Historical and Projected Oil and Gas Consumption

State Of Alaska
Department Of Natural Resources
Division Of Minerals And Energy Management

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ALASKA - HISTORICAL AND PROJECTED OIL AND GAS CONSUMPTION

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EXECUTIVE SUMMARY

The purpose of this report is to comply with the Alaska Statute, Section 38.05.183. SALE OF ROYALTY. This statute requires the Commissioner of the Department of Natural Resources to submit an annual report to the Legislature, within 10 days of the convening of the regular session, that shows the immediate and long-range domestic and industrial needs for oil and gas in Alaska.

Another requirement of the statute is that royalty oil and gas must first be used to satisfy present and projected intrastate domestic and industrial needs before being sold or otherwise disposed of. The statute contains several ambiguities in wording leading to a variety of possible definitions of consumption. Therefore, meeting the requirements of the statute this report first develops a number of definitions of consumption. The purpose of these definitions is to provide a framework for identifying intrastate domestic and industrial needs.

Historical consumption by major use category is then presented. This section is consistent with past reports. It updates the January 1981 report and provides estimated consumption for 1981 by major use category.

This report deviates from past reports in that the historical consumption and forecasts are developed by three major geographic regions: the Southeast, the Railbelt (Anchorage-Cook Inlet, Valdez, and the Greater Fairbanks area) and the rest of the state. Estimated historical gas consumption has been increasing at about 11% per year statewide, while petroleum liquids consumption has been increasing at up to 12% per year for some regions.

Forecasts of oil and gas consumption are developed for these regions by major use category. These forecasts show cumulative consumption by 2000 of natural gas may be as much as 6.3 trillion cubic feet or as low as 1.1 trillion cubic feet, depending on the underlying assumptions and definition of demand.

Cumulative refined product demand varies from 373 million barrels to 884 million barrels, again depending on the assumptions used and the definition of demand. Of particular interest is the question of what uses may be counted as in-state "industrial" use.

Low, medium, and high estimates of oil and gas reserves and the corresponding state royalty share of these reserves are next presented. The mid-level estimates show that of the total crude oil reserves of 10.3 billion barrels about 98% are on the North Slope. Of these crude oil reserves the state claims royalty rights of about 1.3 billion barrels and about 98% of the royalty share is located on the North Slope. The middle case gas reserves of the state total about 39.2 trillion cubic feet, Tcf, with about 90% on the North Slope. Only 0.2 trillion cubic feet of the State's royalty share of 4.7 Tcf are located in the Cook Inlet, which is the major demand center in the state. The remainder lie in the North Slope and the timing of this gas development can have a significant impact upon the state's royalty surplus/deficit situation.

The projected in-state consumption levels of oil and gas are compared with the corresponding estimated reserves and royalty share to determine if a royalty surplus or deficit exists. These comparisons show that for oil the State of Alaska has sizeable surplus reserves whether the reserves "counted" are all reserves or just State royalty reserves. The combination of highest oil demand with lowest royalty oil reserves yields a potential surplus of 203 million barrels. This ranges up to as high as 21.7 billion barrels. As long as Alaska can legally meet its needs for specific refined products with a combination of in-state refining and imported products, there is enough crude oil available to be either refined or traded for product to cover Alaska's projected consumption to the year 2000. No attempt has been made in this report to analyze a situation in which Alaska's refined products requirements would have to be met utilizing only Alaskan crude. This could cause supply problems because Alaska currently imports lighter refined products, while exporting heavier residual oil.

The statewide situation for natural gas is somewhat deceiving. A statewide royalty deficit situation occurs only when consumption is at its highest assumed level and reserves are measured very conservatively. However, 1 to 5.4 Tcf of cumulative gas consumption by the year 2000 is projected to be in the Cook Inlet region. This compares to the state's estimated royalty reserves in the region of 0.2 Tcf. The coverage of total Cook Inlet consumption by total Cook Inlet gas reserves is much better, with a net surplus in most cases. However, in some cases an outside source of gas (new gas discoveries, pipeline gas from the North Slope, LNG, or synthetic gas) would be still be required to cover some of Cook Inlet projected demand by the year 2000.

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1.0 DEFINITION OF CONSUMPTION

Section 38.05.183 of Alaska Statutes states that oil and gas taken in kind as its royalty share of production may not be sold or otherwise disposed of for export from the state until the Commissioner of Natural Resources determines that the royalty-in-kind oil and gas is surplus to the present and projected intrastate domestic and industrial needs for oil and gas. The statute also requires an annual report to the State Legislature showing the immediate and long-term domestic and industrial needs of the state and an analysis of how these needs are to be met.

The section contains several key terms whose meaning must be resolved before an estimate can be made of oil and gas surplus to the state's needs. These key terms are: 1) "oil and gas", 2) "export", 3) "present" 4) "projected", 5) "domestic", 6) "industrial", 7) "intrastate", and 8) "how these needs are to be met." Each key term affects the size of the estimated demand for oil and gas in Alaska and consequently, the size of the projected surplus or deficit. The meaning of each term is discussed below. In addition, this chapter explains how heat rates and the mix of technologies in the electrical sector affect Alaska fuel use forecasts.

Using the varying definitions of industrial use and intrastate use of energy described in this chapter, together with three alternative growth/fuel price scenarios produces multiple forecasts of demand for oil and gas in Alaska. Since it is not obvious which definitions of industrial and interstate use should be chosen from among the possible candidates, this report gives a range of possible forecasts of demand, rather than a single "best" estimate.

"OIL AND GAS"

Crude oil and natural gas are fluids containing hydrocarbon compounds produced from naturally occurring petroleum deposits. Typical crude oil contains several hundred chemical compounds. The lightest of these are gases at normal temperatures and pressures, and are described as "natural gas." These light fractions of the crude oil stream include both hydrocarbon and

non-hydrocarbon gases, such as water, carbon dioxide, hydrogen sulfide, helium, or nitrogen. The principal hydrocarbons are methane (CH_4), ethane (C_2H_6), propane (C_3H_8), butanes (C_4H_{10}), and pentanes (C_5H_{12}). The largest component is typically methane. Heavier factions of the crude stream are usually liquids. If a given hydrocarbon fraction is gaseous at reservoir temperatures and pressures, but is recoverable by condensation (cooling and pressure reduction), absorption, or other means, it is classified by the American Gas Association (AGA) as a natural gas liquid (NGL).[(a)] Natural gas liquids include ethane if ethane is recovered from the gas stream as a liquid. A related term is liquified petroleum gas (LPG), composed of hydrocarbons which liquify under moderate pressure under normal temperatures. LPG usually refers to propane and butane. A second related term is condensate, which refers to LPG plus heavier NGL components (natural gasoline). The lightest hydrocarbon fraction is methane, which is almost never recovered as a liquid, and which makes up the bulk of pipeline gas. If a natural gas stream contains few hydrocarbons which are commercially recoverable as liquids, it is considered "dry gas" or "lean gas." If it contains condensable hydrocarbons, the gas is considered "wet gas." The distinction between "wet" and "dry" is usually a legal one, which varies from state to state. "Crude oil" usually means the non-gaseous portion of the crude oil stream.

Natural gas may occur in reservoirs which are predominantly gas-bearing or in reservoirs in which the gas is in contact with petroleum liquids. Non-associated gas is natural gas from a reservoir where the gas is neither in contact with nor dissolved in crude oil. Associated gas occurs in contact with crude oil, but is not dissolved in it. A gas cap on a crude oil reservoir is a typical example of associated gas. Dissolved gas is dissolved in petroleum liquids and is produced along with them. Dissolved and associated gases are usually good sources of NGL while non-associated gases are often "dry."

(a) Definitions vary with the processes permitted to be counted.

The distinction between natural gas and its NGL components is important to a study of the supply and demand of royalty oil and gas because natural gas liquids have a multitude of uses when separated from the gas stream. For example, propane is both produced in Alaska and sold in Alaska as bottled gas for residential, commercial, and limited transportation uses, while butane is used for blending in gasoline and military jet fuel and a refinery fuel. In addition, Marathon Oil uses LPG to enrich crude oil at its Trading Bay facility. It ships the combined fluids to the Drift River terminal for export.(a) Potential uses for NGL also include the enriching ("spiking") of pipeline gas and crop drying. The Dow-Shell Petrochemical Group and Exxon have also recently studied the feasibility of utilizing the NGL contained in Prudhoe Bay natural gas as the basis for an Alaska petrochemicals industry. Since the State has the option of considering NGL separately from the gas stream, two definitions of natural gas consumption and reserves are possible. One of these would consider natural gas liquids as part of the gas stream. This definition ignores the existing specialized markets for LPG in Alaska and the potential for growth in both markets for ethane and LPG in the State. The second definition would treat the markets for LPG and ethane separately from those for gas. This requires a separate estimate of LPG consumption and gas liquids reserves. In this report, demand for LPG and ethane is estimated separately from that for gas; however, no separate estimate is made of gas liquids reserves.

"EXPORT"

Taken in context, this term appears to mean the direct physical sending of oil and gas out of the state. However, when one considers the fact that much of Alaska's industrial use of oil and gas is processed directly for export markets, the meaning of export versus "intrastate" is not so obvious. For example, it appears that processing of gas into another product, e.g., anhydrous ammonia, would probably be an "industrial" use rather than "export"

(a) Lois Kramer, Bob Williams, and Gregg Erickson. In-State Use Study for Propane and Butane. Prepared for the Alaska Department of Natural Resources. Kramer Associates, Juneau, Alaska. October 1981.

of gas, even though the ammonia is mostly exported. Liquefaction to change the phase of the gas is a less obvious case, except for gas consumed to develop power to run compressors producing the liquid product. It is certainly arguable (indeed, some have so argued) that export of LNG is not an "industrial" use, although it has many of the earmarks: value added in manufacture, payroll, taxable property. Still more troublesome is the use of gas and oil for transportation related to export. Is the gas and oil consumed in TAPS pipeline pump stations, for example, an "industrial" use in state? Or is it really "export" of that energy, since it is consumed in the exporting process? There is no reason why the State may not be approached in the future to commit royalty oil and gas to quasi-export uses. Indeed, a top dollar offer was made by the ALPETCO (later, Alaska Oil Company) for royalty oil ultimately destined (as petrochemical products) for out-of-state markets. Also, the state once committed royalty gas to the El Paso gas pipeline proposal for export of Prudhoe Bay gas, which involved liquefaction. Neither proposal was clearly for in-state industrial use. In this report, industrial demand is treated with multiple definitions as outlined later in the chapter to show how different definitions of "export" affect the estimate of total consumption in Alaska.

"PRESENT"

The problem here is that the term "present" may mean "latest year" consumption, "average recent year" consumption, "weather-adjusted" consumption, or "worst case" consumption. In the residential and commercial sector particularly, each definition gives a somewhat different answer because of the variability of weather. Even the "worst case" scenario could be interpreted in varying ways. Consider Alaska Gas and Service Company residential gas consumption from 1970 to 1980. Base year present consumption plausibly could be figured any of the ways shown in Table 1.1.

Obviously, based on even simple calculations like those in Table 1.1, the "worst case" consumption calculation can result in considerably higher gas consumption than the most recent year, if the most recent year happens to have been a relatively warm one. While it is not correct forecasting procedure to make long run forecasts of intrastate residential consumption of natural gas

TABLE 1.1. Figuring Base Year Consumption of AGAS Natural Gas in the Residential Sector, 1970 to 1980

1.	Actual Residential Consumption, 1980	$7,577 \times 10^3$ mcf
2.	1980 Total Based on Average Consumption Per Customer, 1970-1980	$7,794 \times 10^3$ mcf
3.	1980 Total Based on Weather-Adjusted Average Consumption Per Customer, 1970-1980	$8,083 \times 10^3$ mcf
4.	1980 Total Based on Highest Per Customer Use, 1970-1980	$8,416 \times 10^3$ mcf
5.	1980 Total Based on Most Recent Customer Per Degree Day Use and Coldest Weather Year 1970-1979 (21.43 cf/HDD/customer x 35,482 customers x 12,016 HDD)	$9,137 \times 10^3$ mcf

(a) cf = cubic feet; HDD = Heating degree days.

which assume worst case forecasts for every year, it may be prudent in practice to reserve part of the State's gas and oil supply for bad weather. For forecasting, variability of weather makes the picking of a starting value for consumption somewhat tricky. In this report, Railbelt consumption is based on average weather years, and the starting point for the appliance stock forecast is the most recent year on which full information is available (1981). For the remainder of the state, trended per capita consumption is used, which approximates average weather conditions.

"PROJECTED"

This is a very difficult concept, since many different projections of consumption would be possible even if it were possible to agree on a single concept defining consumption. Rates of economic development, population growth, and relative energy prices are key features of any consumption forecast, but assumptions concerning any of these variables are necessarily controversial. This report describes a range of possible consumption figures

under precisely articulated definitions of consumption and varying paces of economic, population, and fuel price growth. The economic and population forecasts used in this report were done by the University of Alaska Institute of Social and Economic Research in August and September, 1981. The assumptions used to run their economic model are shown in Appendix D. The energy price forecasts were done by Battelle-Northwest in October and November for the Governor's Office Railbelt Electric Power Alternatives Study.

"DOMESTIC"

Domestic consumption appears to mean Alaska residential consumption. As we saw above under the subheading "present", it is not at all obvious which definition of domestic consumption is the most appropriate, even when the identity of the customer is not in dispute. Some multifamily residential use may be described as "commercial," obscuring the definition of the customer and causing forecasting problems for natural gas. The definition of "domestic" considered in this report includes multifamily residential in "residential" or "domestic" use.

"INDUSTRIAL"

As described above, "industrial" energy use has a number of potential definitions. Since one intent of giving in-state industrial needs priority over export uses of royalty oil and gas seems to be to encourage in-state economic activity,[a] a day-to-day working definition of this industrial priority is that the royalty reserves be committed to the market which has the largest potential economic impact in Alaska. For forecasting purposes, however, it is difficult to say which markets will prove to be of the most economic benefit to the state. As a compromise, we will adopt four alternative definitions of "industrial" in this study.

(a) See however, the short discussion of legislative intent beginning on page 9 of Kramer, Williams and Erickson, In-State Use Study for Propane and Butane. That study raises many of the issues regarding surplus gas and oil discussed in this report.

The four alternative definitions of industrial use of oil and gas used in this report are outlined below, beginning with the most restrictive and moving to the most liberal.

Definition 1: Industrial use consists of any consumption of natural gas, petroleum, or their products in combustion (except that required to export oil or gas); or the chemical transformation of natural gas, petroleum, or their products into refined products for local markets. This definition explicitly excludes the exported products from refineries, as well as uses which merely change the physical form of the product (gas conditioning or liquefaction) for export, or which move the product to an export market (pipeline fuel, fuel used on lease, shrinkage, injection, vented and flared gas).

Definition 2: Industrial use consists of any consumption of natural gas, petroleum, or their products in combustion (except in oil and gas production and transportation); or the chemical transformation of natural gas, petroleum, or their products into refined products. This definition counts feedstocks for petrochemical plants and refineries as industrial consumption. It also counts energy consumed by an LNG facility as industrial consumption. It excludes the feedstocks of LNG plants and fuel consumption by conditioning plants, pump stations, fuel used on lease, shrinkage, injection and flared gas.

Definition 3: Industrial use consists of any consumption of natural gas, crude oil, or their products in combustion (except in oil and gas transport and extraction) or their chemical transformation into refined products, or transformation into products having a different phase. This definition permits the feedstocks of refineries and LNG plants both to be counted as industrial consumption, as well as energy consumption of LNG plants. It excludes fuels used in pump stations, in conditioning plants, fuel used on lease, and gas shrinkage, injection, or venting.

Definition 4: Industrial use consists of any use of natural gas, crude oil, or their products in combustion, or their transformation into chemically different products or products having a different phase. This

definition permits feedstocks of refineries and LNG plants to be counted as industrial consumption, as well as energy consumption in LNG plants, conditioning plants, and pump stations. It excludes injected gas, which is ultimately recoverable for other uses.

None of the four definitions treats industrial use (including transportation) to include gas injected to enhance oil recovery, since in theory this gas remains part of the ultimately recoverable gas reserves of the state. Thus, is not "consumed."

"INTRASTATE"

It is unclear what is meant by intrastate consumption. Some uses, such as combustion of oil and gas products in fixed capital facilities in Alaska, are reasonably easy to categorize as intrastate. There are several uses in transportation which are not obviously within Alaska. These categories include the fuel burned in marine vessels such as cargo vessels, ferries, and fishing boats, and fuel burned in international and interstate air travel. There are multiple ways to approach the definition of this consumption. The first is a sales definition: the fuel used in transportation which is sold in Alaska. The second approach is to base consumption on fuel used in Alaska or related to Alaska's economy and population, regardless of the point of sale. This results in three logical definitions, described below:

Definition 1: Intrastate consumption in transportation includes all sales of fuels to motor vehicles, airplanes, and vessels in Alaska, including bonded fuels. It excludes fuel consumed by motor vessels which was purchased in other states, and fuel consumed by airlines between Alaska and out-of-state locations and even between Alaska locations unless the fuel was sold in Alaska. It also excludes out of state military fuel purchases.

Definition 2: Intrastate consumption includes fuel consumed by motor vessels, airlines, and vehicles engaged in Alaskan economic activity. It includes use of fuel by American fishing boats in Alaskan waters regardless of where the fuel was purchased, use of fuel purchased in Washington State by Alaska State Ferries, and fuel consumed by ships and

aircraft involved in Alaska trade. It excludes sales to aircraft on international flights (bonded and unbonded), but includes military out of state purchases.

Definition 3: The final definition is a compromise between the first two. It includes all fuel purchased within the state, plus military uses, but excludes fuel purchased out of state except for military uses.

The basic definition in this report is the third definition. By excluding bonded and exempt jet fuel, the report also approximates Definition 2. Lack of data on out-of-state purchases by the military makes Definition 1 impractical.

"HOW THESE NEEDS ARE TO BE MET"

Any analysis of how the oil and gas needs of intrastate domestic and industrial sectors are to be met could include several sources of supply: royalty oil and gas in proven in-state reserves, other oil and gas in proven in-state reserves under other ownership, probable extensions of proven reserves, and imports of crude oil, petroleum products, and (in theory) natural gas. Since some of the state's needs are currently met with imported petroleum products, the state seems to be allowed to export oil and gas as long as in-state needs are being met from some source. This meets the intent of other parts of Alaska state law to receive top dollar for the State's royalty oil and gas. Since it may be cheaper to meet certain of Alaska's energy needs with imported product than with instate refineries, Alaska Statutes Section 38.05.183 might allow the State's oil to seek buyers who are willing to pay more than Alaskan refiners and ship petroleum products back to Alaska at competitive prices. The intent of the law does not seem to be actual Alaskan self-sufficiency in petroleum and gas products; rather, it seems to be aimed at adequate supplies. It may permit intrastate uses to be met from a variety of sources as long as they are identified and discussed. Thus, it might be acceptable to say that consumption can be met with imported product, even while exports are taking place, so long as it benefits Alaskans. This is the position taken in this report.

The only problems occur if the cost of imported product were significantly above the cost of products which could be refined in Alaska, or if Alaskan users were suffering an absolute shortfall in petroleum products which could be made up by product shipped from out of state. In such a circumstance, the state might not be able to continue exporting.

INFERENCE OF ELECTRIC UTILITY FUEL USE USING HEAT RATES

This is a topic which affects the measurement of consumption of fuel by Alaska's intrastate users, but which is not a definitional problem related to Section 38.105.183. It is quite clear that electric utility fuel is an intrastate use of oil and/or gas. The difficulty is that since no direct sales data is available on petroleum liquids sold to utilities, the amount of such use must be inferred from data on electricity sales and heat rates (Btu's consumed per Kwh produced) of generating facilities.

In previous forecasts, it has been necessary to estimate an average heat rate for electrical generation, as well as a specific set of generating technologies used. The forecasts of electrical consumption in this report were done with Battelle-Northwest's Railbelt Electricity Demand (RED) model, while forecasts of type and dispatching of generating technologies were done with Battelle-Northwest's Alaska Railbelt Electric Energy Planning (AREEP) Model. For a specific set of fuel price forecasts, economic growth, and electrification strategy assumptions, RED and AREEP together forecast the amount of electricity which will be generated by each type of power plant using fossil fuel in the Railbelt. For the Railbelt, heat rates are shown in Section B.11 of Appendix B. In the other two regions (Southeast and Rest-of-State) , the estimates are based on explicit consideration of the probable distribution of generating technologies for each scenario, and historic heat rates for these technologies in specific modes of operation.

Table 1.2 illustrates the 1981 variation in annual heat rates of sample existing plants in the Railbelt. The heat rates depend on the type, age, and mode of operation of the plants. System average heat rates will depend for many years on a group of generating plants like these.

The presence of major hydroelectric, coal-fired, or wind technology in some scenarios will affect the use of these oil and gas-using technologies in generating electricity. Both the percentage of electricity generated by oil and gas and the heat rate will be affected. For this reason, this report describes the consequences of major hydroelectric or coal development in the mid-range forecasts for each region. Wind technology is assumed to make only limited local contributions and is not analyzed further.

TABLE 1.2. Sample Plant Heat Rates, Railbelt Region, 1981

Utility/Plant/Unit	Technology Type[a]	Retirement Date	Fuel[b]	Operating Mode	Average Annual Heat Rate (btu/Kwh)
AMLP, Station #1, Unit 4	SCCT	1992	NG/Dist.	Base Load	12,500
AMLP, Station #1, Unit 2	SCCT	1984	NG/Dist.	Reserve/Peak	14,000
CEA, Beluga, Unit 5	RCCT	1995	NG	Base Load	10,000
CEA, International, Unit 3	SCCT	1990	NG	Peaking	40,000
CEA, Beluga, Units 6,7,8	SCCT/CCST	2012	NG	Base Load	8,500
GVEA, North Pole, Unit 1	SCCT	1996	Dist.	--	14,000
GVEA, Zendher, Diesel	Diesel	1995	Dist.	--	10,500
FMUS, Chena, Diesel 1	Diesel	1987	Dist.	--	12,150
CVEA, Glennallen, Units 6, 7	Diesel	1996	Dist.	--	10,500

(a) SCCT = Single cycle combustion turbine RCCT = Regenerative cycle combustion turbine CCST = combined cycle steam turbine.
(b) NG = natural gas. Dist. = distillate fuel oil.

2.0 ALASKA HISTORICAL OIL AND GAS CONSUMPTION

2.1 METHODOLOGY

The State of Alaska has been divided into three regions which have different energy consumption patterns. These different patterns are reflected in lifestyle, economic activity, and, more salient to this discussion, the mix of fuels used to supply the demand for energy. Figure 2.A shows the three regions (Southeast, Railbelt, Rest-of-State) adopted for this study and, for comparison, Alaska's four Judicial Districts. The Alaska Department of Revenue reports all motor fuel revenues by Judicial District. These reports subsequently become the principal source of information for regional consumption of refined petroleum products. To reallocate the data for purposes of this report, a per capita estimation of fuel use in each region was determined, then reaggregated based on the population in each of the three regions determined by census data.

With the exception of a small amount of gas used at Barrow (1.0 BCF) and gas used for electric power and oil and gas production at Prudhoe Bay, the bulk of natural gas use occurred within the Railbelt region, specifically the Cook Inlet area. The data for this region were obtained from the annual reports to the Alaska Public Utilities Commission by the Kenai Utility Service Corporation, the Alaska Gas and Service Company, and the Alaska Pipeline Company.

