4.9	3.2
MINING	1.1	3.0	6.9 ^A	10.6	8.7	9.6
MANUFACTURING	5.8	7.8	12.0 ^A	3.0	4.4	3.7
TRADE, SERVICE, FIR	14.7	29.9	65.7 ^A	7.4	8.2	7.8
TRANS, COM, P, U.	6.8	9.1	17.0 ^A	3.0	6.5	4.7
<u>POPULATION</u>	226.2	302.2	418.8 ^A	2.9	3.3	3.1
EMPLOY / POPULATION w/o military - would be smaller	25% Critical ratio	31%	40% (female population)	—	—	—
PERSONAL INCOME	643	1412	5544 ^A	8.2	14.7	11.4
BANK ASSETS	227	707	2463 ^A	12.0	13.3	12.7
(G.D. APPROPRIATIONS) STATE EXPENDITURES	41	173	1200 ^C	15.5	21.4	18.4
FED. OUTLAYS	156	729	1545 ^B	16.7	7.8	12.2
REAL PI / POP	3097	4191	5741 ^A	3.1	3.2	3.1
REAL ST. EX / POP	197	513	1242 ^A	10.0	9.2	9.6
RELATIVE AK. PRICES	147	135	137 ^D	-0.9	0.2	-0.4
RELATIVE AK. INCOMES	.81	.85	1.01 ^D	—	—	—
EXCER FY 1977						

SIMPLE EXAMPLE OF PROBABILITY CALCULATION

OUTCOME

①

②

③

input

PROBABILITY

$\frac{1}{3}$

$\frac{1}{3}$

$\frac{1}{3}$

EVENT X

OUTCOME
VALUE

6

12

18

state
space

PROBABILITY

$\frac{1}{4}$

$\frac{1}{2}$

$\frac{1}{4}$

EVENT Y

OUTCOME
VALUE

4

8

12

empirical

output

EVENT Z

pop

Map Model

$$Z = f(X, Y) = x + 2y$$

$$Z_k = f(x_i, y_j)$$

$$p(Z_k) = p[f(x_i, y_j)]$$

outcome

x

y

$f(x, y)$

$p[f(x, y)]$

Z_1

6

4

14

$\frac{1}{12}$

Z_2

6

8

22

$\frac{1}{6}$

Z_3

6

12

30

$\frac{1}{12}$

Z_4

12

4

20

$\frac{1}{12}$

Z_5

12

8

28

$\frac{1}{6}$

Z_6

12

12

32

$\frac{1}{12}$

Z_7

18

4

26

$\frac{1}{12}$

Z_8

18

8

34

$\frac{1}{6}$

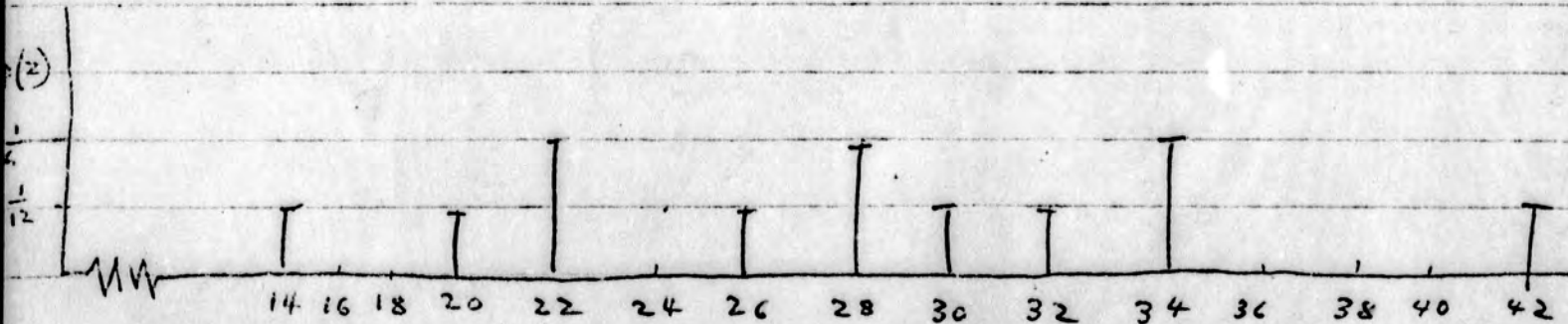
Z_9

18

12

42

$\frac{1}{12}$



Z

Kerfull - how long does he?
 (1 yr.)
 En. supported penis long or all the length

instead, use waste heat for Algea

- 1) postman act - until studies done
- 2) find GUTIA waste heat project
- 3) check Chachachanka (?) site feasibility
- 4) Interior ^{other} sites

Jeff? - FENC

dark brown impacts of Sus the great

Healthy, Beluga / all available
geothermal, tidal, wind in Kailbutt

great flexibility in meeting energy needs

SB 294 - mockery of judgement

usurps feasibility study process
forces negligence in review of costs

Switna - greatest contributor
Cook Inlet salmon

FOG - general siltation will occur
Round head hunting

alternative hydro sites have not been studied

active faults

Fertility - no need for next 10 yrs.

Advantages minimal

SB 385⁰ - Lock door approach

too expensive for live communication

no showing of capacity available to FB thru Aul

PROJECT

- ? 1. ALPETCO
? 2. PACIFIC ALASKA LNG
N 3. STATE CAPITAL MOVE
- / 4. BELUGA COAL FOR EXPORT
? 5. NW ALASKA GAS PIPELINE
N 6. TAPS PIPELINE - *expansion*
N 7. FAIRBANKS PETROCHEMICALS - *fat chance*
? 8. U.S. BORAX
Y 9. PRUDHOE BAY - *sewerly recovery + expansion*
N 10. UPPER COOK OIL & GAS

11. OCS DEVELOPMENTS

~~Lower Cook 1976~~

~~N. Gulf (2 Sales)~~

~~W. Gulf~~

~~Lower Cook~~

~~Bering Norton~~

~~St. George Basin~~

~~Navarin Basin~~

~~N. Aleutian Shelf~~

~~Beaufort I~~

~~Beaufort II~~

~~Chukchi Sea~~

State
sales:

Native Corp
Keweenaw
Barish
RR

Yould - ^{to} NPA Bd.

project goes back to you.

only 4 months ago - private sector / state

Feds have studied project very little
lots of smoke, little fire

8.2m - More than feds
have spent to date

30m over the next 2 yrs.

\$ already out to Alaskans

Corps - US hydro power potential -
930 billion kWh

90% — 430 in Alaska
precluded under HR 39

2% would
provide
for Alaska

2 1/2 m for Lake - USFW intervention

remember other communities around state
700m in small projects (revenue bonds)

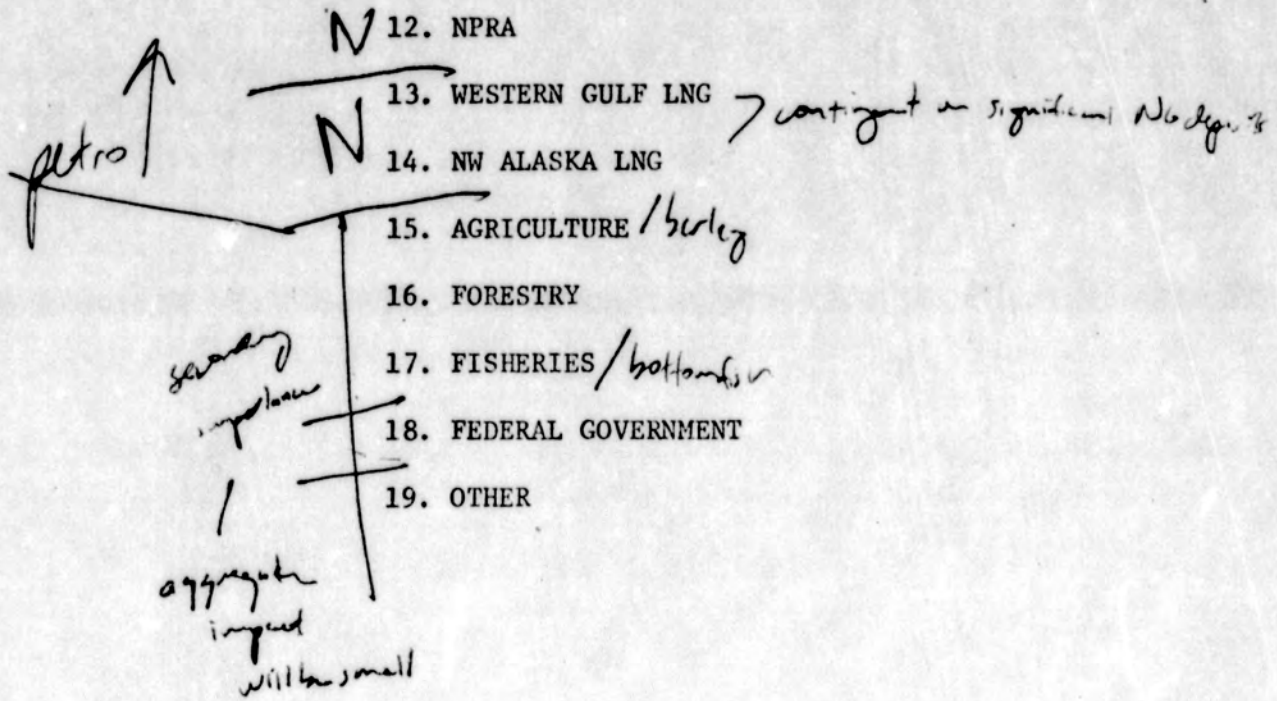
Yould

Cost - 40 - 50 mil - now
doubt by the time it's built
but gets cost & availability "in question"

leave flexibility open to use variety of financing
mechanisms

PROJECT

p. 2



42,000
fed, inc.
military

• * MEA manager - need lead, possible date

CEA - provides cheap power to HEA & MEA
20-25 year contract

Susitna should be considered along w/ other alternatives

CEA - will support (when?)

