

ALASKA LEGISLATURE SPECIAL COMMITTEE / SUBJECT FILES 8672

491 SCOM14: JOINT GAS PIPELINE COMM. (FINANCING) 1979-80

TABLE IV-D-4JAPANESE POLYVINYL CHLORIDE PRODUCERS, 1978
(Thousand Metric Tons)

<u>Company</u>	<u>Capacity</u>
Asahi Glass	28
Central Chemical	25
Chisso	145
Denki Kagaku	171
Kanegafuchi	216
Kawasaki Petrochemical	30
Kureha	138
Mitsubishi Monsanto	100
Mitsui-Toatsu	117
Nippon Geon	192
Nissan Chemical	30
Ryonichi	137
Shin-Etsu	225
Sumitomo	120
Sun Arrow	64
Toa Gosei	59
Tokuyama Sekisui	49
Toyo Soda	75
	<u>1,921</u>

Supply/Demand Situation

The potential supply/demand balance for PVC resin in Japan is presented in Table IV-D-5. Basically, the supply from existing plants is more than sufficient to meet the overall Japanese demand until 1990, when further capacity is expected to be added.

TABLE IV-D-5POTENTIAL SUPPLY/DEMAND BALANCE FOR POLYVINYL CHLORIDE IN JAPAN
(Thousand Metric Tons)

	<u>1977</u>	<u>1978</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>
Potential supply*	1,921	1,921	1,921	1,921	1,921
Forecast demand	1,030	1,200	1,400	1,730	2,100
Surplus/(deficit)	<u>891</u>	<u>721</u>	<u>521</u>	<u>191</u>	<u>(179)</u>

* 100 percent of nameplate capacity.

Pricing

In late June 1979, prices for general-purpose PVC resins were 162 yen per kilo (33.5 cents per pound). Prices are related primarily to vinyl chloride monomer costs.

The duty on polyvinyl chloride is 8 percent ad valorem.

b. Korea

Demand

Korean PVC demand totaled about 185,000 metric tons in 1978, of which approximately 120,000 metric tons was for domestic consumption and the remainder was processed into goods for export. Overall demand is expected to reach 240,000, 350,000 and 460,000 metric tons in 1980, 1985 and 1990, respectively. This represents an average annual growth of 7.9 percent over the period. Almost all material is general-purpose grade; however, the demand for pipe resin is increasing.

The major PVC processors in Korea are Lucky, Chin Yang Chemical, Daihan, National Plastic, Sam Yung Chemical and Korea Plastic Industry. These firms account for over 60 percent of consumption.

Supply

The current PVC capacity in Korea is 200,000 metric tons per year. Paste resins make up 10,000 metric tons per year of this total. Additional facilities are anticipated during the early 1980s to meet the growing demand. The Korean PVC producers and their capacities are presented in Table IV-D-6.

TABLE V-D-6

KOREAN POLYVINYL CHLORIDE PRODUCERS
(Thousand Metric Tons)

<u>Company</u>	<u>Location</u>	<u>Capacity</u>
Korea Plastics Industry	Kunsan, Luchon, Ulsan, Chin Hae, Pegan	150
Lucky Ltd.	Yeochon	50
		<u>200</u>

Supply/Demand Situation

The potential supply/demand balance for PVC resins in Korea is presented in Table IV-D-7. Basically, Korea is anticipated to be in an essentially balanced situation throughout the study period, assuming that new capacity is installed to utilize the available vinyl chloride monomer. In spite of the balanced situation, there will continue to be some importation of special product grades.

TABLE IV-D-7

POTENTIAL SUPPLY/DEMAND BALANCE FOR POLYVINYL CHLORIDE IN KOREA
(Thousand Metric Tons)

	<u>1977</u>	<u>1978</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>
Potential supply	150	200	200	350*	460*
Forecast demand	<u>150</u>	<u>185</u>	<u>240</u>	<u>350</u>	<u>460</u>
Surplus/(deficit)	0	15	(40)	-	-
Actual production	124	195			

* Assumes new plant capacity.

c. TaiwanDemand

Taiwan has a well-developed PVC industry, which probably is the largest in the world in relation to the size of the country. Demand in 1978, including exports of 60,000 metric tons, is estimated at 390,000 metric tons. Domestic demand is anticipated to reach 380,000, 535,000 and

695,000 metric tons in 1980, 1985 and 1990, respectively. Resin exports are expected to remain at about current levels.

The Taiwan PVC industry has been developed to serve world markets and generally has more sophisticated equipment than most major developed nations. As a result, exports in the form of sheet and finished products are anticipated to grow strongly. Most of the PVC produced is consumed captively. Formosa Plastics, China Gulf, Ocean Plastics and Cathay are major consumers.

Supply

In 1978, the Taiwan PVC industry capacity was 428,000 metric tons, with Formosa Plastics dominating the industry. Formosa Plastics added 24,000 metric tons of capacity in 1979, increasing the current industry capacity to 452,000 metric tons. At present, there are no major expansions in progress, but supply is anticipated to keep ahead of demand. The PVC producers and their capacities are listed in Table IV-D-8.

TABLE IV-D-8

TAIWAN POLYVINYL CHLORIDE PRODUCERS, 1978

<u>Company</u>	<u>Capacity</u>
Formosa Plastics	342
China Gulf Plastics	38
Cathay	30
Ocean	18
	<u>428</u>

Supply/Demand Situation

The potential supply/demand balance for PVC in Taiwan is presented in Table IV-D-9. Basically, capacity is expected to be added to meet demand in the future, and it is anticipated that imports of the material will be limited to special grades and spot situations.

TABLE IV-D-9

POTENTIAL SUPPLY/DEMAND BALANCE FOR POLYVINYL CHLORIDE IN TAIWAN
(Thousand Metric Tons)

	<u>1977</u>	<u>1978</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>
Potential supply*	385	385	500**	650**	820**
Forecast demand***	315	390	450	600	770
Surplus/(deficit)	<u>70</u>	<u>(5)</u>	<u>50</u>	<u>50</u>	<u>50</u>
Production	310	390			

* 90 percent of nameplate capacity.

** Assumes new facilities.

*** Demand includes resin exports.

d. Hong Kong

There is no production of PVC resin in Hong Kong, nor is any expected. The total demand for PVC resins was approximately 50,000 metric tons in 1978 and is anticipated to increase to 56,000, 73,000 and 89,000 metric tons in 1980, 1985 and 1990, respectively.

The major products made from PVC are sandals, footwear and artificial leather. In recent years, the rigid pipe market has begun to be significant. Paste resin is consumed for use in dolls. The demand growth in Hong Kong is expected to be relatively modest since the economy is almost totally committed to the export market and its strength is in the development of techniques to make new products most efficiently, rather than in the production of more and more of the same product.

e. ASEAN Countries

Polyvinyl chloride demand in the ASEAN countries is anticipated to increase from 119,400 and 134,500 metric tons in 1977 and 1978 to 315,000 metric tons in 1990, as shown in Table IV-D-10. At present, the eight PVC producers in the region provided about 120,000 metric tons of the region's needs in 1978. The producers and their capacities are listed in

Table IV-D-11. Over the study period, expansion within the region will occur, such that imports from 1985 to 1990 should amount to approximately 50,000 metric tons yearly.

TABLE IV-D-10

ASEAN COUNTRY POLYVINYL CHLORIDE DEMAND
(Thousand Metric Tons)

	<u>1977</u>	<u>1978</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>AAGR, %</u> <u>(Base 1978)</u>
Philippines	30	34	42	75	120	11.1
Singapore	11	12	15	20	30	7.9
Malaysia	18.4	21	28	45	70	10.6
Thailand	25	27.5	35	55	85	9.9
Indonesia	35	40	55	80	110	8.8
	<u>119.4</u>	<u>134.5</u>	<u>175</u>	<u>275</u>	<u>415</u>	<u>9.8</u>

f. People's Republic of China

The PVC market in the PRC is relatively small, and existing capacity is only about 20,000 metric tons per year. It is anticipated that Japan will continue to supply most of the modest imports of the product.

3. Conclusions

Opportunities for an Alaskan Plant

The supply and demand for PVC on the West Coast and in the Pacific Basin are summarized in Table IV-D-12.

It is anticipated that, during the 1980s, new grass-roots polyvinyl chloride facilities will have to be at least 200 million pounds per year in size in order to be competitive. Due to the highly competitive situation in PVC resins, a new West Coast producer could reasonably expect to capture only about 15 percent of the merchant market. This quantity would be sufficient to enable the facility to run essentially at capacity by 1985.

TABLE IV-D-11

ASEAN COUNTRY POLYVINYL CHLORIDE PRODUCERS
(Thousand Metric Tons Per Year)

<u>Company</u>	<u>Capacity</u>	<u>Expansions</u>
Philippines		
Mabuhay Vinyl	28	-
Philippine Vinyl Consortium	25	-
	<u>53</u>	
Singapore		
Singapore Polymer	15	-
Malaysia		
Malaysian Electro-Chemical Industries	12	-
Synthetic Resins	12	
	<u>24</u>	
Thailand		
Thai Plastics & Chemical	20-25	to 45 (1979) 70 (early 1980s)
Indonesia		
Eastern Polymer	15	20 (1979)
Standard Toyo Polymer	24	
	<u>39</u>	
Total	<u>151-156</u>	

TABLE IV-D-12

POLYSTYRENE

	<u>1978</u>	<u>Demand</u>		<u>AAGR, %</u>	<u>Capacity, per year</u>	
		<u>1985</u>	<u>1990</u>		<u>1978</u>	<u>Future</u>
		(Million Pounds)				
West Coast	695	1,330	1,890	8.7	370	370
		(Thousand Metric Tons)				
Japan	1,180	1,660	2,060	4.8	1,921	1,921*
Korea	185	350	460	7.9	200	200*
Taiwan	330	535	695	6.4	428	452*
Hong Kong	50	73	89	4.9	0	0
ASEAN Countries	135	275	415	8.8	151	221*

* Additional expansions likely.

Countries within the Pacific Basin are anticipated to be virtually self-sufficient in PVC. Imports required from outside the Pacific Basin countries are expected to be less than 100 million pounds in 1985, which provides very little opportunity for exports from an Alaskan plant.

Although there is the potential to supply PVC resin to the Pacific Basin countries, the nature of the PVC business generally makes it more attractive to ship vinyl chloride monomer and produce the resin near the consumption point.

E. Styrene1. West Coast Marketa. Demand

The U.S. West Coast demand for styrene is forecast to increase from 597 million pounds in 1977 and 634 million pounds in 1978 to 715, 995 and 1,330 million pounds in 1980, 1985 and 1990, respectively, as shown in Table IV-E-1. Current consumption represents about 10 percent of U.S. domestic demand. At present, polystyrene, ABS resins, styrene-butadiene latices, unsaturated polyester resins and alkyd resins are the only styrene derivatives produced within the region. Production of SBR and various low-volume styrene derivatives is not anticipated over the study period. The West Canadian demand for styrene is about 5 million pounds per year, and it should double over the study period.

TABLE IV-E-1
WEST COAST STYRENE DEMAND
(Million Pounds)

Western U.S.	<u>1977</u>	<u>1978</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>AAGR, % (1978-1990)</u>
Polystyrene	390	410	455	610	780	5.5
SBR elastomer	-	-	-	-	-	-
ABS resins	14	15	16	20	25	4.3
Styrene-butadiene latices	17	18	20	25	30	4.3
Unsaturated polyesters	130	140	166	260	390	8.9
Alkyd resins and other uses	46	51	58	80	105	6.2
Total Western U.S.	<u>597</u>	<u>634</u>	<u>715</u>	<u>995</u>	<u>1,330</u>	<u>6.4</u>
Western Canada	5	5	6	8	10	5.9
Total	<u>602</u>	<u>639</u>	<u>721</u>	<u>1,003</u>	<u>1,340</u>	<u>6.4</u>

Polystyrene is the largest application for styrene within the Western U.S. region. In 1976, about 82 percent of regional polystyrene demand was met by local production by A&E Plastik, Amoco, Cosden, Mobil, Dow and Monsanto. By 1980, locally produced material is expected to represent 80 percent of consumption; by 1985, however, the percentage should increase

to 85 percent due to the probable construction of new facilities by other producers, possibly BASF. Information on the polystyrene market is presented in Section IV-C.

SBR elastomer is not produced within the region and no production is anticipated over the study period. Dow and Union Oil produce styrene-butadiene latex. These firms have about 60 percent of the West Coast market and are expected to maintain their share of this relatively small market.

Dow Chemical, the only producer of ABS resins within the region, has a 30 million pounds per year plant at Torrance, CA. Because of the relatively small size of the ABS resin market, no new facilities are contemplated and only slow growth is anticipated in this application.

All unsaturated polyester resins utilized on the West Coast are produced within the region and, due to the nature of the product, the West Coast is expected to meet its needs with local production. Thus, styrene demand will follow regional growth in unsaturated polyester consumption. Unsaturated polyesters are produced by a number of firms within the region, as shown in Table IV-E-2.

TABLE IV-E-2

U.S. WEST COAST UNSATURATED POLYESTER RESIN PRODUCERS

<u>Company</u>	<u>Location</u>
Alpha Chemical	Perris, CA
Ashland Chemical	Los Angeles, CA
Cargill	Lynwood, CA
Glidden Durkee (SCM)	San Francisco, CA
Koppers	Richmond, CA
PPG Industries	Torrance, CA
Reichhold Chemicals	Azusa, CA
	S. San Francisco, CA
Sherwin Williams	Emeryville, CA
Synres Division of DSM	Anaheim, CA
USS Chemicals	Colton, CA
Vistron (Filon/Silmar)	Hawthorne, CA
Wittaker	Gardena, CA

Alkyd coating resins and molding compounds are produced within the region by at least a dozen firms, including Benjamin Moore, DuPont, Sherwin Williams and Synres. Demand for these products is forecast to grow at about 2.5 percent per year.

The Western Canadian region has styrene consumption for alkyd and unsaturated resin production. At present, demand is about 5 million pounds per year and is expected to double by 1990. Consumers include Bapco Paint at Surrey and Reichhold at Port Moody.

b. Supply

There are no producers of styrene in the West Coast region. Dow, Monsanto, Mobil, Cosden and Amoco have captive or pseudocaptive consumption of styrene, which is supplied from the Gulf Coast. Some of these firms and Gulf are the likely suppliers to the small alkyd and unsaturated polyester consumers. Polysar is the major styrene supplier in Western Canada.

c. Captive Market

In 1978, the captive market for styrene on the U.S. West Coast was about 365 million pounds, or 66 percent of regional demand. This percentage is expected to decrease to about 55 percent by 1985 due to the rapid growth of the unsaturated polyester resin market, which is almost entirely merchant. The captive styrene consumers are presented in Table IV-E-3. There is no captive styrene consumption in Western Canada.

TABLE IV-E-3

U.S. WEST COAST CAPTIVE STYRENE CONSUMERS

<u>Company</u>	<u>Derivatives Made</u>
Amoco	Polystyrene
Cosden	Polystyrene
Mobil	Polystyrene
Dow	Polystyrene, ABS, SB latices
Monsanto	Polystyrene
USS Chemicals	Unsaturated polyesters

d. Pricing

In the U.S., styrene is priced at 35 cents per pound, FOB works in tank cars. The Canadian price is \$0.41 (Canadian) per pound FOB Sarnia. Styrene prices depend primarily on the price and availability of benzene and the market situation for styrene.