The electric utility information is reported by each utility to the Alaska Power Administration (APA), so that aggregation to the three regions was easily done for electricity end use. Only about a dozen towns had to be reallocated from the APA reporting districts to the new regions, but a significant change came from the inclusion of Fairbanks within the Railbelt category. Table 2.1 lists the utility locations which report to the Alaska Power Administration as they were reallocated. The Alaska Electric Power Statistics, 1960-1980, of the Alaska Power Administration became the primary source of data on electricity consumption and fuels used to generate electricity.

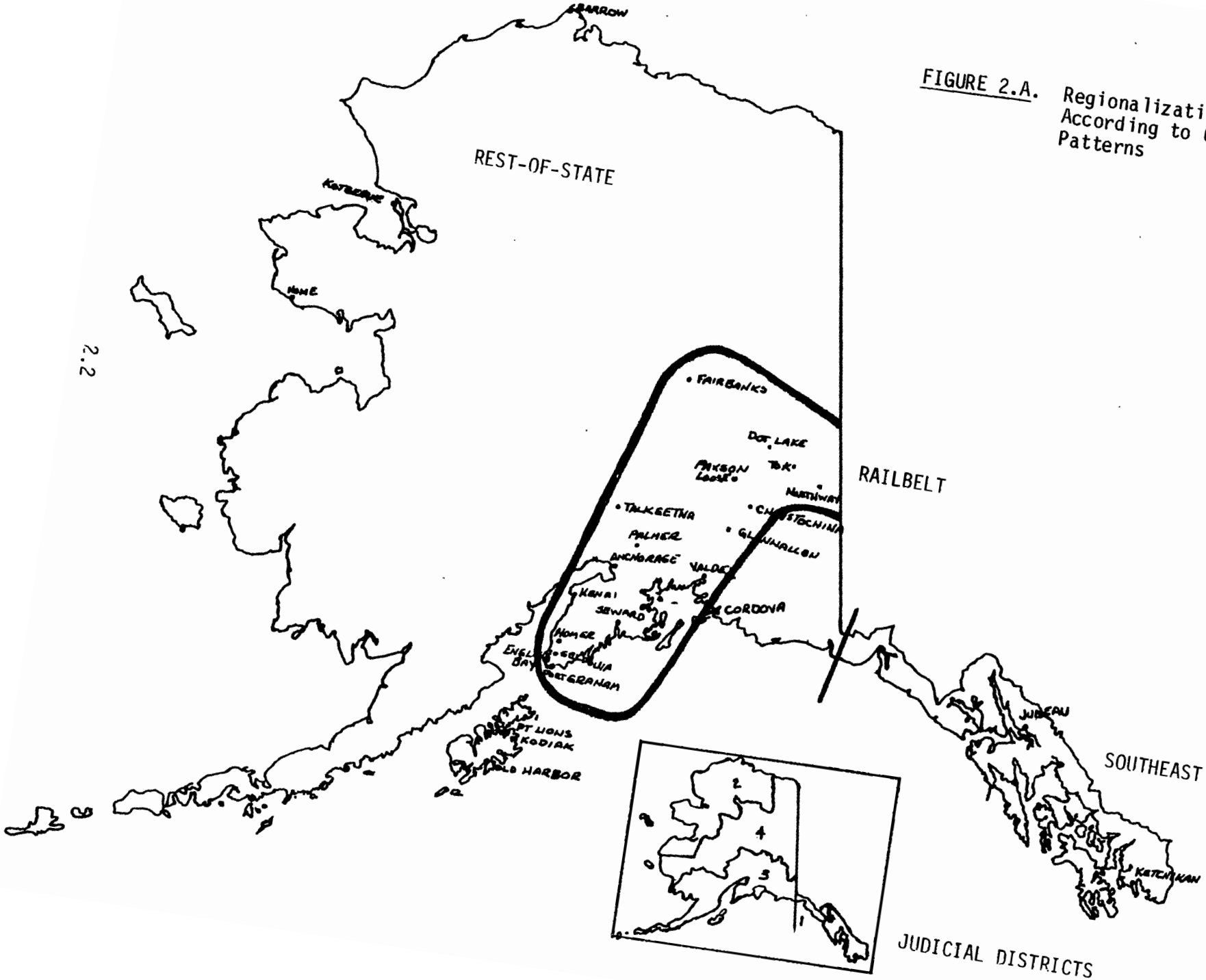


FIGURE 2.A. Regionalization of Alaska According to Consumption Patterns

TABLE 2.1. Location of Utilities Reporting to the Alaska Power Administration

Rest-of-State		Railbelt	Southeast
Alakanuk	Mekoryuk	Anchorage	Angoon
Ambler	Minto	Chistochina	Craig
Anaktuvak Pass	Mt. Village	Dot Lake	Haines
Aniak	Naknek	English Bay	Hoonah
Anvik	Egegik	Fairbanks	Hydaburg
Atkasook	Napakiak	Glennallen	Juneau
Barrow	New Stuyahok	Homer	Kake
Bethel	Nikolski	Kenai	Kasaan
Bettles	Noatak	Larsen Bay	Ketchikan
Chevak	Nome	Northway	Klawock
Cold Bay	Noorvik	Palmer	Klukwan
Cordova	Nuigsut	Paxson Lodge	Metlakatla
Deadhorse	Nulato	Port Graham	Pelican
Dillingham	Nunapitchuk	Seldovia	Petersburg
Aleknagik	Kasigluk	Seward	Sitka
Eek	Old Harbor	Talkeetna	Skagway
Elim	Pilot Station	Tok	Tenakee Springs
Emmonak	Point Hope	Valdez	Wrangell
Ft. Yukon	Point Lay		Yakutat
Gambell	Point Lions		
Goodnews Bay	Quinhagak		
Grayling	St. Mary's		
Holy Cross	Pitkas Point		
Hooper Bay	Andreafski		
Huslia	St. Michael		
Iliamna	Sand Point		
Newhalen	Savoonga		
Nondalten	Scammon Bay		
Kaktovik	Selawik		
Kalskag, Lower	Shageluk		
Kalskag, Upper	Shaktoolik		
Kaltag	Shismaref		
Kiana	Shungnak		
Kivalina	Stebbins		
Kodiak & Pt. Lions	Tanana		
Kotzebue	Teller		
Koyuk	Togiak		
Koyukag, Lower	Toksook Bay		
Lake Minchumina	Tununak		
Manley Hot Springs	Unalakleet		
Manokotak	Unalaska		
Marshall	Wainwright		
McGrath	Wales		

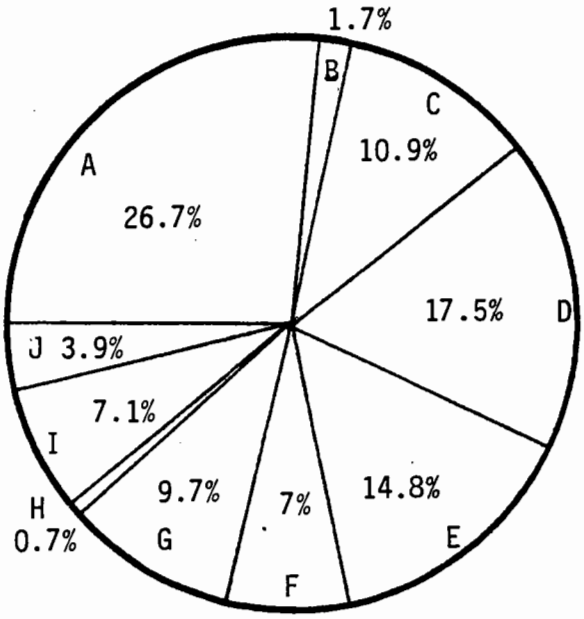
2.2 HISTORICAL CONSUMPTION TRENDS

2.2.1 Alaska Total Oil and Gas Consumption

The Railbelt and the Southeast are Alaska's population and industrial centers. While the Southeast energy needs are almost totally supplied by petroleum (by tanker and barge) and hydroelectricity, the Railbelt (the more heavily industrialized area) relies on a diversified fuel mix of petroleum, natural gas coal, and hydroelectricity. A variety of indigenous fuel sources increases security of supply and stability of prices for the consumer. The Southeast, then, is more vulnerable to the vagaries of the world oil market.

Figure 2.B shows the 1981 estimated Alaska oil and gas consumption. Aviation jet fuel at 26.7% of the total consumed is the largest single category. All aviation categories account for 39.3%. Total highway vehicle travel equals 49%, with gasoline predominant at 17.5%. Marine activity represents 7.8% and oil for electrical power for generation equalled 3.9% of the oil consumed. The following changes have occurred over last year's 1980 estimates: (Large changes could be due to category definitions.)

1981 Category	1980 Category	Change
Aviation - jet Aviation - gas Aviation - bonded	jet fuel	+2.3%
Highway - gasoline Marine - gasoline	motor gasoline	+2.2%
Highway - diesel Off Highway - diesel Marine - diesel	vehicle diesel	+21.6%
Electric Power	electric power	+1%
Highway Other	space heat	-8%



Oil (10^6 gallons)

A	Aviation - Jet	284.5
B	Aviation - Gasoline	18.6
C	Aviation - Bonded	116.1
D	Highway - Gasoline	186.1
E	Highway - Diesel	157.4
F	Highway - Other	74.9
G	Off-highway - Diesel	103.2
H	Marine - Gasoline	7.7
I	Marine - Diesel	75.5
J	Electric Power Generation	41.5
	TOTAL	1,065.5

Natural Gas (BCF)

	Reinjection	
A	Prudhoe	592.9
B	Cook Inlet	100.6
C	Ammonia Urea	47.8
D	LNG Sales	67.6
E	Used by Producers	69.7
F	Electric Utility	42.2
G	Gas Utility	17.1
H	Defense	4.8
	Miscellaneous	4.2
	TOTAL	946.9

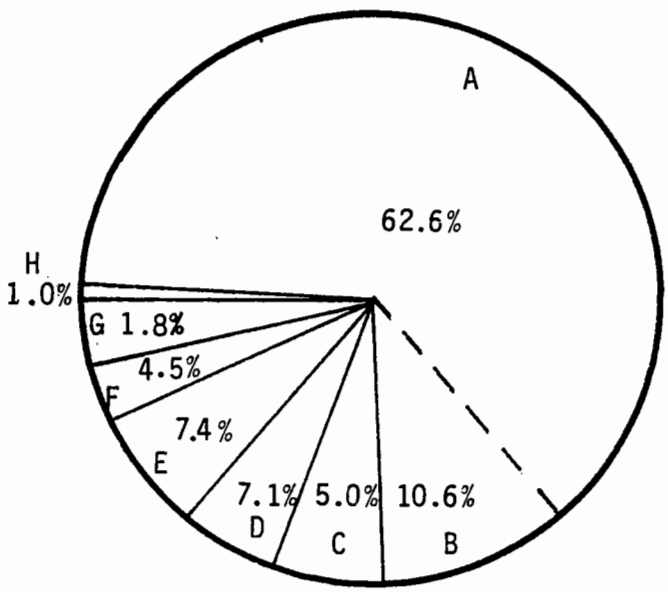


FIGURE 2.B. 1981 Estimated Alaska Oil and Gas Consumption

Natural gas use is still dominated by reinjection gas. At 75% in 1980, it has remained at approximately the same level. Changes over last year's estimates include:

1981 Category	1980 Category	Change
Reinjection		
Prudhoe	same	+0.6%
Cook Inlet	same	-2.7%
Ammonia Urea Production	same	-1.1%
LNG Sales	same	-1.8%
Used by Producers	same	+1.5%
Electric Utility	same	+1.4%
Gas Utility	same	+0.3%
Defense & Miscellaneous	other	-1.8%

2.2.2 Regional Gas and Electric Utility Activity

2.2.2.1 Fuels for Electrical Generation. Table 2.2 lists the oil and gas consumption for electrical generation in the three regions for the last ten years. Discounting for surges of energy consumption during the Alaska Pipeline construction years, we see trends toward reduction of oil use in the Railbelt and the Southeast.

- Railbelt: In the Railbelt the diminishing oil share is being replaced by an increasing gas share. The natural gas consumption is increasing steadily and evenly at about 11% per year. Industry and the increase of population in the Railbelt plus the attractive pricing of natural gas contribute to the increasing gas share.
- Southeast: The Southeast population growth has leveled off with a net change of no more than about 800 people in the last four years. This leveling off is echoed in the tapering oil use with a very slight increase in hydroelectricity produced.

TABLE 2.2. Oil and Gas Consumption for Electrical Generation[3/]

	Railbelt		Southeast		Rest-of-State	
	Oil (10^3 gallons)	Gas (10^9 ft^3)	Oil (10^3 gallons)	Gas (10^9 ft^3)	Oil (10^3 gallons)	Gas[5/] (10^9 ft^3)
1971	9,903	9,980	4,299	0	4,859	22
1972	9,882	12,780	6,791	0	7,345	33[1/]
1973	8,579	15,683	6,818	0	8,603	49[1/]
1974	7,050	17,117	6,252	0	9,357	73[1/]
1975	13,921	19,619	7,289	0	11,332	109[1/]
1976	19,397	22,204	5,174	0	12,342	162
[1/]1977	23,087	23,534	5,076	0	13,913	183
[1/]1978	20,265	24,557	7,115	0	15,167	200
[1/]1979	19,638	28,295[4/]	6,905	0	16,003	228
1980	19,664	28,763	6,011	0	16,105	228
[2/]1981	19,370	31,129	5,525	0	16,596	228

Data Source: Alaska Electric Power Statistics 1960-1980, Sixth Edition, August 1981 and Alaska Electric Power Statistics 1960-1976, Fifth Edition, July 1977. U.S. Department of Interior, Alaska Power Administration.

Data for 1980 is provided by town so that a new regionalization is fairly easy. Data for earlier years (1971-1976) is provided by Alaska Power Administration districts rather than towns and a reallocation scheme had to be devised along the following guidelines:

- Southeast region is the same in both cases.
- The Railbelt designation is basically Southcentral with the addition of Dot Lake, Fairbanks, Northway, and Tok from Yukon. Contributions for these towns were based on 1980 figures for oil use for each and the particular percentages were applied to previous years. Their share amounted to approximately 91% (gas turbine and diesel IC) of the total oil used in the Yukon.
- Rest-of-state is comprised of the remainder of Yukon, Arctic, Northwest, Southwest, villages, and Cordova, Kodiak, Point Lions, Larsen Bay, and Old Harbor from the Southcentral area. These five towns accounted for 61% of the total oil consumed (all diesel IC) in the Southcentral area. Again, the individual percentages were applied to previous years.
- No natural gas was consumed in the reallocated towns.

1/ Preliminary data from Alaska Power Administration
2/ 1981 data is estimated
3/ For reference: Gas - 1,000,000 BTU/MCF
Oil - 138,700 BTU/gal
4/ From AGA Gas Facts
5/ Principally Barrow, Alaska
Doc. 0915A
Disk 0124F

- Rest-of-State: Gas used in Rest-of-State is primarily Barrow and remains quite steady. Oil use is increasing at about 12% per year reflecting increased energy exploration.

2.2.2.2 Net Generation. Tables 2.3 through 2.6 show net generation by fuel for Alaska and the three regions.

- Railbelt: The large increase in Railbelt gas use is weighting the state total so that we see the oil share diminishing, as is the coal share, with the gas share increasing. The hydroelectric share varies as it used to follow the load needs. In the Railbelt there has been a steady rise in the gas share as previously noted, but absolute quantities of fuels used have increased for all categories except coal. Increased industrialization and population, and increases in crude prices (and more attractive gas prices) explain this behavior.
- Southeast: The majority of fuel use in the Southeast is split approximately 3 to 1 by hydroelectric and petroleum fuels. This ratio has been fairly constant due to the static population, the secure access to oil, and the light industrialization.
- Rest-of-State: The Rest-of-State use is all oil and natural gas with gas starting to make inroads by 1976. However, the gas used at Barrow and Prudhoe Bay is limited by demand at oil field production limits. Oil and gas shares do not change significantly. Absolute quantities are increasing, primarily due to increased field activity.

2.2.2.3 Utility Sales. Figure 2.C shows the relationship between markets for the gas and electric utilities. Since practically all of the gas is used in the Railbelt, the state gas chart is essentially the same as that region. The electric utility chart is divided between the three regions. Each region is then separated into commercial/industrial and residential components.

TABLE 2.3. Utility Electricity Generated (10^3MWh)

Alaska Total

	Oil		Gas		Coal		Hydro[2/]		
	10^3 MWh	Share (%)	10^3 MWh	Share (%)	10^3 MWh	Share (%)	10^3 MWh	Share (%)	Total
1971	195.1	13.6	613.9	42.8	262.1	18.3	363.0[1/]	25.3	1434.1
1972	252.5	15.6	742.2	45.8	281.2	17.3	346.0[1/]	21.3	1621.9
1973	250.6	14.1	966.9	54.3	278.5	15.6	286.0[1/]	16.0	1782.0
1974	246.5	12.8	1049.1	54.5	305.0	15.8	325.6	16.9	1926.2
1975	352.8	15.4	1246.4	54.5	328.5	14.4	357.7	15.7	2285.4
1976	384.2	15.0	1482.0	57.7	318.3	12.4	382.6	14.9	2567.1
1977	359.2	12.7	1634.6	57.8	322.4	11.4	512.0[1/]	18.1	2828.1
1978	436.0	14.7	1732.2	58.4	326.3	11.0	472.0[1/]	15.9	2966.1
1979	481.2	15.6	1823.2	59.1	320.8	10.4	459.0[1/]	14.9	3084.9
1980	447.5	14.2	1871.3	59.2	296.3	9.4	543.9	17.2	3159.0
1981[3/]	452.63	14.0	1926.9	59.6	281.3	8.7	572.26	17.7	3233.1

Data Source: Alaska Electric Power Statistics 1960-1980, Sixth Edition, August 1981 and Alaska Electric Power Statistics 1960-1976, Fifth Edition, July 1977. U.S. Department of Interior, Alaska Power Administration.

1/ From State Energy Data Report, U.S. Department of Energy, September, 1981.
2/ Includes industrial, utility production and net imports
3/ Estimated
Note: Numbers fitted for Oil, Gas, and Coal shares for 1977-1979 since data were not available from sources cited.

TABLE 2.4. Utility Electricity Generated (10^3MWh)

Southeast

	Oil		Gas		Coal		Hydro		
	10^3 MWh	Share (%)	10^3 MWh	Share (%)	10^3 MWh	Share (%)	10^3 MWh	Share (%)	Total
1971	51.5	21.1	0	0	0	0	192.4[1/]	78.9	243.9
1972	85.3	31.7	0	0	0	0	183.4[1/]	68.3	268.7
1973	83.3	35.5	0	0	0	0	151.6[1/]	64.5	234.9
1974	78.9	31.4	0	0	0	0	172.6	68.6	251.5
1975	96.0	33.6	0	0	0	0	189.6	66.4	285.6
1976	61.8	23.4	0	0	0	0	202.8	76.6	264.6
1977	47.1	14.8	0	0	0	0	271.38[1/]	85.2	318.5
1978	81.9	24.7	0	0	0	0	250.2 [1/]	75.3	332.1
1979	103.2	29.8	0	0	0	0	243.27[1/]	70.2	346.5
1980	75.4	20.6	0	0	0	0	289.9	79.4	365.3
1981[2/]	96.0	25.0	0	0	0	0	288.1	75.0	384.1

Data Source: Alaska Electric Power Statistics 1960-1980, Sixth Edition, August 1981 and Alaska Electric Power Statistics 1960-1976, Fifth Edition, July 1977. U.S. Department of Interior, Alaska Power Administration.

1/ From State Energy Data Report, U.S. Department of Energy, September 1981. All hydroelectric sources are found within Southeast and Railbelt regions. Alaska total figures for 1971-1973 and 1977-1979 are split 53%-47% (1980 reported split) between the Southeast and Railbelt respectively.

2/ Estimated

Note: Number fitted for Oil share for 1977-1979 since data were missing for these years.

TABLE 2.5. Utility Electricity Generated (10^3MWh)

Railbelt

	Oil		Gas		Coal		Hydro		
	10^3 MWh	Share (%)	10^3 MWh	Share (%)	10^3 MWh	Share (%)	10^3 MWh	Share (%)	Total
1971	48.0	4.4	612.6	56.0	262.1	24.0	170.6	15.6	1093.3
1972	59.1	4.7	748.2	59.8	281.2	22.5	162.6	13.0	1251.1
1973	66.4	4.6	973.1	67.0	278.5	19.2	134.4	9.3	1452.4
1974	66.1	4.2	1049.1	66.7	305.0	19.4	153.0	9.7	1573.2
1975	126.9	6.8	1246.3	66.7	328.5	17.6	168.1	9.0	1869.8
1976	179.8	8.4	1473.8	68.5	318.3	14.8	179.8	8.4	2151.7
1977	182.0	7.8	1596.4	68.4	315.1	13.5	240.64	10.3[1]/	2333.9[1]/
1978	193.5	7.9	1719.6	70.2	313.5	12.8	221.84	9.1[1]/	2449.6[1]/
1979	191.0	7.5	1826.0	71.2	313.2	12.3	215.73	8.5[1]/	2546.7[1]/
1980	187.4	7.2	1857.9	71.6	296.3	11.4	254.0	9.8	2595.6
1981[1]/	186.8	6.9	1959.6	72.4	286.9	10.6	273.4	10.1	2706.6

Data Source: Alaska Electric Power Statistics 1960-1980, Sixth Edition, August 1981 and Alaska Electric Power Statistics 1960-1976, Fifth Edition, July 1977. U.S. Department of Interior, Alaska Power Administration.

1/ Estimated

Note: Numbers were fitted for Oil, Gas and Coal shares for 1977-1979 since data were missing for these years.