— haven't supported project yet

current cost - 14 mil,

q. - cost & availability of gas

costs of Susitna not yet known -
estimated to be 40-50 mil,

need construction employment in Mat-Su

Vince O'Reilly -
inflated dollars?

Lee Wachen -
stabilize kW costs
legacy to future
interior

[Gravel
Sheffield

— windfall profit,

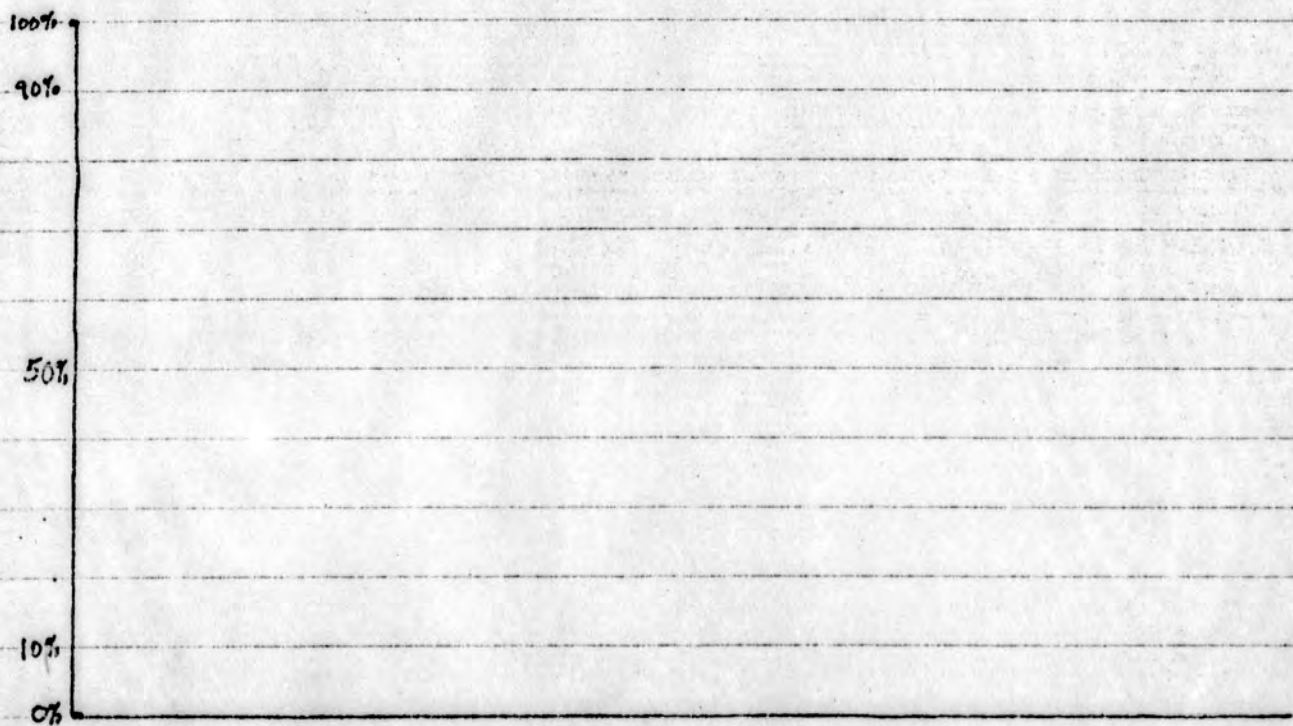
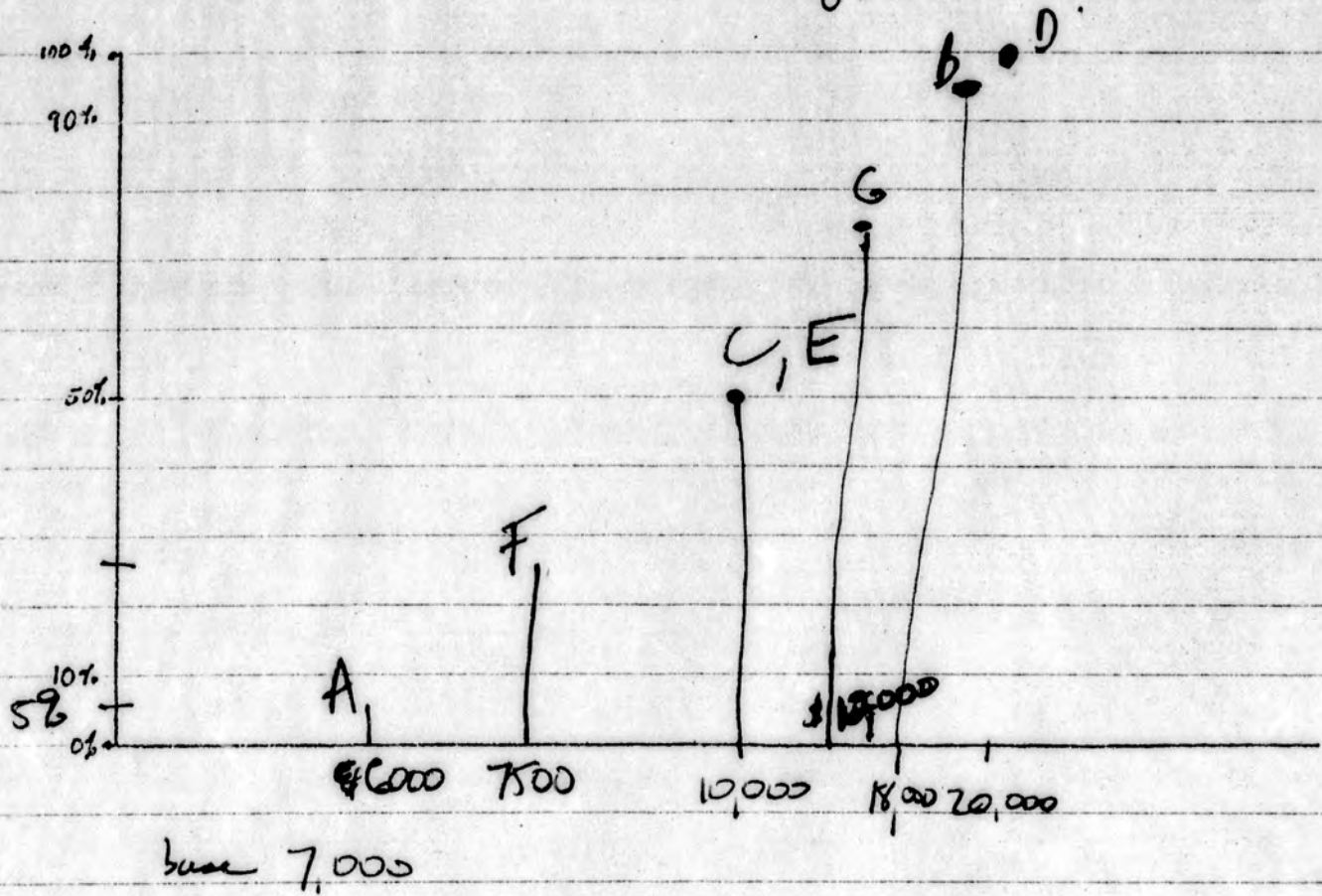
IDB statute - small hydro
all hydro - tax exempt

Gravel - "decimate the cost
of energy

goal - equalize cost of energy across state

Cumulative Probability Distribution for Exogenous Employment in 2000

mining, extractive resource development + ^{related} const. + man.



Mark Wilkin

No Growth Case

	<i>Exogenous employment</i>	<i>state op. exp. real per capita</i>	<i>population</i>	<i>state cap. exp. real per capita</i>
	EMX	SXORPC	POP	SXCRPC
1977	10.3	700.819	407.342	262.338
1978	5.5	714.665	404.436	235.211
1979	4.2	774.49	413.701	224.692
1980	4.4	783.547	419.867	246.51
1981	4.	780.196	425.277	357.824
1982	4.	768.181	431.363	357.737
1983	4.	760.543	437.767	354.164
1984	4.	749.748	444.084	350.844
1985	4.	739.532	450.519	346.095
1986	4.	731.944	457.334	342.843
1987	4.	721.978	463.713	339.636
1988	4.	712.772	469.491	335.548
1989	4.	701.919	476.808	330.316
1990	4.	692.292	483.647	325.927
1991	4.	685.207	490.854	322.82
1992	4.	675.793	497.595	319.895
1993	4.	666.447	504.455	315.473
1994	4.	657.427	511.352	311.149
1995	4.	648.5	518.303	306.981
1996	4.	642.477	525.687	304.129
1997	4.	633.642	532.973	301.458
1998	4.	624.926	540.359	297.345
1999	4.	616.414	547.864	293.246

2000 -

550,000 / population
would probably
be less in no growth

① Effect on Growth of State Spending

② High Growth Case

POPULATION

real = 6%
2 double increase

INCOME
ELASTICITY
OF
STATE
SPENDING

→ 0

1

2

ELH.GL	STATE SPENDING	ELH.GM	ELH.GHY
407.342	1977	407.342	407.342
404.436	1978	404.436	404.436
417.249	1979	417.249	417.249
428.76	1980	428.76	428.76
449.326	1981	450.033	450.748
480.138	1982	485.329	490.639
524.89	1983	535.732	547.947
552.198	1984	574.373	601.399
558.983	1985	589.264	630.341
580.552	1986	614.786	663.625
612.99	1987	650.919	707.067
637.084	1988	681.65	748.501
656.5	1989	707.069	784.91
675.806	1990	731.752	820.303
696.575	1991	756.436	853.675
715.737	1992	779.346	884.517
731.448	1993	798.25	910.282
745.688	1994	816.275	935.811
752.373	1995	827.001	954.426
766.786	1996	843.751	976.239
779.123	1997	859.467	998.182
795.794	1998	878.249	1021.28
812.294	1999	898.69	1048.71
828.712	2000	919.474	1077.6
846.163	2001	941.955	1109.83
864.408	2002	965.771	1145.08
884.031	2003	991.38	1183.73
904.704	2004	1018.8	1226.41
925.031	2005	1046.83	1272.41