2. Pacific Basin Market

a. Japan

The Japanese demand for styrene was about 1,112,000 metric tons in 1978, including net exports of 12,000 metric tons. Domestic demand is forecast to increase to 1,215,000, 1,540,000 and 1,920,000 metric tons in 1980, 1985 and 1990, respectively, while exports are expected to decrease in 1980 due to the startup of facilities in Taiwan and Korea. The Japanese styrene demand is summarized in Table IV-E-4.

TABLE IV-E-4

JAPANESE STYRENE DEMAND
(thousand Metric Tons)

	<u>1977</u>	<u>1978</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>AAGR, % (1978-1990)</u>
Polystyrene	620	660	740	950	1,170	4.8
SBR elastomer and latex	135	140	145	165	185	2.3
Unsaturated polyesters	70	70	75	90	120	4.6
ABS resins	125	130	145	190	255	5.7
SAN resins	45	50	55	70	90	5.0
Others	45	50	55	75	100	5.9
Total domestic demand	<u>1,040</u>	<u>1,100</u>	<u>1,215</u>	<u>1,540</u>	<u>1,920</u>	<u>4.8</u>
Net exports	27	12	0	20	30	-
Total demand	<u>1,067</u>	<u>1,112</u>	<u>1,215</u>	<u>1,560</u>	<u>1,950</u>	<u>4.8</u>

General-purpose, high-impact and foam polystyrene constitute about 60 percent of styrene demand. Demand over the study period is anticipated to increase 4-5 percent per year. This is due to a slowdown in the growth of the electrical appliance and electronics industries as some manufacture is shifted to Korea, Taiwan and elsewhere. In addition,

polypropylene is capturing some markets traditionally held by styrene resins. Consumption in SBR elastomer and latex is anticipated to have only nominal growth. A substantial proportion of SBR is exported and the erection of similar export-oriented SBR facilities in Korea and Taiwan has reduced these exports. ABS resins, which find considerable use in the electrical and electronics industries, are also experiencing slow growth due to the inroads of polypropylene. Unsaturated polyester resins and other styrene applications also have only modest growth prospects.

Supply

The production capacity for styrene in Japan is 1,550,000 metric tons per year, as shown in Table IV-E-5. Mitsubishi Petrochemical is currently expanding by 30,000 metric tons per year, and expansions of at least 200,000 metric tons per year are expected in the early 1980s. Production in 1978 was 1,122,000 metric tons, some 10,000 metric tons above consumption for the year.

TABLE IV-E-5

JAPANESE STYRENE PRODUCERS, 1978
(Thousand Metric Tons per Year)

<u>Company</u>	<u>Location</u>	<u>Capacity</u>
Asahi Dow	Mizushima/Kawasaki	395
Chubu	Yokkaichi	80
Denki Kagaku	Chiba	75
Idemitsu Petrochemical	Chiba	90
Mitsubishi Petrochemical	Kashima/Yokkaichi	410
Mitsui Toatsu	Tokuyama	90
Nippon Oxirane	Chiba	225
Nippon Steel Chemical	Tobata/Ohita	85
Sumitomo Chemical	Chiba	100
		<u>1,550</u>

Supply/Demand Situation

The supply/demand situation for styrene in Japan is shown in Table IV-E-6. Basically, the existing supply is sufficient to meet forecast demand only until the early 1980s. However, during the 1980s, it is anticipated that the smaller, higher cost facilities will be replaced

with larger ones. Although Japan has been self-sufficient in styrene, importation of the product and/or ethylbenzene is a possibility. Japanese styrene producers view ethylbenzene imports as an opportunity to lower costs somewhat, at the same time retaining complete control over styrene manufacture and the styrene market.

Pricing

The Japanese price for styrene was 190 yen per kilo (39 cents per pound) in late June. Prices depend primarily upon benzene prices and market conditions. Styrene imports are subject to an 8 percent duty, while ethylbenzene exports are subject to a duty of only 2 percent.

TABLE IV-E-6

POTENTIAL SUPPLY/DEMAND BALANCE FOR STYRENE IN JAPAN
(Thousand Metric Tons)

	<u>1978</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>
Potential supply*	1,300	1,330	1,530	1,530
Forecast demand	<u>1,112</u>	<u>1,215</u>	<u>1,560</u>	<u>1,950</u>
Surplus/(deficit)	<u>188</u>	<u>105</u>	<u>(30)</u>	<u>(430)</u>

* Estimated effective capacity.

b. Korea

The demand for styrene in Korea was 62,600 and 74,900 metric tons in 1977 and 1978, respectively. Demand is expected to reach 108,000, 167,000 and 235,000 metric tons in 1980, 1985 and 1990, respectively.

Polystyrene, SBR elastomer and unsaturated polyester resins are the major uses for the product in Korea. Almost all of the demand for these products will be met by local production. In addition, a small quantity is used for ABS production.

At present, there is one styrene producer in Korea. A 60,000 metric ton per year unit, owned by Ulsan Petrochemical at the Ulsan complex, came on stream in 1978. A second 125,000 metric ton per year unit, owned by

Chin Yang Chemical and located at the Yochon complex, is scheduled to be completed about 1983. Basically, Korea is anticipated to be self-sufficient in styrene, but the product will be imported in the early 1980s until a second unit is completed.

c. Taiwan

The demand for styrene in Taiwan is forecast to increase from 56,000 metric tons in 1977 to 107,000, 162,000 and 201,000 metric tons in 1980, 1985 and 1990, respectively. Styrene consumption for polystyrene will approximate polystyrene demand. Styrene demand for SBR should continue to grow fairly rapidly, paralleling the growth of domestic markets and tire and elastomer exports. Taiwan has a relatively high demand for unsaturated polyester resins due to the export-oriented sailboat, powerboat and yacht industry on the island. ABS resins are produced by Poly. The market for ABS resins is expected to remain relatively small.

The only styrene producer in Taiwan is Delta Petrochemical, which started production in late 1976 at Kaohsiung. The facility has a capacity of 100,000 metric tons per year. Delta will add 100,000 metric tons of styrene as part of the fourth petrochemical complex at Lin Yuan. With startup of the new unit expected in 1982, Taiwan will have excess styrene capacity until the end of the study period.

d. Hong Kong

Since Dow Chemicals' polystyrene facility is the only styrene consumer in Hong Kong, demand for the product will reflect its requirements, which are estimated as follows:

1978	74,000
1980	75,000
1985	125,000
1990	125,000

The styrene comes from Dow's U.S. and European facilities, although on occasion Asahi-Dow is the source of this material.

e. ASEAN Countries

Demand for styrene in the ASEAN countries is forecast to increase from 13,000 and 25,000 metric tons in 1977 and 1978, respectively, to 34,000 metric tons in 1980 and 125,000 metric tons in 1990, as shown in Table IV-E-7. Demand is almost entirely for polystyrene production. The demand figures for 1985 and 1990 assume additional polystyrene capacity within the region. Dow and affiliates of Japanese companies account for most of the styrene demand within the area.

TABLE IV-E-7
ASEAN COUNTRY STYRENE DEMAND
(Thousand Metric Tons)

	<u>1977</u>	<u>1978</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>AAGR, %</u> <u>(Base 1978)</u>
Philippines	8	12	13			
Singapore	-	-	-			
Malaysia	5	6	7			
Thailand	-	7	14			
Indonesia	-	-	-			
Total	13	25	34	75	125	14.3

At present, there are no styrene plants in the ASEAN region, and it is unlikely that a facility will be built during the study period.

f. People's Republic of China

No significant styrene imports are foreseen over the study period, since the PRC would prefer to import the modest quantity of resins required.

3. Conclusions

Opportunities for an Alaskan Plant

The supply and demand for styrene on the U.S. West Coast and in the Pacific Basin are summarized in Table IV-E-8.

TABLE IV-E-8

STYRENE

	Demand			AAGR, %	Capacity, per year	
	<u>1978</u>	<u>1985</u>	<u>1990</u>		<u>1978</u>	<u>Future</u>
	(Million Pounds)					
West Coast	639	1,003	1,340	6.4	0	0
	(Thousand Metric Tons)					
Japan	1,112	1,540	1,920	4.8	1,550	1,780*
Korea	75	167	235	10.0	60	185
Taiwan	81	162	201	7.9	100	200
Hong Kong	74	125	125	4.5	0	0
ASEAN Countries	25	75	125	14.3	0	0

* Additional expansions likely.

During the 1980s, it is expected that a styrene plant will have to be at least 600-800 million pounds per year in size in order to be competitive. By 1985, the U.S. West Coast will have a requirement for 1,000 million pounds of styrene, but the merchant market will only be about 500 million pounds. The output from an Alaskan plant could be disposed of in the region through exchanges, but due to the nature of the styrene market, a commitment to styrene production would also involve a major commitment to the polystyrene business elsewhere in order to move the styrene produced.

There is no opportunity for the movement of styrene to the Pacific Basin over the long term without the involvement of Dow or the Japanese, which have the captive markets.

In order to produce styrene, it would be necessary to have a source of benzene. This could be obtained from the proposed Alpetco or Alberta facilities.

F. Vinyl Chloride Monomer1. West Coast Marketa. Demand

The U.S. West Coast demand for VCM was estimated at 335 million pounds in 1978, or 5.1 percent of the total U.S. market of 6.5 billion pounds. The only use was for polyvinyl chloride polymer (PVC) production within the region. The three PVC producers, their PVC capacity and their estimated consumption of vinyl chloride monomer are shown in Table IV-F-1. There is no vinyl chloride consumption in Western Canada.

TABLE IV-F-1

WEST COAST VINYL CHLORIDE MONOMER DEMAND
(Million Pounds)

<u>Company</u>	<u>Location</u>	<u>PVC Capacity</u>	<u>Estimated VCM Demand</u>	
			<u>1978</u>	<u>1980</u>
B.F. Goodrich	Long Beach, CA	150	150	150
Keysor Century	Saugus, CA	50	45	50
Stauffer	Carson, CA	160	140	160
Total		360	335	360

The future demand for vinyl chloride monomer on the West Coast is tied to PVC production levels in the region. By 1980, it is anticipated that the existing facilities will be operating at capacity levels due to market growth. As a result, VCM demand will reach about 360 million pounds, and it will remain at this level during the 1980s unless additional facilities are built. Since the West Coast PVC market is expected to reach 1,890 million pounds by 1990, erection of additional facilities is likely, particularly if an adequate supply of VCM exists within the region. As a result, regional VCM demand could approach 500-600 million pounds by 1985 if there were an incentive to build additional facilities.

b. Supply

Stauffer is the only producer of vinyl chloride monomer in the Western region, with a 175 million pound a year plant in Carson, CA. This facility normally operates at close to capacity and meets about half of the regional VCM needs. The remainder is brought into the region by Goodrich. The long-term viability of the Stauffer plant is questionable and it is felt that this unit and the Arco ethylene plant, which supplies it, will be shut down within the next few years.

c. Captive Market

Stauffer is estimated to have utilized 140 million pounds for captive use. Goodrich meets most of its vinyl chloride requirements with captive production, but the firm probably supplies the West Coast with purchased material. As a result, about 40 percent of the total VCM consumed in the U.S. West Coast represents captive production.

d. Pricing

The price for vinyl chloride monomer as of October 1979 was 17 cents per pound. Price levels are primarily determined by energy costs and the supply/demand situation for the product.

2. Pacific Basin Market

a. Japan

Demand

The Japanese demand for vinyl chloride monomer is forecast to increase from 1,550,000 metric tons in 1978 to 1,690,000, 2,090,000 and 2,540,000 metric tons in 1980, 1985 and 1990, respectively, as shown in Table IV-F-2. Details of the polyvinyl chloride market for VCM are provided in

Section IV-D. Other uses are as a chemical intermediate and in the production of modacrylic fibers. In 1978, Japan exported 180,000 metric tons of VCM to Far Eastern countries and Australia. Exports are anticipated to drop by 1980 due to the new facilities in Korea and Taiwan. However, they should rise in the 1980-1990 period, primarily due to increased demand in the ASEAN countries.

TABLE IV-F-2

JAPANESE VINYL CHLORIDE MONOMER DEMAND
(Thousand Metric Tons)

	<u>1977</u>	<u>1978</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>AAGR, % (1978-1990)</u>
Polyvinyl chloride	1,080	1,260	1,470	1,810	2,200	4.8
Other uses	105	110	120	160	210	5.5
Domestic demand	<u>1,185</u>	<u>1,370</u>	<u>1,590</u>	<u>1,970</u>	<u>2,410</u>	<u>4.8</u>
Exports	165	180	100	120	130	-
Total demand	<u>1,350</u>	<u>1,550</u>	<u>1,690</u>	<u>2,090</u>	<u>2,540</u>	<u>4.2</u>
Actual production	1,340	1,505				

Supply

The current Japanese VCM capacity is 2,191,000 metric tons per year, as shown in Table IV-F-3. Since the operating factor for VCM is low, some small facilities are now on standby.

Although there are no expansions in progress at present, an additional 475,000 metric tons of capacity was announced for the early to mid-1980s. In addition, there could be replacement of smaller facilities with new, larger plants.

Supply/Demand Situation

Basically, there is enough current and planned capacity to more than meet demand throughout the study period. However, due to the chlorine/caustic imbalance there could be imports of vinyl chloride or ethylene dichloride into the country in spite of sufficient domestic capacity.

TABLE IV-F-3

JAPANESE VINYL CHLORIDE MONOMER PRODUCERS, 1978
(Thousand Metric Tons Per Year)

<u>Company</u>	<u>Location</u>	<u>Capacity</u>
Asahi Glass	Chiba	56
	Kashima	
Central Chemical	Kawasaki	80
Chiba Enbi Monomer	Chiba	160
Chisso	Minamata	73
Denki Kagaku	Ohmi	42
Kanagafuchi	Takasago	140
Kashima Enbi Monomer	Kashima	220
Kureha	Nishiki	150
Mitsubishi Monsanto	Yokkaichi	80
Mitsui Toatsu	Nagoya	60
	Senpoku	66
Nippon Geon	Takaoka	120
Nissan Chemical	Chiba	60
Ryonichi	Mizushima	220
Sanyo Monomer	Mizushima	150
Sun Arrow Kagaku	Tokuyama	110
Sumitomo Chemical	Niihama	55
Toi Gosei	Tokushima	50
Toyo Soda	Nanyo	170
	Yokkaichi	129
		<u>2,191</u>

b. Korea

The demand for VCM in Korea is expected to increase from an estimated 130,000 metric tons in 1977 and 200,000 metric tons in 1978 to 245,000, 360,000 and 470,000 metric tons in 1980, 1985 and 1990, respectively, in order to meet the production forecast for PVC. This represents an average annual growth of 7.4 percent from 1978.

The current capacity for VCM in Korea is 78,000 metric tons per year, as shown in Table IV-F-4. Capacity will increase by 150,000 metric tons per year in 1979, but the overall capacity should only be 210,000 metric tons per year since the acetylene-based units will be placed on standby. An additional facility is anticipated onstream about 1983 as part of the Yochon complex.