TABLE 2.6. Utility Electricity Generated (10^3MWh)

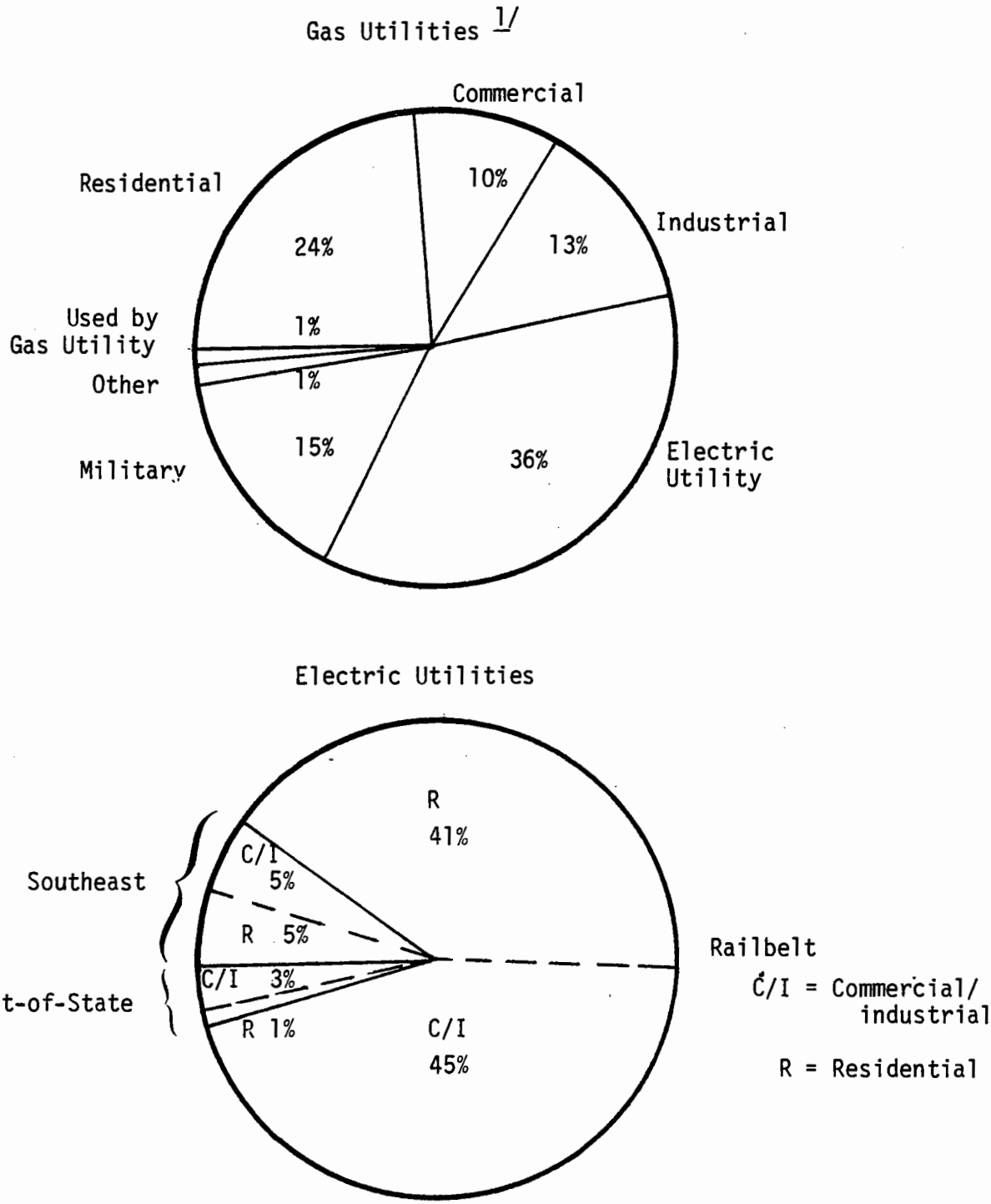
Rest-of-State

	Oil		Gas		Coal		Hydro		
	10^3 MWh	Share (%)	10^3 MWh	Share (%)	10^3 MWh	Share (%)	10^3 MWh	Share (%)	Total
1971	95.6	98.7	1.3	1.3	0	0	0	0	96.93
1972	100.2	100.0	0	0	0	0	0	0	100.2
1973	100.8	100.0	0	0	0	0	0	0	100.8
1974	102.4	100.0	0	0	0	0	0	0	102.4
1975	130.4	100.0	0	0	0	0	0	0	130.4
1976	142.5	94.5	8.3	5.5	0	0	0	0	150.8
1977	165.5	94.2	10.2	5.8	0	0	0	0	175.7[1/]
1978	173.0	93.8	11.4	6.2	0	0	0	0	184.4[1/]
1979	179.2	93.5	12.5	6.5	0	0	0	0	191.7[1/]
1980	184.7	93.2	13.4	6.8	0	0	0	0	198.1
1981[1/]	193.5	93.0	14.6	7.0	0	0	0	0	208.1

Data Source: Alaska Electric Power Statistics 1960-1980, Sixth Edition, August 1981 and Alaska Electric Power Statistics 1960-1976, Fifth Edition, July 1977. U.S. Department of Interior, Alaska Power Administration.

1/ Estimated

Note: Numbers were fitted for oil and gas shares for 1977-1979 since data were missing for these years.



Source: Alaska Electric Power Statistics and the annual gas utility reports to the APUC.

1/ All used within the Railbelt. A small amount (12.7 BCF) is sold at Barrow and Prudhoe Bay.

FIGURE 2.C. Utility End-Use Markets

- Railbelt: The Railbelt has by far the greatest share at 86% of the total electricity sales. Sales are fairly evenly distributed between commercial/industrial and residential demands. (Data reported to the Alaska Public Utilitites Commission does not make the distinction between commercial and industrial sectors). Gas utility market shares in the Railbelt are dominated by sales to utilities. Again the split between residential/commerical and industrial sectors is very even.
- Southeast: Southeast is also evenly divided between commercial/industrial and residential sectors for 10% of total electricity sales.
- Rest-of-State: This region represents only 4% of the total sales of electricity. It is not so evenly divided as the other two regions; the relatively smaller population uses only one-third of the sales for residential use.

2.2.3 Regional Natural Gas Use

As reported, the majority of end-use consumption of gas occurs in the Railbelt. However, we can separate the market areas - Cook Inlet in the Railbelt and Barrow and Prudhoe in Rest-of-State. Table 2.7 is an update of last year's Historical Alaska Natural Gas Use.

- Railbelt: There is a decrease in gas for reinjection in the Cook Inlet. Ammonia urea production and LNG sales do not change. The LNG sales satisfy a contract with Tokyo Gas and Electric Co. which runs through June 1, 1984. All other categories remain the same or slightly increase.
- Rest-of-State: For the Rest-of-State, Barrow is relatively constant. Unlike Cook Inlet with its wide variety of customers Prudhoe Bay use is almost all confined to plant and field operations. This market fluctuates with field activity. The Cook Inlet supply is affected by fuel switching resulting from pricing benefits, export markets, and

TABLE 2.7. Historical Alaska Natural Gas Use (BCF)[1/]

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981E
TOTAL USE[2/]					256.399	271.162	375.832	602.687	738.485	898.5	946.89
COOK INLET[3/]	227.93	222.80	223.10	228.44	252.554	265.253	279.961	293.800	305.056	300.4	299.1
Reinjection[2/]	73.88	76.13	87.,78	86.81	95.183	111.082	115.131	114.074	119.825	115.4	100.6
LNG Sales[4/]	63.24	59.87	60.99	61.87	64.777	63.509	66.912	60.874	64.111	55.3	67.6
Ammonia Urea Production[9/]	19.49	20.58	20.64	22.10	23.888	24.257	28.620	48.879	51.657	47.6	47.8
Electric Utility Sales[5/]	10.31	13.16	15.48	17.11	19.619	22.188	23.590	24.591	28.155	28.7	29.5
Use on Lease, Vented,[2/] and Shrinkage, other	45.25	36.56	20.90	23.89	28.830	24.466	24.396	23.524	17.520	28.0	27.5
Gas Utility Sales[6/]	8.243	8.952	9.653	9.816	12.044	12.552	12.683	13.454	14.045	15.5	17.1
Military Sales[7/]	6.549	6.473	6.069	5.684	5.842	5.424	5.100	5.126	4.986	4.8	4.8
Miscellaneous Sales to Other Producers, Refiners, and Pipelines	0.97	1.08	1.59	1.16	2.371	1.775	3.529	3.277	4.757	5.1	4.2
Item: Alaska Pipeline[8/] Company Sales	20.729	24.093	26.402	26.847	30.423	--	28.281	28.780	30.295	32.1	33.53
Item: Alaska Gas &[8/] Service Co.	14.080	17.610	20.139	20.996	24.281	23.130	22.538	23.489	25.004	27.3	29.17
Item: Kenai Utility[8/] Service Corp.										0.5	0.50

TABLE 2.7. (contd)

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981E
PRUDHOE BAY					3.047	5.077	94.992	307.994	432.498	597.1	646.8
Reinjection[2/]							68.080	271.854	390.136	546.5	592.9
Use on Lease, Vented,[2/] Rental for Reinjection, Shrinkage, other					2.277	3.414	24.069	28.879	33.432	39.3	41.9
Sales[2/]					0.770	1.663	2.843	7.261	8.930	11.3	12.0
BARROW					0.798	0.832	0.879	0.893	0.931	1.0	0.99
Government and[2/] Utility Sales					0.267	0.390	0.504	0.541	0.582	0.7	0.7
Use on Leases, Vented,[2/] and Shrinkage					0.531	0.442	0.375	0.352	0.331	0.3	0.3

See accompanying table notes on following page.

1. Revised from reports of previous years.
2. State of Alaska, Department of Natural Resources, Division of Oil and Gas Conservation, Monthly Report of Gas Disposition.
3. Before 1975 from Natural Gas Demand and Supply to the Year 2000 in the Cook Inlet Basin of South Central Alaska, Stanford Research Institute, prepared for the Pacific LNG Company, November 1977. After 1974 from Monthly Report of Gas Disposition.
4. Before 1975 from SRI; after 1974 this is the sum of two items: (1) sales to Phillips LNG from the Kenai and Beaver Creek gas fields reported in Kenai Gas Sales, internal document of DOGC, and (2) sales from the North Cook Inlet gas field reported in Monthly Report of Gas Disposition, DOGC. For 1980 and 1981 direct communication with Phillips Petroleum Co. for Tokyo Gas & Electric Co. Contract demands.
5. Before 1975 from Stanford Research Institute. After 1974, sales reported by Anchorage Natural Gas to the Alaska Public Utilities Commission plus Beluga River Gas Fields to Chugach Electric reported in Monthly Report of Gas Disposition. 1981 data from Alaska Electric Power Statistics, Sixth Edition, August 1981, U.S. Department of Energy, Alaska Power Administration.
6. Prior to the 1975 Gas Rate Schedule revision, data obtained from internal records of Anchorage Natural Gas. After 1975 sales to final customers as reported to the APUC by Anchorage Natural Gas (or Alaska Gas and Service Co.) and Kenai Utility Service Corp.
7. Prior to 1981, annual financial reports to APUC by Alaska Pipeline Company and Anchorage Natural Gas. For 1981, Alaska Pipeline Company.
8. Annual reports to APUC.
9. Before 1975 from SRI; after 1974 this is the sum of two items: (1) sales to Collier Chemical from the Kenai and Beaver Creek gas fields reported in Kenai Gas Sales, internal document of DOGC, and (2) sales from the McArthur River field reported in Monthly Report of Gas Disposition, DOGC. For 1980 and 1981, direct communication with Union Oil Co.

Note: Electricity sales estimates based on a per capita growth rate.
Gas utility sales estimates based on previous sales growth rate
Military use is assumed to be fairly static
All 1981 statistics based on Division of Oil and Gas data were projected from reports through October, 1981.

industrial activity. Military use remains constant. Figure 2.B shows the estimated market shares for 1981 natural gas use. The markets and their shares are listed here by volume:

Reinjection	74.6%
Producer Use	6.9%
Ammonia-Urea Production	6.0%
LNG Sales	5.4%
Gas Utility	3.5%
Electric Utility	3.1%
Defense	0.5%

Production requirements are still paramount at 81.5% of the use with sales at 18.5%. These figures, when compared to last year's estimates, show an increase in the production share and a decrease in sales by approximately 0.3%.

2.2.4 Regional Petroleum Consumption

The Alaska Department of Revenue supplied the data on consumption of motor vehicle fuels by Judicial District. These were reallocated as previously mentioned in Section 2.1. Tables 2.8 through 2.11 list the motor vehicle fuels consumption statistics as reported for the past four years and the 1981 estimate. Figure 2.D depicts the market share relationship for each region for 1981 estimates.

- Railbelt: The large population and industrial activity in the Railbelt account for the overwhelming use of petroleum for aviation (48%) and highway (35.4%) use. The electricity generation share is quite small and is concentrated in the Fairbanks area. Marine use is 7.7% of the total.
- Southeast: In the Southeast, the aviation share is 7.9% of the regional consumption. The inhabitants rely on highway fuels for 33.9% of the total use. Marine fuels are higher here (13.2%) than in the Railbelt because of the high volume of marine traffic. The Southeast is essentially isolated and most commodities are shipped in. Petroleum and hydropower are the only fuel sources for the Southeast. Off-highway diesel at 39.3% is essentially diesel sold for space heating and power generation.

TABLE 2.8. Consumption of Motor Vehicle Fuels: Alaska[1]
(Million Gallons)[9]

	1977	1978	1979	1980	1981E[7]
Aviation - Jet					
Taxable[4]	103.163	113.006	126.190	130.074	132.840
Exempt[5]	190.392	220.789	220.988	190.881	151.672
Aviation - Gas					
Taxable	15.249	15.145	16.373	16.354	17.962
Exempt[12]	1.521	.685	.552	.558	.636
Aviation Bonded[6]					
Exempt	37.189	29.812	67.986	95.229	116.058
Highway - Gas					
Taxable	181.119	179.069	173.802	169.191	177.088
Exempt[12]	5.094	8.290	7.527	8.162	9.023
Highway - Diesel					
Taxable	118.999	101.598	56.597	64.791	135.541
Exempt[10]	45.162	54.050	39.477	23.935	21.902
Highway - Other					
Taxable	[2]	[2]	91.562	116.897	74.878
Off Highway - Diesel					
Exempt[11]	[2]	[2]	81.483	97.004	103.226
Marine - Gas					
Taxable	6.059	7.160	8.004	7.573	7.574
Exempt[13]	.384	.554	.292	.025	.091
Marine - Diesel					
Taxable	32.217	41.869	53.167	62.341	70.298
Exempt[12]	6.396	10.116	6.325	5.370	5.168
Marine - Non-propulsion					
Exempt	5.323	[2]	[2]	[2]	[2]
Other[8]					
Taxable	.593	29.228	.258	.020	.002
Exempt	.998	[2]	[2]	[2]	[2]

See footnotes which follow tables on Consumption of Motor Vehicle Fuels.

TABLE 2.9. Consumption of Motor Vehicle Fuels: Southeast[1/]
(Million Gallons)[9/]

	1977	1978	1979	1980	1981E [7/]
Aviation - Jet					
Taxable[4/]	4.765	5.167	4.914	3.760	5.054
Exempt[5/]	3/	3/	.226	.377	.573
Aviation - Gas					
Taxable	1.852	1.543	1.757	1.712	1.892
Exempt[12/]	3/	3/	.023	.115	.135
Aviation Bonded[6/]					
Exempt	2/	2/	2/	2/	2/
Highway - Gas					
Taxable	14.102	14.131	13.867	14.612	15.339
Exempt[12/]	3/	3/	.590	.570	.670
Highway - Diesel					
Taxable	10.746	5.731	6.578	7.293	10.202
Exempt[10/]	3/	3/	5.660	6.144	6.505
Highway - Other					
Taxable	2/	2/	.002	.003	.001
Off Highway - Diesel					
Exempt[11/]	2/	2/	20.157	26.192	37.885
Marine - Gas					
Taxable	2.135	2.128	2.075	1.739	1.634
Exempt[13/]	3/	3/	.103	-.011	.061
Marine - Diesel					
Taxable	7.707	8.773	9.888	10.569	10.814
Exempt[12/]	3/	3/	.498	.111	.178
Marine - Non-propulsion					
Exempt	.667	2/	2/	2/	2/
Other[8/]					
Taxable	.131	.139	.134	-.045	.002
Exempt	3/	2/	2/	2/	2/

See footnotes which follow tables on Consumption of Motor Vehicle Fuels.

TABLE 2.10. Consumption of Motor Vehicle Fuels: Railbelt[1] (Million Gallons)[9]

	1977	1978	1979	1980	1981E[7]
Aviation - Jet					
Taxable[4]	83.555	91.783	102.585	106.451	107.852
Exempt[5]	[3]	[3]	189.785	163.754	129.852
Aviation - Gas					
Taxable	10.413	10.370	11.339	11.242	12.432
Exempt[12]	[3]	[3]	.453	.345	.343
Aviation Bonded[6]					
Exempt	37.189	[2]	67.986	95.229	116.058
Highway - Gas					
Taxable	14.023	140.250	133.261	128.190	134.051
Exempt[12]	[3]	[3]	5.792	6.276	7.053
Highway - Diesel					
Taxable	74.742	77.989	26.556	17.666	53.225
Exempt[10]	[3]	[3]	24.016	10.738	11.378
Highway - Other					
Taxable	[2]	[2]	78.741	100.528	64.393
Off Highway - Diesel					
Exempt[11]	[2]	[2]	46.690	51.505	48.677
Marine - Gas					
Taxable	3.826	3.887	4.614	4.459	4.652
Exempt[13]	[3]	[3]	.135	.031	.025
Marine - Diesel					
Taxable	20.826	28.291	36.913	43.871	50.314
Exempt[12]	[3]	[3]	4.997	4.517	4.292
Marine - Non-propulsion					
Exempt	3.823	[2]	[2]	[2]	[2]
Other[8]					
Taxable	.355	25.001	.063	.050	.001
Exempt	[3]	[2]	[2]	[2]	[2]

See footnotes which follow tables on Consumption of Motor Vehicle Fuels.

TABLE 2.11. Consumption of Motor Vehicle Fuels: Rest-of-State[1/]
(Million Gallons)[9/]

	1977	1978	1979	1980	1981E [7/]
Aviation - Jet					
Taxable[4/]	14.844	16.057	18.691	19.863	19.933
Exempt[5/]	3/	3/	30.977	26.750	21.247
Aviation - Gas					
Taxable	2.984	3.232	3.277	3.400	3.638
Exempt[12/]	3/	3/	.075	.099	.159
Aviation Bonded[6/]					
Exempt	2/	2/	2/	2/	2/
Highway - Gas					
Taxable	25.994	24.688	26.675	26.389	27.697
Exempt[12/]	3/	3/	1.146	1.316	1.300
Highway - Diesel					
Taxable	33.512	17.878	23.462	39.833	72.114
Exempt[10/]	3/	3/	9.801	7.053	4.018
Highway - Other					
Taxable	2/	2/	12.819	16.366	10.483
Off Highway - Diesel					
Exempt[11/]	2/	2/	14.635	19.307	16.664
Marine - Gas					
Taxable	.690	1.144	1.316	1.375	1.288
Exempt[13/]	3/	3/	.053	.005	.004
Marine - Diesel					
Taxable	3.684	4.804	6.366	7.902	9.169
Exempt[12/]	3/	3/	.830	.742	.699
Marine - Non-propulsion					
Exempt	.833	2/	2/	2/	2/
Other[8/]					
Taxable	.107	4.089	.061	.015	.000
Exempt	3/	2/	2/	2/	2/

See footnotes which follow tables on Consumption of Motor Vehicle Fuels.

Source: Alaska Department of Revenue, Motor fuel Tax Return Worksheets

1/ Data were developed from Judicial District reports and reallocated according to the following procedure:

Southeast = Judicial District I

Railbelt = Population Share x (Judicial District III + Judicial District IV)

Rest-of-State = (Judicial District III + Judicial District IV) - Railbelt + Judicial District II

2/ Data were not reported for that year.

3/ Data were not reported by Judicial District.

4/ Civilian domestic operations.

5/ Military and international operations utilizing domestic fuel.

6/ International operations utilizing foreign fuel.

7/ Estimate for the year based on first nine months.

8/ Other is essentially a type of diesel.

9/ For purposes of conversion:

1 gallon gasoline = .0215 barrel crude oil equivalent
1 barrel gasoline = 5.248 million Btu
1 gallon diesel = .0239 barrel crude oil equivalent
1 barrel diesel = 5.825 million Btu
1 gallon jet fuel = .023 barrel crude oil equivalent
1 barrel jet fuel = 5.604 million Btu

10/ Military, government, and electric utility power generation.

11/ Off-highway diesel is diesel sold for space heating and power generation.

12/ Military and government.

13/ Military, government, and non-propulsion.

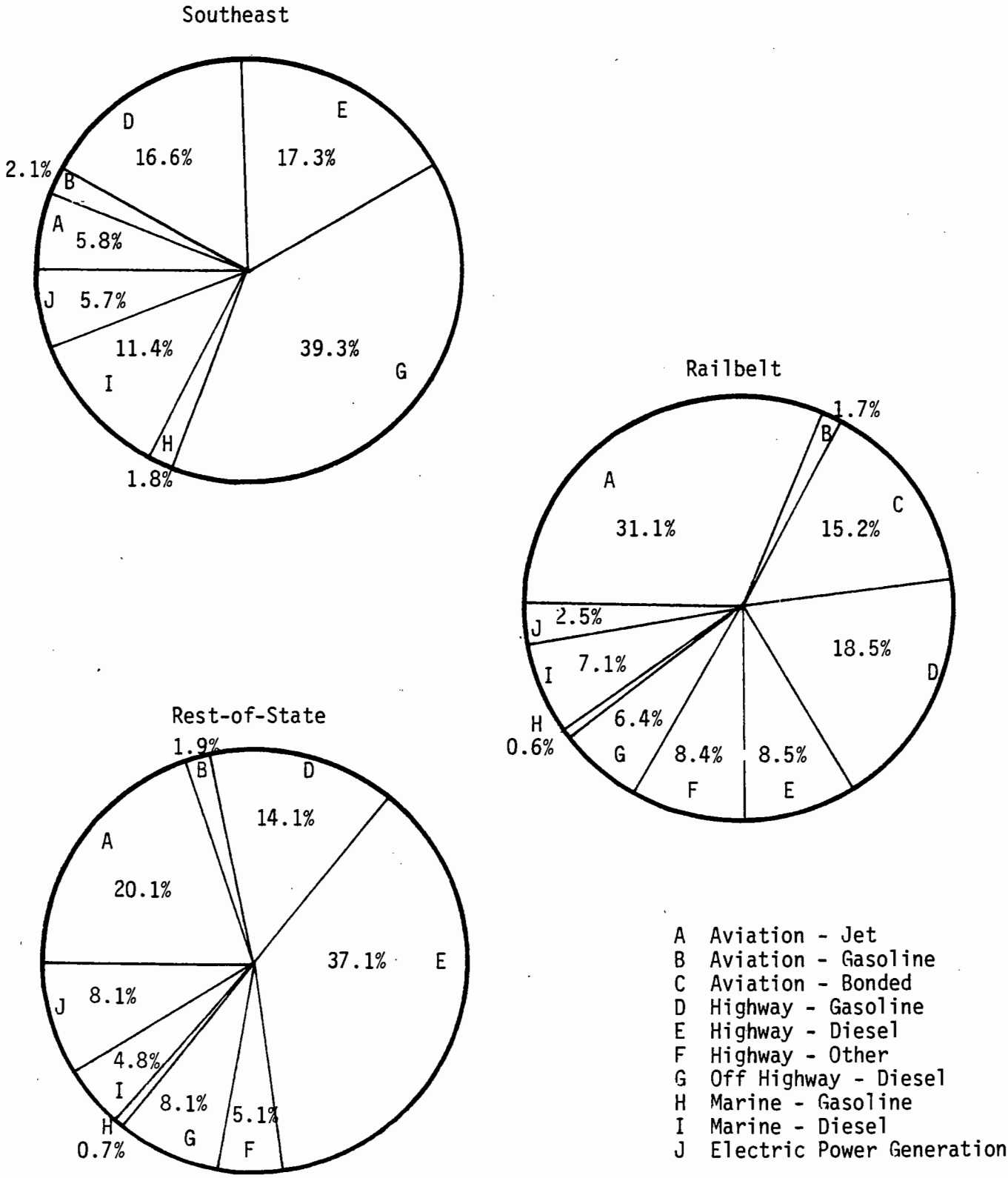


FIGURE 2.D. Estimated 1981 Percentages of Regional Oil Consumption

- Rest-of-State: For the Rest-of-State the shares of aviation fuel (22%) and highway use (64.4%) are a function of the vast tracts of land which must be crossed. Highway diesel at a significant 37.1% is used in large volumes by the pipeline companies for electric generation and by construction companies for trucks hauling heavy equipment. Electricity generation from oil has a higher share (8.1%) than in the other two regions; gas in the Railbelt and hydroelectricity in the Southeast are the dominant fuels used. Marine use (5.5%) is principally the ports of Cordova, Kodiak, and Dutch Harbor plus a few southwestern ports. Petroleum from northern Alaska is transported by pipeline to Valdez in the Railbelt and marine traffic for the Prudhoe oil is shown in Railbelt figures.