Effect on Growth of State Spending

REAL PER CAPITA STATE OPERATING EXPENDITURES

INCOME
ELASTICITY
OF
STATE
SPENDING

0		1	2
ELH.GL		ELH.GM	ELH.GH
700.961	1977	700.961	700.961
714.666	1978	714.666	714.666
768.117	1979	768.117	768.117
765.323	1980	765.323	765.323
735.714	1981	748.125	760.445
721.508	1982	804.688	888.17
687.449	1983	827.156	981.783
747.62	1984	989.365	1271.27
771.717	1985	1033.85	1371.86
748.24	1986	984.631	1300.35
731.58	1987	968.892	1285.26
746.405	1988	1024.59	1385.05
748.908	1989	1044.24	1434.94
756.528	1990	1051.38	1452.41
753.424	1991	1038.59	1435.93
753.32	1992	1034.73	1429.3
750.643	1993	1029.24	1421.86
753.328	1994	1035.32	1431.84
766.698	1995	1051.71	1451.98
754.587	1996	1027.97	1415.22
763.496	1997	1038.09	1422.62
749.973	1998	1016.96	1392.62
752.609	1999	1027.75	1408.85
751.115	2000	1034.29	1426.08
750.161	2001	1040.69	1444.32
749.209	2002	1048.22	1467.33
746.7	2003	1054.15	1490.85
744.772	* * 2004 * * *	* 1063.1 * * *	* 1521.81 *
744.157	2005	1075.58	1561.27

Moderate Growth Cases (Median)

B. 4

Exogenous
Employment

real per capita
operating expenditures

Population

(0 income elasticity)

employment
population

Population (1 income
elasticity)

ELL.GL

YEAR	EMX	SXORPC	POP	Y10M12A33	EROWAS131	POP
1977	9.9	700.961	407.342	0.478378	407.342	
1978	5.632	714.666	404.436	0.478437	404.436	
1979	5.776	768.117	417.248	0.470818	417.248	
1980	7.656	765.324	428.758	0.473365	428.758	
1981	12.342	735.613	449.375	0.48436	450.081	
1982	17.233	722.083	479.931	0.498205	485.135	
1983	23.107	689.386	523.723	0.514091	534.575	
1984	20.03	750.737	549.022	0.518922	571.22	
1985	12.187	775.127	552.896	0.512647	582.96	
1986	13.095	758.75	569.029	0.5098	603.51	
1987	15.65	755.222	588.87	0.507536	626.298	
1988	15.222	762.627	600.411	0.504592	640.977	
1989	12.843	765.762	607.338	0.499873	650.675	
1990	12.586	765.762	618.245	0.497785	663.463	
1991	11.486	771.249	625.894	0.492441	672.355	
1992	10.689	766.161	635.023	0.488788	682.137	
1993	10.012	764.165	643.544	0.485447	691.502	
1994	9.426	761.004	653.533	0.48344	702.818	
1995	8.64	762.645	663.763	0.481846	715.103	
1996	8.649	760.709	676.388	0.481866	729.792	
1997	8.615	761.768	689.25	0.482022	745.668	
1998	8.525	758.708	702.935	0.482696	762.767	
1999	8.466	757.592	717.329	0.483635	781.287	
2000	8.431	756.217	732.47	0.484911	801.187	
2001	8.409	754.973	748.202	0.486297	822.242	
2002	8.394	753.694	764.539	0.487717	844.376	
2003	8.376	752.515	781.413	0.489185	867.573	
2004	8.358	751.247	798.895	0.490734	891.895	
2005	8.341	750.14	816.861	0.492277	917.247	

SCOMM

#44:31



GOLDEN VALLEY ELECTRIC ASSOCIATION INC. Box 1249, Fairbanks, Alaska 99707, Phone 907-452-1151

March 6, 1979

Representative
Alaska State House
Pouch V
Juneau, Alaska 99811

Dear

Following are a few comments and observations relative to capture of Alyeska Waste Heat:

At the present time only Pump Stations 7 through 12, due to their favorable geographical locations, offer practical opportunities to utilize waste heat for generation purposes. GVEA would be interested in developing 7 through 10. Copper Valley Electric Association may be interested in 11 and 12.

Pump Station 7 is a phase-3 station not completed at the present time. Others are running either one or two pumps depending on desired thru put.

★ [Based on the exhaust temperature and volume data available to us, each Alyeska turbine driven pump is capable of producing about 5,000 kW following capture and processing in a waste heat recovery steam generator. These potential increments of generation additions are extremely attractive to GVEA.

As mentioned previously, Pump 7 has not been completed and therefore may be an easier nut to crack. However, we have no idea as to when Alyeska plans to commission that station.

The actual capture of exhaust from existing stations can be accomplished with no interruption to the Alyeska system. This is due to the built in redundancy of existing pumps and drive turbines. We would intend to finance the entire installation and purchase exhaust BTUs from Alyeska.

Thomson

Representative
March 6, 1979
Page 2

Relative to proposed legislation that would perhaps "force" Alyeska to accommodate capture of their waste heat, I would suggest the following:

That the State by law prohibit the exhausting of waste heat from any source when it is determined that said exhaust would definitely be utilized for electrical generation and/or agricultural purposes.

Other stipulations suggested are as follows:

1. Such prohibition would apply only to those sources exhausting volumes exceeding 250,000 lbs. per hour at a temperature of 450° or more and operating in excess of 3,500 hours per year. 160° monthly
✓
ridiculous
2. The exhaust heat recovery system must be designed, installed and operated in such a manner as to avoid loss of efficiency of the exhausting units and insure non-degradation of service continuity. ✓
3. A public notice indicating waste heat availability must be published annually. Said notice will include geographical location, nominal volume and temperatures available, and anticipated annual hours of operation. Notice must also include a statement of willingness to negotiate a contract to accommodate capture and purchase of exhaust heat. Those parties interested in waste heat must notify owners within 30 days from date of published notice. In the event notice is not received in a timely manner, owner has no further obligation under this act until the next annual notice is published the following year. 250,000
BTU's
/ hour
4. Failure to issue public notice and comply with contract negotiation requirements will result in a fine equal to the total estimated energy wasted on an annual basis multiplied by .05¢ per million BTU increments. 15,000 BTU hour

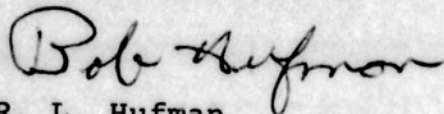
there may be some problems regarding certain stipulations contained in the Right-of-Way Leasing Act. Alyeska contends that any physical connection with their facilities must be owned and operated by Alyeska. This is so even though paid for by others.

GOLDEN VALLEY ELECTRIC ASSOCIATION INC.

Representative R. L. Huffman
March 6, 1979
Page 3

I hope to see you in Juneau next week. At that time we can discuss this subject in further detail.

Best wishes,

A handwritten signature in cursive script, appearing to read "Bob Huffman".

R. L. Huffman
General Manager

cc: M. Kelly
W. Baker

STATE OF ALASKA

DEPT. OF ENVIRONMENTAL CONSERVATION

JAY S. HAMMOND, GOVERNOR

POUCH 0 - JUNEAU 99811

December 13 1978

RECEIVED

DEC 13 1978

GOLDEN VALLEY
ELECTRIC ASSN., INC.

Mr. Bob Huffman
General Manager
Golden Valley Electric Assoc., Inc.
Box 1249
Fairbanks, AK 99707

Dear Mr. Huffman:

After reviewing your question on whether a permit to operate would be necessary if heat recovery devices were put on an already existing combustion facility, the Department has concluded that no additional permitting would be necessary. This would be the case in any situation where the additional equipment to be added to an existing facility did not change the amount of combustion products emitted.

Your question specifically concerned the possibility of adding heat recovery equipment on the exhaust stacks of some of the Trans-Alaska Pipeline pump stations. Our understanding is that this equipment addition would only change the temperature of the exhaust gases and would have no effect whatsoever on the air contaminant emissions. Consequently no change would be needed on the Alyeska permits.

The only thing we would need from you would be a description of the equipment and how it will be used, as well as notification of when it starts up, its schedule of operation, and the anticipated exhaust gas temperature. This information is needed for our statewide air quality emission inventory.

Please let me know if you have need of any further verification of the air quality permit requirements as they effect your power generation plans.

Sincerely yours,

Thomas R. Hanna

Thomas R. Hanna
Supervisor
Air Quality Control

please return this letter to me, along with

3.22.79



the original

letter a waste

heat le
sent

GOLDEN VALLEY ELECTRIC ASSOCIATION INC. Box 1249, Fairbanks, Alaska 99707, Phone 907-452-1151

March 16, 1979

Mr. Dave Hutchens
ARECA
Baranof Hotel - Room 501
Juneau, AK 99811

Dear Dave:

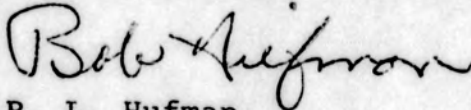
Following are comments on H.B. 364 re Energy Policy:

- Sec 2, 3, 4 Low grade heat and small volumes should
be exempted entirely. I doubt the capa-
bilities of the Commissioner of Commerce
to determine feasibility in any event.
- Sec 5, 6 No comment.
- Sec 8 The Department of Commerce should stay out
of electrical power development plans. We
do not need another agency to become involved.
FERC, APA State and APA Federal, REA Power
Requirements, etc., are more than sufficient.
- Same thought applies relative to social and
environme-tal impacts.
- Sec 9 Add to the Alaska Power Authority budget,
do not create another agency.
- Sec 10 OK
- Sec 11 OK
- Title 46. I believe that the suggestions contained in
my letter to Brian Rogers are much more
practical and workable than that suggested
in this bill. A copy of said letter is
enclosed.
- Sec 46.11.020 OK
- Sec 46.11.025 OK

Mr. Dave Hutchens, ARECA
March 16, 1979
Page 2

Sec 46.11.030 We strenuously object to another layer of regulation covering issues already under jurisdiction of numerous agencies. Even though mention is made as to avoidance of duplication, it is a lead pipe cinch that further delay would result from double standards and we would be caught in the middle as the respective agencies fought for jurisdiction to justify their existence.