TABLE IV-F-4

KOREAN VINYL CHLORIDE MONOMER PRODUCERS, 1978
(Thousand Metric Tons)

<u>Company</u>	<u>Capacity</u>	<u>Expansions</u>	<u>Process</u>
Korea Plastic Industry (4 plants)	18	-	Acetylene
Korea Pacific	60	150 (1979)	Ethylene
	78	200 (1983)	
		350	

The supply/demand balance for VCM in Korea is presented in Table IV-F-5. The local industry operates, when possible, essentially at capacity, with imports filling the remainder of the demand. After completion of the new VCM plants, Korea will have excess capacity. It is anticipated that this material will be exported in the form of both VCM and ethylene dichloride to Australia and other Far Eastern nations.

TABLE IV-F-5

POTENTIAL SUPPLY/DEMAND BALANCE FOR VINYL CHLORIDE MONOMER IN KOREA
(Thousand Metric Tons)

	<u>1977</u>	<u>1978</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>
Potential supply	78	78	230	410	410
Forecast demand	130	200	245	360	470
Surplus/(deficit)	(52)	(122)	(15)	50	(60)
Actual production	73	65			

c. Taiwan

The demand for VCM is anticipated to increase from about 320,000 metric tons in 1977 and 400,000 metric tons in 1978 to 460,000, 615,000 and 785,000 metric tons in 1980, 1985 and 1990, respectively, in order to meet the PVC resin production forecast. This represents an average annual growth of 5.8 percent from 1978. VCM exports are expected to be small.

The capacity for VCM production in Taiwan is estimated at 360,000 metric tons per year, as shown in Table IV-F-6.

TABLE IV-F-6

TAIWAN VINYL CHLORIDE MONOMER PRODUCERS, 1978
(Thousand Metric Tons)

	<u>Capacity</u>
Formosa Plastics	240
Taiwan VCM	<u>120</u>
	360

In 1978, Taiwan produced about 330,000 metric tons of VCM and imported 70,000 metric tons. VCM capacity in Taiwan is expected to increase to meet forecast demand throughout the study period. A significant part of the additional needs will be met through ethylene dichloride imports.

d. Hong Kong

There is no PVC production in Hong Kong nor is any expected throughout the study period. As a result, there is no anticipated requirement for VCM.

e. ASEAN Countries

ASEAN countries' VCM demand is forecast to increase from 108,000 and 120,000 metric tons in 1977 and 1978, to an estimated 149,000, 235,000 and 365,000 metric tons in 1980, 1985 and 1990, respectively, as shown in Table IV-F-7. These demand forecasts take into account anticipated increased production within the region from facilities which would be built in the 1980-1990 period.

TABLE IV-F-7

ASEAN COUNTRY VINYL CHLORIDE MONOMER DEMAND
(Thousand Metric Tons)

	<u>1977</u>	<u>1978</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>AAGR, %</u> (Base 1978)
Philippines	27	31	42	70	115	11.5
Singapore	15	15	15	15	15	-
Malaysia	18	20	24	40	65	10.3
Thailand	24	27	33	50	75	8.9
Indonesia	24	27	35	60	95	11.1
Total	<u>108</u>	<u>120</u>	<u>149</u>	<u>235</u>	<u>365</u>	<u>9.7</u>

At present, there is no supply of VCM within the ASEAN countries.

f. People's Republic of China

Vinyl chloride imports into the PRC are insignificant in relation to a world-scale plant and, as such, were not considered.

3. Conclusions

Opportunities for an Alaskan Plant

The supply and demand of vinyl chloride monomer on the West Coast and in the Pacific Basin are summarized in Table IV-F-8.

TABLE IV-F-8

VINYL CHLORIDE MONOMER

	Demand*				Capacity, per year	
	<u>1978</u>	<u>1985</u>	<u>1990</u>	AAGR, %	<u>1978</u>	<u>Future</u>
	(Million Pounds)					
West Coast	335	500-600	500-600	-	175	175**
	(Thousand Metric Tons)					
Japan	1,370	1,970	2,410	4.8	2,191	2,191
Korea	200	360	470	7.4	78	410
Taiwan	400	615	785	5.8	360	700
Hong Kong	0	0	0	0	0	0
ASEAN Countries	120	235	365	9.7	0	0

* In part dependent upon new PVC facilities.

** Plant may shut down.

Vinyl chloride monomer consumption on the West Coast was about 335 million pounds in 1978, and it could conceivably reach 500-600 million pounds by 1985 if there were a large-scale availability of material within the region. All of this material would have to be supplied by a new producer, since the existing Stauffer plant is expected to be shut down within the new few years.

The ASEAN countries are expected to be major VCM importers through the study period. In addition, both Japan and Taiwan have severe chlorine/caustic soda imbalances and thus could be substantial importers of vinyl chloride and/or ethylene dichloride in spite of adequate domestic capacity.

The production of vinyl chloride monomer and/or ethylene dichloride in Alaska would entail producing or bringing chlorine into the plant site. In the future, it is anticipated that the West Coast area could support an 800 million to 1 billion pound per year VCM plant without causing a surplus of caustic soda in the region.

G. Ethylene Glycol1. West Coast Marketa. Demand

The U.S. West Coast demand for ethylene glycol was 200 million pounds in 1977 and 185 million pounds in 1978. Essentially all was used in antifreeze manufacture. By 1990, ethylene glycol demand is expected to be 230 million pounds, a 1.8 percent average annual growth rate over the period, as shown in Table IV-G-1. The Western Canadian ethylene glycol market was about 15 million pounds in 1978, and only nominal growth is forecast.

TABLE IV-G-1
WEST COAST ETHYLENE GLYCOL DEMAND
(Million Pounds)

	<u>1977</u>	<u>1978</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>AAGR, % (1978-1990)</u>
Western U.S.						
Antifreeze	197	182	191	210	224	1.7
Polyester fiber	-	-	-	-	-	-
Polyester film	-	-	-	-	-	-
Other	3	3	4	5	6	-
Total Western U.S.	<u>200</u>	<u>185</u>	<u>195</u>	<u>215</u>	<u>230</u>	<u>1.8</u>
Western Canada	15	15	16	17	18	1.5
Total	<u>215</u>	<u>200</u>	<u>211</u>	<u>232</u>	<u>248</u>	<u>1.8</u>

The U.S. West Coast accounts for only about 5 percent of the ethylene glycol market, since there is no consumption for polyester fiber and film within the region.

About 10 percent of U.S. antifreeze consumption is on the West Coast. This market is forecast to grow slowly due to saturation of the automobile market and decreasing cooling system size. Most antifreeze is sold as branched products. The remaining consumption is in specialty applications such as in latex paints.

The Canadian ethylene glycol market is utilized almost entirely for antifreeze. Minor amounts are used in paints.

b. Supply

There are no production facilities on the West Coast. All ethylene glycol is shipped into the region. Union Carbide and Dow are the major suppliers to the U.S. West Coast. Other suppliers include PPG, BASF-Wyandotte, Texas and Northern Petrochemical. Most of the Canadian market is also supplied by Union Carbide and Dow.

c. Captive Market

Approximately 60-70 percent of the West Coast market for ethylene glycol is represented by the national antifreeze brands of the ethylene glycol manufacturers and by the petroleum companies with a captive ethylene glycol source.

Although the antifreeze is merchanted, the consumer is purchasing a branded item, so this market is really not available to an independent ethylene glycol producer. It is anticipated that the percentage of the market attained by firms with a captive ethylene glycol source will increase by 5-10 percent over the study period, following a national trend.

d. Pricing

The U.S. ethylene glycol price is 28 cents per pound, while the Canadian price is \$0.35 (Canadian) per pound at producing locations. Glycol prices are primarily related to ethylene costs and market conditions. Ethylene glycol imports into Canada are subject to a 10 percent ad valorem duty.

2. Pacific Basin Market

a. Japan

In Japan, the situation for ethylene glycol is related to the overall ethylene oxide picture. The demand for ethylene oxide in Japan (Table IV-G-2) depends largely upon the production of ethylene glycol to meet both domestic and export needs. Demand is anticipated to grow 6.0 percent per year during the 1977-1990 period, primarily to meet increases in domestic textile consumption. Textile exports are anticipated to remain static or decline, while fiber exports are expected to show only modest growth, with an increasing percentage of exports consisting of the more specialized grades. Demand growth in the post-1980 period is anticipated at about 3 percent per year due to saturation of domestic markets and a declining export market.

Polyester film is used in x-ray, photographic, fiber, and audio and video tapes. Antifreeze sales are tied to domestic vehicle registrations and export sales of vehicles and will also be enhanced by the trend to the production of somewhat larger vehicles. The industrial markets for ethylene glycol and the higher glycols are forecast to grow at about 5 percent per year.

Ethylene glycol net exports were 200,000 metric tons in 1978. A substantial decline is anticipated by 1980, primarily because of the start-up of new glycol plants in Taiwan and Korea.

Other uses for ethylene glycol include surfactants, ethanolamines, glycol ethers and other derivatives. Growth in the 4-5 percent per year range is anticipated.

Overall demand for ethylene oxide was 538,000 metric tons in 1977 and 631,000 metric tons in 1978. Demand is forecast to reach 615,000, 775,000 and 925,000 metric tons in 1980, 1985 and 1990, respectively. This represents an average annual growth rate of 3.2 percent during the 1978-1990 period.

TABLE IV-G-2

JAPANESE ETHYLENE OXIDE/GLYCOL DEMAND
(Thousand Metric Tons)

	<u>1977</u>	<u>1978</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>AAGR, % (1978-1990)</u>
Ethylene glycol						
Polyester fiber	210	235	250	310	340	3.1
Polyester film	12	13	15	20	25	5.6
Polyethylene terephthalate resin	1	3	5	15	20	17.1
Antifreeze	40	43	50	65	80	5.3
Others, individual higher glycols	110	116	130	165	210	5.0
Total domestic demand	<u>373</u>	<u>410</u>	<u>450</u>	<u>575</u>	<u>675</u>	<u>4.2</u>
Net exports	195	200	130	145	165	-
Total demand	<u>568</u>	<u>610</u>	<u>580</u>	<u>720</u>	<u>840</u>	<u>2.7</u>
Inventory change	(45)	20	-	-	-	-
Ethylene glycol production	<u>523</u>	<u>630</u>	<u>580</u>	<u>720</u>	<u>840</u>	<u>2.4</u>
Ethylene oxide						
Ethylene glycol	382	473	435	540	630	2.4
Other uses	156	158	180	235	295	5.3
Total demand	<u>538</u>	<u>631</u>	<u>615</u>	<u>775</u>	<u>925</u>	<u>3.2</u>

Supply

The current ethylene oxide capacity in Japan is 635,000 metric tons per year. Capacity should increase by 120,000 metric tons per year in the next 2-3 years, with completion of the new Mitsubishi Petrochemical facility. Glycol capacity is currently at the 575,000 metric tons per year level, and it will increase by 100,000 metric tons per year, as is shown in Table IV-G-3.

TABLE IV-G-3

JAPANESE ETHYLENE OXIDE/GLYCOL PRODUCERS
(Thousand Metric Tons per Year)

<u>Company</u>	<u>Capacity</u>		<u>Expansions</u>
	<u>Ethylene Oxide</u>	<u>Ethylene Glycol</u>	
Mitsubishi Petrochemical	105	95	120/100 (early 1980s)
Mitsui Petrochemical	207	190	
Nippon Catalytic Chemical	195	180	
Nisso Petrochemical	128	110	
	<u>635</u>	<u>575</u>	

Supply/Demand Situation

The supply/demand balance for ethylene oxide in Japan is shown in Table IV-G-4. Basically, existing and announced capacity is sufficient to meet demand until 1985.

TABLE IV-G-4

POTENTIAL SUPPLY/DEMAND BALANCE FOR ETHYLENE OXIDE IN JAPAN
(Thousand Metric Tons)

	<u>1977</u>	<u>1978</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>
Potential supply*	635	635	635	755	755
Forecast demand	<u>538</u>	<u>631</u>	<u>615</u>	<u>775</u>	<u>925</u>
Surplus/(deficit)	<u>97</u>	<u>4</u>	<u>20</u>	<u>(20)</u>	<u>(170)</u>
Actual production	538	631			
Operating rate, %	85	99			

* 100 percent of nameplate capacity.

Pricing

In August 1979, the Japanese prices for industrial and antifreeze ethylene glycol were 184 and 178 yen per kilo, respectively (38 and 36.8 cents per pound). Glycol prices are primarily related to ethylene costs.

b. Korea

Polyester fiber production represents almost all ethylene glycol use in Korea. A small amount is used as antifreeze. The Korean demand for ethylene glycol is forecast to grow from 80,000 metric tons in 1978 to 220,000 metric tons in 1990, as shown in Table IV-G-5. About 70 percent of Korean polyester fiber production is exported, primarily in the form of finished goods.

TABLE IV-G-5
KOREAN ETHYLENE GLYCOL DEMAND
 (Thousand Metric Tons)

	<u>1977</u>	<u>1978</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>AAGR, %</u> <u>(1978-1990)</u>
Polyester fiber production	158	190	250	380	520	8.8
Ethylene glycol requirement	65	75	100	150	210	8.8
Other glycol uses	4	5	6	8	10	-
Total demand	<u>69</u>	<u>80</u>	<u>106</u>	<u>158</u>	<u>220</u>	<u>8.8</u>

At present, there are no ethylene glycol producers in Korea. However, an 80,000 metric ton per year facility in which Mitsui is a part owner is under construction at Yeosu. Completion is anticipated in 1979. Since demand is increasing at a faster pace than capacity, Korea is expected to be an importer of the product in increasing volumes throughout the early 1980s.

c. Taiwan

Almost all ethylene glycol in Taiwan is used for the production of polyester fibers. The polyester fiber industry relies almost completely upon exports since domestic consumption represents only about 10 percent of production. Of the material exported, about half is shipped as filament and yarn, while the remainder is in the form of finished goods and textiles. As shown in Table IV-G-6, ethylene glycol demand in Taiwan is expected to increase from 85,000 metric tons in 1977 and 120,000 metric tons in 1978 to 160,000, 240,000 and 300,000 metric tons in 1980, 1985 and 1990, respectively.

TABLE IV-G-6
TAIWAN ETHYLENE GLYCOL DEMAND
 (Thousand Metric Tons)

	<u>1977</u>	<u>1978</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>AAGR, %</u> <u>(1978-1990)</u>
Polyester fiber production	210	300	400	600	750	8.0
Ethylene glycol demand	85	120	160	240	300	8.0

The current ethylene glycol capacity in Taiwan is 175,000 metric tons per year. Capacity will be increased by 50,000 metric tons per year when the planned petrochemical complex at Lin Yuan comes on stream in 1983, as shown in Table IV-G-7.