3.0 DEMAND FORECAST

The purpose of this chapter is to develop projections for oil and gas consumption to the year 2000. The projections are made, to the extent possible, by major use category and geographic region. Sensitivity analysis is used to assess the effects of three major areas of uncertainty on the consumption forecasts. These are the Pacific Alaska liquified natural gas (LNG) project, the Susitna hydroelectric project and future electricity demands in the Railbelt Region. The disaggregated forecasts are then aggregated to the state level to provide the overall cumulative forecast of oil and gas consumption for the forecast period. The element of uncertainty is incorporated into the aggregate forecast on a probability basis. The procedure for developing the probability weighted forecast is designed so that the aggregate forecast can be reassessed should a change occur in the level of uncertainty for one or more of the three areas.

The forecasts of consumption are developed by geographic region to the extent possible. The geographic regions selected are the Southeast, the Railbelt (Fairbanks and Southcentral Alaska) and Rest-of-State. There are two reasons for this region selection. First, these three regions are identified as having different energy use patterns due to major differences in lifestyle and economic activity. The Southeast and Railbelt regions are more energy intensive users due to stronger economic bases and better developed energy distribution systems, as well as populations accustomed to a more energy intensive lifestyle. The Railbelt is more diverse in terms of industrial base than is Southeast, and so is the availability of fuels.

Second, the distribution of natural gas and refined petroleum products generally fits into these three regions.(a) Virtually all natural gas consumption other than that for oil and gas production is in the Cook Inlet region, part of the Railbelt.

(a) University of Alaska, Institute of Social and Economic Research, "Alaska's Unique Transportation System," Alaska Review of Social and Economic Conditions, June 1980, Vol. XVII, No. 2; and Connie Barlow, House Research Agency, Alaska State Legislature, Petroleum Refining and Consumption in Alaska: Implications for Management of Royalty Oil, House Research Agency Report 81-1, May 8, 1981.

The Southeast consumes very little of the petroleum product produced in Alaska, and has a different (but overlapping) group of suppliers than the Railbelt or the Rest-of-State. The northern and southern parts of the Railbelt are distinct petroleum marketing areas, with the former also supplying parts of the rest of the interior of the state open to river navigation. However, the two markets are interconnected by road, by the potential cross-shipments of refined products, and by planned future electric utility transmission lines. Consequently the Railbelt is treated as one demand region. The rest of the state consists largely of small coastal communities and villages along major rivers. They have small size, little highway use (with the exception of Haul Road use) and dependence upon petroleum as common features.

The Southeast's refined products are delivered by tankers and barges. The two major suppliers to this region are Chevron, U.S.A., and the Union Oil Company of California. Mobil Oil Company is a minor supplier. The Railbelt region is served by three in-state refineries: Chevron at Nikiski, Tesoro at Nikiski, and the MAPCO North Pole refinery near Fairbanks. In addition, fuel is imported by Chevron, Union, Texaco and Shell Oil Company. The distribution system in this portion of the state is connected for the most part by a Kenai-to-Anchorage products pipeline and other conventional surface transportation (rail and truck). The rest of the state is served almost exclusively by Chevron. The products are delivered by barge to local distribution points.

The remainder of this chapter is composed of two sections. The first discusses the methodology and data used for the forecasts. The forecasts are presented in the second section. Where noted, the reader is referred to Appendix B for a more detailed discussion of the forecast development. This chapter also presents one set of forecasts given a set of probabilities for the areas of uncertainty.

3.1 DATA AND METHODOLOGY

The fuel consumption data available for constructing the forecasts differ between natural gas and refined petroleum products. These differences exist

with respect to the level of disaggregation and the length of the historical series. Given the differences in the data, the methodology for constructing the forecasts will also differ for natural gas and refined products.

3.1.1 Natural Gas

Natural gas consumption is limited primarily to the Cook Inlet area and a considerable amount of historical data is available for constructing forecasts of future consumption. This section presents the consumption categories and the basis for projecting consumption within each category. Alternate consumption scenarios are stated where the element of uncertainty exists regarding the level of consumption. The reader may wish to refer to Table 3.1 for an overview of the forecast scenarios and their underlying assumptions. Economic growth assumptions are summarized in Appendix D.

Cook Inlet

- LNG Exports to Tokyo Gas and Tokyo Electric Company. Three scenarios are presented for this category. The first is based on the assumption that future exports track those of the past at an annual level of about 60 Bcf. The alternate two scenarios are based on the provisions of the contract that Tokyo Gas has with Phillips Petroleum Company and assume that alternate sources of natural gas do not become available. The contract dedicates 191 Bcf of gas to Tokyo Gas at a rate of about 50 Bcf/yr and expires in 1984 with a provision for a five year extension with the mutual consent of both parties. One alternate case assumes that the contract is not extended in 1984 and the cumulative take equals that dedicated by the contract. The other alternate case assumes that the contract is extended to 1989 and that the annual average take is about 50 Bcf.
- LNG Sales to Pacific Alaska LNG (PALNG) Associates. It is assumed in two cases that gas sales to PALNG begin in 1986. Dedicated reserves to PALNG are currently about 829 Bcf. One scenario assumes that these reserves are consumed by the year 2000 for an average annual consumption of about 55 Bcf and no additional gas is consumed. The second scenario assumes that 1200 Bcf of gas are consumed over a 20 year life for the project for annual average consumption of 60 Bcf.

TABLE 3.1. Natural Gas Consumption, Assumptions and Projections, 1981-2000

Region/Consumption Category	Forecast Scenarios and Underlying Assumptions	Cumulative Consumption (Bcf) from 1981 to 2000		
		0.9 Probability of at Least	0.5 Probability of at Least	0.1 Probability of at Least
Cook Inlet:				
LNG Exports to:				
Tokyo Gas and Tokyo Electric Company	In lowest case, consumption equals reserves dedicated by existing contract. In middle case, contract is renewed until 1989 at existing dedicated (50 Bcf) level. In high case, consumption continues at historic levels (60 Bcf).	191	450	1200
Pacific LNG Associates	In lowest case, no plant is built. In the middle case, consumption equals presently dedicated reserves. In the high case, consumption equals Pacific Alaska's preferred level.	0	829	900
Electric Utility Sales, Railbelt (without Susitna)	See residential consumption for assumptions. If Susitna project is built, middle case gas demand falls to 389.1. In high growth case, coal displaces oil and gas, lowering consumption.	353.5	413.3	411.1
Ammonia-Urea	In low case, consumption equals dedicated reserves. In middle and high cases, annual consumption equals historic levels (55 Bcf).	499	1100	1100
Military	Consumption equals historic levels (5 Bcf) in all cases.	60	60	60
Residential	In low case, low growth (see text), 7% inflation, and 3% real oil price escalation; in middle case, moderate growth, 7% inflation, and 2% real oil price escalation; in the high case, high growth, 0% inflation, and 1% real oil price escalation.	213.9	281.1	370.8
Commercial	See residental assumptions.	90.3	115.8	123.8
Oil and Gas Production	Tracks historical consumption throughout forecast period (25 Bcf/yr).	500	500	500
Miscellaneous	Remains constant at about 5 Bcf/yr.	5	5	5
SUBTOTAL, Cook Inlet		1912.7	3754.2	4670.7

TABLE 3.1. (contd)

Region/Consumption Category	Forecast Scenarios and Underlying Assumptions	Cumulative Consumption (Bcf) from 1981 to 2000		
		0.9 Probability of at Least	0.5 Probability of at Least	0.1 Probability of at Least
Fairbanks Area:				
Residential	See residential assumptions for Cook Inlet. In highest case, all residential and commercial fuel oil demand is assumed to be displaced by natural gas between 1987 and 1995.	8.5	15.8	48.5
Commercial	See residential assumptions.	0.7	2.1	18.9
SUBTOTAL, Fairbanks Area		9.2	17.9	67.4
Prudhoe Bay Oil and Gas Production:	Tracks historic trend and levels off.	1100	1100	1100
Petrochemical Production	Assumes Phase I Dow-Shell	0	0	465.7
Barrow Area:	Tracks historic trend and levels off.	1.5	1.5	1.5
STATE TOTAL		3023.4	4873.6	6305.3

- Electric Utility Sales. Gas sales to electric utilities will change over the period due to capacity additions and retirements. A study of Railbelt electrical power alternatives being conducted for the State by Battelle-Northwest provides estimates of electric utility gas consumption for a number of load growth scenarios using two computer models: the Railbelt Electricity Demand (RED) model to estimate demand for electricity and the Alaska Railbelt Electric Energy Planning (AREEP) model to plan corresponding generation capacity and cost of power. Three scenarios are a low, medium and high corresponding to different levels of population growth and economic activity as outlined in Appendix D. The three load growth scenarios are developed, and the effect of the Susitna hydroelectric project is noted.

- Ammonia Urea Production. Two scenarios are stated for the Collier Carbon and Chemical operation. The first assumes that consumption tracks the historical level at about 55 Bcf/yr. The low case assumes that consumption follows the contract with Union Oil for annual delivery of about 47.5 Bcf and that total consumption is equal to the remaining amount dedicated by the contract, about 499 Bcf.

- Military Sales. Gas consumption by military customers is expected to track the historical level of about 5 Bcf annually.

- Cook Inlet Residential Sales. Current residential consumption is restricted to the Kenai and Anchorage areas and is primarily for space heating and water heating purposes. Consumption is estimated as a function of population and the real prices of natural gas, distillate oil, and electricity. Scenarios are presented to develop the sensitivity of gas consumption to the low, medium, and high population and economic growth scenarios discussed in the electric utility sales category above. Appendix B presents additional detail on the relationships estimated for residential gas consumption. Appendix D presents the assumptions underlying the economic scenarios.

- Cook Inlet Commercial/Industrial Sales. This category is also currently restricted to the Kenai and Anchorage area. It includes commercial buildings and light industrial users not mentioned above, where gas is used primarily for space heating and process energy. This consumption is estimated as a function of commercial/industrial floor space, employment, and the real prices of gas, distillate oil, and electricity. Scenarios are presented to develop the sensitivity of gas consumption to the low, medium, and high population and economic growth scenarios discussed in the electric utility sales category above. The detailed relationships for this category are also presented in Appendix B.

- Oil and Gas Production. This category covers gas used on lease, vented and shrinkage. It is assumed that this consumption will track that for the recent historical period at about 25 Bcf/yr.

- Miscellaneous Sales. This category includes sales to other producers, refiners and pipelines. These sales have increased over time and are assumed to level off at about 5 Bcf/yr.

- Fairbanks Residential. There is presently no pipeline gas consumption in Fairbanks, but gas sales are expected to begin in 1987 with the completion of the Alaska Natural Gas Transportation System (ANGTS). A penetration of gas sales to households in the Fairbanks area is assumed in order to develop consumption estimates for the low, medium and high population and economic growth scenarios discussed in the electric utility sales category above. The penetration rate is based upon the adoption of gas heat and hot water by all new housing stock built after 1985. If gas is cheap enough at Fairbanks, much of the older housing stock may also convert to gas. We have assumed two scenarios bounding the problem. In the first scenario, all old housing heated with oil is converted to gas. In the second scenario, only new housing adopts gas. The penetration is applied to the forecasts of households

developed by the RED model for the three growth scenarios in the Railbelt Electric Power Alternatives Study. The per household consumption is calculated by the RED model. See Appendix B for detail.

- Fairbanks Commercial. Sales to commercial and industrial users in the Fairbanks area are also expected to begin with the completion of ANGTS in 1987. This consumption is also developed from an assumed penetration rate and per unit consumption applied to forecasts of the commercial/industrial building stock developed by the RED model in the Railbelt Electric Power Alternatives Study. Penetration scenarios similar to those in the residential sector are assumed. Per unit Btu consumption is calculated by the RED model.

- Dow/Shell Petrochemical Development. In the high case only, this category includes the stated methane requirements and electricity requirements of the Phase I Dow/Shell petrochemical complex, which is assumed to be completed in 1990. In the other cases, no plant is built. Dow/Shell gives 75 MW and 4.3 billion Btu of natural gas per hour as its utility requirements. The electricity is assumed to be generated with combustion turbines.

- Prudhoe Bay Oil and Gas Consumption. This category includes: use on lease, vented and shrinkage; pipeline fuel; and electric power generation. The sum of these categories has been increasing over time and are assumed to level off at 55 Bcf/yr.

- Barrow. Consumption at Barrow includes sales to government and utilities as well as use on lease, vented and shrinkage. This consumption is assumed to level off at about 1.5 Bcf/yr.

3.1.2 Refined Products

The forecasting method used is dependent upon the type of refined product because of available data sources for individual product types. The forecast may be developed for geographic regions other than the three referred to in this study (Southeast, Railbelt and Rest-of-State) and then reallocated to

these regions. In the case of refined products consumed for electricity generation, the forecasts are developed directly for three regions. Historical electricity generation data is available at a detailed level and can be easily reaggregated to the desired regions. Fuel oil consumption for residential space heating and for commercial/industrial space heating and process energy is available only at the state level. These forecasts are developed at the State level and then allocated to the Southeast and Rest-of-State; the Railbelt forecasts are drawn from the Railbelt Electric Power Alternatives Study.

The motor fuels data are available only at the Judicial District level; there are four Judicial Districts. The Southeast is the only region that directly corresponds to a single Judicial District, Judicial District 1. The Railbelt region lies in parts of Judicial Districts 3 and 4 so the consumption forecasted for Judicial Districts 2, 3, and 4 cannot be disaggregated in a manner to accurately reflect the different energy use intensities between the Railbelt and Rest-of-State. A simple per employee energy use measure is used in Judicial Districts 3 and 4 to disaggregate the consumption between the Railbelt and Rest-of-State within those two judicial districts. This method may not accurately reflect consumption between the Railbelt and Rest-of-State, but little information exists to permit a more accurate disaggregation of the data.

The forecasting methods used for each region and use category are explained in more detail below. An overview of the forecasts and underlying assumptions are shown in Tables 3.2 through 3.4.

Southeast

- Electric Utility Sales. Consumption of fuel oils by electric utilities are forecasted for two scenarios: with substantial hydroelectric capacity added as outlined in Senate Bill 26 of the 1981 Legislature and without additional hydroelectric development, shown in Appendix B. Each of these two basic scenarios is then constructed for the medium population and economic growth scenarios discussed earlier. Electricity consumption is forecasted on a per

TABLE 3.2. Refined Products Consumption, Assumptions and Projections, Railbelt, 1981-2000

Region/Consumption Category	Forecast Scenarios and Underlying Assumptions	Cumulative Consumption (10^6 Bbls Crude Oil Equivalent) from 1981 to 2000		
		0.9 Probability of at Least	0.5 Probability of at Least	0.1 Probability of at Least
Railbelt:				
Residential Distillate	In the low case, based on slow Railbelt economic growth, 7% inflation, 3% real oil price escalation; middle case on moderate economic growth, 7% inflation, and 2% real oil price escalation; high case on high economic growth, 0% inflation, 1% real oil price escalation.	12.0	17.4	24.1
Commercial/Industrial Distillate	See residential assumptions.	36.0	44.5	59.7
Transportation:				
Highway Gasoline	Based on state level forecast of employment using historical consumption to employment relationship. Allocated assuming equal per employee usage across the state.	68.7	78.5	96.6
Highway Diesel	Based on state level forecast of employment using historical consumption to employment relationship. Allocated assuming equal per employee usage across	21.6	24.8	30.7
Aviation Gasoline	Based on state level forecast of employment using historical consumption to employment relationship. Allocated assuming equal per employee usage across	6.0	6.8	8.5
Aviation Jet Fuel (taxable)	Based on state level forecast of employment using historical consumption to employment relationship. Allocated assuming equal per employee usage across	57.7	65.5	81.1
Aviation Jet Fuel (bonded and exempt)	Based on state level forecast of exempt sales of 200 million gallons per year. Allocated by employment. Bonded sales into the Railbelt set at state total.	95.7	95.7	95.7
Marine Gasoline	Based on state level forecast of employment using historical consumption to employment relationship. Allocated assuming equal per employee usage across the state.	2.1	2.5	3.0
Marine Diesel	Based on state level forecast of employment using historical consumption to employment relationship. Allocated assuming equal per employee usage across the state.	22.6	25.6	31.1
Electric Utility Sales (without Susitna)	See residential demand for assumptions. If Susitna project is built, middle case cumulative demand falls by only 18x103 Bbls.	1.6	1.9	2.3
Railbelt TOTAL		323.3	363.2	432.8

TABLE 3.3. Refined Products Consumption, Assumptions and Projections, Southeast, 1981-2000

Region/Consumption Category	Forecast Scenarios and Underlying Assumptions	Cumulative Consumption (10^6 Bbls Crude Oil Equivalent) from 1981 to 2000		
		0.9 Probability of at Least	0.5 Probability of at Least	0.1 Probability of at Least
Southeast:				
Residential Distillate	Based on state level forecast of residential distillate consumption. Allocated to Southeast assuming equal per capita consumption across the state.	10.2	11.3	13.0
Commercial/Industrial Distillate	See residential assumption allocated with share of employment assuming equal per employee consumption across the state.	11.8	14.0	17.9
Transportation Highway Gasoline	Based on state level forecast of employment using historical consumption to employment relationship. Allocated assuming equal per employee usage across the state.	7.5	8.3	10.2
Highway Diesel	Based on state level forecast of employment using historical consumption to employment relationship. Allocated assuming equal per employee usage across the state.	4.2	4.9	6.0
Aviation Gasoline	Based on state level forecast of employment using historical consumption to employment relationship. Allocated assuming equal per employee usage across the state.	1.0	1.1	1.4
Aviation Jet Fuel (Taxable)	Based on state level forecast of employment using historical consumption to employment relationship. Allocated assuming equal per employee usage across the state.	2.9	3.3	4.1
Aviation Jet Fuel (Bonded and Exempt)	Based on state level forecast of exempt sales of 200 million gallons per year. Allocated by employment. No bonded sales in southeast.	0.2	0.2	0.2
Marine Gasoline	Based on state level forecast of employment using historical consumption to employment relationship. Allocated assuming equal per employee usage across the state.	1.1	1.3	1.6
Marine Diesel	Based on state level forecast of employment using historical consumption to employment relationship. Allocated assuming equal per employee usage across the state.	6.2	7.1	8.8
Electric Utility Sales (without Hydroelectric)	Based upon historical per capita electricity generation growth rate; share of electricity generated by oil; and conversion efficiency.	5.3	5.8	6.6
Southeast Total		50.4	57.3	69.8

TABLE 3.4. Refined Products Consumption, Assumptions and Projections, Rest-of-State 1981-2000

Region/Consumption Category	Forecast Scenarios and Underlying Assumptions	Cumulative Consumption (10^6 Bbls Crude Oil Equivalent) from 1981 to 2000		
		0.9 Probability of at Least	0.5 Probability of at Least	0.1 Probability of at Least
Rest-of-State:				
Residential Distillate	Based on state level forecast of residential distillate consumption. Allocated assuming equal per capita consumption across the state.	12.1	14.0	16.9
Commercial/Industrial Distillate	See residential assumptions. Allocated with employment assuming equal per employee consumption across the state	13.6	16.7	21.9
Transportation				
Highway Gasoline	Based on state level forecast of employment using historical consumption to employment relationship. Allocated assuming equal per employee usage across the state.	14.5	16.6	20.4
Highway Diesel	Based on state level forecast of employment using historical consumption to employment relationship. Allocated assuming equal per employee usage across the state.	16.5	19.0	23.5
Aviation Gasoline	Based on state level forecast of employment using historical consumption to employment relationship. Allocated assuming equal per employee usage across the state.	2.0	2.2	2.8
Aviation Jet Fuel (Taxable)	Based on state level forecast of employment using historical consumption to employment relationship. Allocated assuming equal per employee usage across the state.	12.3	14.1	17.5
Aviation Jet Fuel (Bonded and Exempt)	Based on state level forecast of exempt sales of 200 million gallons per year. Allocated by employment. No bonded sales in the rest of state.	14.7	14.7	14.7
Marine Gasoline	Based on state level forecast of employment using historical consumption to employment relationship. Allocated assuming equal per employee usage across the state.	0.7	0.8	0.9
Marine Diesel	Based on state level forecast of employment using historical consumption to employment relationship. Allocated assuming equal per employee usage across the state.	4.7	5.4	6.5
Electric Utility Sales (without Hydroelectric)	Based upon historical per capita electricity generation growth rate; share of electricity generated by oil; and conversion efficiency.	15.9	18.4	22.1
Rest-of-State Total		107.0	121.9	147.2

capita basis based upon the trend exhibited in the Alaska Power Administration's periodic reports on electric power statistics for the state. The per capita estimate is then multipled by population in each of the forecast periods for the low, medium and high population and economic scenarios. In the case without substantial further hydroelectric development it is assumed that the share of total electricity generated by fuel oil remains constant. The oil consumed is then backed out by multiplying electrical generation fired by oil times the past operating efficiency of oil fired generation in the Southeast. The fuel oil consumption scenario for substantial hydroelectric development differs only in that the share of electricity generated by oil declines due to the additional hydroelectric capacity shown in Appendix B. Then the fuel oil consumed is backed out by multiplying the historic operating efficiency of oil-fired capacity times electricity generated, as above.

- Residential. As mentioned above, there is no reliable data base detailing oil consumption for space heating and other purposes in either the residential or commercial/industrial sectors. The approach taken here is the same as that taken in the April, 1981 Long Term Energy Plan, where state total heating oil consumption data from the U.S. DOE annual report of fuel oil use are used. The residential oil consumption is forecasted at the state level from this data as a function of population based upon the past relationship. The state level forecasts are then distributed back to the three regions. Appendix B presents the estimated relationship for the state level forecast and the method for disaggregating the forecasted consumption to the Southeast and Rest-of-State regions.

- Commercial/Industrial. The data here are also from the DOE annual energy use report. Consumption in these sectors is related to historical state level employment. Again the reader is referred to Appendix B for a discussion of the forecast and disaggregation methods.

- Motor Fuels. The consumption forecasts for motor fuels were constructed from Department of Revenue data for seven general use categories: aviation jet fuel, aviation gas, highway diesel, highway gas, marine diesel, marine gas and all other. These data are available at the Judicial District level for the period 1977 to 1980. The forecasts were developed for the State level and then disaggregated to the three regions. The off highway diesel use category reported by the Department of Revenue covers oil used for residential consumption. It is reported that this category may not accurately reflect residential heating oil consumption. This is because at least one of the reporting refiners and distributors does not submit information on sales for this category and the published figures are estimates constructed from sales information submitted by those refiners and distributors that do report. The residential, commercial and industrial fuel oil consumption data is taken from U.S. Department of Energy estimates. A more detailed discussion regarding the development of the forecasts is located in Appendix B.

Railbelt

- Electric Utility Sales. The approach used for fuel oil consumption by electric utilities in the Railbelt differs from that outined above for the Southeast. The study of electric power alternatives for this region by Battelle provides estimates of utility fuel oil consumption for the three growth scenarios. These estimates are developed for both the absence and presence of the Susitna hydroelectric project.
- Residential. The Railbelt Electric Power Alternatives Study has also developed estimates of household formation in the Railbelt over the forecast period. These estimates contain the share of households using electricity for space heating, clothes drying, cooking, and water heating. After adjusting for present natural gas and other heating fuels consumption, the remainder is assumed to be

heated with oil until 1987 when the ANGTS is completed. At this time natural gas is assumed to be available in the Fairbanks area. Two rates of market penetration of gas are used to compute the share of residential units using oil, which is the remainder after the price-dependent addition in natural gas heated homes is deducted.