Best regards,



R. L. Huffman
General Manager

Enclosure

cc: Rep Bill Miles (w/Encl)
✓ Rep Brian Rogers

Bill aims at use of waste heat

JUNEAU (AP)—Pump and compressor stations for new oil or natural gas pipelines in Alaska would have to be designed to use waste heat for farm production or to generate electricity, under a measure approved by the Senate.

Gas or oil pipelines for in-state processing would be exempt from the law, unless contracts for the purchase of waste heat are negotiated before the lines' construction.

The measure, SB68, as originally introduced by Sen. Jay Kerttula, D-Palmer, would have applied to use of waste heat for agricultural purposes only.

A substitute offered by the Rules Committee and sent to the House on a unanimous vote today adds the provision that waste heat be used to generate power.

The cost of design and construction of the stations so waste heat can be used could be passed along to the purchasers of the heat, under the substitute measure.

Such design would not have to be incorporated if it is not technologically or economically feasible.

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GOLDEN VALLEY ELECTRIC ASSOCIATION INC. Box 1249, Fairbanks, Alaska 99707, Phone 907-452-1151

April 9, 1979

Representative Brian Rogers
Alaska State House
Pouch V
Juneau, AK 99811

Dear Brian:

It appears evident that Northwest Alcan desperately needs State financial assistance if the Gas Pipeline is to fly. I for one would encourage the State to assume an equity position and to further assist with a tax exempt revenue bond issue.

However, in doing so, the State should have no hesitancy in requesting further commitments from Northwest. (Enclosed is a list of acknowledged commitments.)

Here are a few suggestions and comments:

Three of their proposed compressor stations fall within or are in close proximity to our existing service area. The waste exhaust heat from these three stations is of interest to GVEA. From information available we believe from 5,000 to 7,000 KW could be generated from turbine exhaust at each site. To accomplish this efficiently with waste heat recovery boilers we need relatively high temperatures re 700°F and above. Gas turbine driven compressors are ideal for such a system and usually produce temperatures between 850°F and 950°F at base load. I am quite sure that Northwest will use these for compressor drives.

Following capture of the hi temp heat, we would discharge exhaust from our Recovery Steam Generator at about 250°F to 350°F. The volumes of exhaust would remain the same and lower temperatures would still be sufficient for most all agricultural purposes.

What I am saying is that the best and most efficient first use of the exhaust heat is the generation of electricity from these stations. Therefore, the State should request Northwest to expand its "Commitments to Alaska" through a written agreement to make waste heat available for the generation of electricity from at least the three compressor stations closest to the Fairbanks/Big Delta areas.

*Financing
Authority*

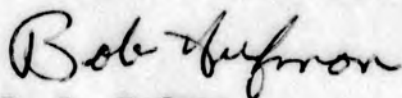
Rep. Brian Rogers
April 9, 1979
Page 2

Of further interest to us is the refrigeration process planned to cool the gas at each compressor station. At the present time I understand Northwest intends to install propane or natural gas fired units. We assume that the gas pipeline will have built in redundancy similar to Alyeska. In that case probably two refrigeration plants will be installed at each site to provide 100% contingency in the event of a plant failure. We would propose to install one electric operated refrigeration plant and one gas fired plant. The electric plant to be scheduled for operation during the six summer months and gas fired for winter. This of course would greatly improve our annual load factor and thereby reduce the average annual cost per KWH. Summertime load is hard to come by in Alaska while winter peaks are horrendous and costly. The additional summertime load could easily be handled by existing units that are sized to cover wintertime peaks; greatly improving operating efficiency.

As you will see from the two letters enclosed, we suggested this approach to Northwest over one year ago. No formal response was received to either my letter or the one written by Bob LeResche. We are in hopes that further commitments will be made to accommodate the refrigeration scheme or at least grant it serious consideration.

I will appreciate your consideration and assistance in this important matter. It is environmentally sound and utilizes a waste product that would otherwise be exhausted to atmosphere and lost forever.

Thanks and best wishes.



R. L. Huffman
General Manager

Enclosures
cc: D. Hutchens, ARECA

Copied from Brochure published by Northwest Alaskan Pipeline Company entitled "The Alaska Highway Gas Pipeline - how Alaska can participate."

Our Commitments to Alaska

In return for Alaska's support we have made a number of commitments which will further enhance employment and economic opportunities in the state. Among them:

Local Hire: We intend to work with the state to implement Alaska's local hire policy to ensure that all qualified Alaskans have an opportunity to be hired for pipeline construction jobs and that local community residents will be given first preference for permanent pipeline operation and maintenance jobs.

Business Opportunities: Alaskan businesses and organizations will be given the opportunity to compete for contracts for goods and services required by the pipeline.

Petrochemical Development: We will actively support the state's efforts to develop an economically viable in-state industry based upon Prudhoe Bay natural gas and associated liquids.

Other In-State Uses: Subject to Federal approval, we will pay for the installation of pipeline taps to provide access to Alaska's gas for use as desired by the state and local communities. We've even agreed to make the waste heat from one of our compressor stations near Delta available for drying grain.

Through commitments like these, we pledge to build the best possible pipeline for Alaska — one that will provide the greatest long-term benefits, while keeping to a minimum any adverse impact on communities and the environment along the pipeline route.



GOLDEN VALLEY ELECTRIC ASSOCIATION INC. Box 1249, Fairbanks, Alaska 99707, Phone 907-452-1151

April 4, 1978

Mr. Morris Thompson, Vice President
Alaska Highway Pipeline Project
310 "K" Street, Suite 504
Anchorage, AK 99501

Dear Morrie:

GVEA is interested in exploring opportunities to provide electric service for your project compressor/refrigeration stations that may ultimately be located within our certified service area.

Your refrigeration requirements are of particular interest. We understand that present plans call for chilling by a propane refrigeration plant. However, in the event you plan on 100% redundancy in these installations, perhaps one propane refrigeration plant and one electric refrigeration plant could be attractive and at the same time provide 100% back up in the event either unit failed for any reason.

At any rate in this event we would propose that the propane plant run as the prime refrigeration unit for the six winter months, i.e., October thru March, and the electric unit assume prime running responsibility for the remaining six summer months.

Such an arrangement would be extremely beneficial to us. Therefore I feel certain we could offer an attractive special rate covering this specific application.

Please be advised that we are not proposing electric drives for your compressor requirements. This conceptual proposal deals only with refrigeration as set forth herein.

I would appreciate an opportunity to meet with you and your project design personnel at your earliest convenience.

Very truly yours,

R. L. Huffman
R. L. Huffman
General Manager

cc: J. Killion
W. Baker
M. Kelly

May 22, 1978

Mr. R. R. "Andy" Myer
President
Northwest Alaska Pipeline
P. O. Box 1527
Salt Lake City, Utah 84110

Dear Andy:

The Governor and I have recently been approached by Golden Valley Electric Association, who would very much like to explore with your firm the possibility of providing some power for gasline operation from their generating facilities. They hope that this might make it possible to expand their winter margin more so than would otherwise be the case.

We would appreciate it very much if you could arrange to have your technical people discuss this with Mr. Huffman of GVEA at your earliest convenience. It might well be possible to work out an arrangement beneficial to both parties.

Best personal regards,

Robert E. LeResche
Commissioner

cc: Jay S. Hammond
R. L. Huffman

bcc: Larry Holmstrom
Jessie Dodson

REL:cb

Offered: 4/2/79

Original sponsor: Kerttula

1 IN THE SENATE

BY THE RULES COMMITTEE

2

CS FOR SENATE BILL NO. 68

3

IN THE LEGISLATURE OF THE STATE OF ALASKA

4

ELEVENTH LEGISLATURE - FIRST SESSION

5

A BILL

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For an Act entitled: "An Act relating to the use of waste heat produced by
certain pipeline facilities; and providing for an
effective date."

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BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF ALASKA:

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* Section 1. AS 38.35 is amended by adding a new section to read:

11

Sec. 38.35.226. DESIGN AND CONSTRUCTION OF PUMP AND COMPRESSOR

12

STATIONS. (a) To the extent technologically possible and economically
feasible, pump or compressor stations designed and constructed after
January 1, 1980 for an oil or natural gas pipeline on state land leased
under this chapter shall be designed and constructed so that waste heat
produced by the pump or compressor station may be used for agricultural
production and for the generation of electricity.

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(b) The lessee may charge to users of the waste heat the addi-
tional cost of designing and constructing a pump or compressor stations
for use of waste heat as required by (a) of this section.

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(c) The amount of money to be paid for waste heat generated by
pump or compressor stations shall be determined under terms of a con-
tract negotiated between the lessee and the users of the waste heat.

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(d) Waste heat facilities are not required under this section
unless they are compatible with pipeline facilities and do not interfere
with the operation of the pipeline or create safety or environmental
hazards.

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(e) This section does not apply to a pipeline used to gather gas
or oil for processing, treatment or liquefaction by a facility located

1 in the state, unless an agreement for the purchase of the waste heat for
2 agricultural production or for the generation of electricity is executed
3 before the lessee designs or constructs the pump or compressor station.

4 * Sec. 2. This Act takes effect January 1, 1980.
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Introduced: 1/23/79
Referred: Resources

1 IN THE SENATE

BY KERTTULA

2 SENATE BILL NO. 68

3 IN THE LEGISLATURE OF THE STATE OF ALASKA

4 ELEVENTH LEGISLATURE - FIRST SESSION

5 A BILL

6 For an Act entitled: "An Act relating to the use of waste heat produced by
7 certain pipeline facilities; and providing for an
8 effective date."