TABLE IV-G-7

TAIWAN ETHYLENE GLYCOL PRODUCERS, 1978
(Thousand Metric Tons per Year)

<u>Company</u>	<u>Location</u>	<u>Capacity</u>	<u>Expansions</u>
China Man-Made Fiber	Kaohsiung	50	
Oriental Union Chemical	Kaohsiung	125	50 (1983)
		<u>175</u>	

The China Man-Made unit was completed in early 1976. The firm is 100 percent owned by local interests. The Oriental Union Chemical plant is owned by Oriental Chemical (20 percent), China Development (25 percent), Central Investment (30 percent) and Union Carbide (25 percent). Union Carbide is currently handling export sales from this plant and has been active in Southeast Asian markets.

d. Hong Kong

The current demand for ethylene glycol in Hong Kong is about 200 metric tons per year and is expected to remain small since it is very unlikely that polyester fiber production will commence in spite of substantial demand in the Colony. This is due to the absence of import duties and business relationships between local textile producers and Japanese fiber producers.

There are no producers of ethylene glycol in Hong Kong nor are any expected throughout the study period.

e. ASEAN Countries

Polyester fiber production is the only use for ethylene glycol in the ASEAN countries. Polyester fiber production within the ASEAN group and

estimated ethylene glycol consumption by country are presented in Table IV-G-8. Ethylene glycol consumption is forecast to increase from 57,000 metric tons in 1977 and 69,000 metric tons in 1978 to 73,000, 98,000 and 126,000 metric tons in 1980, 1985 and 1990, respectively.

TABLE IV-G-8
ASEAN COUNTRY ETHYLENE GLYCOL DEMAND
(Thousand Metric Tons)

	<u>1977</u>	<u>1978</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>AAGR, %</u> <u>(1978-1990)</u>
ASEAN country polyester fiber production	142	171	195	247	317	5.3
Ethylene glycol						
Philippines	9	10	11	16	25	7.9
Singapore	-	-	-	-	-	-
Malaysia	12	13	14	14	14	0.6
Thailand	20	28	30	36	44	3.8
Indonesia	16	18	23	32	43	7.5
Total ethylene glycol demand	57	69	78	98	125	5.3

At present, there are no ethylene glycol facilities within the ASEAN countries. A 120,000 metric ton per year facility is planned as part of the Singapore petrochemical project. This plant would be at least partially owned by the four Japanese ethylene glycol producers. Completion is anticipated in the 1982-1983 period. Firms have also been investigating the possibility of erecting a facility in Indonesia, but completion before 1985 appears unlikely.

A large part of the polyester fiber industry in the ASEAN countries is controlled by affiliates of the Japanese fiber companies. These firms have traditionally purchased most of their ethylene glycol from Japanese sources.

f. People's Republic of China

Ethylene glycol consumption in the PRC will grow rapidly due to the planned emphasis on polyester fibers. However, it is anticipated that essentially all of the ethylene glycol required will ultimately be produced within the country.

3. Conclusions

Opportunities for an Alaskan Plant

Supply and demand for ethylene glycol on the West Coast and in the Pacific Basin are summarized in Table IV-G-9.

TABLE IV-G-9

ETHYLENE GLYCOL

	<u>1978</u>	<u>Demand</u>		<u>AAGR, %*</u>	<u>Capacity, per year</u>	
		<u>1985</u>	<u>1990</u>		<u>1978</u>	<u>Future</u>
		<u>(Million Pounds)</u>				
West Coast	200	232	248	1.8	0	0
		<u>(Thousand Metric Tons)</u>				
Japan	410	575	675	4.2	575	675
Korea	80	158	220	8.8	0	80
Taiwan	120	240	300	8.0	175	225
Hong Kong	neg.	neg.	neg.	-	0	0
ASEAN Countries	69	98	126	5.3	0	120*

* Future project not certain.

The ethylene glycol market available to a new producer is small and has little prospect for growth. Korea and the ASEAN countries are the only countries in the Pacific Basin region which will require imports of ethylene glycol during the mid-1980s. However, since much of the fiber industry in these countries is controlled by Japanese firms, it is anticipated that almost all of the ethylene glycol required will be supplied by Japan, either directly or through the Singapore project and by Taiwan, which will have considerable excess capacity until the mid-1980s.

H. Ethylene

Ethylene boils at -119°F and must be shipped in cryogenic tankers. As a result, shipment of ethylene is not widespread and is primarily limited to coastal movements in Japan and special situations in Europe. It is generally preferable to ship ethylene in the form of derivatives rather than as the product itself.

Shipment of liquid ethylene to West Coast markets for derivative manufacture would have to compete with derivatives manufactured in large facilities on the Gulf Coast. This is not considered to be a viable alternative.

The only really large potential market for liquid ethylene in the Pacific Basin countries would be in Japan. On the basis of discussions with major Japanese companies, it is felt that importation (vs incremental production in existing plants) would not be viable due to the high costs for transportation and the necessity of building a large receiving and storage terminal. It is felt that Japanese firms would prefer to import ethylene in the form of derivatives, especially derivatives such as ethylene dichloride or vinyl chloride monomer, which are energy-intensive.

At present, projects based upon imported ethylene are being planned in the Philippines and Thailand. The Philippine project would require up to 90,000 metric tons per year for LDPE manufacture, while the Thai project would require 90,000 and 50,000 metric tons per year for LDPE and HDPE manufacture, respectively. Completion of both projects is planned for the 1983-1985 period, but additional delays could occur. In both cases, eventual ethylene production at the plant site is anticipated. As a result, supplying some incremental ethylene to these projects from an Alaskan plant is feasible, but shipment of liquid ethylene on a large scale for a long period of time does not appear to be viable.

I. Polypropylene

1. West Coast Market

a. Demand

The demand for polypropylene resin in the U.S. West Coast region in 1977 and 1978 is estimated at 110 and 125 million pounds, respectively. In addition, some polypropylene film was shipped into the region by converters during the year. Compared to the total U.S. market, the western consumption of resin is small, being only 4.6 percent of the U.S. total. The reason for this is that the West Coast states do not have the three largest consuming industries for polypropylene, namely fibers, automotive component production and major appliances.

By 1990, demand is expected to total 355 million pounds, an average annual growth rate of 9.1 percent over the 1978-1990 period. The growth pattern, by broad end use category, is shown in Table IV-I-1. Western Canadian demand is currently 5-10 million pounds and is anticipated to reach 20 million pounds by 1990.

TABLE IV-I-1
WEST COAST POLYPROPYLENE DEMAND
(Million Pounds)

Western U.S.	<u>1977</u>	<u>1978</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>AAGR, % (1978-1990)</u>
Injection molding	69	73	90	130	190	8.3
Film and sheet	6	7	10	15	20	9.1
Fiber and filaments	-	-	-	-	-	-
Other extrusions	20	25	30	45	70	9.0
All other uses	15	20	30	55	75	11.6
Total Western U.S.	<u>110</u>	<u>125</u>	<u>160</u>	<u>245</u>	<u>355</u>	<u>9.1</u>
Western Canada	5	5	10	15	20	12.0
Total	<u>115</u>	<u>130</u>	<u>170</u>	<u>260</u>	<u>375</u>	<u>9.1</u>

The largest end use in the U.S. West Coast region is that of injection molding, which accounts for about 60 percent of polypropylene consumption. Typical uses for injection-molded products are food

containers, nursery tubs, toys, instrumentation, housewares, medical uses and battery cases. Film and sheet, mainly for packaging, account for only 5-6 percent of the resin use. The remaining resin is used for extruded pipe, for cordage, for sweeper brushes and for wire coating.

Injection molding consumed an estimated 73 million pounds of polypropylene resin in 1978. This end use is expected to grow to 190 million pounds by 1990, an 8.3 percent average annual growth rate. The end-use markets for injection-molded products are varied. They include food containers by Triplastics, pens by Paper Mate, razors by Gillette, spray pumps by Calmar, toys by Mattel, medical products by Cutter Labs and battery cases, which are made by Amerace, Gould, Delco, Globe Union and Richardson.

Film and sheet needs for resin are relatively small, with very few companies actually extruding film. A number of companies convert polypropylene film, which is shipped to the West Coast from the Gulf Coast.

Among the extruders of film on the West Coast are Richland Corporation, Crown Zellerbach and Dixico (La Mirada, CA). Gage Industries of Oregon is the only extruder of polypropylene sheet on the West Coast.

Extrusions, other than for film, fibers and filaments, accounted for 25 million pounds of resin in 1978. There was consumption of polypropylene resin for straws by NSF, Diamond Straw and Maryland Corporation; for rope and cordage by Tubs Cordage and Straplock; and for extruded pipe by U.S. Plastic Pipe and R. H. Sloane.

All other uses, consuming 20 million pounds of resin in 1978, included substantial amounts for medical use, specifically saline solutions. There is also some blow molding carried out by Continental Can. In addition, glass-reinforced polypropylene is being used in appliances.

The Western Canadian polypropylene market is currently in the 5-10 million pound per year range. It is anticipated to reach 20 million

pounds by 1990. Among the consumers are Canada Western Cordage, Vancouver (monofilament) and Cameo Plastic Products, Langley, B.C. (drinking straws).

b. Supply

There are no producers of polypropylene resin in the U.S. West Coast region. The demand for resin is met mostly by six U.S. producers: Hercules, Exxon, Eastman, Dart, Amoco and Novamont. Hercules is by far the largest supplier. Hercules is the sole Canadian producer, and Shell is also starting up a facility; both of these plants are in Eastern Canada. These firms and other U.S. producers serve the Canadian market.

c. Captive Consumption

Captive consumption of polypropylene on the West Coast is small, and it is anticipated that the percentage will remain low through the study period. There is no captive consumption in Western Canada.

d. Pricing

The price of polypropylene in the Western U.S. was 32 cents per pound for the homopolymer, delivered in bulk. Copolymer prices are 3 cents per pound higher. Canadian prices are \$0.38 and 0.42 (Canadian) per pound, respectively. Canadian imports of polypropylene are subject to a 10 percent ad valorem duty.

2. Pacific Basin Market

a. Japan

Demand

Japanese domestic demand for polypropylene is forecast to increase from 507,000 metric tons in 1977 and 577,000 metric tons in 1978 to 1,045,000 metric tons in 1990, an average annual growth of 5.1 percent. In addition, Japan has been a significant exporter of polypropylene, with

exports totaling 136,000 metric tons in 1978. Exports are anticipated to decline somewhat in future due primarily to the impact of new facilities in the region. Japanese polypropylene demand by end use is presented in Table IV-I-2.

TABLE IV-I-2
JAPANESE POLYPROPYLENE DEMAND
(Thousand Metric Tons)

	<u>1977</u>	<u>1978</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>AAGR, %</u> <u>(1978-1990)</u>
Domestic demand						
Film	152	171	205	260	320	5.4
Injection molding	206	239	285	360	435	5.1
Blow molding	20	20	23	30	40	5.9
Film yarn	47	61	67	85	105	4.6
Fiber	28	29	30	30	30	-
Extrusion and misc.	54	57	65	90	115	6.0
Total domestic demand	<u>507</u>	<u>577</u>	<u>675</u>	<u>855</u>	<u>1,045</u>	<u>5.1</u>
Exports	124	136	100	95	85	-
Total demand	<u>631</u>	<u>713</u>	<u>775</u>	<u>950</u>	<u>1,130</u>	<u>3.9</u>

Both cast and oriented polypropylene are produced in Japan. Since usage of these products is considerably greater than in the U.S. and polypropylene has already penetrated most potential markets, demand growth is anticipated to be in line with GNP growth. Injection molding applications are the largest use for the product. Demand is expected to increase about 5 percent per year. Slit film yarn for bags and carpet backing is a relatively mature market, and Japan is facing increased competition from South Korea and Taiwan in export markets. Polypropylene fiber is relatively minor in Japan since very little is used as a carpet face fiber and in upholstery. Significant applications for fiber include rope and other industrial uses and as a filler in comforters. In this latter application, polypropylene is facing increased competition from polyester.

Supply

The present capacity of the Japanese polypropylene industry is 1.1 million metric tons, as shown in Table IV-I-3. New facilities by Chubu,

Mitsui Petrochemical, and Tonen and are anticipated to increase capacity by 200,000 metric tons per year by the early 1980s. In addition, Sumitomo will probably build a facility in the 100,000 metric ton per year range if their proposed plant in Singapore is not built.

TABLE IV-I-3

JAPANESE POLYPROPYLENE PRODUCERS, 1978

<u>Company</u>	<u>Location</u>	<u>Capacity</u>	<u>Expansions</u>
Chisso	Chiba	155	
Chubu	Yokkaichi		40
Idemitsu	Chiba	60	
Mitsubishi Chemical	Mizushima	30	
Mitsubishi Petrochemical	Yokkaichi	105	
	Kashima	85	
Mitsui Petrochemical	Chiba	120	100
Mitsui-Toatsu	Ohtake	90	
	Senpoku	65	
Showa Petrochemical	Ohita	75	
Sumitomo	Chiba	96	
	Niihama	30	
Tonen	Kawasaki	60	60
Tokuyama Soda	Tokuyama	70	
Ube	Sakai	90	
Total		1,131	200

Supply/Demand Situation

The potential supply/demand situation for polypropylene in Japan is presented in Table IV-I-4. Existing and announced capacity for the product is sufficient to meet domestic demand plus significant export demand through the study period. Polypropylene is a product in which the Japanese specialize, and there is little potential for exports from an Alaskan plant to Japan under ordinary circumstances.

TABLE IV-I-4

POTENTIAL SUPPLY/DEMAND BALANCE FOR POLYPROPYLENE IN JAPAN
(Thousand Metric Tons)

	<u>1978</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>
Potential supply*	1,131	1,131	1,331	1,331
Forecast demand	713	775	950	1,130
Surplus/(deficit)	418	356	381	201

* 100 percent of nameplate capacity.

Pricing

In late June 1979, the price for polypropylene was 210 yen per kilo (43.4 cents per pound), delivered. Polypropylene prices in Japan depend upon propylene costs, and they tend to be similar to prices for polystyrene resins, with which they compete. Polypropylene imports into Japan are subject to an 8 percent ad valorem duty.

b. Korea

Demand

In 1978, the Korean polypropylene demand was 131,000 metric tons. Demand is anticipated to reach 170,000, 245,000 and 330,000 metric tons by 1975, 1980 and 1985, respectively. Woven bags constitute the largest market. Film, fiber and injection-molded articles are also made.

Supply

The sole Korean producer of polypropylene is Korea Petrochemical Industry Company (50 percent Korean interests/50 percent Chisso, Marubeni) at Ulsan, which has facilities capable of producing 110,000 metric tons per year of high density polyethylene and polypropylene. Capacity was increased to 140,000 metric tons per year during 1978 by adding a new line.

About one-third of the propylene feedstock for the unit is obtained from Korea Oil, with the remainder being obtained from imports from Europe, Japan and the U.S. The firm anticipates being a propylene importer until the Yeosu project comes on stream, at which time it will receive propylene from this source.

Honam Petrochemical (50 percent Honam Ethylene (Korean Government)/50 percent Mitsui Group) is also constructing an 80,000 metric ton per year unit at Yeochon, which is anticipated to be on stream during 1980.

Supply/Demand Situation

The potential supply/demand situation for polypropylene in Korea is shown in Table IV-I-5.

TABLE IV-I-5

POTENTIAL SUPPLY/DEMAND BALANCE FOR POLYPROPYLENE IN KOREA
(Thousand Metric Tons)

	<u>1977</u>	<u>1978</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>
Potential supply*	55	70	150	150	150
Forecast demand	123	131	170	245	330
Surplus/(deficit)	(68)	(61)	(20)	(95)	(180)
Actual production	110	74			

* Ulsan plant taken at 50 percent capacity for polypropylene.