- Commercial/Industrial. This fuel oil consumption is also calculated from forecasts of commercial building stock and employment developed in the Railbelt Electric Power Alternatives Study. The forecasts will be developed in the same manner as in the residential sector where oil consumption is netted out from all other heating and process energy fuels. Completion of ANGTS is also factored in these calculations in 1987.
- Dow/Shell Industrial Use. In the high scenario only, the Dow/Shell Phase I project is assumed to be constructed, taking 90,000 Bbl/day of ethane as feedstock. Other NGL are assumed to be exported. Project completion is assumed to be in 1990.
- Motor Fuels. See motor fuels discussion for the Southeast.

Rest-of-State

- Electric Utility Sales. Fuel oil consumption by electric utilities is calculated in the same manner as for the Southeast. A list of potential hydroelectric projects outined by Senate Bill 26 are factored into the calculations to provide the with and without hydroelectric development scenarios.
- Residential. Fuel oil consumption in this sector is calculated in the same manner as in the Southeast.
- Commercial/Industrial. Fuel oil consumption in this sector is also handled as in the Southeast.
- Motor Fuels. See motor fuels discussion for the Southeast.

3.2 CONSUMPTION FORECASTS

The consumption forecasts for natural gas and refined products are developed by region and sector according to the methodologies described in Sections 3.1.1 and 3.1.2. Tables 3.1 through 3.5 summarize the assumptions used for each region and sector for natural gas and refined products. In addition, these tables show the cumulative consumption by region and sector for the forecast period. Table D.1 in Appendix D summarizes the underlying assumptions for these economic growth scenarios. These disaggregated forecasts are then assessed as to the likelihood of a given scenario transpiring, a cumulative probability is assigned, and a cumulative consumption forecast corresponding to the probability is obtained for each sector and region. The probability assigned is a cumulative probability that the consumption listed will be at least as large as shown. This is consistent with the manner in which oil and gas reserves are usually reported.

The tables are designed to be flexible so that additional consuming sectors can be included and so that the user may examine a number of "what if" scenarios. Given the level of consumption for some sectors, a change in the uncertainty of a given scenario may have a big impact on the total cumulative consumption and, hence, the royalty surplus situation. The probabilities selected in this example are based upon current information regarding the uncertainty of each scenario. Any change in the level of uncertainty may easily be incorporated into the calculations.

The effect of changes in the definition of consumption discussed in Chapter 1 on cumulative consumption forecasts for 1981 to 2000 are displayed in Tables 3.6 and 3.7 for natural gas and refined products, respectively. These forecasts are constructed from the probabilities selected for Tables 3.1 through 3.5. The display of information helps to show how changing the definition of consumption, probabilities of given projects/scenarios, and the effects of growth in given sectors change the potential consumption in Alaska.

TABLE 3.5. State Total Refined Products Projected Consumption, 1981-2000

Region/Consumption Category	Forecast Scenarios and Underlying Assumptions	Cumulative Consumption (10^6 Bbls Crude Oil Equivalent) from 1981 to 2000		
		0.9 Probability of at Least	0.5 Probability of at Least	0.1 Probability of at Least
Residential Distillate	See Table 3.2-3.4 for assumptions for Railbelt, Southeast and rest of state	34.3	42.7	54.0
Commercial/Industrial Distillate	See Table 3.2-3.4 for assumptions for Railbelt, Southeast and rest of state	61.4	75.2	39.8
Transportation				
Highway Gasoline	Based on historical relationship of consumption to employment	90.5	103.4	127.3
Highway Diesel	Based on historical relationship of consumption to employment	42.3	48.6	60.2
Aviation Gasoline	Based on historical relationship of consumption to employment	8.9	10.2	12.6
Aviation Jet Fuel (Taxable)	Based on historical relationship of consumption to employment	72.2	82.9	102.6
Aviation Jet Fuel (Bonded and Exempt)	Assumed exempt sales of 200 million gallons per year and bonded sales of 50 million gallons per year.	110.4	110.4	110.4
Marine Gasoline	Based on historical relationship of consumption to employment.	3.9	4.5	5.6
Marine Diesel	Based on historical relationship of consumption to employment.	33.6	38.1	46.4
All Other Motor Fuels (Mostly Turbine Fuels)	Forecasted only at state level based upon recent historical past at 125 million gallons per year.	59.8	59.8	59.8
Electric Utility Sales (Without substantial hydroelectric development)	See Table 3.2 - 3.4	22.8	26.1	31.0
Other Categories				
Natural Gas Liquids (Propane and Butane)	Residential demand for propane is assumed to double from present levels by the year 2000. In high case, Phase I of the Dow-Shell project is built and utilizes 90 x 103 Bbls ethane per day.	2.6	2.6	174.5
State Total		542.7	604.5	824.2

TABLE 3.6. Effect of Definitions of Consumption on Forecast of Total In-State Natural Gas Consumption, 1981-2000 (Bcf)

Definition/ Changes in Definition	0.9 Probability of at Least	0.5 Probability of at Least	0.1 Probability of at Least
All uses except injection: (same as Table 3.1)			
Cook Inlet	1912.7	3754.2	4670.7
Fairbanks	9.2	17.9	67.4
Prudhoe Bay + Other	1100	1100	1565.7
Barrow	1.5	1.5	1.5
TOTAL	3023.4	4873.6	6305.3
Exclude gas used to produce and transport oil for export (Industrial Definition 3):			
Cook Inlet	1912.7	3754.2	4670.7
Fairbanks	9.2	17.9	67.4
Prudhoe Bay + Other	0	0	465.7
Barrow	1.5	1.5	1.5
TOTAL	1923.4	3773.6	5205.3
Exclude, in addition, gas used as feedstocks to LNG plants (Industrial Definition 2):			
Cook Inlet[a]	1755.9	2701.6	2942.4
Fairbanks	9.2	17.9	67.4
Prudhoe Bay + Other	0	0	465.7
Barrow	1.5	1.5	1.5
TOTAL	1766.2	2721.0	3477.0
Exclude, in addition, gas consumed in LNG plants and Petrochemical plants (Industrial Definition 1):			
Cook Inlet	1076.2	1375.2	1470.7
Fairbanks	9.2	17.9	67.4
Prudhoe Bay + Other	0	0	0
Barrow	1.5	1.5	1.5
TOTAL	1086.9	1394.6	1539.6

(a) Natural gas consumed in liquefaction at the Philips/Marathon LNG plant is about 11 Bcf out of total purchases of 62 Bcf, according to SRI International (R. E. Fullen and J. E. Pelline, Natural Gas Demand and Supply to the Year 2000 in the Cook Inlet Basin of Southcentral Alaska, SRI, Menlo Park, California, December, 1975). About 17.7 percent of gas purchases by LNG facilities is assumed to be used in conversion.

TABLE 3.7. Effect of Definitions of Consumption on Forecast of Total In-State Refined Products Consumption, 1981-2000 (Million Bbl. Crude Oil Equivalent)

Definition/ Changes in Definition	0.9 Probability of at Least	0.5 Probability of at Least	0.1 Probability of at Least
All sales of Refined Products (Same as Tables 3.2-3.4)			
Railbelt	323.3	363.2	432.8
Southeast	50.4	57.3	69.8
Rest-of-State	107.0	121.9	147.2
Unallocated	62.4	62.4	234.3
Total	543.1	604.8	884.1
Exclude refined products used to produce and transport oil for export (Industrial Definition 3):			
Railbelt	323.3	363.2	432.8
Southeast	50.4	57.3	69.8
Rest-of-State	107.0	121.9	147.2
Unallocated	2.6	2.6	174.5
Total	483.3	545.0	824.3
Exclude, in addition, fuel used to make product for export (Industrial Definition 1):			
Railbelt	323.3	363.2	432.8
Southeast	50.4	57.3	69.8
Rest-of-State	107.0	121.9	147.2
Unallocated	2.6	2.6	2.6
Total	483.3	545.0	652.4
Exclude, in addition, fuel used in international and interstate air travel (Jet fuel, bonded and exempt: Approximate Intrastate Definition 2)(a)			
Railbelt	227.6	267.5	337.1
Southeast	50.2	57.1	69.6
Rest-of-State	92.3	107.2	132.5
Unallocated	2.6	2.6	2.6
Total	372.7	434.4	541.8

(a) No reliable data is available to adjust out-of-state purchases of fuels for military and marine uses in Alaska.

4.0 RESERVE ESTIMATES AND ROYALTY SHARE

This section develops estimates of recoverable oil and gas reserves in the state and the states royalty share of these reserves. The reserve estimates are developed for low, mid and high cases. The low and mid estimates are based upon proven and probable reserves and the high estimates contain undiscovered reserves. The royalty share is based upon existing contracts and best estimates of future royalty contracts.

4.1 ESTIMATED RESERVES

The estimated recoverable reserves for oil and gas are shown in Tables 4.1 and 4.2, respectively. The estimates are developed separately for Cook Inlet, the North Slope and undiscovered as different sources of information were drawn upon for each category.

Cook Inlet

Much information is available about the oil and gas reserves in the Cook Inlet area and major new discoveries are not considered likely. The reserves are assumed to remain constant for all three cases. In addition, Cook Inlet reserves account for about 2% and 10% of the state's proven and probable oil and gas reserves, respectively. The high estimate of reserves further reduces the Cook Inlet share of total reserves.

North Slope

Oil and gas reserve estimates for the North Slope are taken from the report by William Van Dyke to the Governor and Department of Natural Resources.[a] These estimates provide the low, mid and high proven and probable oil reserves on currently leased state lands. These estimates were compiled from public information available to the author.

Current North Slope oil production is from only the Sadlerochit reservoir. The Kuparuk Field is expected to enter production in 1982 or 1983. The other fields listed in the Van Dyke report are lumped together because production is not expected to begin until the mid to late 1980s.

(a) William Van Dyke, Proven and Probable Oil and Gas Reserves, North Slope, Alaska, September 25, 1980.

TABLE 4.1. Estimated Recoverable Oil Reserves, MMBbl

Location/Field	Reserve Estimate Low	Mid	High
Cook Inlet[a]			
Beaver Creek	1	1	1
Granite Point	35	35	35
McArthur River	91	91	91
Middle Ground Shoal	33	33	33
Swanson River	22	22	22
Trading Bay	5	5	5
Subtotal	187	187	187
North Slope[b]			
Prudhoe Bay, Sadlerochit Reservoir	7,050	7,830	8,220
Kuparuk	400	750	1,300
Other North Slope	1,090	1,580	2,375
Subtotal	8,540	10,160	11,895
Undiscovered[c]	____	____	10,150
Total	8,727	10,347	22,234

(a) Alaska Oil and Gas Commission, 1980 Statistical Report.
(b) William Van Dyke, Proven and Probable Oil and Gas Reserves, North Slope, Alaska, September 25, 1980.
(c) Oil and Gas Journal, "NPC Sees Big U.S. Arctic Resources," November 23, 1981; and U.S. Geological Survey, Estimates of Undiscovered Recoverable Resources of Conventionally Producible Oil and Gas in the United States, a Summary, Open-File Report 81-192, 1981.

No gas is currently exported from the North Slope. The Alaska Natural Gas Transportation System for carrying gas to the Lower 48 is targeted for completion in 1986 or 1987. The pipeline capacity will then permit exports in the range of 2.0 to 2.4 Bcf per day, with an expected level of 2.0 Bcf per day.

Undiscovered

Undiscovered oil and gas reserves are taken as the simple average of the low estimates recently developed by the U.S. Geological Survey and the National Petroleum Council (NPC). The USGS estimates are for conventionally

TABLE 4.2. Estimated Recoverable Gas Reserves, Bcf

Location/Field	Reserve Estimate Low	Mid	High
Cook Inlet			
Beaver Creek	240	240	240
Beluga River	760	760	760
Birch Hill	11	11	11
Falls Creek	13	13	13
Granite Point	26	26	26
Ivan River	26	26	26
Kenai	1,215	1,215	1,215
Lewis River	22	22	22
McArthur River	98	98	98
Middle Ground Shoal	17	17	17
Nicolai Creek	17	17	17
North Cook Inlet	1,001	1,001	1,001
North Fork	12	12	12
Sterling	23	23	23
Swanson River	265	265	265
Trading Bay	13	13	13
West Foreland	20	20	20
West Fork	6	6	6
Subtotal	3,785	3,785	3,785
North Slope[b]			
Prudhoe Bay, Sadlerochit Reservoir	29,000	29,000	29,000
Other North Slope	4,500	6,400	8,800
Subtotal	33,500	35,400	37,800
Undiscovered[c]			15,000
Total	37,285	39,185	56,585

(a) Alaska Oil and Gas Commission, 1980 Statistical Report.
(b) William Van Dyke, Proven and Probable Oil and Gas Reserves, North Slope, Alaska, September 25, 1980.
(c) Oil and Gas Journal, "NPC sees Big U.S. Arctic Resources," November 23, 1981; and U.S. Geological Survey, Estimates of Undiscovered Recoverable Resources of Conventionally Producible Oil and Gas in the United States, by Summary, Open-File Report 81-192, 1981.

producible reserves based upon information available to USGS. The low USGS estimates of undiscovered oil and gas reserves are 2.5 BBbl and 19.8 Tcf, respectively at the 95% confidence level. The NPC reserve estimates were developed for yields on investment of 10% for oil and gas and 15% for oil. These estimates are 17.8 BBbl of oil that will yield a 15% return on investment and 10.1 Tcf of gas that will yield a 10% return on investment. The averaged low estimate of undiscovered reserves is entered as the high estimate in this report in order to present a conservative estimate.

4.2 ROYALTY SHARE

The royalty share assigned to each field may vary according to field ownership and the terms of the contract. The share used for the Cook Inlet fields and the Prudhoe Bay Sadlerochit Reservoir are taken from the "Disposition of the States Royalty Share of Its Oil and Gas," prepared by the Division of Minerals and Energy Management (Appendix A). The share for the other existing North Slope fields is set at 12.5%, and at 0% for the undiscovered reserves, due to the fact that not enough information is available to estimate what portion of undiscovered reserves may be on state lands.

The royalty share of oil and gas reserves based upon these shares are presented in Tables 4.3 and 4.4, respectively. In the middle case the royalty oil available from Cook Inlet Fields is less than 2% of the State total reserves and about 5% for gas reserves.

TABLE 4.3. Estimated Royalty Share of Oil, MMBbl

Location/Field	Royalty Share Corresponding to Reserve Estimate		
	Low	Mid	High
Cook Inlet			
Beaver Creek			
Granite Point	4.4	4.4	4.4
McArthur River	11.4	11.4	11.4
Middle Ground Shoal	4.1	4.1	4.1
Swanson River			
Trading Bay	0.6	0.6	0.6
Subtotal	20.5	20.5	20.5
North Slope			
Prudhoe Bay, Sadlerochit Reservoir	881	979	1,028
Kuparuk	50	94	163
Other North Slope	136	198	297
Subtotal	1,067	1,271	1,488
Undiscovered			0
Total	1,087.5	1,291.5	1,508.5

TABLE 4.4. Estimated Royalty Share of Gas, Bcf

Location/Field	Royalty Share Corresponding to Reserve Estimate		
	Low	Mid	High
Cook Inlet			
Beaver Creek			
Beluga River	57.4	57.4	57.4
Birch Hill			
Falls Creek			
Granite Point	3.3	3.3	3.3
Ivan River			
Kenai	25.1	25.1	25.1
Lewis River			
McArthur River	12.3	12.3	12.3
Middle Ground Shoal	2.1	2.1	2.1
Nicolai Creek	2.1	2.1	2.1
North Cook Inlet	125.1	125.1	125.1
North Fork			
Sterling	.4	.4	.4
Swanson River			
Trading Bay	1.6	1.6	1.6
West Foreland			
West Fork			
Subtotal	229.4	229.4	229.4
North Slope			
Prudhoe Bay, Sadlerochit Reservoir	3,625	3,625	3,625
Other North Slope	563	800	1,100
Subtotal	4,188	4,425	4,725
Undiscovered			0
Total	4,417.4	4,654.4	4,954.4

5.0 ANALYSIS OF SURPLUS

This chapter provides estimates of the state's royalty surplus or deficit of gas and oil for the low, medium and high demand, and reserve estimates of each. Chapter 3 cumulative consumption estimates for the period 1981 to 2000 for the low, medium, and high cases are shown in Tables 3.6 and 3.7.

The three estimates of reserve, royalty reserves and cumulative consumption through 2000 from Chapter 4 are cross tabulated for gas in the matrices in Tables 5.1 and 5.2 for the state and Cook Inlet, respectively. The entries in the body of the tables without brackets indicate a surplus over the period and those with brackets indicate a deficit. The Cook Inlet reserve and consumption estimates are presented separately because at least 60% of gas consumption is projected to occur in this region. In addition, there are currently no other sources of supply and reserves in this region account for only about 5% of the state total.

The estimated total state natural gas reserves and the corresponding royalty gas reserves were compared with the estimated consumption to produce the surplus (deficit) estimates in Table 5.1. All possible combinations of reserves and royalty reserves versus consumption estimates were not computed at the state level because a surplus exists for nearly all combinations.

TABLE 5.1. Total State Natural Gas Reserve and Royalty Reserve Surplus (Deficit) by Low, Mid and High Estimates of Reserves and Consumption, Cumulative to 2000

Consumption Estimate	Reserve Surplus by Reserve Estimate, Bcf			Royalty Reserve Deficit by Royalty Reserve Estimate, Bcf		
	Low	Mid	High	Low	Mid	High
Low, Industrial Definition 1 (1087 Bcf)	36,198	38,098	55,498	3,330	3,567	3,867
Mid, Industrial Definition 2 (2721 Bcf)	34,564	36,464	53,864	1,696	1,933	2,233
High, All Uses (6305 Bcf)	30,980	32,880	50,280	(1,888)	(1651)	(1,351)

TABLE 5.2. Cook Inlet Natural Gas Reserve and Royalty Reserve Surplus (Deficit) by Low, Mid and High Estimates of Reserves and Consumption Definition, Cumulative to 2000

Cook Inlet Consumption Definition	Cook Inlet Reserve Surplus (Deficit), Bcf	Cook Inlet Royalty Reserve Deficit, Bcf
All Uses		
Low	1872	(1683)
Mid	31	(3525)
High	(886)	(4441)
Excluding gas used for gas and oil production		
Low	1872	(1683)
Mid	31	(3525)
High	(886)	(4441)
In addition, excluding gas used for LNG		
Low	2029	(1527)
Mid	1083	(2472)
High	843	(2713)
In addition, excluding gas used for petrochemicals		
Low	2709	(847)
Mid	2410	(1146)
High	2314	(1241)

Total reserves cover consumption by about 31 Tcf for the high consumption-low reserve case and by 55 Tcf for the low consumption high reserve case. Royalty reserves cover consumption in all but the high consumption case.

The estimated coverage of consumption in the Cook Inlet region by the reserves and royalty reserves in that region is not as favorable as at the state level. Cook Inlet reserves are adequate in all cases except for the high consumption scenarios for the two broadest definitions of consumption.

The state's royalty reserves in the Cook Inlet region are not adequate to cover projected consumption in any case, with the deficit ranging from 847 Bcf in the low case and the most narrow definition of consumption to 4441 Bcf in the high case and broadest definition of consumption.

The coverage of consumption of refined products by the states' crude oil reserves and royalty reserves is shown in Table 5.3. Total crude oil reserves easily cover cumulative consumption of refined products over the period. In the case with highest consumption vs. lowest reserves, the margin of crude oil reserves over consumption is 7,843 million barrels and this ranges to a high of 21,861 million barrels for the case with lowest consumption vs. highest reserves. The royalty reserves also cover projected consumption over the period. In the low case, there is a surplus of 203 million barrels and this ranges to a high of 1,136 million barrels.

It should be noted in analyzing the "surplus"reported that no attempt has been made in this report to analyze in detail the balance of estimated demand for refined products by fuel with the potential sources of supply of these fuels. The supply problem is more than simply a question of how much crude oil is available in the state. It also involves questions of refinery capacity and transportation not covered in this report. For example, as pointed out in Petroleum Refining and Consumption in Alaska[a], the current Alaskan supply and demand for crude oil cannot balance out without cracking facilities on the existing Alaska refineries. Given the chemical composition of North Slope and Cook Inlet crude, distillation will yield too little naphtha (for gasoline and military jet fuel), too little kerosene (for commercial jet fuel, #1 diesel and heating fuel) and too much light gas-oil (for #2 diesel and heating fuel). Thus, Alaska might have to export some products while importing others even if overall crude oil supplies were sufficient. Furthermore, it is evidentally cheaper for existing suppliers to provide Southeast and Western Alaska's refined products from Lower 48

(a) Barlow, Connie, Petroleum Refining and Consumption in Alaska: Implications for Management of Royalty Oil, House Research Agency Report 81-1, May 8, 1981.

TABLE 5.3. Total State Oil Reserve and Royalty Reserve Surplus (Deficit) by Low, Mid and High Estimates of Reserves and Consumption Definition, Cumulative to 2000

Consumption Definition	Reserve Surplus by Reserve Estimate, (Million Bbl)			Royalty Reserve Surplus by Royalty Reserve Estimate, (Million Bbl)		
	Low	Mid	High	Low	Mid	High
All Uses						
Low	8,184	9,804	21,691	544	748	965
Mid	8,122	9,742	21,629	483	687	904
High	7,843	9,463	21,350	203	407	624
Excluding oil used for gas and oil production						
Low	8,244	9,864	21,751	604	808	1,025
Mid	8,182	9,802	21,689	543	747	964
High	7,903	9,523	21,410	263	467	684
In addition, excluding oil used for feedstocks in exported products						
Low	8,244	9,864	21,751	604	808	1,025
Mid	8,182	9,802	21,689	543	747	964
High	7,903	9,523	21,410	263	467	684
In addition, excluding oil used for international and interstate air travel						
Low	8,354	9,974	21,861	715	919	1,136
Mid	8,293	9,913	21,800	653	857	1,074
High	8,185	9,805	21,692	546	750	967

refineries than from Alaskan refineries. It is not clear that even if it were possible to supply these two areas from Alaskan refineries using royalty crude that this would result in the lowest cost to the consumer.

In this report, the approach for determining crude surplus or deficit is to assume that Alaska crude oil can be traded on an equivalent-Btu basis for refined products which are in demand in Alaska. This permits an analysis of the crude oil surplus as only a question of Btu's demanded and supplied, and ignores questions of specific chemical composition. This is appropriate when reserves of unknown chemical composition (undiscovered reserves) must be included in the analysis.

APPENDIX A

ROYALTY OIL AND GAS DISPOSITION

(1981 Update has not been requested of Division of Minerals and Energy Management by the State of Alaska)

TRADING BAY

Statistics relating to this field are shown on the attached table.

Current Status

All Royalty oil produced from this field is taken in kind and sold to Tesoro-Alaska Petroleum Company.

Gas produced for this field is casinghead gas and was formerly flared. DOGC Flaring Order Number 104 dated June 30, 1971, has prohibited flaring since July 1, 1972, and this gas is now recovered and used locally. This gas is considered to have no value because the costs of extraction, compression, and amortization purportedly exceed its value; therefore, no royalty is paid, but because of the recent price increases this gas should be looked at again for proper value.