9 BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF ALASKA:

10 * Section 1. AS 38.35.120(a) is amended by adding a new paragraph to
11 read:

12 (15) to the extent technologically possible, pump or com-
13 pressor stations constructed after January 1, 1980 shall be designed,
14 located, and constructed so that waste heat generated by those facili-
15 ties may be used for agricultural production.

16 * Sec. 2. This Act takes effect January 1, 1980.
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FISCAL NOTE

I. REQUEST (HJR 68 and HJR 72)
SJ Resolution No. 46 Title: Relating to the Alaska Power Authority and the incurring
of revenue bond indebtedness of the Alaska Power Authority for the Golden Valley
Electric Association waste heat power generation Date 2/18/80
project near Fairbanks.
Requested by State Affairs Committee in the Senate (HJR 68 and HJR 72 are the same
bill requested by 6 House Members)

II. FISCAL DETAIL
Agency Affected Department of Commerce and Economic Development
Program Category Affected Economic Development
BRU, Program, or Subprogram(s) Affected Alaska Power Authority
(Note: If more than one budget component is affected, separate line-item amounts and funding for each
component in the analysis section.)

EXPENDITURES (Thousands of Dollars)

	FY 80	FY 81	FY 82	FY 83	FY 84	FY 85
100 PERSONAL SERVICES		---				
200 TRAVEL						
300 CONTRACTUAL						
400 COMMODITIES						
500 EQUIPMENT						
600 LAND & STRUCTURES						
700 GRANTS, CLAIMS, ETC.						
TOTAL		---				

FUNDING (Thousands of Dollars)

GENERAL FUND		---				
FEDERAL FUNDS		---				
OTHER (Specify Fund Source)		---				

POSITIONS

FULL TIME		---				
PART TIME						
TEMPORARY		---				

III. ANALYSIS (See Fiscal Note Preparation Instructions, Section III)

The Alaska Power Authority intends to finance the project by issuing revenue bonds guaranteed by the National Rural Electric Utilities Cooperative Finance Corporation. No state assistance will be required to finance the Project due to the strong economic merits of the project.

(Note: If more than one budget component is affected, separate line-item amounts and funding for each component in the analysis section.)

EXPENDITURES (Thousands of Dollars)

	FY 80	FY 81	FY 82	FY 83	FY 84	FY 85
100 PERSONAL SERVICES		---				
200 TRAVEL						
300 CONTRACTUAL						
400 COMMODITIES						
500 EQUIPMENT						
600 LAND & STRUCTURES						
700 GRANTS, CLAIMS, ETC.						
TOTAL		---				

FUNDING (Thousands of Dollars)

GENERAL FUND		---				
FEDERAL FUNDS		---				
OTHER (Specify Fund Source)		---				

POSITIONS

FULL TIME		---				
PART TIME						
TEMPORARY		---				

III. ANALYSIS (See Fiscal Note Preparation Instructions, Section III)

The Alaska Power Authority intends to finance the project by issuing revenue bonds guaranteed by the National Rural Electric Utilities Cooperative Finance Corporation. No state assistance will be required to finance the Project due to the strong economic merits of the project.

IV. DATE 2/21/80 PREPARED BY Terry J. McGuire
 AGENCY Alaska Power Authority
 PHONE 276-2715
 Original: Legislative Finance
 cc: Budget and Management
 Prime Sponsor (First Legislator Named)

Section 1. The Alaska Power Authority has previously submitted to the governor and the legislature a statement of its recommendations for financing certain power projects and a statement outlining the general design, demonstration of financial feasibility and maximum amount of revenue bonds and appropriations necessary for the projects, together with a statement as to the design, acquisition, construction and financing of the projects by the authority or another person, which statements satisfy the conditions of AS 44.56.180. The legislature has adopted joint resolutions approving the general design and maximum amount of bonds to be issued for several of the projects and those actions are hereby confirmed. Similar joint resolutions affecting the other projects have been introduced in the legislature but have not been finally passed.

APA

Introduced: 3/21/80
Referred: Resources and
Finance

IN THE HOUSE

BY THE RULES COMMITTEE

HOUSE BILL NO. 967

IN THE LEGISLATURE OF THE STATE OF ALASKA

ELEVENTH LEGISLATURE - SECOND SESSION

A BILL

For an Act entitled: "An Act relating to the Alaska Power Authority and approving the general design and maximum amount of bonds for power projects; and providing for an effective date."

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF ALASKA:

* Section 2. ²¹ ~~Actions taken by the legislature before the effective date of this Act to approve~~ The general design and maximum amount of bonds for ^{the following} power projects ^{is approved} and the Alaska Power Authority is authorized to issue its bonds for the ~~following~~ power projects in the maximum principal amount set out after each:

- (1) Solomon Gulch, \$20,000,000;
- (2) Terror Lake, \$120,000,000;
- (3) Golden Valley Electric Association waste heat, \$110,000,000;
- (4) Tyee Lake, \$70,000,000;
- (5) Swan Lake, \$120,000,000;
- (6) Glacier Highway Electric Association, \$800,000;
- (7) Cordova Electric Cooperative, \$6,500,000;
- (8) Matanuska Electric Association, \$2,500,000;
- (9) Homer Electric Association, \$3,360,000; and
- (10) Naknek Electric Association, \$730,000.

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" (Nisank EA)
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* Sec. 3 This Act takes effect immediately in accordance with AS 01.10.-

Introduced: 3/21/80
Referred: (Resources and
Finance)

1 IN THE HOUSE

BY THE RULES COMMITTEE

2 HOUSE BILL NO. 967

3 IN THE LEGISLATURE OF THE STATE OF ALASKA

4 ELEVENTH LEGISLATURE - SECOND SESSION

5 A BILL

6 For an Act entitled: "An Act relating to the Alaska Power Authority and
7 approving the general design and maximum amount of
8 bonds for power projects; and providing for an effective date."
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10 BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF ALASKA:

11 * Section 1. Actions taken by the legislature before the effective date
12 of this Act to approve the general design and maximum amount of bonds for
13 power projects are confirmed and the Alaska Power Authority is authorized to
14 issue its bonds for the following power projects in the maximum principal
15 amount set out after each:

- 16 (1) Solomon Gulch, \$20,000,000; *passed*
17 (2) Terror Lake, \$120,000,000; *passed*
18 (3) Golden Valley Electric Association waste heat, \$110,000,000;
19 (4) Tyee Lake, \$70,000,000; *passed H*
20 (5) Swan Lake, \$120,000,000; *passed H*
21 (6) Glacier Highway Electric Association, \$800,000;
22 (7) Cordova Electric Cooperative, \$6,500,000;
23 (8) Matanuska Electric Association, \$2,500,000;
24 (9) Homer Electric Association, \$3,360,000; and
25 (10) Naknek Electric Association, \$730,000.

26 * Sec. 2. This Act takes effect immediately in accordance with AS 01.10.-
27 070(c).

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29 (+) Lake Elva (HJR 60) Nishagak REA

Introduced: 2/21/80
Referred: Resources and
Finance

1 IN THE HOUSE

BY THE RULES COMMITTEE

2 HOUSE JOINT RESOLUTION NO. 79

3 IN THE LEGISLATURE OF THE STATE OF ALASKA

4 ELEVENTH LEGISLATURE - SECOND SESSION

5 Relating to the Alaska Power Author-
6 ity, and the incurring of revenue
7 bond indebtedness of the Alaska Power
8 Authority for the Cordova Electric
9 Cooperative, Inc., to finance the
10 relocation of the present main diesel
11 power generation plant, acquisition
12 and installation of a new diesel
13 power generator, acquisition of
14 general equipment, acquisition and
15 installation of feeder and distri-
16 bution line improvements and con-
17 struction of a new headquarters
18 building, to be located in and near
19 Cordova.

20 BE IT RESOLVED BY THE LEGISLATURE OF THE STATE OF ALASKA:

21 WHEREAS the Cordova Electric Cooperative, Inc., a Rural Electric Asso-
22 ciation cooperative, plans to relocate the present main diesel power genera-
23 tion plant, acquire and install a new diesel power generator, acquire general
24 equipment, acquire and install feeder and distribution line improvements and
25 construct a new headquarters building, in and near Cordova; and

26 WHEREAS the Cordova Electric Cooperative, Inc., has submitted an appli-
27 cation to the Alaska Power Authority for assistance in financing these pro-
28 jects, and the Alaska Power Authority has by resolution determined to sell
29 its bonds to finance the projects; and

1 WHEREAS the Alaska Power Authority, under AS 44.56.180, has submitted to
2 the governor and to the legislature a statement of its recommendations for
3 financing the Cordova Electric Cooperative projects and a statement outlining
4 the general design, demonstration of financial feasibility, and maximum
5 amount of revenue bonds and appropriations necessary for the projects; and

6 WHEREAS, the statements of the Alaska Power Authority submitted to the
7 governor and to the legislature fully satisfy the requirements contained in
8 AS 44.56.180(b) and the statements required by AS 44.56.180(c); and

9 WHEREAS, according to the statements of the Alaska Power Authority, the
10 authority intends, through the issuance of revenue bonds, to finance the
11 Cordova Electric Cooperative projects only and not to construct, acquire or
12 own the projects; and

13 WHEREAS the statements of the Alaska Power Authority provide that the
14 projects are to be designed, acquired and constructed by the Cordova Electric
15 Cooperative, Inc., under an agreement with the Alaska Power Authority which
16 will provide that the Alaska Power Authority has ownership rights in the
17 projects only as may be necessary to secure the payment of the revenue bond
18 indebtedness; and

19 WHEREAS the costs to be incurred in financing the project will require
20 the issuance of revenue bonds of the Alaska Power Authority in a maximum
21 estimated amount not to exceed \$6,500,000; and

22 WHEREAS it is in the best interests of the state that revenue bonds of
23 the Alaska Power Authority be issued to finance the cost of the projects;

24 BE IT RESOLVED by the Alaska State Legislature that the general design
25 of the Cordova Electric Cooperative, Inc. projects in and near Cordova, and
26 the incurring of revenue bond indebtedness by the Alaska Power Authority in a
27 maximum amount not to exceed \$6,500,000 to pay the costs of the projects are
28 approved; and be it

29 FURTHER RESOLVED that the \$6,500,000 may be combined in one bond issue

1 with the amount needed to finance other Rural Electric Association coopera-
2 tive projects approved by the legislature in accordance with AS 44.56.180.