Basically, even with expansion of the Korean Petrochemical Industry plant and the new Honam Petrochemical facility, Korea will remain a net importer of polypropylene. The country cannot, however, be considered a long-term consumer of material from an Alaskan plant.

c. Taiwan

The demand for polypropylene in Taiwan is anticipated to increase from 55,000 metric tons in 1977 and 74,000 metric tons in 1978 to 225,000

metric tons in 1990, as shown in Table IV-I-6. Consumption is primarily for the production of molded items and film for packaging applications and for slit film. Polypropylene fiber consumption is relatively small.

TABLE IV-I-6
TAIWAN POLYPROPYLENE DEMAND
(Metric Tons)

1977	55,000
1978	74,000
1980	95,000
1985	155,000
1990	225,000
AAGR, % (1978-1990)	9.7

Taiwan Polypropylene, in which Hercules has an interest, is the sole producer of polypropylene at present, with a 50,000 metric ton per year facility. This plant started up in late 1976, and there are plans to double the size of the plant in the early 1980s. Formosa Plastics is planning an 80,000 metric ton per year plant as part of a new petrochemical complex at Lin Yuan. Start-up is expected in 1982. As a result, there should be some export opportunities to Taiwan in the early 1980s, but Taiwan cannot be considered as a long-term export market from an Alaskan facility. The supply/demand balance for the product is shown in Table IV-I-7.

TABLE IV-I-7
POTENTIAL SUPPLY/DEMAND BALANCE FOR POLYPROPYLENE IN TAIWAN
(Thousand Metric Tons)

	<u>1977</u>	<u>1978</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>
Potential supply*	45	45	45	165	165
Forecast demand	55	74	95	155	225
Surplus/(deficit)	(10)	(29)	(50)	10	(60)

* 90 percent of nameplate capacity.

d. Hong Kong

The demand for polypropylene in Hong Kong is anticipated to increase from 18,000 metric tons in 1978 to 41,000 metric tons in 1990, as shown in Table IV-I-8. Demand in Hong Kong is essentially for production of molded articles and film. Although Hong Kong has a very large polystyrene consumption, it is anticipated that the inroads of polypropylene into these markets will be relatively modest. As a result, demand for polypropylene in the Colony will remain small relative to that for polyethylene and polystyrene.

TABLE IV-I-8

HONG KONG POLYPROPYLENE DEMAND
(Metric Tons)

1977	15,000
1978	18,000
1980	25,000
1985	33,000
1990	41,000
AAGR, % (1978-1990)	7.1

At present there are no polypropylene producers in Hong Kong, and none are foreseen. Hong Kong represents a long-term export market from an Alaskan facility, but unfortunately the market is relatively small.

e. ASEAN CountriesDemand

The demand for polypropylene in the ASEAN countries is anticipated to increase from 94,000 and 105,000 metric tons in 1977 and 1978 to 303,000 metric tons in 1990. The forecast demand, by country, is presented in Table IV-I-9. Most of the demand is in film and injection molding applications. Indonesia is the largest market, with consumption being relatively high due to the use of polypropylene in some traditional polyethylene applications. This is due to the efforts of Pertamina, which has a polypropylene facility.

TABLE IV-I-9

ASEAN COUNTRY POLYPROPYLENE DEMAND
(Thousand Metric Tons)

	<u>1977</u>	<u>1978</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>AAGR, %</u> <u>(Base 1978)</u>
Philippines	26	28	35	64	95	10.7
Singapore	6	7	9	14	18	8.2
Malaysia	12	15	18	26	35	7.3
Thailand	17	19	22	35	55	9.3
Indonesia	33	36	45	70	100	8.9
Total	94	105	119	209	303	9.2

Supply

The only polypropylene plant in the ASEAN countries is the 20,000 metric ton per year plant of Pertamina in Indonesia. Propylene from an adjacent refinery is used as the feedstock and, as a result of refining operating conditions, polypropylene production was only about 6,000 metric tons in 1978. No change in this situation is foreseen at least through the mid-1980s.

Two additional projects for the region have been announced: Sumitomo has plans for a 100,000 metric ton per year facility as part of the Singapore petrochemical complex, scheduled to come on stream in 1983, and Hercules has plans for a 60,000 metric ton per year plant as part of the Philippines petrochemical project. The latter project is not firm at present.

Supply/Demand Situation

The supply/demand balance within the ASEAN group will depend upon the completion of the proposed projects. By 1985 the Sumitomo project will be on stream, and by 1990 the Philippines project should be on stream. As a result, imports are anticipated to remain at over 100,000 metric tons from 1985 to 1990.

f. People's Republic of China

Capacity for production of polypropylene in the PRC is about 40,000 metric tons per year. Imports of the products are anticipated to be relatively small.

3. ConclusionsOpportunities for an Alaskan Plant

The supply and demand for polypropylene on the West Coast and in the Pacific Basin are summarized in Table IV-I-10.

TABLE IV-I-10

POLYPROPYLENE

	Demand			AAGR, %*	Capacity, per year	
	<u>1978</u>	<u>1985</u>	<u>1990</u>		<u>1978</u>	<u>Future</u>
		(Million Pounds)				
West Coast	130	260	375	9.1	0	0
	(Thousand Metric Tons)					
Japan	577	855	1,045	5.1	1,131	1,331
Korea	131	245	330	8.0	70	150
Taiwan	74	155	225	9.7	50	180
Hong Kong	13	33	41	7.1	0	0
ASEAN Countries	105	209	303	9.2	20	100-200*

* Future projects not certain.

During the 1980s, it is anticipated that new grass-roots polypropylene facilities will have to be at least 220 million pounds per year in size in order to be competitive. Because the market is dominated by Hercules, it is anticipated that a polypropylene producer with a West Coast plant could, at most, expect to obtain 25 percent of the market. However, this would amount to 65 million pounds in 1985, or less than 30 percent of plant capacity.

In 1985, the Pacific Basin countries are anticipated to have imports totaling 400-500 million pounds, of which at least half would be supplied from countries within the area. Because a large number of firms compete for this business, the maximum exports to the Pacific Basin region would be about 40 million pounds.

Unless the firm were already a major polypropylene supplier to the region, polypropylene production would not be too attractive, except to utilize propylene feedstock that had no other use.

J. Phenol1. West Coast Marketa. Demand

The demand for phenol on the West Coast is forecast to increase from about 305 million pounds in 1978 to 520 million pounds in 1990, as shown in Table IV-J-1. Phenolic resins, alkylphenols and some specialty products are the only phenol derivatives produced within the region.

TABLE IV-J-1
WEST COAST PHENOL DEMAND
(Million Pounds)

Western U.S.	<u>1977</u>	<u>1978</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>AAGR, % (1978-1990)</u>
Phenolic resins	225	235	265	325	385	4.2
Bisphenol-A	-	-	-	-	-	-
Caprolactam	-	-	-	-	-	-
Alkylphenols	10	10	11	13	15	3.4
Phenolic plasticizers	-	-	-	-	-	-
Salicylic acid	-	-	-	-	-	-
2,6-Xylenol	-	-	-	-	-	-
Miscellaneous	30	35	39	52	70	6.0
Total Western U.S.	<u>265</u>	<u>280</u>	<u>315</u>	<u>390</u>	<u>470</u>	<u>4.4</u>
Western Canada	25	25	30	40	50	5.9
Total	<u>290</u>	<u>305</u>	<u>335</u>	<u>430</u>	<u>520</u>	<u>4.5</u>

Phenolic resins represent over 80 percent of U.S. West Coast phenol consumption. In 1978, an estimated 320 million pounds of phenolic resins were consumed, or about 18 percent of overall U.S. consumption. The major use is in plywood manufacture, although hardboard, laminates and insulation usage is also significant. West Coast phenolic resin producers include Reichhold, Borden, Georgia-Pacific, Monsanto, Skelly, Simpson Timber, Univar and Weyerhaeuser.

Alkylphenol production on the U.S. West Coast was estimated at 25 million pounds in 1978. The largest use areas for alkylphenols are surfactants, tube oil additives, resin copolymers and rubber and plastic additives.

Kalama Chemical produces nonylphenol in Kalama, Washington, at its 20 million pound per year capacity plant. Productol has a 5 million pound per year capacity plant in Santa Fe Springs, California, and also has a small capacity for producing octylphenol.

Miscellaneous uses of phenol accounted for an estimated 35 million pounds in 1978. This category includes phenolphthalein, 2,4-D, pentachlorophenol, petroleum refining, para-tert-butylphenol and agricultural chemicals.

Phenolic consumption in Western Canada was about 25 million pounds in 1978, and consumption is expected to double by 1990. Consumption is almost entirely for phenolic resin production from plywood, particle board and glass fiber insulation use. The phenolic resin producers in Western Canada are Reichhold at Port Moody and Kamloops and Borden at Vancouver. Each of these firms has 40-50 million pounds per year of resin capacity.

Cumene

Actual cumene consumption on the West Coast is about 70 million pounds per year. Potential cumene demand, if the region were self-sufficient in phenol, is forecast to increase from 315 million pounds in 1978 to 600 million pounds in 1990, as shown in Table IV-J-2. Cumene is not the only feedstock for phenol in the region, since Kalama Chemical and Dow at Ladner, B.C. utilize toluene.

TABLE IV-J-2

POTENTIAL U.S. WEST COAST CUMENE DEMAND
(Million Pounds)

	<u>1977</u>	<u>1978</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>AAGR, % (1978-1990)</u>
Phenol demand	290	305	335	430	520	4.5
Less: phenol by other routes	80	80	90	90	90	
Phenol from cumene	210	225	245	340	430	
Cumene requirement	295	315	345	475	600	

b. Supply

Chevron is the only producer of cumene in the Western region, with a 100 million pound per year plant at El Segundo, CA. Chevron uses its cumene captively for the production of phenol and acetone in a 55 million pounds per year phenol plant. Kalama Chemical at Kalama, WA, and Dow at Ladner, B.C., also produce phenol, but by the toluene oxidation route. The West Coast phenol producers are summarized in Table IV-J-3. Productol recovers small quantities of natural phenol at its Santa Fe Springs, CA, facility.

TABLE IV-J-3

U.S. WEST COAST PHENOL PRODUCERS, 1978
(Million Pounds per Year)

<u>Company</u>	<u>Location</u>	<u>Capacity</u>	<u>Process</u>
Chevron	Richmond, CA	55	Cumene
Dow	Ladner, BC	30	Toluene Oxidation
Kalama Chemical	Kalama, WA	80	Toluene Oxidation
Productol	Sante Fe Springs, CA	neg.	Natural
Total		165	

All of the U.S. phenol producers, except Clark, are reported to market on the West Coast. In addition to the local producers, Shell, Dow and Monsanto are major suppliers. Dow supplies the entire Western Canadian market.

c. Captive Market

It is estimated that the captive market for phenol in the Western region was about 130-140 million pounds in 1978. Among the largest users of phenol for phenolic resins in the region are Monsanto, Reichhold, Skelly and Georgia-Pacific. Chevron uses phenol internally for agricultural products, and Kalama and Productol produce alkylphenols. No significant change in the percentage of captive consumption is anticipated over the study period.

d. Pricing

The U.S. price for phenol was 36 cents per pound as of October 1, 1979. Canadian prices were \$0.45 (Canadian) per pound for the Eastern Canadian plants. Phenol prices are primarily related to the price and availability of benzene feedstock and the supply/demand situation for the product. Phenol imports into Canada are subject to a 15 percent ad valorem duty, but some Canadian resin producers are able to take advantage of duty drawback situations.

2. Pacific Basin Market

a. Japan

Demand

Japan's domestic demand for phenol is forecast to increase from 202,000 metric tons in 1978 to 405,000 metric tons in 1990, a growth rate of 3.9 percent per year over the period. Imports are due to the cumene toll processing agreement between Mitsubishi Petrochemical and Dow. Exports should decline throughout the study period, reaching zero by 1990.

The Japanese demand for phenol is presented in Table IV-J-4.

TABLE IV-J-4

JAPANESE PHENOL DEMAND
(Thousand Metric Tons)

	<u>1977</u>	<u>1978</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>AAGR, % (1978-1990)</u>
Phenolic resins	106	110	125	175	240	6.7
Bisphenol-A	55	53	55	70	90	4.5
Alkylphenols	15	15	15	20	30	5.9
Phenolic plasticizers	2	2	2	3	4	6.0
Aniline	20	20	21	24	37	5.3
Other	2	2	2	3	4	6.0
Total domestic	<u>200</u>	<u>202</u>	<u>220</u>	<u>295</u>	<u>405</u>	<u>6.0</u>
Exports	<u>33</u>	<u>53</u>	<u>25</u>	<u>5</u>	<u>-</u>	<u>-</u>
Total demand	<u>233</u>	<u>255</u>	<u>245</u>	<u>300</u>	<u>405</u>	<u>3.9</u>

Phenolic resins demand is forecast to grow at around 6.7 percent per year. Bisphenol-A is used in Japan primarily for epoxy resins (50 percent) and polycarbonates (45 percent). Growth of bisphenol-A demand for epoxies and polycarbonates has been slower than in other parts of the world, and a relatively slow growth of only 4.5 percent is projected for the study period. Alkylphenols are used for alkylphenol ethoxylate manufacture and for production of lube oil additives, agricultural chemicals and antioxidants. Demand growth should average nearly 6 percent over the study period. Aniline is produced from phenol by Mitsui Petrochemical, and the aniline needs of the Mitsui group tend to be met from this source. Other applications include surfactants, agricultural chemicals, pharmaceuticals, plasticizers and stabilizers.

Supply

Current phenol capacity is 316,000 metric tons per year, as indicated in Table IV-J-5. No expansions are in progress. However, a new 100,000 metric ton per year plant, which should be built in the 1980s, is being planned by Mitsubishi Petrochemical. As a result, Japan is anticipated to be self-sufficient in phenol.

TABLE IV-J-5

JAPANESE PHENOL PRODUCERS, 1979
(Thousand Metric Tons per Year)

<u>Company</u>	<u>Location</u>	<u>Capacity</u>	<u>Process</u>
Mitsui Toatsu	Senpoku	100	Cumene
	Nagoya	36	Sulfonation
Mitsui Petrochemical	Chiba	150	Cumene
	Iwakuni	30	Cumene
		<u>316</u>	

Pricing

The Japanese price for phenol was 220 yen per kilo (45.4 cents per pound) as of early August. Phenol imports are subject to an 8 percent duty.

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b. Korea

Korean demand for phenol was about 9,000 metric tons in 1977 and 10,000 metric tons in 1978. Demand should reach 14,000, 24,000 and 35,000 metric tons by 1980, 1985 and 1990, respectively. Use is primarily for the production of resins.

Keumho Chemical is constructing a 25,000 metric ton per year phenol plant at Yeosu. This facility and an associated 35,000 metric ton per year cumene unit should be on stream in the 1979-1980 period. As a result, Korea should be self-sufficient in phenol through the mid-1980s.

c. Taiwan

The demand for phenol in Taiwan was about 5,000 metric tons in 1977 and 8,000 metric tons in 1978. Demand is forecast to reach 12,000, 18,000 and 24,000 metric tons by 1980, 1985 and 1990, respectively. Essentially all demand is for the manufacture of phenolic resins.