Royalty Oil and Gas Status

Unit: Trading Bay

Location: West Side Cook Inlet (Offshore)

Operator: Union

Owners: Union, Amoco, Phillips, Arco, Getty

Leases: ADL 17579, 17594, 17602, 18716, 18729, 18730, 18758, 18772, 18777, 21068

Royalty: 12.5%

Purchaser:	Price $/Mcf	Price $/Bbl	
Tesoro		9.87	(as of Nov. 1980)
Date Initial Production:	12-67 (oil) 12-68 (gas)		State Royalty Sta
Avg. Monthly Production Rate (10/31/80) gas:	122,285 Mcf		RIV
Avg. Monthly Production Rate (11/30/80) oil:	133,304 Bbls		RIK
Total Production to 10/31/80 (casinghead) gas:	51,781,247 Mcf		
Total Production to 9/30/79 oil:	80,502,934 Bbls		
Estimated percent produced to 10/31/80	87.7% Oil		

RIV: Royalty in Value

RIK: Royalty in Kind

KENAI UNIT AND KENAI DEEP

Statistics relating to this field are shown on the attached table.

Current Status

The Kenai Unit and Kenai Deep provide most of the gas sales in the Cook Inlet area. The estimated quantity of Alaska State royalty gas sales amounts to approximately 127,000 MCF per month. The State does not receive the full 12 1/2% royalty share because of the predominance of Federal leases in the unit and the recent conveyance of land to CIRI. The price the State receives for its royalty share results from prices paid under existing contracts between the lessees and their purchasers. Anchorage Municipal Light and Power has entered into a purchase contract with the State to purchase its royalty share.

Royalty Oil and Gas Status

Kenai and Kenai Deep

Location: Kenai, Alaska

Operator: Union

Owners: Union, Marathon, Arco, Chevron, Charles Schraier, Samuel Gray

Leases: Fed. A028047, A028055, A028056, A028103, A028140, A028142, A028143
State ADL 22330, 00460, 02397, 00588, 00593, 00594, 02411

Royalty: State's effective rate is 2.06879% from the Kenai Unit. 0% from Kenai Deep.

Purchaser:

	Royalty Price $/Mcf
City of Kenai	0.29
Collier Chemical Corp.	0.18 & 0.61
Phillips-Marathon LNG	0.52
Alaska Pipeline	0.52
Rental Gas (Swanson River Oil Field)	0.16
Chevron Refining	0.52

Date Initial Production: 1-62

Avg. Monthly Production Rate (1980) 6,640,000 Mcf

Cumulative Production to 11/30/80 1,074,081,577 Mcf

Estimated percent produced to 10/31/80 9.9%

State Royalty S
RIV

RIV: Royalty in Value

McARTHUR RIVER FIELD

Statistics relating to this field are shown on the attached table.

Current Status

All Royalty oil produced from this field is taken in kind and sold to Tesoro-Alaska Petroleum Company.

Gas Produced from this field is casinghead gas and was formerly flared. DOGC Flaring Order Number 104 dated June 30, 1971 has prohibited flaring since July 1, 1972, and this gas is now recovered and used locally. This gas is considered to have no value because the costs of extraction, compression, and amortization purportedly exceed its value; therefore, no royalty is paid, but due to the increasing value of this gas the net value should be reevaluated.

Royalty Oil and Gas Status

McArthur River Field

Location: West Side - Cook Inlet (Offshore)

Operator: Union

Leases: ADL 18777, 17579

Royalty: 12.5%

Purchaser:

Tesoro

	Price $/Mcf	Price $/Bbl	
	-	8.97	(as of Nov. 1980)
Date Initial Production:	12-67		
Avg. Monthly Production Rate (to 10/31/80) gas:	571,763 Mcf		State Royalty Sta RIV
Avg. Monthly Production Rate (1980) oil:	1,740,029 Bbls		RIK
Total Production to 10/31/80 (casinghead & dry) gas:	135,835,372 Mcf		
Total Production to 10/31/80 oil:	436,560,176 Bbls		
Estimated percent produced 10/31/80 (gas):	38%		
Estimated percent produced 10/31/80 (oil):	81%		

RIV: Royalty in Value

RIK: Royalty in Kind

GRANITE POINT FIELD

Statistics relating to this field are shown on the attached table.

Current Status

All Royalty oil produced from this field is taken in kind and sold to Tesoro-Alaska Petroleum Company.

Gas produced from this field is casinghead gas and was formerly flared. DOGC Flaring Order Number 194 dated June 30, 1971, has prohibited flaring since July 1, 1972, and this gas is now recovered and used locally. This gas is considered to have no value because the costs of extraction, compression, and amortization purportedly exceed its value; therefore, no royalty is paid, but due to recent increases in the value of this gas there should be a reevaluation of this gas.

Royalty Oil and Gas Status

Granite Point Field

Location: West Side - Cook Inlet (Offshore)

Operator: Amoco

Leases: ADL 17586, 17587, 18742, 18761

Royalty: 12.5%

Purchaser:

		Price $/Mcf	Price $/Bbl
Tesoro			12.00
Amoco Platform	(1)	0.118	
Arco	(1)	0.10	
Union	(1)	0.118	

Date Initial Production: 12-67

		State Royalty Sta
Avg. Monthly Production Rate (1980) gas:	275,736 Mcf	RIV
Avg. Monthly Production Rate (1980) oil:	360,483 Bbls	RIK
Total Production to 10/31/80 (casinghead) gas:	73,546,506 Mcf	
Total Production to 10/31/80 oil:	82,836,316 Bbls	
Estimated percent oil produced to 10/31/80:	82%	

Footnotes: (1) Small amount of casinghead gas sold to Amoco for use on platform, the remainder has a negative value.

RIV: Royalty in Value

RIK: Royalty in Kind

PRUDHOE BAY

Statistics relating to this unit are shown on the attached table.

Current Status

Small quantities of casinghead gas are presently being sold to the owners of the Trans-Alaska Pipeline. The State is receiving royalty in value with the price being set by the owners of the gas cap. They are using the price established by the Natural Gas Policy Act of 1978 as their guideline. There presently isn't any other market. The State's share of sales is 12 1/2%.

The State's royalty share of the oil produced is 12 1/2% with 56.5% of this share presently being taken in kind and sold to North Pole Refinery, Alaska Oil Company, Tesoro, and Chevron. The State has requested that an additional 43.4% of the State's share be taken in kind beginning July 1, 1981, which will go to, in addition to the current purchasers, Golden Valley Electric Association, Shell, Union, Alaska Petroleum, Oasis Petroleum, and Energy Cooperative Incorporated. The remainder will continue to be taken in value which will be fully decontrolled by October 1981.

Royalty Oil and Gas Status

Unit: Prudhoe Bay

Location: Northslope (Onshore)

Operator: Arco-Sohio

Owners: See Attachment

Leases: See Attachment

Royalty: 12.5%

Purchaser:

	Price $/Mcf	Price $/Bbl	
TAPS Owners	1.37		
Topping Plant, Power-plant, & Pump Stations			
Avg. Well Head Price		16.94	(as of Oct 1980)

Date Initial Production: 10-69

		State Royalty St RIV
Avg. Monthly Production Rate (1980) gas:	50,363,142 Mcf	
Avg. Monthly Production Rate (1980) oil:	46,448,708 Bbls	RIV RIK
Total Production to 10/31/80 gas:	1,344,185,727 Mcf	
Total Production to 10/31/80 oil:	1,460,173,383 Bbls	
Estimated percent produced to 10/31/80:	18% oil	
Estimated percent produced to 10/31/80:	9% gas	

RIV: Royalty in Value

RIK: Royalty in Kind

A.1n

OWNERS

Amerada Hess—Amerada Hess Corporation

A.R.Co.—Atlantic Richfield Company

BP Alaska—BP Alaska Exploration Inc.

Chevron—Chevron U.S.A., Inc.

Exxon—Exxon Corporation

Getty—Getty Oil Company

Hunt Ind.—Hunt Industries

Caroline Hunt Tr.—Caroline Hunt Trust Estate

Lamar Hunt Tr. Est.—Lamar Hunt Trust Estate

N. B. Hunt—N. B. Hunt

Wm. Herbert Hunt Tr.—William Herbert Hunt Trust Estate

LL&E—The Louisiana Land and Exploration Company

Marathon—Marathon Oil Company

Mobil—Mobil Oil Corporation

Phillips—Phillips Petroleum Company

Placid—Placid Oil Company

Sohio—Sohio Petroleum Company

Tract No.	Description	No. of Acres	ADL Serial No.	Basic Royalty	Lessee of Record	O.R.R. Interest	Working Interest Ownership
	(Umiat Meridian, Alaska)						
22A	T12N-R12E, SW/4 Sec. 26	160	28257	1/8	Mobil, Phillips, Chevron		Mobil—33⅓% Phillips—33⅓% Chevron—33⅓%
23	T12N-R13E, Secs. 29, 30, 31, 32	2,459	28279	1/8	Sohio Petroleum Co.	•	Sohio—100%
24	T12N-R13E, Secs. 27, 28, 33, 34	2,560	28278	1/8	Sohio Petroleum Co.	•	Sohio—100%
25	T12N-R13E, Secs. 26, 35, 36	1,920	28277	1/8	Sohio Petroleum Co.	•	Sohio—100%
26	T12N-R14E, Secs. 29, 31, 32	1,871	28299	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
27	T12N-R14E, Secs. 27, 28, 33, 34	2,560	28300	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
28	T12N-R14E, Secs. 25, 26, 35, 36	2,560	28301	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
29	T12N-R15E, Secs. 29, 30, 31, 32	2,459	34628	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
30	T12N-R15E, Secs. 27, 28, 33, 34	2,560	34629	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
31	T12N-R15E, Secs. 25, 26, 35, 36	2,560	34630	1/8	Sohio Petroleum Co.	•	Sohio—100%
32	T12N-R16E, Secs. 29, 30, 31, 32	2,459	34635	1/8	Sohio Petroleum Co.	•	Sohio—100%
33	T12N-R16E, Secs. 27, 28, 33, 34	2,560	34634	1/8	Sohio Petroleum Co.	•	Sohio—100%
34	T12N-R16E, Secs. 25, 26, 35, 36	2,560	34633	1/8	Sohio Petroleum Co.	•	Sohio—100%
35	T11N-R16E, Secs. 1, 2, 11, 12	2,560	34636	1/8	Sohio Petroleum Co.	•	Sohio—100%
36	T11N-R16E, Secs. 3, 4, 9, 10	2,560	28337	1/8	Sohio Petroleum Co.	•	Sohio—100%
37	T11N-R16E, Secs. 5, 6, 7, 8	2,469	28338	1/8	Sohio Petroleum Co.	•	Sohio—100%
38	T11N-R15E, Secs. 1, 2, 11, 12	2,560	28320	1/8	Sohio Petroleum Co.	•	Sohio—100%
39	T11N-R15E, Secs. 3, 4, 9, 10	2,560	34631	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
40	T11N-R15E, Secs. 5, 6, 7, 8	2,469	34632	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
41	T11N-R14E, Secs. 1, 2, 11, 12	2,560	28302	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
42	T11N-R14E, Secs. 3, 4, 9, 10	2,560	28303	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
43	T11N-R14E, Secs. 5, 6, 7, 8	2,469	28304	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
44	T11N-R13E, Secs. 1, 2, 11, 12	2,560	28280	1/8	Sohio Petroleum Co.	•	Sohio—100%
45	T11N-R13E, Secs. 3, 4, 9, 10	2,560	28281	1/8	Sohio Petroleum Co.	•	Sohio—100%
46	T11N-R13E, Secs. 5, 6, 7, 8	2,469	28282	1/8	Sohio Petroleum Co.	•	Sohio—100%
47	T11N-R12E, Secs. 1, 2, 11, 12	2,560	28260	1/8	Sohio Petroleum Co.	•	Sohio—100%
48	T11N-R12E, Secs. 3, 4, 9, 10	2,560	28261	1/8	Mobil and Phillips		Mobil—50% Phillips—50%
49	T11N-R12E, Secs. 5, 6, 7, 8	2,469	47450	1/8	Mobil, Phillips, Chevron		Mobil—33⅓% Phillips—33⅓% Chevron—33⅓%
50	T11N-R11E, Secs. 1, 2, 11, 12	2,560	28240	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
51	T11N-R11E, Secs. 4, 9, 10, N/2 and SW/4 Sec. 3	2,400	28241	1/8	Mobil and Phillips		Mobil—50% Phillips—50%
51A	T11N-R11E, SE/4 Sec. 3	160	28241	1/8	Mobil, Phillips, Chevron		Mobil—33⅓% Phillips—33⅓% Chevron—33⅓%

LEASES

	Description (Umiat Meridian, Alaska)	No. of Acres	ADL Serial No.	Basic Royalty	Lessee of Record	O.R.R. Interest	Working Interest Ownership
	T12N-R11E, Secs. 9, 10	1,280	47445	1/8	Mobil and Chevron		Mobil—50% Chevron—50%
	T12N-R11E, Secs. 11, 12	1,280	28235	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
	T12N-R12E, Sec. 7	580	28254	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
	T12N-R15E, Sec. 23, 24	1,280	34625	1/8	Sohio Petroleum Co.	*	Sohio—100%
5	T12N-R15E, Secs. 21, 22	1,280	34626	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
6	T12N-R15E, Secs. 19, 20	1,225	34627	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
7	T12N-R14E, Secs. 23, 24	1,280	34624	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
8	T12N-R14E, Sec. 22	610	28297	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
9	T12N-R13E, Sec. 19	585	47469	1/8	Mobil and Phillips		Mobil—50% Phillips—50%
10	T12N-R12E, Secs. 23, 24	1,280	47448	1/8	Mobil and Phillips		Mobil—66⅔% Phillips—33⅓%
11	T12N-R12E, Secs. 21, 22	1,280	28256	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
12	T12N-R12E, Secs. 17, 18, 19, 20	2,448	28255	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
13	T12N-R11E, Secs. 13, 14, 23, 24	2,560	28237	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
14	T12N-R11E, Secs. 15, 16, 21, 22	2,560	47447	1/8	Mobil and Chevron		Mobil—50% Chevron—50%
15	T12N-R11E, Secs. 17, 18, 19, 20	2,448	47446	1/8	Mobil and Chevron		Mobil—50% Chevron—50%
16	T12N-R10E, Secs. 13, 24	1,280	25637	1/8	A.R.Co., BP Alaska, Sohio Petroleum Co.		A.R.Co.—50% BP Alaska—37½% Sohio—12½%
17	T12N-R11E, Secs. 29, 30, 32	1,568	47449	1/8	Mobil and Chevron		Mobil—50% Chevron—50%
18	T12N-R11E, Secs. 27, 28, 33, 34	2,560	28239	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
19	T12N-R11E, Secs. 25, 26, 35, 36	2,560	28238	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
20	T12N-R12E, Secs. 29, 30, 31, 32	2,459	28259	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
21	T12N-R12E, Secs. 27, 28, 33, 34	2,560	28258	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
22	T12N-R12E, Secs. 25, 35, 36, N/2 and SE/4 Sec. 26	2,400	28257	1/8	Mobil and Phillips		Mobil—50% Phillips—50%

*See comment on page A-5.

Tract No.	Description	No. of Acres	ADL Serial No.	Basic Royalty	Lessee of Record	O.R.R. Interest	Working Interest Ownership
	(Umiat Meridian, Alaska)						
52	T11N-R11E, Sec. 15	640	28244	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
53	T11N-R11E, Secs. 13, 14, 24	1,920	28245	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
54	T11N-R12E, Secs. 17, 18, 19	1,840	28262	1/8	Chevron		Chevron—100%
54A	T11N-R12E, Sec. 20	640	28262	1/8	Chevron, Mobil, Phillips		Chevron—33⅓% Mobil—33⅓% Phillips—33⅓%
55	T11N-R12E, Secs. 15, 16	1,280	28263	1/8	Mobil and Phillips		Mobil—50% Phillips—50%
55A	T11N-R12E, Secs. 21, 22	1,280	28263	1/8	Mobil, Phillips, Chevron		Mobil—33⅓% Phillips—33⅓% Chevron—33⅓%
56	T11N-R12E, Secs. 13, 14, 23, 24	2,560	47451	1/8	Mobil, Phillips, Chevron		Mobil—33⅓% Phillips—33⅓% Chevron—33⅓%
57	T11N-R13E, Secs. 17, 18, 19, 20	2,480	28283	1/8	Sohio Petroleum Co.	•	Sohio—100%
58	T11N-R13E, Secs. 15, 16, 21, 22	2,560	28284	1/8	Sohio Petroleum Co.	•	Sohio—100%
59	T11N-R13E, Secs. 13, 14, 23, 24	2,560	28285	1/8	Sohio Petroleum Co.	•	Sohio—100%
60	T11N-R14E, Secs. 17, 18, 19, 20	2,480	28305	1/8	Sohio Petroleum Co.	•	Sohio—100%
61	T11N-R14E, Secs. 15, 16, 21, 22	2,560	28306	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
62	T11N-R14E, Secs. 13, 14, 23, 24	2,560	28307	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
63	T11N-R15E, Secs. 17, 18, 19, 20	2,480	28321	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
64	T11N-R15E, Secs. 15, 16, 21, 22	2,560	28322	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
65	T11N-R15E, Secs. 13, 14, 23, 24	2,560	28323	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
66	T11N-R16E, Secs. 17, 18, 19	1,840	28339	1/8	Sohio Petroleum Co.	•	Sohio—100%
67	T11N-R16E, Secs. 15, 16	1,280	28340	1/8	Sohio Petroleum Co.	•	Sohio—100%
68	T11N-R16E, Secs. 13, 14	1,280	28341	1/8	Sohio Petroleum Co.	•	Sohio—100%
69	T11N-R16E, Secs. 30, 31, 32	1,851	28343	1/8	Sohio Petroleum Co.	•	Sohio—100%
70	T11N-R15E, Secs. 25, 26, 35, 36	2,560	28324	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
71	T11N-R15E, Secs. 27, 28, 33, 34	2,560	28325	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
72	T11N-R15E, Secs. 29, 30, 31, 32	2,491	28326	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
73	T11N-R14E, Secs. 25, 26, 35, 36	2,560	28308	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
74	T11N-R14E, Secs. 27, 28, 33, 34	2,560	28309	1/8	Sohio Petroleum Co.	•	Sohio—100%
75	T11N-R14E, Secs. 29, 30, 31, 32	2,491	28310	1/8	Sohio Petroleum Co.	•	Sohio—100%
76	T11N-R13E, Secs. 25, 26, 35, 36	2,560	28286	1/8	Sohio Petroleum Co.	•	Sohio—100%
77	T11N-R13E, Secs. 27, 28, 33, 34	2,560	28287	1/8	Sohio Petroleum Co.	•	Sohio—100%
78	T11N-R13E, Secs. 29, 30, 31, 32	2,491	28288	1/8	Mobil and Phillips		Mobil—50% Phillips—50%
79	T11N-R12E, Secs. 25, 26, 35, 36	2,560	28264	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%

*See comment on page A-5.

Tract No.	Description	No. of Acres	ADL Serial No.	Basic Royalty	Lessee of Record	O.R.R. Interest	Working Interest Ownership
	(Umiat Meridian, Alaska)						
80	T11N-R12E, Secs. 27, 28, 33, 34	2,560	47452	1/8	Mobil, Phillips, Chevron		Mobil—33⅓% Phillips—33⅓% Chevron—33⅓%
81	T11N-R12E, Secs. 29, 30, 31, 32	2,491	47453	1/8	Mobil, Phillips, Chevron		Mobil—33⅓% Phillips—33⅓% Chevron—33⅓%
82	T11N-R11E, Sec. 25	640	28246	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
83	T10N-R12E, Secs. 3, 4, 10	1,920	47454	1/8	Mobil, Phillips, Chevron		Mobil—33⅓% Phillips—33⅓% Chevron—33⅓%
84	T10N-R12E, Secs. 1, 2, 11, 12	2,560	28265	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
85	T10N-R13E, Secs. 6, 7, 8, S/2 and NE/4 Sec. 5	2,341	28289	1/8	Mobil and Phillips		Mobil—50% Phillips—50%
85A	T10N-R13E, NW/4 Sec. 5	160	28289	1/8	Mobil, Phillips, Chevron		Mobil—33⅓% Phillips—33⅓% Chevron—33⅓%
86	T10N-R13E, Secs. 3, 4, 9, 10	2,560	47471	1/8	Amerada Hess, et. al.		Amerada Hess—27% Getty—30.5% LL&E—13.25% Placid—9.125% N. B. Hunt—6.3625% Hunt Ind.—3.8625% Caroline Hunt Tr.—3.3% Wm. Herbert Hunt Tr.—3.3% Lamar Hunt Tr. Est.—3.3%
87	T10N-R13E, Secs. 1, 2, 11, 12	2,560	47472	1/8	Amerada Hess and Getty		Amerada Hess—50% Getty—50%
88	T10N-R14E, Secs. 5, 6, 7, 8	2,501	28313	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
89	T10N-R14E, Secs. 3, 4, 9, 10	2,560	28312	1/8	Sohio Petroleum Co.		Sohio—100%
90	T10N-R14E, Secs. 1, 2, 11, 12	2,560	28311	1/8	Sohio Petroleum Co.		Sohio—100%
91	T10N-R15E, Secs. 5, 6, 7, 8	2,501	28329	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
92	T10N-R15E, Secs. 3, 4, 9, 10	2,560	28328	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
93	T10N-R15E, Secs. 1, 2, 11, 12	2,560	28327	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
94	T10N-R16E, Secs. 5, 6, 7, 8	2,501	28345	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
95	T10N-R16E, Secs. 4, 9	1,280	28344	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
96	T10N-R16E, Sec. 16	640	28347	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%

*See comment on page A-5.

Tract No.	Description	No. of Acres	ADL Serial No.	Basic Royalty	Lessee of Record	O.R.R. Interest	Working Interest Ownership
	(Umiat Meridian, Alaska)						
97	T10N-R16E, Secs. 17, 18, 19, 20	2,512	28346	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
98	T10N-R15E, Secs. 13, 14, 23, 24	2,560	28332	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
99	T10N-R15E, Secs. 15, 16, 21, 22	2,560	28331	1/8	Sohio Petroleum Co.	*	Sohio—100%
100	T10N-R15E, Secs. 17, 18, 19, 20	2,512	28330	1/8	Sohio Petroleum Co.	*	Sohio—100%
101	T10N-R14E, Secs. 13, 14, 23, 24	2,560	28315	1/8	Sohio Petroleum Co.	*	Sohio—100%
102	T10N-R14E, Secs. 15, 16, 21, 22	2,560	28314	1/8	Mobil and Phillips		Mobil—50% Phillips—50%
103	T10N-R14E, Secs. 17, 18, 19, 20	2,512	47475	1/8	Amerada Hess, et. al.		Amerada Hess—25% Getty—25% Marathon—25% Placid—7.5% N. B. Hunt—5% Hunt Ind.—3.125% Caroline Hunt Tr.—3.125% Wm. Herbert Hunt Tr.—3.125% Lamar Hunt Tr. Est.—3.125%
104	T10N-R13E, Secs. 13, 14, 24	1,920	47476	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
105	T10N-R13E, Secs. 15, 16	1,280	28290	1/8	Mobil and Phillips		Mobil—50% Phillips—50%
106	T10N-R14E, Secs. 27, 28	1,280	47482**	1/8	A.R.Co. and Exxon		A.R.Co.—50% Exxon—50%
107	T10N-R14E, Secs. 26, 36	1,280	28316	1/8	Chevron		Chevron—100%
107A	T10N-R14E, Sec. 25	640	28316	1/8	Chevron, Mobil, Phillips		Chevron—33⅓% Mobil—33⅓% Phillips—33⅓%
108	T10N-R15E, Secs. 29, 30, 31, 32	2,523	28335	1/8	Sohio Petroleum Co.		Sohio—100%
109	T10N-R15E, Secs. 33, 34	1,280	28334	1/8	Mobil and Phillips		Mobil—50% Phillips—50%
109A	T10N-R15E, Secs. 27, 28	1,280	28334	1/8	Mobil, Phillips, Chevron		Mobil—33⅓% Phillips—33⅓% Chevron—33⅓%
110	T10N-R15E, Secs. 25, 26, 35, 36	2,560	28333	1/8	Sohio Petroleum Co.		Sohio—100%
111	T10N-R16E, Secs. 29, 30, 31	1,883	28349	1/8	Sohio Petroleum Co.		Sohio—100%
		245,767					

*BP Alaska, Inc. owns an overriding royalty interest equal to 75% of all net profits from production between certain levels of oil production.