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Introduced: 2/21/80
Referred: Resources and
Finance

1 IN THE HOUSE

BY THE RULES COMMITTEE

2 HOUSE JOINT RESOLUTION NO. 75

3 IN THE LEGISLATURE OF THE STATE OF ALASKA

4 ELEVENTH LEGISLATURE - SECOND SESSION

5 Relating to the Alaska Power Author-
6 ity, and the incurring of revenue
7 bond indebtedness of the Alaska Power
8 Authority for the Homer Electric
9 Association for the financing of
10 acquisition and installation of new
11 consumer connections and electric
12 power distribution lines in the area
13 served by the Homer Electric Associ-
14 ation.

15 BE IT RESOLVED BY THE LEGISLATURE OF THE STATE OF ALASKA:

16 WHEREAS the Homer Electric Association, Inc., a Rural Electric Associ-
17 ation cooperative, plans to construct, acquire and install approximately
18 3,750 new consumer connections and approximately 250 miles of electric power
19 distribution lines; and

20 WHEREAS the Homer Electric Association, Inc., has submitted an appli-
21 cation to the Alaska Power Authority for assistance in financing the consumer
22 connections and distribution lines project, and the Alaska Power Authority
23 has by resolution determined to sell its bonds to finance the project; and

24 WHEREAS the Alaska Power Authority, under AS 44.56.180, has submitted to
25 the governor and to the legislature a statement of its recommendations for
26 financing the Homer Electric Association project and a statement outlining
27 the general design, demonstration of financial feasibility, and maximum
28 amount of revenue bonds and appropriations necessary for the project; and

29 WHEREAS, the statements of the Alaska Power Authority submitted to the

1 governor and to the legislature fully satisfy the requirements contained in
2 AS 44.56.180(b) and the statements required by AS 44.56.180(c); and

3 WHEREAS according to the statements of the Alaska Power Authority, the
4 authority intends, through the issuance of revenue bonds, to finance the
5 Homer Electric Association project only and not to construct, acquire or own
6 the project; and

7 WHEREAS the statements of the Alaska Power Authority provide that the
8 project is to be designed, acquired and constructed by the Homer Electric
9 Association, Inc., under an agreement with the Alaska Power Authority which
10 will provide that the Alaska Power Authority has ownership rights in the
11 project only as may be necessary to secure the payment of the revenue bond
12 indebtedness; and

13 WHEREAS the costs to be incurred in financing the project will require
14 the issuance of revenue bonds of the Alaska Power Authority in a maximum
15 estimated amount not to exceed \$3,360,000; and

16 WHEREAS it is in the best interests of the state that revenue bonds of
17 the Alaska Power Authority be issued to finance the cost of the project;

18 BE IT RESOLVED by the Alaska State Legislature that the general design
19 of the Homer Electric Association, Inc. project to construct, acquire and
20 install consumer connections and electric power distribution lines, and the
21 incurring of revenue bond indebtedness by the Alaska Power Authority in a
22 maximum amount not to exceed \$3,360,000 to pay the costs of the project are
23 approved; and be it

24 FURTHER RESOLVED that the \$3,360,000 may be combined in one bond issue
25 with the amount needed to finance other Rural Electric Association coopera-
26 tive projects approved by the legislature in accordance with AS 44.56.180.

Introduced: 2/21/80
Referred: Resources and
Finance

1 IN THE HOUSE

BY THE RULES COMMITTEE

2 HOUSE JOINT RESOLUTION NO. 76

3 IN THE LEGISLATURE OF THE STATE OF ALASKA

4 ELEVENTH LEGISLATURE - SECOND SESSION

5 Relating to the Alaska Power Author-
6 ity, and the incurring of revenue
7 bond indebtedness of the Alaska Power
8 Authority for the Naknek Electric
9 Association for the financing of
10 acquisition and installation of a new
11 diesel-powered electric power genera-
12 tor in Naknek.

13 BE IT RESOLVED BY THE LEGISLATURE OF THE STATE OF ALASKA:

14 WHEREAS the Naknek Electric Association, a Rural Electric Association
15 cooperative, plans to construct, acquire and install a 1,000 kilowatt capa-
16 city diesel-powered electric power generator in Naknek; and

17 WHEREAS the Naknek Electric Association has submitted an application to
18 the Alaska Power Authority for assistance in financing the generator project,
19 and the Alaska Power Authority has by resolution determined to sell its bonds
20 to finance the project; and

21 WHEREAS the Alaska Power Authority, under AS 44.56.180, has submitted to
22 the governor and to the legislature a statement of its recommendations for
23 financing the generator project and a statement outlining the general design,
24 demonstration of financial feasibility, and maximum amount of revenue bonds
25 and appropriations necessary for the project; and

26 WHEREAS, the statements of the Alaska Power Authority submitted to the
27 governor and to the legislature fully satisfy the requirements contained in
28 AS 44.56.180(b) and the statements required by AS 44.56.180(c); and

29 WHEREAS, according to the statements of the Alaska Power Authority, the

1 authority intends, through the issuance of revenue bonds, to finance the
2 generator project only and not to construct, acquire or own the project; and

3 WHEREAS the statements of the Alaska Power Authority provide that the
4 project is to be designed, acquired and constructed by the Naknek Electric
5 Association under an agreement with the Alaska Power Authority which will
6 provide that the Alaska Power Authority has ownership rights in the project
7 only as may be necessary to secure the payment of the revenue bond indebted-
8 ness; and

9 WHEREAS the costs to be incurred in financing the generator project will
10 require the issuance of revenue bonds of the Alaska Power Authority in a
11 maximum estimated amount not to exceed \$730,000; and

12 WHEREAS it is in the best interests of the state that revenue bonds of
13 the Alaska Power Authority be issued to finance the cost of the generator
14 project;

15 BE IT RESOLVED by the Alaska State Legislature that the general design
16 of the Naknek Electric Association project to construct, acquire and install
17 a diesel-powered electric power generator, and the incurring of revenue bond
18 indebtedness by the Alaska Power Authority in a maximum amount not to exceed
19 \$730,000 to pay the costs of the project are approved; and be it

20 FURTHER RESOLVED that the \$730,000 may be combined in one bond issue
21 with the amount needed to finance other Rural Electric Association coopera-
22 tive projects approved by the legislature in accordance with AS 44.56.180.
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Introduced: 2/18/80
Referred: Resources and
Finance

1 IN THE HOUSE

BY ROGERS, MOSS, PARR AND SMITH

2 HOUSE JOINT RESOLUTION NO. 68

3 IN THE LEGISLATURE OF THE STATE OF ALASKA

4 ELEVENTH LEGISLATURE - SECOND SESSION

5 Relating to the Alaska Power
6 Authority and the incurring of
7 revenue bond indebtedness of the
8 Alaska Power Authority for the Golden
9 Valley Electric Association waste
10 heat power generation project near
11 Fairbanks.

12 BE IT RESOLVED BY THE LEGISLATURE OF THE STATE OF ALASKA:

13 WHEREAS the Golden Valley Electric Associaton, Inc., plans to construct,
14 acquire and operate a waste heat power generating project located at pump
15 stations 7, 8, 9 and 10 of the trans-Alaska pipeline near Fairbanks; and

16 WHEREAS the project will provide an additional 27,500 kilowatts of
17 generating capacity through the utilization of BTU's which are now being
18 exhausted into the atmosphere and the project will thereby displace oil now
19 in short supply; and

20 WHEREAS the Golden Valley Electric Association, Inc., has submitted an
21 application to the Alaska Power Authority for assistance in financing the
22 waste heat power generation project and the Alaska Power Authority has by its
23 resolution determined to sell its bonds for the project; and

24 WHEREAS the Alaska Power Authority, under AS 44.56.180, has submitted to
25 the governor and to the legislature a statement of its recommendations for
26 financing the waste heat power generation project and a statement outlining
27 the general design, demonstration of financial feasibility, and maximum
28 amount of revenue bonds and appropriations necessary for the project; and

29 WHEREAS the statements of the Alaska Power Authority submitted to the

1 governor and to the legislature fully satisfy the requirements contained in
2 AS 44.56.180(b) and the statements required by AS 44.56.180(c); and

3 WHEREAS the statements of the Alaska Power Authority provide that
4 through the issuance of revenue bonds the authority is to finance the waste
5 heat power generation project only and is not to construct, acquire or own
6 the project; and

7 WHEREAS, the statements of the Alaska Power Authority provide that the
8 project is to be designed, acquired and constructed by the Golden Valley
9 Electric Association, Inc., under an agreement with the Alaska Power
10 Authority which will provide that the Alaska Power Authority has ownership
11 rights in the project only as may be necessary to secure the payment of the
12 revenue bond indebtedness; and

13 WHEREAS the costs to be incurred in financing the waste heat power
14 generation project will require the issuance of revenue bonds of the Alaska
15 Power Authority in a maximum estimated amount not to exceed \$110,000,000; and

16 WHEREAS it is in the best interests of the state that revenue bonds of
17 the Alaska Power Authority be issued to finance the cost of the waste heat
18 power generation project;

19 BE IT RESOLVED by the Alaska State Legislature that the general design
20 of the Golden Valley Electric Association, Inc., waste heat power generation
21 project near Fairbanks, and the incurring of revenue bond indebtedness by the
22 Alaska Power Authority in a maximum amount not to exceed \$110,000,000 to pay
23 the costs of the project are approved.