At present, there is no phenol production in Taiwan. The government has been attempting to promote production of the material, but the low demand makes production unlikely until at least the mid-1980s.

d. Hong Kong

The demand for phenol in Hong Kong is about 300-400 metric tons per year. In addition, the Colony imports about 4,000 metric tons per year of phenolic resins. The demand for phenol is anticipated to remain small, and no local production is foreseen.

e. ASEAN Countries

Phenol demand in the ASEAN countries is forecast to increase from 7,800 and 12,000 metric tons in 1977 and 1978 to 14,100, 17,900 and 22,800 in 1980, 1985 and 1990, respectively, as shown in Table IV-J-6. Essentially all of the material is used in the production of plywood adhesives.

There are no phenol producers in the ASEAN countries, and no production is anticipated during the study period.

TABLE IV-J-6
ASEAN COUNTRY PHENOL DEMAND
(Thousand Metric Tons)

	<u>1977</u>	<u>1978</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>AAGR, %</u> <u>(Base 1978)</u>
Philippines	1.9	2.2	2.4	2.9	3.5	3.9
Singapore	2.7	5.0	5.5	6.0	6.5	2.2
Malaysia	2.6	4.0	5.0	6.5	8.3	6.3
Thailand	0.6	0.7	1.0	2.0	3.0	12.9
Indonesia	nil	0.1	0.2	0.5	1.5	25
Total	7.8	12.0	14.1	17.9	22.8	5.5

f. People's Republic of China

Phenol imports to the PRC are very small.

3. Conclusions

Opportunities for an Alaskan Plant

The supply and demand for phenol on the West Coast and in the Pacific Basin are summarized in Table IV-J-7.

TABLE IV-J-7

	<u>PHENOL</u>				<u>Capacity, per year</u>	
	<u>1978</u>	<u>Demand</u>		<u>AAGR, %</u>	<u>1978</u>	<u>Future</u>
		<u>1985</u>	<u>1990</u>		<u>(Million Pounds)</u>	
West Coast	305	430	520	4.5	0	165
	<u>(Thousand Metric Tons)</u>					
Japan	202	295	405	6.0	316	416
Korea	10	24	35	11.0	0	30
Taiwan	8	18	24	9.6	0	0
Hong Kong	neg.	neg.	neg.	-	0	0
ASEAN Countries	12	18	23	5.5	0	0

During the 1980s, the minimum size for a phenol plant will be 400-500 million pounds per year. The relatively small merchant market on the West Coast, coupled with small markets in the Pacific Basin countries, makes production in Alaska relatively unattractive under normal circumstances.

K. Acrylonitrile

1. West Coast Market

a. Demand

The U.S. West Coast demand for acrylonitrile was about 7-8 million pounds in 1978. It is expected to grow to about 10 million pounds in 1985 and 13 million pounds by 1990. The only major market for the product on the West Coast is for the production of ABS resins by Dow, which is a merchant consumer. There is no acrylonitrile consumption in Western Canada.

b. Supply

There are no producers of acrylonitrile in the West Coast region. Abundant capacity exists in the U.S. to supply this region.

c. Captive Market

There is no captive consumption of acrylonitrile on the West Coast.

d. Pricing

The price for acrylonitrile as of October 1, 1979, was 27.5 cents per pound.

2. Pacific Basin Market

a. Japan

Demand

Japanese domestic acrylonitrile demand is forecast to increase from 515,000 metric tons in 1978 to 550,000, 700,000 and 860,000 metric tons in 1980, 1985 and 1990, respectively. This represents an average annual

growth of 4.4 percent. Exports were 95,000 metric tons in 1978, and these are expected to decrease due to the addition of plant capacity in Korea, the major export market. On an overall basis, demand is expected to increase from 610,000 metric tons in 1978 to 930,000 metric tons in 1990, as shown in Table IV-K-1.

TABLE IV-K-1
JAPANESE ACRYLONITRILE DEMAND
(Thousand Metric Tons)

	<u>1977</u>	<u>1978</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>AAGR, % (1978-1990)</u>
Acrylic fiber	320	320	335	430	525	4.2
ABS resin and nitrile rubber	85	90	100	130	160	4.9
Others	100	105	115	140	175	4.3
Total domestic demand	<u>505</u>	<u>515</u>	<u>550</u>	<u>700</u>	<u>860</u>	<u>4.4</u>
Exports	90	95	60	60	70	-
Total demand	<u>595</u>	<u>610</u>	<u>610</u>	<u>760</u>	<u>930</u>	<u>3.6</u>

About 60-65 percent of Japanese acrylonitrile is in the production of acrylic fibers. Acrylic fiber demand is expected to grow at nearly 5 percent per year, due to the growth of the Japanese carpet market. In 1978, imports of acrylic staple from the U.S. rose sharply, due primarily to the lower cost of the U.S. products. In Japan, higher naphtha prices have resulted in imports of U.S. acrylic fiber selling for about 20 percent less than the domestic product. It is believed that Japan will limit these imports by 1980 through the imposition of import tariffs or other means. Acrylonitrile demand for fibers is thus expected to exhibit slow growth until about 1980 and then average about 4 to 5 percent per year throughout the study period. ABS resins will have a growth of about 5 percent per year. Other applications include acrylamide and adiponitrile for hexamethylenediamine production.

Supply

At the end of 1978, Japanese acrylonitrile capacity totaled 744,000 metric tons, divided among seven producers. The Japanese acrylonitrile producers are shown in Table IV-K-2.

TABLE IV-K-2JAPANESE ACRYLONITRILE PRODUCERS

Asahi Chemical Industry
 Mitsubishi Chemical
 Mitsui Petrochemical
 Mitsui-Toatsu
 Nitto Chemical
 Showa Denko
 Sumitomo Chemical

Supply/Demand Situation

The supply/demand for acrylonitrile in Japan is relatively tight, as shown in Table IV-K-3. In 1978, the operating rate was 82 percent, and additional capacity will be required by 1985 in order to meet demand growth.

TABLE IV-K-3

POTENTIAL SUPPLY/DEMAND BALANCE FOR ACRYLONITRILE IN JAPAN
 (Thousand Metric Tons)

	<u>1977</u>	<u>1978</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>
Potential supply*	744	744	744	744**	744**
Forecast demand	595	610	610	760	930
Surplus/(deficit)	149	134	134	(16)	(186)
Operating rate, %	80	82	82	-	-

* 100 percent of nameplate capacity.

** Additional expansions likely.

Pricing

The Japanese acrylonitrile price was 210 yen per kilo (43.4 cents per pound) in early August 1979. Imports of acrylonitrile into Japan are subject to an 8 percent ad valorem duty.

b. Korea

The Korean demand for acrylonitrile was 116,000 metric tons in 1977 and 124,000 metric tons in 1978. Demand is forecast to reach 150,000, 190,000 and 240,000 metric tons in 1980, 1985 and 1990, respectively. Acrylic fiber is the major use, but there is also demand for ABS resins and other applications.

The sole producer of acrylonitrile in Korea is Tongsuh Petrochemical, which expanded capacity from 27,000 to 77,000 metric tons per year in 1978. An additional 100,000 metric tons of capacity are planned at the third petrochemical complex at Yochon, which is expected to be on stream by the mid-1980s.

c. Taiwan

Domestic demand for acrylonitrile in Taiwan increased from 53,000 metric tons in 1977 to 84,000 metric tons in 1978. It is expected to increase to 105,000, 154,000 and 198,000 metric tons in 1980, 1985 and 1990, respectively.

Acrylic fiber is the major application for acrylonitrile, representing over 90 percent of the demand. Acrylic fibers are used in the country's export-oriented textile business.

China Petrochemical Development Corporation is the only producer of acrylonitrile in Taiwan, with a nameplate capacity of 132,000 metric tons per year. The country has sufficient capacity to meet demand until the early 1980s.

d. Other Countries

Other countries in the Pacific Basin area do not consume acrylonitrile.

3. Conclusions

Opportunities for an Alaskan Plant

The supply and demand for acrylonitrile on the West Coast and in the Pacific Basin are summarized in Table IV-K-4.

TABLE IV-K-4

ACRYLONITRILE

	Demand			AAGR, %	Capacity, per year	
	<u>1978</u>	<u>1985</u>	<u>1990</u>		<u>1978</u>	<u>Future</u>
	(Million Pounds)					
West Coast	8	10	13	4.2	0	0
	(Thousand Metric Tons)					
Japan	515	700	860	4.4	744	744
Korea	124	190	240	5.7	77	177
Taiwan	84	154	198	7.4	132	132*
Hong Kong	neg.	neg.	neg.	-	0	0
ASEAN Countries	neg.	neg.	neg.	-	0	0

* Additional facilities expected.

The acrylonitrile market on the West Coast is very small, and markets in the Far East are anticipated to grow modestly, with the region being generally self-sufficient in the product. As a result, there is little opportunity for large acrylonitrile exports from an Alaskan facility, and a plant would not be viable.

L. Isopropyl Alcohol

1. West Coast Market

a. Demand

Isopropyl alcohol consumption in 1978 in the Western region totaled 165 million pounds, of which about 100 million was used captively for acetone production by Shell. Isopropanol is used in chemical extraction, pharmaceuticals and coatings. Some isopropanol is sold for use in its own right as an alcohol. The breakdown of isopropanol use is shown in Table IV-L-1.

TABLE IV-L-1
WEST COAST ISOPROPANOL DEMAND
(Million Pounds)

Western U.S.	<u>1977</u>	<u>1978</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>AAGR, % (1978-1990)</u>
Acetone	120	100	100	100	104	-
Other uses and export	55	60	71	90	106	-
Total Western U.S.	<u>175</u>	<u>160</u>	<u>171</u>	<u>190</u>	<u>210</u>	<u>2.3</u>
Western Canada	5	5	6	8	10	5.7
Total	<u>180</u>	<u>165</u>	<u>177</u>	<u>198</u>	<u>220</u>	<u>2.4</u>

Acetone is the largest use for isopropanol, consuming 100 million pounds in 1978. Very little growth in demand is expected over the 1978-1990 period due to capacity limitations of the Shell unit.

Coatings and solvent still provide a large market for isopropanol; they account for over half of the "other" uses. Oils, gums, shellac and synthetic resins are typical solvent uses. One significant chemical use is the extraction of pectin from rind. Pharmaceuticals and various miscellaneous uses account for the remaining use of isopropanol in the West Coast region.

b. Supply

There is only one producer of isopropanol in the West. Shell has a 215 million pound plant in Dominguez, California. Shell has most of the market, with Exxon and others also supplying the area. Shell, Van Waters & Rogers and Shore-Line Engineering distribute in Western Canada.

c. Captive Market

The only captive consumption on the West Coast is Shell's use of isopropanol for acetone production. This use will remain at about 100 million pounds per year over the study period unless increased by-product acetone is available from a new phenol plant.

d. Pricing

The price for anhydrous isopropyl alcohol in the U.S. was \$1.25 per gallon as of October 1, 1979. The Canadian price in late September was \$0.243 (Canadian) per pound in the east, with prices somewhat higher in the west. Canadian imports of isopropyl alcohol are subject to an 8 percent ad valorem duty.

2. Pacific Basin Region

a. Japan

Isopropanol demand in Japan is relatively modest since very little is used for the production of acetone. Overall demand is anticipated to have modest but continued growth over the study period, with demand increasing from 75,000 metric tons in 1978 to 100,000 metric tons by 1990, as shown in Table IV-L-2.

TABLE IV-L-2
JAPANESE ISOPROPANOL DEMAND
 (Million Pounds)

	<u>1977</u>	<u>1978</u>	<u>1980</u>	<u>1985</u>	<u>1990</u>	<u>AAGR, %</u> <u>(1978-1990)</u>
Solvent	31	32	33	36	39	1.7
Agricultural chemicals	5	5	6	8	10	-
Medical uses	5	5	6	8	10	-
Surfactants	5	5	6	8	10	-
Chemical manufacture	3	3	4	5	6	-
Miscellaneous	13	15	16	18	20	-
Total domestic demand	<u>62</u>	<u>65</u>	<u>71</u>	<u>83</u>	<u>95</u>	<u>3.2</u>
Exports	10	10	9	7	5	-
Total demand	<u>72</u>	<u>75</u>	<u>80</u>	<u>90</u>	<u>100</u>	<u>2.4</u>

Supply

Japanese producers of isopropanol are listed in Table IV-L-3. Existing isopropanol capacity is 105,000 metric tons per year. There are no expansions in progress, but Tokuyama Soda has considered a 15,000 metric ton per year expansion. It is anticipated that supply of isopropanol will be sufficient to meet Japanese and some export demand.

TABLE IV-L-3
JAPANESE ISOPROPANOL PRODUCERS, 1978
 (Thousand Metric Tons per Year)

<u>Company</u>	<u>Location</u>	<u>Capacity</u>
Mitsui-Toatsu	Senpoku	30
Nippon Petrochemical	Kawasaki	60
Tokuyama Soda	Tokuyama	15
		<u>105</u>

Pricing

The Japanese isopropyl alcohol price was 160 yen per kilo (33 cents per pound) in early August 1979. Isopropyl alcohol imports are subject to an 8 percent ad valorem duty.

b. Korea

Demand for isopropanol in Korea is modest, with demand for this material expected to remain under 2,000-3,000 metric tons per year throughout the study period.

c. Taiwan

In 1978, isopropanol demand in Taiwan was estimated at or near 1,000 metric tons. Demand is expected to reach over 2,000 metric tons by 1990 in existing applications. The major use for the product is in cosmetics and toilet goods.

At present, isopropanol is not produced in Taiwan. A 30,000 metric ton per year isopropanol unit has been planned as part of the fourth petrochemical complex and is expected on stream about 1983. The material would be used for acetone manufacture.

d. Hong Kong

Hong Kong consumption of isopropanol in 1978 was about 1,700 metric tons. Consumption of this material is forecast to grow 6-8 percent per year over the study period. There is no production of isopropanol in the Colony and none is anticipated.

e. ASEAN Countries

Demand for isopropanol in the ASEAN countries is expected to increase from 7,000 metric tons in 1978 to 15,000 metric tons in 1990, as shown in Table IV-L-4.

TABLE IV-L-4ASEAN COUNTRY ISOPROPANOL DEMAND
(Thousand Metric Tons)

1977	6.5
1978	7
1980	8
1985	11
1990	15
AAGR (base 1978), %	6.6

The Philippines accounts for about half of isopropanol demand. Imports for Singapore, Malaysia and Indonesia, which are handled through Singapore, account for most of the remaining consumption.

There are no isopropanol facilities in the ASEAN countries and none are expected throughout the study period.

f. People's Republic of China

PRC isopropyl alcohol imports are insignificant.

3. Conclusions

Opportunities for an Alaskan Plant

The supply and demand for isopropyl alcohol on the West Coast and in the Pacific Basin are summarized in Table IV-L-5.

Since there is sufficient capacity to meet forecast demand during the study period throughout the Pacific Basin countries, an isopropyl alcohol plant in Alaska is not viable.