**This Tract Number 106 was assigned to A.R.Co. and Exxon. Upon approval of the assignment by the Director a new ADL Serial No. will be given to this Tract.

NICOLAI CREEK

Statistics relating to this unit are shown on the attached table.

Current Status

Gas from this small field, when produced, is used only to provide fuel for platform and shore facilities supporting petroleum production in this area. However, at the present time there is no production. There is no prospective purchaser for the State's royalty share.

Royalty Oil and Gas Status

Unit: Nicolai Creek

Location: West Side - Cook Inlet (Onshore-Offshore)

Operator: Texaco

Owners: Texaco, Superior

Leases: Fed. A034161, ADL 17585, 17598

Royalty: 12.5%

Purchaser:

	Royalty Price $/Mcf	State Royalty Stat
Amoco (1)		
Date Initial Production:	10-68	
Avg. Monthly Production Rate (1980) gas:	-0- Mcf	RIV
Total Production to 10/31/80 (dry gas):	1,062,055 Mcf	

Footnotes: (1) Shut-in

RIV: Royalty in Value

NORTH COOK INLET

Statistics relating to this field are shown on the attached table.

Current Status

Gas from this offshore field is primarily delivered to the Phillips LNG plant and the products are subsequently sold in Japan. However, in 1977, the State entered into agreements with Phillips and Alaska Pipeline Company to sell the royalty share to Alaska Pipeline Company for delivery to the Alaska market. Royalty gas in excess of purchases by Alaska Pipeline Company is purchased by Phillips.

Royalty Oil and Gas Status

Unit: North Cook Inlet

Location: North Cook Inlet

Operator: Phillips

Owners: Phillips, Chevron

Leases: ADL 17590, 18741, 37831, 18740, 17589

Royalty: 12.5%

Purchaser:	Royalty Price $/Mcf		State Royalty Sta!
Alaska Pipeline	1.90	(RIK; as of Nov 1980)	RIK
Phillips	2.0469	(RIV; as of Jan 1981)	RIV

Date Initial Production: 3-69

Avg. Monthly Production Rate (1980) gas: 2,955,896 Mcf

Total Production to 10/31/80 (dry gas): 490,487,024 Mcf

Estimated percent produced to 10/31/80: 18.6%

Comments: Contracts completed 1977 to take in kind for sale to Alaska Pipeline Company.

RIK: Royalty in Kind

RIV: Royalty in Value

STERLING

Statistics relating to this field are shown on the attached table.

Current Status

This is a small field in Kenai Peninsula. Since Federal leases are involved, the State's royalty share is approximately 1.6% due to the recent land conveyance to CIRI. The only gas sold from this field is consumed locally. There is no gas pipeline currently available to deliver this gas from this field to any other market. Because of limited reserves, there is no prospect of additional markets.

Royalty Oil and Gas Status

Unit: Sterling

Location: Kenai Peninsula (Onshore)

Operator: Union

Owners: Union, Marathon

Leases: Fed. A028135, A028063, ADL 01836, 02497, 00479-A

Royalty: 12.5% (1)

Purchaser:	Royalty Price $/Mcf	State Royalty Sta RIV
Sport Lake Greenhouse	0.40	

Date Initial Production: 5-62

Avg. Monthly Production Rate (11/30/80) gas: 2,000 Mcf

Total Production to 10/31/80 (dry gas): 1,979,777 Mcf

Estimated percent produced to 10/31/80: 8.1%

Footnotes: (1) A portion of Unit is owned by Federal government and CIRI. The State's effective rate is 1.55461%.

RIV: Royalty in Value

BELUGA RIVER

Statistics relating to this field are shown on the attached table.

Current Status

This operating unit is located on the North-West side of the Cook Inlet. Chugach Electric is the only current purchaser of this gas. Their contract price is as stated and results in the royalty "in value" price. It is understood that Pacific Alaska LNG has contracted to purchase gas from this field in the future.

Chugach Electric uses this gas for power generation which is delivered to the Anchorage market.

There is no gas pipeline currently available to deliver gas from this field to any other market.

There is no current purchaser for the State's royalty, and due to the majority of Federal leases the State's share is 7.55% which was reduced due to a reallocation of the royalty ownership. The reallocation was due to changing the ownership from surface acre to reservoir percentage.

Royalty Oil and Gas Status

Unit: Beluga River

Location: West Side - Cook Inlet (Onshore)

Operator: Chevron

Owners: Chevron, Arco, Shell

Leases: Fed. AO29656, AO29657, ADL 17658, 17592, 17599, 21128, 21127, 21129, 21126

Royalty: 12.5% (1)

Purchaser:	Royalty Price $/Mcf
Chugach Electric	.1974

Date Initial Production: 1-68

Avg. Monthly Production Rate (11/30/80) gas: 1,350,000 Mcf

Total Production to 10/31/80 (dry gas): 104,006,863 Mcf

Estimated percent produced to 9/30/79: 10.9%

State Royalty Sta
RIV

Footnotes: (1) Federal leases involved. State's effective royalty rate is 7.55%

RIV: Royalty in Value

MIDDLE GROUND SHOALS FIELD

Statistics relating to this field are shown on the attached table.

Current Status

All Royalty oil produced from this field is taken in kind and sold to Tesoro-Alaska Petroleum Company.

Gas produced for this field is casinghead gas and was formerly flared. DOGC Flaring Order Number 104 dated June 30, 1971, has prohibited flaring since July 1, 1972, and this gas is now recovered and used locally. This gas is considered to have no value because the costs of extraction, compression, and amortization purportedly exceed its value; therefore, no royalty is paid.

Recent increases in gas prices are now becoming high enough to cause the State to take another look.

Royalty Oil and Gas Status

Middle Ground Shoals Oil Field

Location: East Side - Cook Inlet (Offshore)

Operator: Shell & Amoco

Leases: ADL 17595, 18754, 18756, 18744, 18746

Royalty: 12.5%

Purchaser: Tesoro

	Price $/Mcf	Price $/Bbl	
	-	10.77	(as of Nov. 1980)
Date Initial Production:	9-67		
Avg. Monthly Production Rate (10/31/80) gas:	220,349 Mcf		State Royalty Stat RIV
Avg. Monthly Production Rate (10/31/80) oil:	400,788 Bbls		
Total Production 10/31/80 (casinghead gas):	62,430,236 Mcf		
Total Production 10/31/80 oil:	128,696,691 Bbls		
Estimated percent produced to 9/30/79 oil:	68%		

RIV: Royalty in Value

APPENDIX B

FUEL CONSUMPTION FORECASTS

APPENDIX B

FUEL CONSUMPTION FORECASTS

B.1 COOK INLET RESIDENTIAL NATURAL GAS

Consumption of natural gas by residential consumers is limited to the Cook Inlet area, primarily those areas served by the Kenai Utility Service Corporation and Alaska Gas and Service Company. For the purpose of constructing a forecast, two methods were used and checked against each other: econometric, single-equation techniques using historical data to estimate the relationship between residential consumption and several explanatory variables; and end use techniques adapted from Battelle-Northwest's RED (Railbelt Electricity Demand) electric power forecasting model using cost of power derived by a companion model called the Alaska Railbelt Electric Energy Planning (AREEP) model. The RED model relies on an end-use survey of Railbelt electric power customers to determine the initial 1981 appliance stock and fuel mode split for each major appliance using gas or fuel oil. The RED model forecast was adjusted using price elasticities derived from a national study of fuel substitution in the residential sector.

Consumption data regarding annual rates, number of customers, revenues and hence average prices are available from annual reports filed with the Alaska Public Utilities Commission. The econometric analysis study relied in part upon data from the Gas Facts report published annually by the American Gas Association. A comparison of several years of data from Gas Facts with the annual APUC filings show this data to be reliable. It also detailed sales, number of customers and average price. Sufficient data was available to construct a 16-year series on gas consumption from 1964 to 1979.

Other data used in the econometric analysis were heating degree days, the Anchorage consumer price index, resident population and total personal income. The gas price and income data were adjusted to real terms with the CPI. Several model specifications were attempted, with the most satisfactory

being consumption specified as a function of population and real price. The equation estimated for the forecasts is:

$$\begin{array}{lcccc} \text{TBtu Consumption} = & 4.325 & + 0.02722 \times \text{Population} & - 3.979 \times \text{Price} \\ \text{(t-statistics)} & (1.90) & (3.88) & (-4.07) \end{array}$$

$$\text{adjusted } R^2 = 98.3$$

The coefficients are both significant at the 0.05 level. The population coefficient shows the change in Trillion Btu (TBtu) consumption per 1,000 people. The price coefficient relates the TBtu decrease in consumption per constant dollar per MMBtu, so a one dollar per MMBtu increase in price will reduce gas consumption by 3.979 TBtu.

All of the independent variables except the heating degree day variable were highly correlated, which helps to explain why equations containing, say population and income, were less satisfactory. The heating degree day variable was not significant in any equation tried.

The end-use forecast was derived using a three-stage technique. First, the number of appliances of each housing type i and appliance type j was estimated by the RED model for each economic and population growth scenario in each forecast year by multiplying the 1981 saturation rate for each type household and appliance times the number of households:

$$\text{No. of Appliance}_{ij} = \text{No. of Households}_i \times \text{Appliance Saturation}_{i,j}$$

Next, the 1981 fuel mode split is multiplied times the number of appliances of each type in each load center, times the estimated 1981 use of gas for the existing stock, and adjusted use rates for new appliances added between 1981 and 2000. This gives the first round (unadjusted) forecast of gas use:

$$\text{Unadjusted Forecast}_{i,j} = \text{No. of Appliances}_{i,j} \times \text{Fuel Mode Split}_{i,j}$$

This unadjusted forecast is then added together for all gas-using appliances and adjusted for price effects. The price effects are derived in three stages. First, weighted elasticities were derived from the own-price elasticity for gas use in each type of appliance and the cross-price elasticities of oil and electricity on the consumption of gas in each type of appliance. The unweighted elasticities were available from a national study by M.L. Baughman and P.L. Joskow, Interfuel Substitution of Energy in the United States,[a] and the weights were numbers of each type of appliance forecast by the RED model. Next, weighted price effects were derived by multiplying the percentage growth or decline in each fuel's price in Cook Inlet, from 1980 to the forecast year, by its corresponding weighted elasticity. The three price effects were then added together to give the percentage increase or decrease in consumption from 1980 conditions for a given expansion in the housing stock and a given set of price scenarios (P_t). The percentage price adjustment was multiplied times each five year increase or decrease in the unadjusted forecast and then accumulated to produce a price-adjusted forecast:

$$\text{Price-Adjusted Forecast}_t = (\text{Unadjusted Forecast}_t - \text{Unadjusted Forecast}_{t-5}) \times (1 + P_t) + \text{Price-Adjusted Forecast}_{t-5}$$

Of the two techniques we judged the end-use technique to be the more accurate, so it was used to produce the forecasts in the text. The high range forecast assumes 7% inflation, 3% annual real price growth for oil, and about 2.8% real annual increase in electricity prices computed by the RED/AREEP models. The low range forecast assumes 0% inflation, 1% real oil price escalation and about 2.8% real annual increases in electricity prices, again computed by the RED/AREEP models. The medium (most likely) case assumes 7% inflation, 2% real oil price escalation, and 2.8% real electricity price escalation. The general

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(a) As reported in Attachment B, Table 3 of National Economic Research Associates, Considerations of the Price Elasticity of Demand for Electricity, Topic 2 Electric Utility Rate Design Study, 11-NERA-2, Electric Power Research Institute, January 31, 1977.

rate of inflation is important to the forecast because utility gas is sold on long term contracts with escalator clauses. For Cook Inlet, a 7% rate of inflation gives an average real escalation rate for gas of 4.3%; at zero percent, real escalation is 11.3% per annum.

B.2 COOK INLET COMMERCIAL/INDUSTRIAL NATURAL GAS

Two techniques were again used to derive the commercial/industrial forecast. The first technique tried was econometric, the second was a price-adjusted end-use forecast. The same data sources are used as to provide the data base for the commercial and light industrial users in the Cook Inlet region. Equations were tried using employment, heating degree days and real gas price. Again, heating degree days did not enter into the equation as significant. The equation fitted is:

$$\begin{array}{lcccc} \text{TBtu Consumption} = & 0.357 & + 0.09382 \times \text{Employment} & - 1.989 \times \text{Price} \\ \text{(t-statistics)} & (0.32) & (10.54) & (-2.96) \end{array}$$

$$\text{adjusted } R^2 = 98.0$$

The coefficients for employment and real price are significant at the 0.05 significance level. The employment coefficient relates the change in TBtu consumption per 1,000 employees and the price coefficient is per dollar per MMBtu.

The end use forecast for the commercial/industrial sector was similar to that for residential demand, with the following differences. First, there was only a single "end use" assumed for gas--the space conditioning, process heat, and water heat for the estimated commercial building stock (including civilian government). Second, the price elasticities are different. They were derived from data in Kraft, Kraft, and Reiser, "A National Energy Demand Simulation Model," in A.B. Askin and J. Kraft, Econometric Dimensions of Energy Demand and Supply, Lexington, 1976. Finally, the year-to-year price changes for gas and electricity are slightly different because of the differences in pricing of these two regulated energy sources between the residential and commercial

sector. The price forecasts were produced in the RED/AREEP model runs used for the forecast of the residential sector and are consistent.

The end-use forecast was again judged the more accurate, and was used in the text forecasts.

B.3 FAIRBANKS RESIDENTIAL NATURAL GAS

Only end-use techniques were used in Fairbanks because of the introduction of gas between 1985 and 1990. In all cases, gas is considerably cheaper than oil on a Btu basis because of the conditions applying to the ANGTS pipeline tariff and the likely competitive conditions for gas in the Lower 48 markets. In the middle and low cases, gas is assumed to displace all incremental 1985-2000 oil consumption estimated before price adjustments. The difference between cases occurs because residential energy is cheaper in the high case, so more gas is consumed. In the high case, all residential oil demand is replaced by gas within the 1985-95 time frame.

B.4 FAIRBANKS COMMERCIAL/INDUSTRIAL NATURAL GAS

Only end use techniques were used in Fairbanks. The same basic assumptions were made for commerical/industrial gas as for residential, allowing for differences in end use, price changes, and price elasticities.

B.5 COOK INLET RESIDENTIAL FUEL OIL

An end use technique identical to the one used for natural gas was employed to estimate future demand for fuel oil in Anchorage's residential sector. The only difference is that the residential weighted own-price and cross-price elasticities used are different for oil than for gas because of the different fuel mode splits for oil and the more restricted choice of appliances (no cooking ranges or clothes dryers are oil-fired). An interesting outcome from the price effects is that since oil and natural gas are substitutes, the conditions which lead to highest gas consumption (seven percent inflation, 3% real oil escalation) reduce the consumption of oil. Thus, highest case oil and natural gas consumption cannot happen simultaneously; nor can lowest. Medium consumption of both is possible.

B.6 COOK INLET COMMERCIAL FUEL OIL

An end use technique identical to those used for natural gas in Anchorage was used for fuel oil. The differences are in the weighted price effects and initial fuel mode split for the commercial sector. The same conditions apply in commercial fuel substitution as in residential fuel substitution--neither highest nor lowest gas and oil consumption can take place simultaneously for both oil and gas.

B.7 FAIRBANKS RESIDENTIAL FUEL OIL

An end use technique identical to that for gas was used, with the exception that the highest case oil consumption does not involve the displacement of existing natural gas uses after 1985. In the lowest demand case, fuel oil is completely displaced by gas by 1995.

B.8 FAIRBANKS COMMERCIAL FUEL OIL

An end use technique identical to that used to forecast natural gas use was employed, subject to the same conditions as in residential fuel oil demand.

B.9 GLENNALLEN-VALDEZ RESIDENTIAL AND COMMERCIAL FUEL OIL

End use techniques were used here in the same fashion as in Anchorage and Fairbanks. The differences were: 1) fuel mode splits in the residential and commercial sector were different from those in Anchorage and Fairbanks; 2) natural gas was assumed not to be available. Instead, propane was used as the "gas" fuel in the residential forecasts; and 3) unadjusted commercial sector forecasts were based on employment rather than building stock.

B.10 RAILBELT RESIDENTIAL AND COMMERCIAL LPG

The Battelle-Northwest 1981 Railbelt residential end use survey revealed that only very small amounts of LPG (exclusively propane) are used by the Railbelt residential sector. An end-use unadjusted forecast was done with the

RED model for each subregion based on 1981 fuel mode splits, which were then added together. The commercial sector was assumed to use no LPG, although small amounts of such use undoubtedly exist. This is not expected to affect the overall forecast results.

B.11 RAILBELT UTILITY NATURAL GAS AND FUEL OIL

The RED/AREEP models produce estimates of electrical generation by type of generation technology for the forecast years. Total energy generated was multiplied by heat rates for the generation technologies selected by the AREEP model to meet the RED electric load forecast. Combustion turbines were assumed to operate at 15,000 Btu/kWh, while combined cycle plants were assumed to operate at 8,500 Btu/kWh. This may be slightly optimistic for the year 1985, as the current system-wide average heat rates on combustion turbines seems to be around 15,000 Btu/kWh, and older units are higher. This forecast of total primary energy input is then converted to physical units using standard heat content assumptions: 1.020 MMBtu/Mcf for gas and 5.825 MMBtu/Bbl for distillate fuel oil.

The impact of the Susitna Project on total gas demand is to reduce gas consumption by about 30% in the middle case. In the high case, there is sufficient electrical demand to cause the AREEP model to schedule new coal-fired base load capacity in both Cook Inlet and Fairbanks regions. This results in much reduced gas demand in the high case, compared to what it otherwise would be.

B.12 SOUTHEAST AND REST-OF-STATE UTILITY FUEL OIL

The estimates of electricity generation and fuel oil consumption are done on a per capita basis and then aggregated back to the region using the population forecasts. First, the trends in per capita electricity generation for the two regions are examined and a trend for future generation is inferred. The two scenarios regarding hydroelectric development are then applied to these figures to develop per capita estimates of electricity generated by fuel oil. Third, the past conversion efficiency, i.e., oil to

electricity for the two regions, is used in order to develop a relationship for future oil consumption to generate electricity. Finally, the per capita oil generation estimate for each time period is multiplied by the population forecast to obtain total fuel oil consumption for electricity generation. These steps are explained in more detail below.

The past trends electric energy generation are examined to develop an estimate of a future trend and the base numbers from which to begin. The electricity generated in past periods was put on a per capita basis to determine if a trend existed in the level of individual consumption. The data available for the decade for the 1960's was not available at the regional level, but per capita generation for the entire state increased at a rate of about 7% per year. In the 1970's the rate of increase at the state level fell to about 6% per year. Differences in per capita electricity generation in Mwh from 1971 to 1980 and the rates of increase for the three regions are as follows:

	Railbelt	Southeast	Rest-of-State
1971	5.17	5.69	1.67
1980	9.20	6.79	3.06
Annual Rate of Increase	6.6%	2.0%	7.0%

The 1980 estimates of per capita generation are used as the base for the forecasts. It is assumed that per capita generation in the Southeast will continue at a rate of 2% per year. This provides an estimated per capita generation of 10.09 Mwh in the year 2000. The rate of increase for the Rest-of-State area is reduced to 5% per year. This provides a per capita electricity generation level of 8.12 Mwh in 2000.

The two hydroelectric scenarios are then developed in order to obtain estimates of fuel oil consumed for electricity generation. The scenario without substantial additions of hydroelectric capacity assumes that the share of electricity generated by fuel oil is consistent with this share in the

past. In the Southeast, the share of oil generated electricity rose from about 21% in 1971 to a high of about 36% in 1973 and fell back to about 21% in 1980. This study assumes a share of 25% over the forecast period for the Southeast. Thus, over the forecast period in the Southeast, 1.70 Mwh per capita of consumption in 1980 is assumed to be generated by oil and this increases to 2.52 Mwh per capita by 2000. The share of oil fired consumption for the Rest-of-State area began at about 99% in 1971, increased to 100% through 1975 and fell to 93% by 1980. The assumed share of oil fired capacity without substantial hydroelectric development is 95%.

The operating efficiencies of the oil fired capacity were examined for the two regions. It was determined that during the 1970's an average of 80 gallons of fuel oil were consumed for every Mwh of electricity produced. This consumption figure, applied to the per capita generation provides the estimated per capita fuel oil consumed to generate electricity. So, in 1970 an estimated 136 gallons of fuel oil were consumed per capita for electricity generation and this increases to an estimated 202 gallons by the year 2000. For the Rest-of-State, the estimated consumption of fuel oil per Mwh electricity is 85 gallons.

The total fuel oil consumed for electricity generation is calculated by multiplying the per capita fuel oil estimate determined above by the forecasted population. The calculations discussed above are done for each year of the forecast period for the three population and economic growth scenarios with the scenario assuming no major hydroelectric development. For the case of substantial hydroelectric development, the calculations are carried out only for the mid level population and economic growth assumptions.

The hydroelectric projects assumed for development were taken from FCCSSB 26.[a] A conversation with an official from the Division of Energy and Power Development provided the likely capacity of the projects listed in the act and eliminated several as to the likelihood of being constructed within the near future. These projects and their respective capacity for the Southeast and Rest-of-State regions are as follows:

(a) Alaska State Legislature, FCCSB 26, Chapter No. 90, August 4, 1981.

Project Name	MW Installed Capacity	Expected MWh Average Annual Energy
Southeast		
Green Lake	13.5	65
Swan Lake	18.0	85
Tyee Lake	30.0	131
Black Bear Lake	5.0	22
West Creek	21.0	150
		453
Rest-of-State		
Port Lions	1.0	4
Terror Lake	20.0	125
Tazimina	51.0	224
		353

These projects were assumed to come on line in 1985 and were subtracted from the quantity of oil generated electricity calculated above. The remainder is then assumed to be generated by oil. This produced estimates of total oil fired electricity generation over the forecast period of 659 x 10^3 MWh for the Southeast and 3694 x 10^3 MWh for the Rest-of-State. This compares to oil generation estimates of about 3 million and 9.6 million MWh for the Southeast and Rest-of-State without substantial hydroelectric development.

B.13 SOUTHEAST AND REST-OF-STATE RESIDENTIAL FUEL OIL

Oil consumption data for residential and commercial uses is not available on a historical basis below the state level. The Department of Revenue does release one category of motor fuel data at the judicial district level termed off highway diesel that they classify as used for space heating and other purposes. It is felt that this data understates residential and commercial oil use because it is reported that not all the refiners and distributors

report these sales to the Department of Revenue and the published figures are based on estimates developed from limited data that is reported.

This study follows that of the 1981 Long-Term Energy Plan prepared for the Governor's Office, and uses U.S. Department of Energy State Energy Data Report data.[a] This data is a historical series from 1960 to 1979 covering total consumption at the state level by major sector. Although this data is subject to question in terms of accurately reflecting consumption, it is felt to be a more accurate estimate than the Department of Revenue data.