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Introduced: 2/21/80
Referred: Resources and
Finance

1 IN THE HOUSE

BY THE RULES COMMITTEE

2 HOUSE JOINT RESOLUTION NO. 77

3 IN THE LEGISLATURE OF THE STATE OF ALASKA

4 ELEVENTH LEGISLATURE - SECOND SESSION

5 Relating to the Alaska Power Author-
6 ity, and the incurring of revenue
7 bond indebtedness of the Alaska Power
8 Authority for the Matanuska Electric
9 Association for the financing of
10 acquisition and installation of new
11 consumer connections and acquisition
12 and installation of electric power
13 distribution lines in the area served
14 by the Matanuska Electric Association.

15 BE IT RESOLVED BY THE LEGISLATURE OF THE STATE OF ALASKA:

16 WHEREAS the Matanuska Electric Association, Inc., a Rural Electric
17 Association cooperative, plans to construct, acquire and install approximately
18 800 new consumer connections and approximately 200 miles of electric power
19 distribution lines; and

20 WHEREAS the Matanuska Electric Association, Inc., has submitted an
21 application to the Alaska Power Authority for assistance in financing the
22 consumer connections and distribution lines project, and the Alaska Power
23 Authority has by resolution determined to sell its bonds to finance the
24 project; and

25 WHEREAS the Alaska Power Authority, under AS 44.56.180, has submitted to
26 the governor and to the legislature a statement of its recommendations for
27 financing the Matanuska Electric Association project and a statement outlining
28 the general design, demonstration of financial feasibility, and maximum
29 amount of revenue bonds and appropriations necessary for the project; and

1 WHEREAS, the statements of the Alaska Power Authority submitted to the
2 governor and to the legislature fully satisfy the requirements contained in
3 AS 44.56.180(b) and the statements required by AS 44.56.180(c); and

4 WHEREAS according to the statements of the Alaska Power Authority, the
5 authority intends, through the issuance of revenue bonds, to finance the
6 Matanuska Electric Association project only and not to construct, acquire or
7 own the project; and

8 WHEREAS the statements of the Alaska Power Authority provide that the
9 project is to be designed, acquired and constructed by the Matanuska Electric
10 Association, Inc., under an agreement with the Alaska Power Authority which
11 will provide that the Alaska Power Authority has ownership rights in the
12 project only as may be necessary to secure the payment of the revenue bond
13 indebtedness; and

14 WHEREAS the costs to be incurred in financing the project will require
15 the issuance of revenue bonds of the Alaska Power Authority in a maximum
16 estimated amount not to exceed \$2,500,000; and

17 WHEREAS it is in the best interests of the state that revenue bonds of
18 the Alaska Power Authority be issued to finance the cost of the project;

19 BE IT RESOLVED by the Alaska State Legislature that the general design
20 of the Matanuska Electric Association, Inc. project to construct, acquire and
21 install consumer connections and electric power distribution lines, and the
22 incurring of revenue bond indebtedness by the Alaska Power Authority in a
23 maximum amount not to exceed \$2,500,000 to pay the costs of the project are
24 approved; and be it

25 FURTHER RESOLVED that the \$2,500,000 may be combined in one bond issue
26 with the amount needed to finance other Rural Electric Association coopera-
27 tive projects approved by the legislature in accordance with AS 44.56.180.
28
29

Introduced: 2/21/80
Referred: Resources and
Finance

1 IN THE HOUSE

BY THE RULES COMMITTEE

2 HOUSE JOINT RESOLUTION NO. 78

3 IN THE LEGISLATURE OF THE STATE OF ALASKA

4 ELEVENTH LEGISLATURE - SECOND SESSION

5 Relating to the Alaska Power Author-
6 ity, and the incurring of revenue
7 bond indebtedness of the Alaska Power
8 Authority for the Glacier Highway
9 Electric Association for the
10 financing of acquisition and in-
11 stallation of electric power trans-
12 mission and distribution lines and
13 new consumer connection in the City
14 and Borough of Juneau.

15 BE IT RESOLVED BY THE LEGISLATURE OF THE STATE OF ALASKA:

16 WHEREAS the Glacier Highway Electric Association, Inc., a Rural Electric
17 Association cooperative, plans to construct, acquire and install seven miles
18 of electric power transmission lines, 15 miles of electric power distribution
19 lines, and approximately 150 new consumer connections, to be located in the
20 City and Borough of Juneau ; and

21 WHEREAS the Glacier Highway Electric Association, Inc., has submitted an
22 application to the Alaska Power Authority for assistance in financing the
23 transmission and distribution lines and consumer connections project, and the
24 Alaska Power Authority has by resolution determined to sell its bonds to
25 finance the project; and

26 WHEREAS the Alaska Power Authority, under AS 44.56.180, has submitted to
27 the governor and to the legislature a statement of its recommendations for
28 financing the Glacier Highway Electric Association project and a statement
29 outlining the general design, demonstration of financial feasibility, and

1 maximum amount of revenue bonds and appropriations necessary for the project;
2 and

3 WHEREAS, the statements of the Alaska Power Authority submitted to the
4 governor and to the legislature fully satisfy the requirements contained in
5 AS 44.56.180(b) and the statements required by AS 44.56.180(c); and

6 WHEREAS, according to the statements of the Alaska Power Authority, the
7 authority intends, through the issuance of revenue bonds, to finance the
8 Glacier Highway Electric Association project only and not to construct,
9 acquire or own the project; and

10 WHEREAS the statements of the Alaska Power Authority provide that the
11 project is to be designed, acquired and constructed by the Glacier Highway
12 Electric Association, Inc., under an agreement with the Alaska Power Autho-
13 rity which will provide that the Alaska Power Authority has ownership rights
14 in the project only as may be necessary to secure the payment of the revenue
15 bond indebtedness; and

16 WHEREAS the costs to be incurred in financing the project will require
17 the issuance of revenue bonds of the Alaska Power Authority in a maximum
18 estimated amount not to exceed \$800,000; and

19 WHEREAS it is in the best interests of the state that revenue bonds of
20 the Alaska Power Authority be issued to finance the cost of the project;

21 BE IT RESOLVED by the Alaska State Legislature that the general design
22 of the Glacier Highway Electric Association, Inc., project to construct,
23 acquire and install electric power transmission and distribution lines and
24 consumer connections in the City and Borough of Juneau and the incurring of
25 revenue bond indebtedness by the Alaska Power Authority in a maximum amount
26 not to exceed \$800,000 to pay the costs of the project are approved; and be
27 it

28 FURTHER RESOLVED that the \$800,000 may be combined in one bond issue
29 with the amount needed to finance other Rural Electric Association coopera-

1 tive projects approved by the legislature in accordance with AS 44.56.180.
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ALASKA POWER AUTHORITY

GVEA-ALYESKA WASTE HEAT POWER

GENERATION PROJECT

PROJECT SUMMARY AND

FINANCING PLAN STATEMENT

This report summarizes key characteristics of the GVEA-Alyeska Waste Heat Power Generation Project for the purpose of satisfying requirements of Section 180 of Alaska Statute 44.56. Information to prepare this summary was furnished by the Golden Valley Electric Association (GVEA).

ALASKA POWER AUTHORITY

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Introduction

Project Description

Existing Capabilities and Expected Demand

Alternatives Considered

Environmental Impacts

Engineering Considerations

Project Costs and Financing

Conclusion

ALASKA POWER AUTHORITY

INTRODUCTION

The Golden Valley Electric Association, Incorporated (GVEA) intends to construct and operate waste heat recovery systems on four pump stations of the Alyeska pipeline. The 1980 Project construction cost is approximately \$53.9 million. GVEA desires to finance the entire cost of the Project with revenue bonds issued by the Alaska Power Authority with security provided by the National Rural Electric Utilities Cooperative Finance Corporation (CFC). The State of Alaska will not have to commit any funds or provide assistance in any form to achieve the Project financing. The maximum amount of bonds necessary to finance the Project over a 4-year construction schedule is \$110 million.

ALASKA POWER AUTHORITY

The waste heat boiler would receive the exhaust from each of the pump station gas turbines through a damper system. An induced draft fan would be provided to control pressure at the point of intersection with the pump station gas turbine stacks to prevent excessive back pressures at the exhaust of the gas turbines. Means would be provided to rapidly maneuver the damper system during periods of steam plant difficulty so that pump station operation would not be affected by steam plant problems.

The steam turbine would be a conventional type unit which would exhaust to an air-cooled condenser preferably mounted on the roof of the steam plant building. No extraction points would be considered for the turbine. Condensed steam would be pumped from the condenser "hot well" through suitable regulating equipment to the waste heat boiler.

Water make up to this plant would be added to the system in the de-aerating section of the condenser. Due to the lack of waste disposal system around the pump station, make up water treatment would probably be off-site. The only "on site" make up facility would be a storage tank to accommodate a number of days' operations, which would periodically be filled.

Included in this scheme would be a small oil fired steam boiler to provide heat for the building and for the waste heat boiler during periods of pump station difficulty. Also included in the scheme would be some type of radiator to accommodate generator and bearing cooling.

GVEA's concept of plant operation would be to pass all of the pump station gas turbine exhaust through the waste heat boiler and let the power generation float with waste heat availability. Parameters which must be monitored would be done with a data logging system. Data so acquired would be collected on a periodic basis while the more important data would be transmitted to a control center in Fairbanks.

This concept of waste heat power generation would provide the pump station with an additional electric power supply and supply the members of GVEA with a less expensive supply of electric power. Inconvenience to pump station operation would be minimal and energy that is now wasted would be utilized to the benefit of the community.

The proposed transmission line additions appear appropriately sized to transmit power from the pump station systems toward Fairbanks. They also will provide sufficient voltage for power transfer in the opposite direction when the demand for power increases along the transmission line routes.