TABLE IV-L-5

ISOPROPYL ALCOHOL

	Demand			AAGR, %	Capacity, per year	
	<u>1978</u>	<u>1985</u>	<u>1990</u>		<u>1978</u>	<u>Future</u>
	(Million Pounds)					
West Coast	165	198	220	2.4	215	215
	(Thousand Metric Tons)					
Japan	65	83	95	3.2	105	105
Korea	2	3	3	-	0	0
Taiwan	1	32	32	-	0	30
Hong Kong	2	3	4	-	0	0
ASEAN Countries	7	11	15	6.6	0	0

M. Propylene

Propylene is normally consumed in derivative plants at or near the production site. However, Korea has been a significant importer due to a supply/demand imbalance, but all other countries have sufficient propylene or have imported the product in the form of derivatives. The imbalance in Korea is not anticipated to continue, since new sources of supply will come on stream in the early 1980s. It has been proposed that propylene be imported as feedstock for a new polypropylene plant in the Philippines. Requirements would be about 150 million pounds per year. At present, however, it is uncertain if this project will proceed.

Over the longer term, it is expected that propylene will be in surplus in the Pacific Rim area and, as a result, no significant propylene markets exist for production from an Alaskan facility.

V. FEASIBILITY OF AN ALASKAN PETROCHEMICAL COMPLEX

The core of a natural gas liquids-based petrochemical complex is an olefins plant which produces ethylene as the prime product. The simplest and lowest cost olefin units are based on ethane feed. If propane and/or butane are used instead, significant quantities of propylene are also produced.

For a petrochemical complex to be viable, a sufficient volume of derivatives must be produced to utilize the production from a world-scale olefins unit. The economic size is at least 1 billion pounds per year of ethylene capacity.

As shown in the analyses presented in Section IV, the manufacture of low and high density polyethylene, styrene, vinyl chloride and ethylene glycol in world-scale units were found to be viable. Table V-1 summarizes the potential ethylene consumption by derivative.

TABLE V-1
POTENTIAL ETHYLENE CONSUMPTION BY DERIVATIVE
(Million Pounds Per Year)

<u>Derivative</u>	<u>Derivative Plant Size</u>	<u>Ethylene Consumption at Capacity</u>
Low density polyethylene	500	525
High density polyethylene	250-400	260-420
Styrene	600-800	200-270
Vinyl chloride	500-1,000	250-500
Ethylene glycol	400-500	320-400
		<u>1,555-2,115</u>

Based on the market situations, an Alaskan petrochemical complex would most likely consist of low and high density polyethylene facilities, plus a styrene, vinyl chloride, or ethylene glycol plant. The choice of units would primarily be dictated by the nature of the firms involved in the project.

The market for propylene derivatives does not look very good. However, if it were necessary to use propane and/or butanes as part of the feed, a 200 million pound per year polypropylene plant would probably be viable.

Basically, the petrochemical markets in the Pacific Rim area are sufficient to support a major complex in Alaska at present and probably a second complex in the late 1980s.

SCOMM

#14:17



Alaska State Legislature

POUCH Y, STATE CAPITOL
JUNEAU, ALASKA 99811
907 465-3800

TRANSCRIPT OF TESTIMONY OF

DR. ARLON TUSSING

March 16, 1978

BEFORE THE SPECIAL COMMITTEE ON ROYALTY OIL AND GAS

Committee:

Senators:

Chairman Mike Colletta
Pat Rodey
Bill Sumner
John Sackett
Kay Poland

Representatives:

Chairman Bill Miles
Chat Chatterton
Joe McKinnon
Charlie Parr
Al Osterback

DR. TUSSING:

You all know who I am, and I won't waste time on introducing myself. I have a number of questions I intend to address myself to this evening, and let me run through the questions which I would deal with, if I have the time, which I won't, and we'll try to be selective. What I'll do is I'll take up one issue at a time, and let you discuss....let's have some interchange during the discussion. I won't have a formal presentation. We'll just take these issues up. Feel free to interrupt me if there is something you are not following.

Here are the issues that had been identified as possible areas for my treatment on which I'm ready to comment. First, what is the likelihood that the ALPETCO project will be commercially viable? And under that, comment on the Alaska disadvantage and how ALPETCO might overcome it. Second, comment on the realism of ALPETCO's marketing plans for Japan and for the U. S. West Coast. Third, is it possible, or likely, ALPETCO could get its project financed without an overwhelming assurance of its commercial feasibility? Fourth, what would happen if the ALPETCO facility were financed and built and, after its completion, it were to be unprofitable? What would be the consequences for ALPETCO's sponsors, for the bond holders,

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for the employees, for the community in which the plant was located, and for the State? Fifth, if ALPETCO were to encounter difficulties, either in financing the project or in operating it profitably, what other assistance, if any, would ALPETCO be likely to ask from the State, apart from a discount on crude oil prices? What would be the cost risks or other implications for the State from any of these measures? Sixth, what will be the likely impact of the ALPETCO project on the West Coast oil market and on the value of Alaska crude oil generally, both before and after the proposed facility goes on-stream. Seventh, comment on Sections 2.3 and 2.4 of the contract, specifically the option to buy non-Prudhoe royalty oil. Seven, comment on the procedures by which the Commissioner of Natural Resources and the Royalty Board decided to negotiate this contract. And eight, how can the Legislature best resolve the factual, legal, analytical, and policy questions presented by this contract.

Of all of these things, I think that the Battelle presentation has set the background for discussing some of the issues which relate to the West Coast surplus. Firstly, let me say that the West Coast surplus will have, and is having, a consequence that the Battelle study did not point up and that is in exerting downward pressures on West Coast oil prices. And, as the West Coast surplus increases, those downward pressures will increase. I will want to show you in a brief scheme how these downward pressures are likely to work.

Taking a series of hypothetical prices at Valdez - these are net back prices at Valdez for shipments to various parts to various markets based upon what net back prices were posted by the company in September of 1977, with some modifications, but, essentially, the sales in Alaska to Alaska refiners were at \$12.50 a barrel; that is, as of Valdez. West Coast sales were at an average of \$12.63. Gulf Coast sales were at \$10.72. And this reflects the differences in transportation costs to those markets, as the average transportation cost from Valdez to the Gulf Coast was \$3.05, while the average transportation cost to California was \$.82, and to Cherry Point \$.60. And this is what results in the difference in Valdez price.

Okay, now let's move forward to 1980 and assume that nothing changes in terms of the real prices of oil, that the OPEC price in real dollars, remains constant, and the transportation costs remain constant. And that, of course, assumes that for the Gulf Coast price to remain constant and assumes there will be no higher prices.

CHAIRMAN MILES:

Doctor, are you sure that your figures are right there - \$12.50

at Valdez price for sale in Alaska and a higher sale for the West Coast?

DR. TUSSING:

Yes. I'm not sure these are right. I took this figure from Bonner and Moore, who claim to have derived it from state revenue figures. Since I had just one day to prepare this, I had to grab the only materials I had at hand. I didn't have a chance to go to the original data. Whether or not this is precisely right is irrelevant to the thrust of my explanation. What I am dealing with is the large difference between the West Coast and the Gulf Coast net back, and Battelle set out the same thing. They had different numbers, but they were in the same order of magnitude - roughly, a \$2.00 difference in the net back price from the West Coast and the Gulf Coast.

As you know, ARCO was able to market most of the oil through its own West Coast refineries; EXXON, a somewhat smaller proportion; and SOHIO, with no outlets of their own on the West Coast, must ship most of their crude to the Gulf Coast markets. Now projecting ahead the shares of the various markets to 1980, and assuming 1.2 million barrels per day, which is more than is going to be produced at this stage - but, again, it's a minor....I'm not trying to predict the future in this - but, projecting the differences, we have for ARCO an average net back price at Valdez of \$12.23, for SOHIO, an average net back price of \$12.21 - not for SOHIO....for EXXON, SOHIO - \$11.46, and for a total, including the other minor companies, a weighted average price of \$11.79.

Alright, now, what we see here is that the cost of oil for SOHIO is more than a dollar under the West Coast price. It's an interesting situation, which in our competitive textbook economics would say would not last very long because SOHIO, rather than accept this price for its oil, would want to penetrate this market for every barrel, additional barrel, that SOHIO could put into the West Coast market. SOHIO would make \$1.17 more. Our textbook market economics would say SOHIO would keep trying to sell oil on the West Coast until - what would happen if SOHIO tried to sell more oil out on the West Coast? They would drive this price down. In other words, to make room in the market, they would have to offer a discount because ARCO and EXXON are selling all they can at this price, or moving all they can at this price - the biggest customer is SOCAL - to displace more Saudi crude out of SOCAL's supply, or, for that matter, to convince refiners to not to take oil somebody else. So, SOHIO would have to offer a discount. Now, SOHIO would be ahead as long as it could get more than \$11.46; that is, on the last barrel. The reason SOHIO doesn't do this is that by pushing more crude into the West Coast they are not just making....suppose they offer it on the West Coast for

\$11.63, for a dollar discount. Well, they are making the difference between \$11.46 and \$11.63 on that incremental barrel, but, in the meanwhile, they are provoking the others to cut their prices, too, to maintain their market share. The California independents will cut their prices to maintain their market share. So, all the producers would end up worse off than they were before, as they would all end up selling roughly the same amount of oil into the West Coast market. But all of them would be getting less, and the state would be getting less. So, SOHIO, because it's such a big element in the market, suffers most from its own competitive actions. SOHIO is not about to start a price war which will drive the West Coast price down.

Other than that, with the growing surplus, SOHIO really does want to market this. One of the things that came out in the suit of the Maritime Unions against the Virgin Island Exchanges - what was doing was SOHIO was swapping its oil with SOCAL; it was delivering its oil to SOCAL and taking SOCAL's Saudi crude and selling the Saudi crude in the Virgin Islands at a discount. They weren't discounting on the West Coast. They were posting their net back prices in Alaska as if they were selling it in competition with Saudi crude on the West Coast. Yet, they were taking a loss on the Saudi crude they sold in the Virgin Islands. So, in effect, they were discounting without it appearing on the books, and the State of Alaska was getting royalties and severance taxes on the basis of a crude price which was higher than the true value - the market value - of the crude. In other words, SOHIO was willing to pay a higher royalty and a higher tax than it had to, based on the true value of the crude in order not to appear to be pushing down the West Coast price.

This was what was happening with production at less than 700 million barrels a day - 700 thousand barrels a day. As production gets up to 1.1, the downward pressure of the temptation of any of the producers to try to get more of the West Coast market. All of them can do better on the West Coast than they can.... Their average price is lower than the West Coast price. They can all do better so long as that's the case.

Now, if competition broke out, what would happen is the West Coast price would be driven down to \$10.72. The competition that each of these producers, say SOHIO, would keep trying to sell more oil on the West Coast. It could keep making more oil on the incremental barrel, on the last barrel, by selling it on the West Coast at a discount until they got it down to this price.- until they were making no more from selling on the West Coast than they made on the East Coast. If they could receive \$10.73 by selling an extra barrel on the West Coast, instead of \$10.72 by selling on the Gulf Coast, they would do it, if there were competition. Now, where does ALPETCO come

into this?

In a situation where the surplus is going to be increasing, at least until 1985, and I suspect it's going to continue to increase faster than that - the projections that were cited by Battelle that show it falling off are both pessimistic about future discoveries. By 1985 we are going to have the (indisc.) Sea sale, the lower Cook Inlet sale - will have been taken place long enough that if there are any discoveries to be made there they will be ready to go on-stream. There will be, according to the Interior Department's schedule, seven more OCS leases off Alaska in that time, so that the supply may continue to expand far beyond the highest of those projections. While it's my belief we are in for a long period of low economic growth and low increase in energy demand, for reasons which you can see.

Now the economic management of the United States and the Free World is not really at its optimum, and I think that we're going to see very low rates of growth - of economic growth and energy growth, generally. So, we're going to have an increasing surplus on the West Coast, increasing downward pressure on prices if exports aren't authorized and if none of these proposed transcontinental pipelines are authorized. And I think the odds are against all of them. Anyway, you have continued downward pressure.

What does ALPETCO do? If it comes in as a petrochemical plant, it removes some of the surplus crude that otherwise tends to depress the West Coast price. It does not go into the petroleum market as such. And so a crude-base petrochemical facility in Alaska, or anywhere on the West Coast, if it used Alaska-type crudes, would reduce the surplus of crude on the West Coast, it would reduce the amount which has to be pushed through to the Gulf Coast. The weighted average price, the price that ALPETCO would have to pay under these assumptions, would be \$11.79. They would be paying \$11.79 essentially for oil that would otherwise have to be marketed on the Gulf Coast for \$10.72. So there would be two effects of that. One is that the pressure on the part of the other producers to market their surplus on the West Coast, and drive down the price, will be reduced. The second is that the weighted average itself will tend to go up because some of this will be pulled out. Some of the \$10.72 will be pulled out of the weighted average and replaced.... say, this is oil that SOHIO pays \$10.72 for, will be reduced.... and, instead, ALPETCO will be paying the \$11.79. So the weighted average will go up, and ALPETCO's price will be more than \$11.79.

So everybody's price will be....the total price will be higher. So, (indisc.) in that context, any facility which removes oil from the West Coast market and reduces the pressures on the West Coast market, the surplus is favorable to the state. Now, as the Battelle people pointed out, the thing that is over-

whelmingly most favorable to the state would be exports to Japan. I think that they made a good case that this is the best thing, under any circumstances, that could happen to the state. I think that the state has not devoted it the attention it might have to overcome the political bottlenecks. This is something that is a subject for another discussion, but I believe that exports could be authorized with the proper political strategy.

But, getting back to this.... Second best would be a petrochemical plant as opposed, say, to a products refinery which would simply push more oil into a West Coast market that's got more oil in. Now, (indisc.) from the petrochemical plant, however, to the ALPETCO proposal as a whole, there is another problem and one sees another picture. The proposed contract entitles ALPETCO to take up to 150,000 barrels, or up to its full Prudhoe Bay entitlement, of crude oil for re-sale up until the time their plant is ready to use it. Let's see what the effect of their taking that oil in (indisc.) will be. According to their pro forma financial statements, they intend to market their oil on the West Coast of the United States, and they intend to mark it up by two percent. Then they expect to earn a two percent margin on it and they give a purchase price of \$7.00 at the well head, plus shipping costs to the West Coast of \$.85, plus an ALPETCO margin of \$.25, and tax (indisc.) for \$5.40, and give a \$13.50 sales price on the West Coast. Well now they're starting with different numbers - and I won't quarrel with those, because they are based on other assumptions as to what the actual tax tariff will be and what the net back will be. But the problem here is ALPETCO takes oil that costs the \$11.79 at Valdez, that is, well head price plus tax tariff, and there is no way that it can sell it on the Gulf Coast. ALPETCO gets 150,000 barrels, 140,000 barrels, of oil for \$11.79. They lose money unless they can sell it for \$10.72 plus transportation to the Gulf Coast, which is \$3.00. So there is no way that ALPETCO can consider marketing on the Gulf Coast. ALPETCO, if it takes this oil, has to go into the West Coast. What can ALPETCO afford to do? ALPETCO says that it is looking for a two percent margin, so that brings its price at Valdez to \$12.03. And, in that case, they can undersell the West Coast price by \$.60. In other words, the value of North Slope crude oil on the West Coast as set by what the other producers are charging is \$12.63. ALPETCO is getting its oil and is willing to sell oil for \$12.60. I mean \$12.03.