Given the data is at state level, it was not realistic to use heating degree day and price data to support the estimated relationship because the geographic size and climate diversity of the state renders this information meaningless. The only variable used was population, and data for the years 1961 to 1978 was used to estimate the following equation:

$$\text{MBbl Consumption} = -867.9 + 9.457 \times \text{Population}$$
$$\text{(t-statistics)} \quad (-2.87) \quad (9.83)$$

$$\text{adjusted } R^2 = 84.9$$

The coefficient for population is highly significant and indicates that residential fuel oil consumption increases 9457 barrels for every 1,000 increase in the state's population.

Since the data and forecasts were available and developed on the state level, a procedure for apportioning the forecasts to the Southeast and Rest-of-State had to be worked out (the Railbelt forecasts are developed from the Railbelt Electric Power Alternatives Study). One method would be to assume that the per capita use of residential fuel oil is constant across the

(a) U.S. Department of Energy, Energy Information Administration, State Energy Data Report, DOE/EIA-0214(79), September 1981.

state so the forecasted consumption would then be shared by the population in those two regions. A priori, one would think that this disaggregation method would overstate consumption for the Rest-of-State area and understate consumption for the Railbelt and Southeast because it does not recognize difference in energy use intensities between the three regions.

A recent report to the Alaska State Legislature[a] provides some information on the distribution of distillate fuels, excluding residual, in 1980. The estimated share of total distillate fuels, about 67,800 b/d, for four defined regions and the corresponding populations for these regions is as follows:

Region	Share Distillate Consumption	Share Population
Southeast	13%	13%
South Central	63%	60%
Interior	16%	17%
Western	8%	10%

There is some uncertainty in both the quantities of distillate distributed to each region. Also, the populations of each as census regions do not match exactly with the corresponding fuel distribution regions. In sum, while there is reason to believe that differences in energy use intensity exist, there is no information available to make an informed decision on an allocation method. Thus, a constant per capita use pattern is assumed and total state consumption of residential fuel oil is allocated to the defined Southeast and Rest-of-State by their respective share of population in each of the forecast periods. The population shares used for the two regions as a percentage of total state population over the forecast period are then as follows:

(a) Barlow, Connie, Petroleum Refining and Consumption in Alaska: Implications for Management of Royalty Oil, House Research Agency, Alaska State Legislature, House Research Agency Report 81-1, May 1981.

Population Shares

Year	Low Forecast		Mid Forecast		High Forecast	
	Southeast	Rest-of-State	Southeast	Rest-of-State	Southeast	Rest-of-State
1980	13.0%	15.7%	13.0%	15.7%	13.0%	15.7%
1985	12.5	16.8	12.3	16.8	12.1	16.3
1990	13.2	15.2	13.0	16.3	12.6	16.3
1995	13.4	15.0	13.1	15.8	12.7	16.4
2000	13.6	14.6	13.1	15.2	12.8	15.2

B.14 SOUTHEAST AND REST-OF-STATE COMMERCIAL/INDUSTRIAL FUEL OIL

The same data problems exist for commercial and industrial fuel oil use and disaggregation as for the residential sector. The forecast equation was estimated using state level data for the two sectors combined and expressed as a function of employment. The estimated relationship is:

$$\text{MBbl Consumption} = 1046.5 + 19.54 \times \text{Employment}$$
$$\text{(t-statistics)} \quad (-2.80) \quad (7.76)$$

$$\text{adjusted } R^2 = 77.7$$

This is interpreted to mean that 19,540 barrels of distillate are used in the commercial/industrial sector for every 1,000 employees.

Forecasted consumption is allocated to the Southeast and Rest-of-State by their respective shares of total population. These shares over the forecast period are as follows:

Employment Shares

	Low Forecast		Mid Forecast		High Forecast	
Year	Southeast	Rest-of-State	Southeast	Rest-of-State	Southeast	Rest-of-State
1980	14.8%	17.7%	14.8%	17.7%	14.8%	17.7%
1985	14.5	18.4	14.4	18.7	14.3	18.5
1990	15.3	17.1	15.1	18.0	15.0	18.1
1995	15.5	16.8	15.2	17.7	15.0	18.3
2000	15.7	16.3	15.4	17.0	15.5	17.2

Distillate oil consumption by the commercial/industrial sector in the Railbelt is also drawn from the Railbelt Electric Power Alternatives Study.

B.15 MOTOR FUELS CONSUMPTION, ALL AREAS

Data for fuel consumed for transporation purposes is reported on a monthly basis to the Department of Revenue. The Department then records this data on the Judicial District level. This data has been compiled for taxed fuels at the Judicial District level since 1977 and for exempt (non-taxed) fuels since 1979.

Forecasts were constructed for seven use catagories for both taxable and exempt sales. These seven categories are aviation jet fuel, aviation gas, highway diesel, highway gas, marine diesel, marine gas and all other excluding off highway diesel. Off highway diesel covers residential sales and this consumption is dealt with in Section B.13 of this appendix. The forecasts for each use category are derived at the state level based upon employment and then reallocated to the three defined regions using the historical share of consumption between the Judicial Districts.

Attempts were made to develop a statistical basis for forecasting motor fuel consumption in each category. The first attempt used to Judicial District data with consumption in each use category regressed against population. The Judicial District data was pooled to increase the degrees of freedom for examination purposes. Indicator (dummy) variables were used to

pick up differences in fuel use patterns between the regions. These use patterns were hypothesized to be selected to differences in the regional use intensity and price. The estimated equations generally did not exhibit a poor fit, but there was significant error in predicting consumption (versus the actual) for individual regions. An examination of the data showed a high variation of per employee use of some regions for the four years of data, which helps to explain the poor fit. Another potential hinderance may have been that total employment was used in the estimations rather than a more disaggregate employment measure. A specific example would be employment in the fishing industry as the marine diesel equations were generally less satisfactory than the others. Finally a longer data series may help to establish a pattern that can be fitted statistically.

The other attempt to develop a statistically forecasting tool was using state level data, with fuel consumption by use cateogory regresed upon employment. These equations were fitted using data for the period 1971 to 1980 and generally produced a good fit. This method was rejected as a forecasting tool, however, because the per employee consumption predicted for the end of the forecast period was greater than the highest per employee consumption in the historical data. This is felt to product forecasts that error on the high risk because the per employee consumption number in the historical data has declined since the late 1970's. Also, future expected fuel price will induce continued conservation, both in user actions and the adaption of more fuel efficient equipment. Perhaps a longer data series and the use of disaggregate employment data would strengthen this estimation procedure.

The forecasting method used in this analysis is to examine the state level data by use category and project future consumption on the best estimate of past consumption. The basis for the state level projections by use category is shown in Table B.1. More detailed explanation for each use category follows.

TABLE B.1. Assumptions for Projecting Motor Fuels Consumption by Use Category

Use Category	Assumption
Aviation Jet Fuel	
Taxable	620 gallons/employee/yr. Equal to 1980 consumption. Airliner efficiency will prevent increases greater than employment growth.
Exempt	200 million gallons/yr. This level fairly stable in past with no discernable trend.
Bonded	40 million gallons/yr. Past relationship unstable and no trend.
Aviation Gasoline	
Taxable	80 gallons/employee/yr. Remains constant at 1980 level.
Exempt	500 thousand gallons/yr. Remains constant at 1980 level.
Highway Gasoline	
Taxable	800 gallons/employee/yr. Consistent with 1970's and 1980 level.
Exempt	8 million gallons/yr. Equal to last half of 1970's level.
Highway Diesel	
Taxable	350 gallons/employee/yr. In line with late 1970's level.
Marine Gasoline	
Taxable	35 gallons/employee/yr. Simple average of past level.
Exempt	300 thousand gallons/year. Consistent in recent historical consumption.
Marine Diesel	
Taxable	250 gallons/employee/yr. Assumed to decrease slightly from late 1970's level.
Exempt	7 million gallons/yr. Simple average of historical.
All Others	125 million gallons/yr.

The state level forecasts are developed for the three economic and population growth scenarios. The state level forecasts are shown in the text in Table 3.5.

Aviation Jet Fuel

There are three sales categories of this fuel: taxable for domestic or in state consumption; bonded to international air traffic; and exempt primarily for military consumption. Consumption in the taxable category has increased over time from about 50 million gallons per year in the 1970's to 130 million gallons by 1980. The 1980 level of 620 gallons per employee is selected as the point for forecasting purposes because improvements in airliner efficiency are likely to prevent further increases, if not result in decreases. There was no distinct trend in consumption for tax exempt jet fuel, but rather a fairly stable level of about 200 million gallons per year. The forecasts of consumption maintains this level. Bonded jet fuel consumption did not exhibit a trend or stable relationship. The forecast assumes that future consumption will be approximately equal to the average of the last six years, about 40 million gallons per year.

Aviation Gas

Taxable aviation gas consumption has increased from 8.6 million gallons annually in 1971 to about 16 million gallons annually in 1980. The annual per employee consumption over the same period was about 61 to 79 gallons. It is assumed that consumption per employee will remain at 80 gallons annually over the period. Tax exempt fuel consumption for military and government purposes has decreased over the period from about 3 million to 500,000 gallons annually. A constant annual level of 500,000 gallons is assumed for this forecast.

Highway Gas

Consumption of taxable gas for high use has increased over the 1970's, peaking with the pipeline employment, and declining mostly during the latter 1970's, probably due to recent price increases and the use of more fuel efficient automobiles. The annual per employee consumption ranged from about 710 to nearly 890 gallons. The per employee consumption in 1980 was about 810 gallons. This forecast will assume a per employee level of 800 gallons in view of likely continued escalation in real oil prices and the continued adoption of more efficient cars. The consumption of tax exempt gasoline by

government and military is assumed to remain at eight million gallons annually in keeping with the last half of the 1970's.

Highway Diesel

Only the taxable sales of highway diesel which are considered as the exempt sales are for government, military and electric utility sales. The bulk of this fuel is used for electricity generation. No clear trend in consumption of taxable highway diesel fuel is discernable within total volume over time or on a per employee basis. Both before and after the pipeline construction the consumption of this fuel fell in total volume with corresponding increases in employment. During the years of the pipeline construction activity consumption of this fuel underwent a sharp increase. The forecast relies upon the recent history of consumption at a level of about 350 gallons per year per employee. This compares to a level of about 210 gallons per year per employee in the early 1970's before construction began on the pipeline.

Marine Diesel

The consumption of taxable fuel in this category remained fairly constant in the first half of the 1970's at about 21 million gallons annually and increased to about 60 million gallons by 1980. The state level per employee consumption increased from about 145 gallons annually to nearly 300 gallons; however, per employee consumption did not increase significantly until 1977. It is not felt that this trend will continue and a per employee consumption level of 250 gallons on an annual basis is assumed. The consumption of exempt fuel for military and government shows a high level of fluctuation over the 1970's, ranging from 2 to 13 million gallons annually. The range of consumption seems to be fairly well distributed over the decade so the average, 7 million gallons annually, is assumed to be representative of future consumption levels.

Marine Gas

Consumption of taxable gasoline over the 1970's for marine purposes has not been as unstable as other fuels during the 1970's. Consumption has increased from about 5 million gallons annually in the first two years of the decade to about 8 million gallons per year at the end of the decade. The state level per employee consumption level ranged from about 26 to 42 gallons per employee per year. A simple trend equation using only time pegged the state level at about 35 gallons per employee per year, which is the average over the period and this relationship is used for the forecast. Consumption of tax exempt marine gasoline is assumed to be about 300,000 gallons per year, in line with recent historical consumption.

All Other

The consumption of fuels classified as other has increased dramatically over the past few years from less than one million gallons annually in the mid-1970's to about 117 million gallons in 1980. Nearly all of this category is reported as taxable highway fuel used for other purposes. This fuel has been reported for only the last two years, which accounts for the rapid rise in this category. Forecasting this series is difficult because of the recent addition of two categories (primarily the highway fuel) so it is assumed that consumption in this category remains constant at 125 million gallons annually beginning in 1981. No attempt is made to break this down to a regional level.

The forecasts are disaggregated to the three geographic regions recognizing, to the extent possible, differences in consumption patterns within each of the three regions. The Judicial District data are not consistent with the three regions except for the Southeast which is identical to Judicial District 1. The Railbelt lies in parts of Judicial Districts 3 and 4.

First, it is interesting to examine to distribution of employment and fuel consumption by use category within the Judicial Districts as shown in Table B.2. The employment is estimated for 1980, the distribution of taxable fuel is from the four-year average of 1977 to 1980 and the distribution of

TABLE B.2. Distribution of Employment and Fuel Consumption by Judicial District

	Judicial District			
	I	II	III	IV
Employment (1980)	15%	4%	62%	19%
Aviation Jet				
Taxable	4	2	77	17
Exempt	0.2	0.05	76	24
Bonded			100	
Aviation Gas				
Taxable	11	9	50	30
Exempt	13	4	47	37
Highway Gas				
Taxable	8	2	69	21
Exempt	8	4	75	14
Highway Diesel				
Taxable	10	29	40	22
Exempt	20	19	58	4
Marine Gas				
Taxable	29	7	48	16
Exempt	17	6	73	4
Marine Diesel				
Taxable	20	1	78	1
Exempt	5	0.2	95	0.2

exempt fuel is from the two-year average of 1979 and 1980. This table shows a significant variation of consumption between fuels within any given region. The distribution of fuel consumption between regions is also not well approximated by the class of employment.

The forecasted state level fuel consumption in each use category is then shared to the three regions used in this study. The share to the Southeast is identical to that for Region 1. The shares for Regions 3 and 4 are added and

applied to the state level forecast. This number is then divided between the Railbelt and the outlying portions of the two regions by the respective employment shares. The share of historical consumption from District 2 is applied to the state level forecast and this is added to the outlying portion of the District 3 and 4 forecast to provide the consumption forecast for the Rest-of-State region. This procedure is shortened somewhat by applying the shares for the three regions shown in Table B.3 directly to the consumption forecasts. The forecasts developed are displayed in the text in Tables 3.2, 3.3 and 3.4.

TABLE B.3. Shares Used for Collecting Consumption Forecasts by Use Category to the Southeast, Railbelt, and Rest-of-State Regions

Use Category	Southeast	Railbelt	Rest-of-State
Aviation Jet			
Taxable	4%	79%	17%
Exempt	0.2	84	16
Bonded		100	
Aviation Gasoline			
Taxable	11	67	22
Exempt	13	70	17
Highway Gasoline			
Taxable	8	76	16
Exempt	8	74	18
Highway Diesel			
Taxable	10	51	39
Marine Gasoline			
Taxable	29	54	17
Exempt	17	65	18
Marine Diesel			
Taxable	20	66	14
Exempt	5	80	15

APPENDIX C

REFINERY AND PIPELINE DATA

STATE OF ALASKA
PETROLEUM PROCESSING PLANTS

REFINERY	PLANT CAPACITY	DATE PLANT IN OPERATION	DATE EXPANSIONS	PLANT PRODUCT	DESTINATION
NIKISKI					
Chevron Refinery	26,000 BPD	1962		JP4, JA50, Furnace Oil, Diesels, Fuel Oil, Asphalt, Unfinished Gasoline.	JP4, JA50, Furnace Oil, Diesels, and Asphalt for Alaska; Unfinished Gasoline, High Sulfur Fuels to Lower-48 states.
Tesoro Refinery	48,500 BPD	1969 (17,500 BPD)	1974,1975,1977 1980(7500 BPD Hydrocracker Unit.)	Propane, Unleaded, Regular, and Premium Gasoline, Jet A, Diesel Fuel, No. 2 Diesel, JP 4 and No. 6 Fuel Oil.	Alaska except No.6 Fuel Oil to Lower-48 states.
Phillips-Marathon LNG	230,000 MCF/Day	1969		Liquified Natural Gas.	Japan, by tanker, 2 tankers capacity 71,500 cubic meters each, avg. one ship every 10 days.
Union Chemical Division	Ammonia 1,100,000 tons/yr Urea 1,000,000 tons/yr	1969	1977	Anhydrous Ammonia, Urea Prills and Granules.	West Coast and export by tanker and bulk freighter.
Pacific Alaska LNG	200,000 MCF/Day initial 400,000 MCF/Day (2nd yr)	Planned 1986 (?)		Liquified Natural Gas.	Southern California one ship every 13 days.
INTERIOR ALASKA					
North Pole Refinery	46,600 BPD	1977	Fall 1980	Military Jet Fuel (JP4), 3000-4000 BPD; Commercial Jet Fuel, 5000-6500 BPD; Diesel/Heating Fuel No. 1, 1000-1500 BPD; Diesel/Heating Fuel No. 2, 1800-2500 BPD, Diesel Fuel Type No. 4, 600-1800 BPD.	Fairbanks area, Nenana and river villages, Eilson AFB.
VALDEZ					
Alaska Oil Company (formerly Alpetco Company)	100,000 BPD	Planned 1985 (?)		To be determined by December, 1981. Required by amendment of May 30, 1981 to contract with State of Alaska.	Alaska, Lower-48, world markets.

ALYESKA PIPELINE SERVICE CO.
TRANS-ALASKA PIPELINE STATISTICS

1980	THROUGHPUT PUMP STATION #1 BBLS OIL	CLOSING STORAGE VALDEZ BBLS OIL	NUMBER SHIPS LOADED	SHIP AVERAGE VOLUME BBLS OIL	SHIP LIFTINGS BBLS OIL
January	47,299,999	3,412,824	56	840,000	47,037,658
February	44,228,161	7,659,308	48	823,200	39,513,248
March	47,844,227	5,137,724	61	816,999	49,773,081
April	46,329,657	2,896,719	54	889,600	48,037,130
May	47,259,011	2,306,550	54	875,100	47,253,345
June	45,712,368	3,924,374	54	822,600	43,596,634
July	46,942,528	5,346,532	55	817,200	44,945,107
August	46,956,856	3,372,591	58	834,400	48,397,355
September	45,488,046	3,705,767	51	873,200	44,534,825
October	46,176,556	1,565,241	59	813,100	47,975,363
November	43,934,449	2,889,320	50	838,500	41,924,148
December	46,762,185	3,045,037	58	791,500	45,907,325
Total Year	554,934,043		657		548,895,221
Average Month	46,244,503.6		54.75	733,421	45,741,268.4

APPENDIX D

ECONOMIC GROWTH ASSUMPTIONS

TABLE D.1. Assumptions Used in Railbelt Power Alternatives Study

Industry	Project(s)	Assumption	Low (1) Case	Moderate (2) Case	High (3) Case
Agriculture		Various levels of development depending on State & Federal policies combined with market conditions	Unfavorable policies or market conditions. Slow decline.	Restrictive land policies and generally unfavorable market conditions. 9% annual growth	Favorable policies & market conditions 16% annual growth
Fisheries		Major development of bottom fishing for 50-100% replacement of foreign fishing in 200 mile limit	No development	50% replacement	100% replacement
Oil, Gas and Mining	Trans-Alaska Pipeline	Additional employment due to construction of 4 pumping stations	Yes	Yes	Yes
	Northwest Gas Pipeline	Construction of natural gas pipeline from Prudhoe Bay and associated facilities 1981-85	Yes	Yes	Yes
	Prudhoe Bay	Production including primary recovery, and secondary recovery using water flooding, new developments, and rise in permanent employment	Yes	Yes	Yes
	Upper Cook Inlet	Declining employment in oil production replaced with employment in gas production	Yes	Yes	Yes
	National Petroleum Reserve in Alaska	Development and production of 5 oil fields and construction of 525 miles of pipeline	No Slow development	Yes Rapid development	Yes Rapid development

TABLE D.1. (contd page 2 of 3)

Industry	Project(s)	Assumption	Low (1) Case	Moderate (2) Case	High (3) Case
	Outer Continental Shelf (OCS) Petroleum and Gas	Exploration, development, and production of 3 more areas 1985-90	Production at Beaufort only; no sales after 1985. One billion barrels of oil discovered.	Yes, 7 billion barrels of oil discovered, 3 lease sales after 1985.	Yes, 17 billion barrels of oil discovered, 7 lease sales after 1985.
	Coal Development	Further development of Beluga coal reserves for export	No	Yes 1985-89 Production 4.4 million tons/year	Yes 1984-87 Production 11 million tons/year
	U.S. Borax	Development of mining operation by 1993	No	No	Yes
	Other Mining	Various levels of expansion of hardrock and other mining activities	No	Yes 1% annual growth	Yes 2% annual growth
Manufacturing	Aluminum Smelting	Construction and manufacturing by 1990-92	No	No	No
	Synfuels	Construction and manufacturing by 1990	No	No	No
	Alpetco Project	Development of major oil refining facility at Valdez from 1983-86	No	Yes	Yes
	Pacific LNG Project	Development of a liquid natural gas project in the Anchorage area between 1985-87	No	Yes	Yes
	Petrochemical	Development of the Dow-Shell project	No	No	Yes (Phase I)
	Food Processing	Development based on and correspondent to growth of fisheries	No	Yes	Yes

TABLE D.1. (contd page 3 of 3)

Industry	Project(s)	Assumption	Low (1) Case	Moderate (2) Case	High (3) Case
	Timber, Lumber, Pulp	Expansion to accommodate annual cut of 960 million to 1.3 billion board feet by 2000	Yes 960 million	Yes 960 million	Yes 1.3 billion
	Other Manufacturing	Expansion of existing production as well as new manufacturing at 1% to 3%	Yes (1%)	Yes (2%)	Yes (3%)
Government	State Capital Move	Moving state capital to Willow 1983	No	No	Yes
	Federal Government	Increases in civilian growth rate; military remains constant	Civilian growth at historial rate of 0.5% annually	Same as Low	Civilian growth rate of 1% annually
	State Government	Real per capita spending grows due to population and prices	Spending constant in real per capita terms (declines as a fraction of income)	Spending increases at rate of per capita income	Spending increases at 1.5 x rate of per capita income
Tourism		1% to 5% annual growth above 1980 level	1%	3%	5%

(1) Has 90-95% probability of projections occurring.
(2) Has 50% probability of projections occurring.
(3) Has 5 - 10% probability of projections occurring.
(4) Same as moderate case with addition of a series of industrial developments: 1) petrochemical development; 2) Beluga coal; 3) aluminum; 4) synfuels; and 5) local manufacturing
(5) Same as high case plus: 1) petrochemical; 2) synfuels; 3) aluminum; and 4) local manufacturing.

Sources: Alaska Economic Scenarios Review Document Comment Draft Working Paper No. 2.1, Battelle Pacific Northwest Laboratories, March 1981. Alaska Economic Projections for Estimating Electricity Requirements for the Railbelt. Scott Goldsmith and Ed Porter, Institute of Social and Economic Research, October 1981.

TABLE D.2. Population and Employment Forecasts
(10^3 Persons)

		Southeast		Railbelt		Best of State	
		Pop	Emp	Pop	Emp	Pop	Emp
Low:	1985	60.0	36.5	339.1	168.8	80.7	46.3
	1990	67.9	39.6	366.8	175.2	78.0	44.3
	1995	71.6	40.4	380.8	176.1	80.0	43.8
	2000	76.5	43.2	405.4	187.5	82.4	44.8
Mid:	1985	61.5	38.7	352.7	179.6	83.9	50.4
	1990	72.9	45.2	398.0	200.1	91.5	53.7
	1995	79.6	48.2	433.4	212.1	96.0	55.9
	2000	88.7	54.0	483.7	237.8	102.6	59.8
High:	1985	62.3	40.8	369.4	191.8	84.2	52.8
	1990	82.6	56.3	466.9	251.6	106.9	67.9
	1995	95.9	64.2	537.9	284.5	124.1	78.1
	2000	113.2	76.1	636.9	337.0	134.3	84.2

Pop = population.

Emp = employment.