Project Costs and Financing

As stated in the introduction, the Power Authority desires to issue revenue bonds guaranteed by CFC to finance the GVEA-Alyeska Waste Heat Power Generation Project. The estimated cost in 1980 dollars is as follows:

ALASKA POWER AUTHORITY

1. Generation consisting of 7,500 KW units installed at P.S. 8, 9 and 10 and 5,000 KW at P.S. 7 = 27,500 KW @ \$1,000.00 per KW = \$27,500,000.
2. Transmission line to P.S. 7, 40 miles of 69 KV at \$100,000/mile = \$4,000,000. 46 miles of 138 KV to P.S. 10 at \$150,000/mile = \$6,900,000. Total transmission = \$10,900,000.
3. Engineering, Design, Project Management, RW Acquisition \$5,000,000.
4. Substations, Breakers, Controls, Communications \$5,500,000.
5. Contingencies \$5,000,000.
6. Inflation @ 10%/year applied to estimated construction expenditure schedule, \$24,600,000.
7. Capitalized Interest During Construction, @ 7.5%/year, \$24,100,000.

TOTAL \$104,500,000

The total capital requirements could be reduced if the Project is financed in two phases corresponding to the phases of construction. A firm Plan of Finance will be prepared based upon completion of a detailed engineers report to minimize the ultimate cost of power to GVEA consumers.

The Project will not require any form of state assistance to be financed. The estimated busbar cost of power from the Project is approximately 60 mills/kwh if financed at 7.5% over 20 years compared to the current cost of approximately 70 mills/kwh today for the cost of the diesel fuel alone for the diesel generation which will be displaced. The Project financing will again be secured by guarantees of the CFC which may result in a lower interest rate than actually presented.

ALASKA POWER AUTHORITY

PROJECT DESCRIPTION

The Waste Heat Power Generation Project is designed to utilize the waste heat of Alyeska pipeline pump station generation to generate additional power utilizing waste heat for steam electric generation. The Project consists of two phases. Phase I includes a 7,500 KW generation system at both Pump Station (P.S.) 8 and P.S. 9. Phase II includes a 5,000 KW generation system at P.S. 7, a 40 mile 69 KV transmission line to P.S. 7, a 7,500 KW generation system at P.S. 10, and a 46 mile 138 KV transmission line to P.S. 10. Construction will commence on Phase I by 1981 and be completed by early 1983. Phase II will commence in 1983 and be completed by 1985. The 27,500 KW in combination of installed capacity is capable of producing 177 million kwh's of annual energy. All energy produced with the waste heat system will be used to displace more expensive energy that would otherwise be generated by oil fired units.

Existing Capabilities and Expected Demand

The GVEA system is an REA borrower serving the Fairbanks North Star Borough, approximately 3,000 customers in the City of Fairbanks, and a portion of the Unorganized Borough extending South on the Parks Highway to Summit and South on the Richardson Highway to a point 35 miles South of Delta Junction. Existing capacity consists of 25 MW's of coal fired steam generation and 200 MW's of diesel and gas turbine generation. Peak demand in 1979 was 70 MW and consumption was 340 million kwh's of energy.

Demand for power in the GVEA service area increased rapidly from 1970-1976 due to the increased population and industrial activity associated with construction of the Trans-Alaska Pipeline. Since 1976, the energy demand in the service area has leveled and actually decreased slightly due to decline in economic activity associated with pipeline completion. Energy demand in the 1980's is forecast to increase again at more moderate rates than in the early 1970's due to new construction of the proposed natural gas pipeline.

The purpose of the Project is not to increase available generation capacity. The purpose is to displace existing diesel and/or gas turbine generation in the most economical manner. The Project decreases reliance on non-renewable fuels by utilizing available waste heat from existing pipeline pump station generation which would otherwise be inefficiently dispersed to the atmosphere. Existing diesel and gas turbine generation units will be retained for emergency standby and reserve capacity.

Alternatives Considered

Alternatives considered are No Action, a new coal fired steam combustion generation plant, and hydroelectric development. No Action requires continued

ALASKA POWER AUTHORITY

dependence on non-renewable fuels with their associated rapidly rising cost. This alternative is considered economically unattractive.

A new coal plant was analyzed in 1978 for GVEA by Stanley Consultants. A 104 MW mine mouth plant near Healy was proposed and disregarded due to high capital costs associated with air quality emission controls.

Hydroelectric options in Interior Alaska principally consist of large capital intensive projects which far exceed the capacity and energy needs of the Fairbanks area. The long term desirable solution for electric energy generation for GVEA is the Susitna Hydroelectric Project which could be developed to supply renewable energy to both Interior and Southcentral Alaska.

The proposed waste heat Project appears to be the best alternative in the short run to decrease dependence on non-renewable fuel for electric power generation.

Environmental Impacts

The major environmental impacts of the Project are associated with the actual construction activity itself and the visual impact of the proposed 86 miles of transmission line in Phase II. All construction will take place within the existing boundaries of the pump stations and within the transportation/pipeline corridor between the pump stations. No impact is expected upon the existing ecosystems of the area. Operation of the Project will not degrade air quality. However, some temporary impacts on air quality may be experienced during construction due to exhaust and crankcase emissions from vehicles and construction equipment and the dust generated by movement of equipment. Noise levels will increase due to machinery operation, and other construction activities. Project operation may result in a small decrease in noise, since pump station generation exhaust will be controlled to capture waste heat. Project construction will result in beneficial social and economic impacts associated with increased economic activity and control of electric power costs.

Engineering Considerations

GVEA's concept for utilizing waste heat from the gas turbine prime movers in oil pipeline pump stations is a very simple steam cycle as illustrated in the attached conceptual design. Such a cycle would consist of a waste heat boiler producing steam at approximately 250 psi, a 7.5 MW steam turbine generator set, an air-cooled condenser, pumping equipment to return condensed steam to the waste heat boiler and the necessary auxiliaries to make this cycle operate properly. Power so produced would be delivered directly to the Pump Station Power Buss and the excess would be delivered to GVEA's transmission system. Frequency relays would monitor the connection to GVEA's system and would isolate the pump station from GVEA's system during periods of GVEA difficulty.

ALASKA POWER AUTHORITY

CONCLUSION

This executive summary and financing plan statement was prepared by the staff of the Alaska Power Authority to comply with Section 44.56.180 of the enabling statutes of the Power Authority. The maximum amount of bonds estimated to be necessary to finance the GVEA-Alyeska Waste Heat Power Generation Project is \$110,000,000. The Power Authority desires to assist the GVEA to finance the Project with the National Rural Electric Utilities Cooperative Finance Corporation guarantee. The Power Authority does not intend to design or construct the Project itself. The Project will be designed, constructed, owned and operated by the Golden Valley Electric Association, Incorporated, and rights to the capacity of the Project will remain with the Golden Valley Electric Association. The general design and financial feasibility of the Project is acceptable, and the Project should proceed to construction. The Power Authority recommends that the Legislature adopt a joint resolution approving the general design and financial feasibility of the GVEA-Alyeska Waste Heat Power Generation Project, and approve action of the Power Authority to assist in financing the Project in cooperation with the Cooperative Finance Corporation by issuing bonds in an amount not to exceed \$110,000,000 for the Project.

SCOMM

#44:32



Alaska Center for the Environment
1069 W. 6th Avenue
Anchorage, Alaska 99501
(907) 274-3621

Mark -
Do you think
we should
print this?

Brian,

You once mentioned that ^B
your committee on the alternate
power study might be able to
publish The Lovins proceedings.

Here are/is good typed copy of my
conversation/interview with
Amory, his lecture at APO and
the soft path study workshop
in Fairbanks. They may need
some final editing, but are
basically ready to go. I would
think 50 copies would be
adequate — 100 would be best.

A for AE is off. The mailing
is out. Jane Balblum is organizing
legislative priorities w/ Fairbanks
Directors.

I regret that it has moved
so slowly. We have been not a
little hampered by holidays,
weather & the mid-winter slow-
down/hibernation. I would guess
that legislators are not
allowed such cycles.

Be well, and good luck.
Don't hesitate to call if you
need anything. With the
hiring of a new librarian for
ACE, (my good right arm, Jennifer
departed in a burn-out frenzy this
January) we will be on
line again & somewhat more
dependable.

Peace,
Nancy

HOUSE POWER ALTERNATIVES
STUDY COMMITTEE
610F Gruening Building
University of Alaska
Fairbanks, Alaska 99701

December 28, 1979

Chris Conway
Energy Probe
12 Madison Avenue
Toronto, Ontario
CANADA

Dear Chris:

Unfortunately, Legislative Affairs in Juneau has informed me that they were unsatisfied with the contract between Energy Probe and the House Power Alternatives Study Committee. I had neglected to specify that we were talking about United States dollars, so I have changed page 2 of the contract to correct that.

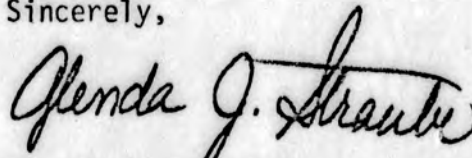
Also, enclosed is an application for an Alaska State Business License. The cost is U.S.\$25. The Juneau office informed me that you were ineligible to do business here unless you had applied for the license. It's really no big matter, except that there's a possibility that you will be liable for taxes here. Check with your accountant on that.

Please sign the contract right away and forward it in the enclosed envelope. Also, the Department of Revenue must receive your business license application before you can get paid.

When you submit a bill, please send it to the committee and Brian will authorize payment and forward it to Legislative Affairs.

We will be here in Fairbanks until January 7, so it might be best that you send correspondence to Brian to his Juneau address: Pouch V, Juneau, Alaska 99811. Mark Wittow, aide to the committee, will return soon so I probably will not be dealing with you anymore. However, if you or Bob make it to Alaska again, you can reach me through Brian.

Sincerely,



Glenda J. Straube
Administrative Assistant

Happy New Year!