I really doubt whether, out of roughly 6 to 700,000 barrels per day of Alaska crude, which can be marketed on the West Coast, they are going to push in 130 or 140,000 barrels a day of it for only a \$.60 discount. If you recall, ARCO will be moving all of its own oil through its own refineries. There is no way they could push ARCO's crude out of ARCO's refineries. EXXON

is going to be running a substantial amount of its own crude in its own refineries. Essentially, if ALPETCO is going to market this, they are going to have pretty much mop up the independent refiners who could accept the backing out of a very large portion of California independent production. And they are going to have to butt heads with SOHIO. They are going to have to undersell SOHIO at the CHEVRON refinery. Let's go back, There is no way they can sell Alaska royalty oil on the Gulf Coast. The only way they can sell it on the West Coast is to undersell SOHIO. And, essentially, they've got to undersell SOHIO at CHEVRON's refinery.

CHAIRMAN MILES:

Why would a CHEVRON refinery, an independent refinery, be willing to strike a temporary agreement with ALPETCO when they know that essentially they are going to have to go back to producers once the proposed facility starts producing petrochemicals?

DR. TUSSING:

Because there's a surplus of oil.

CHAIRMAN MILES:

Simply because of this?

DR. TUSSING:

Well, if you had a seller's market, which you don't have now and you won't have in 1980, and, very likely, you won't have in 1985. You certainly will have a buyer's market on the West Coast of the United States, at least through 1985. They are going to shop around.

Now, I'm not saying that the process is going to be perfectly competitive just because there's one seller. But now we've got a wild card in the deck. We have a different kind of seller. SOHIO will not behave competitively, will not use its full market power to capture its maximum market share on the West Coast because it knows it's spoiling its own market.

ALPETCO's in a different position, because to the extent ALPETCO drives down the West Coast price and can make a profit in doing so. Next month the composite average goes down if ALPETCO sells for \$12.03. You can see SOHIO's getting their oil cheaper than ALPETCO is. SOHIO can defend its market position. SOHIO will not initiate a price war, but SOHIO will not be backed out, either. So SOHIO will go as low as ALPETCO can go, and it can go lower for the purpose of protecting its market

share. Some of the California independents can't. And you're having this problem right now that Alaska oil is backing out California independent production. The Economic Regulatory Administration just gave an additional \$1.79 entitlement benefit, or reduced the entitlement penalty, for the California producers by \$1.79. And, thus, oil is still backing up California production. So those people, some of them can't back down. Some of them will make room for additional North Slope production, but you bet they will be in Washington and trying to get some new entitlements (indisc. - cough) or some other thing that prevents them from being backed out.

So, if ALPETCO can't afford to drive the West Coast price down to \$12.03 and still make money. Unlike SOHIO, unlike ARCO, and unlike EXXON, they don't lose a penny by doing it, because they have no stake in the production of the rest. They have no production. They are a middle-man. And, to get this market share, they will go in and compete - they will engage in what textbook economics calls arbitrage (ph). And they will make their two percent, or they will make more than two percent on the arbitrage (ph). They don't have to take the full 150,000 barrels at once. They can start with a minimum of 10,000 barrels. You find a home for 10,000 barrels today. Give me 10,000 barrels of oil today at the composite average price, and I can find a home for it in California at \$12.00. No question. I can find some California crude, or some SOHIO crude, that I can back out. So you take that next month. Meanwhile, you have driven this down a little bit and you've got a greater price advantage. Where does the process end?

If this becomes \$12.03 - the West Coast net back price becomes \$12.03 - the in-value price becomes \$11.48, and here we get another round. And, so, where the process ends....it probably won't go all the way, but the only place that brings it to a definitive halt is when the West Coast price gets down to \$10.72, which is the competitive equilibrium price. That is what your textbook economics would say is the natural price. That is the value of North Slope crude oil on the West Coast. Because, why should any producer on the West Coast accept this price, ship it to the Gulf Coast, and take a lower price if they could sell it for even a penny more on the West Coast? So the end of the process is this.

People tell me, or I have been told by people who are in these negotiations, that ALPETCO has no intention of taking this oil and marketing it. I know that Sea Train (ph) and Alaska Consolidated Shipping, which was the predecessor organization, had this as the main thrust of their participation, and they were most interested in getting an option on the royalty oil for the purpose of marketing. Now, I'm not urging any, or suggesting there's any bad faith here, I see no evidence that

any of the ALPETCO participants have ever thought this through. I know when I was on the Royalty Board the submissions (indisc.) asked of Consolidated Shipping, with respect to their proposal, were totally unrealistic because they were expecting to take oil at the in-value price and sell it on the Gulf Coast. They had professed letters of intent from purchasers on the Gulf Coast; they gave this as evidence they could do it, saying that we would take it at a price no higher than the lowest price at Prudhoe plus transportation cost.

Anyway, I don't know what their intentions are, and we'll get to how I think that the Committee ought to proceed in looking at some of these things a little later. But I can tell you that....with confidence, that just as Battelle sets out the case it would be a disaster for the state to market its own royalty crude oil, for the same reason, and perhaps even more so, a disaster if you let somebody like ALPETCO market the state's crude oil. The West Coast consumer will benefit, the national economic efficiency will benefit, but the tendency is to introduce into that market a major seller who has no stake in the business of an orderly market, who is not an oligopoly, profit maximizer.

Now, this moves on to something else. Let me put my statement to the Royalty Board in the record at some point. At that time I'd be reported on a survey I did for the Commission, mainly on the realism of ALPETCO's plans for marketing in Japan.

CHAIRMAN MILES:

Representative Chatterton.

MR. CHATTERTON:

Thank you, Mr. Chairman.

Doctor, did you say you wanted to....were willing to be interrupted before you switched to another subject?

DR. TUSSING:

Yes. Surely.

MR. CHATTERTON:

I have one question of you. This exercise we have gone through.... I think it's great, but aren't you analyzing just a small portion of the total system and not analyzing the system? Is not, with about 14 million barrels a day producible capacity today that Saudi Arabia has, and yet they're only producing about

8.7 million barrels per day....don't you think that they are the ones that control the West Coast price and not SOHIO? If you look at the total system?

DR. TUSSING:

If you look at the total system you see who controls the level of world prices. But the prices in individual markets vary according to transportation arrangements and local supply-demand situations. The Saudis control the price at the North Slope. If Saudis decide to cut back further on production to raise the OPEC price, the net back at the North Slope will go up. But it's not true from that to say the tax tariff doesn't determine the price on the North Slope. So, here you've got the OPEC price here at this level and, depending on the distance from Saudi Arabia and from the Persian Gulf, you'll have prices in various markets in the world like this - prices at the refineries. And then there will be other places that feed into these refineries, and you'll have to subtract transportation costs from the price there. This is the.... If this is the West Coast price, then the transportation cost from Prudhoe Bay to the West Coast influences the West Coast price. Now suppose Prudhoe Bay, plus California, put in more oil than the California can use - than the West Coast can use. That, in a sense, begins to free it from the OPEC price, because California is no longer importing OPEC oil. The only way that California price is determined by OPEC is - what is the transportation cost beyond California to the next market, which is the Gulf Coast, or to Japan? That is, it's the OPEC price in a third market that then begins to determine the Prudhoe price.

So, yes, it's true. OPEC moves the whole structure up and down. But what goes on on the West Coast of the United States determines whether this is wide or narrow and determines whether the West Coast price is above or below the OPEC price. I think it is inevitable, as long as there's a surplus on the West Coast, that the West Coast price, particularly for middle-sulfur, middle-gravity crude oil, like Prudhoe Bay crude oil, will be below the OPEC plus transportation. It's got to stay below that or we won't even absorb all the North Slope and California crude. The price situation can't be such that refiners are indifferent to whether they use Saudi twenty-seven degree, one percent sulfur crude or North Slope twenty-seven degree, one percent sulfur crude. So the West Coast price is going to be lower than the OPEC price for as long as we can forecast in the future.

I think that Battelle is reasonable in saying, we really don't want to forecast beyond 1985, because both supply and demand.... there are so many uncertainties in both supply and demand. The general consensus is that world oil prices are going to go down until some time in the 80's, and then they'll start

turning up again some time in the 80's, but there's enormous disagreement about when that is. Some...the C.I.A. and Dr. Schlessinger (ph) and EXXON say 1982, there are other people who say that the crunch is like the horizon, as you get close to it it recedes because the geologists and the government officials have always, historically always, underestimated the new discoveries. The Paley (ph) Commission in 1946 had us running out of oil by 1949, the Geological Survey had us - in 1921 - running out in before 1929. That's why they set up the Naval Petroleum Reserve in Alaska, so the battleships would have some oil to run on in World War II.

Anyway, up to 1985, the West Coast price is going to be below the OPEC price - how much below the OPEC price depends on the market behavior of the producers and sellers on the West Coast, among other things. If the oil is closely held and flows through controlled channels - the North Slope oil is controlled overwhelmingly by ARCO, EXXON, and SOHIO - the effect of competition is going to be minimum. They don't have to violate anti-trust laws, they just have to behave like gentlemen toward each other. They just have to avoid getting into price wars that they know would be mutually ruinous.

The state royalty oil sold to an independent marketer has no such constraint. And, if one of the non-majors came in with a discovery out in the Western Arctic, or something like that, and it was somebody who was not tied in by intimate relationships with the (indisc.) agreement, and things like that, somebody came in with a large field - it could be Occidental, or even a major - Texaco or Gulf - they could break the market, too. Let's say that if ALPETCO attempts to move 150,000 barrels to the West Coast market, they are almost certain to break the market, and the bottom is somewhere in the vicinity of \$2.00 below the present price. Now it won't hit bottom. Maybe the SOHIO pipeline will be built which would mean the bottom would be in the vicinity of \$1.25 below the present price.

MR. GRUENING:

Does that mean that this is money that ALPETCO is going to lose if forced to sell it, so this is money to pay the state if, supposedly, they lose? Let's say they lost \$1.00 a barrel, and it takes seventy-two months, I think in the contract, before they are actually putting it in a form where it could be sold. But, as a refined product, you're talking about over \$300 million.

DR. TUSSING:

They don't lose any money. They sell it at above cost. Their cost is \$11.79. When it first comes in they can sell it on

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the West Coast. The West Coast refiners are paying \$12.63 for that kind of oil.

MR. GRUENING:

You're saying that they won't prolong if they get....

DR. TUSSING:

Okay. Now the question is....the contract does not compel them to refine in Alaska or to process into petrochemicals any specific amount. So they don't reach full production. In their pro forma, their financial statement, they assume that they reach full capacity of 150,000 barrels a day in the fourth quarter of 1985. There is nothing that prevents them from continuing to sell. Suppose their petrochemical production contract is slower, and suppose they are making a good deal of money on these West Coast.... There is nothing in the contract that compels them to refine all that oil.

Now, I'm not trying to predict what they are going to do, because they don't know. I'm sure if you asked them, they'd say - well, these are the projections we're working on, but we don't know what markets will be like; we haven't even got our products laid down. But I would say, in general, that the existence of a crude-based petrochemical facility benefits Alaska in terms of the tax and royalty (indisc.).

An independent marketer very much hurts Alaska. It cannot do anything but hurt the state, and the state would be much better off to say - we'll keep the oil until you go on-stream, but we'll pay the two percent margin that you expected to earn on it. Let's just give them the money and let the producers.... The state would be far better off just handing them the two percent outright.

Okay. Well, let's go on and get back to the Alaska disadvantage. You've all heard about the Alaska disadvantage. I don't need to repeat it. You've got transportation cost disadvantages, higher construction costs, higher operating costs. And virtually everybody in the business, whether it's in the oil business or the chemical business, except this group, believes the Alaska disadvantage can't be overcome without some sort of subsidy. Now this group believes that....ALPETCO believes that it can.

I haven't worked through their economic analysis, and I don't know. I just know that it's a minority point of view. It's virtually a minority of one....

UNIDENTIFIED SPEAKER:

You've been there before.

DR. TUSSING:

No, I'm not the minority. I'm with the majority. They are the minority of one. And even their marketing consultant at the Royalty Board agreed that Joe Moore's assessment of the probability of success is fifty percent, at best - agreed that that was a fair assessment. Let's say they are going against the entire weight of industry sentiment, and I won't quarrel with that. But there is an Alaska disadvantage. Now, how can it be overcome?

The marketing plan we talked about has two elements. One is the expectation of getting long-term, hell or high-water, take or bake contracts from Japanese chemical consumers - Japanese industry. I did an investigation of this for the Commissioner and found no reason whatever to believe that there was any possibility that they would accomplish that, and I would say that the odds on that part of their program are - maybe they are finite - very close to zilch. Now it is conceivable that the notion that they can market on the West Coast....there is a substantial possibility that, given their cost structure, they can market on the West Coast. There is no basic petrochemical-producing facility on the West Coast.

Given any reasonable assumptions about economic growth, the demand will increase, and there is a gap that they could fill if they could overcome the cost disadvantages of operating in Alaska. They realize that the alternative sources for the West Coast are, for example, the Gulf Coast - the expansion of the existing petrochemical industry there - and there is part of the cost disadvantage, the transportation cost disadvantage, the transportation cost component of the Alaska disadvantage, is offset by the fact that if that crude has to go to the Gulf Coast and the products come back to the West Coast. So a West Coast petrochemicals plant would have a substantial advantage for the West Coast market over the Gulf Coast. Now it's quite conceivable, even though a California-based petrochemical facility would be in better economic shape than an Alaska one, that because of air-quality problems, site problems, it may simply be impossible to get a site for a petrochemical plant in California. So given those two considerations, they might be able to offset on the West Coast a good portion of the Alaska disadvantage.

The remainder of the equation is an interesting one - that if the West Coast price for Alaska-type crudes were substantially below world market price, below the Gulf Coast price, if there were no SOHIO pipeline, if exports to Japan weren't allowed, then we'd have a price for a North Slope crew. There would be a price advantage for a West Coast producer, whether in Alaska

or in California of a dollar more per barrel over its competition in the Gulf Coast region or, for that matter, competition on a crude- or naphtha-based facility anywhere in the world. Here's where the marketing fits in, and, again, I don't believe this is ALPETCO's game plan. But, if by marketing crude independently between now and 1985 they broke the West Coast price, pushed it down to a level \$2.00 below the world market equivalent, they would have gotten their subsidy from the state. They would have gotten that \$2.00 by the back door. Now, why, when they go on-stream, doesn't the price go back up again? And that's an interesting question. Would it go back up when they take the crude out of the crude market and start marketing petrochemicals. I suspect it's a one-way downward ratchet, because the equilibrium price - that is - the normal situation and the absence of some sort of anti-competitive behavior, is the same for all destinations at Valdez. And that the big three would have to collude, and they'd probably have to get the California independents on board. They would have to engage in per se violations of the anti-trust laws to re-establish the differential price structure. I think that once this differential price structure is knocked down by competition it would take a positive intervention - anti-competitive intervention - for the market to restore. So....

UNIDENTIFIED SPEAKER:

Dr. Tussing, just a moment. If we're talking about a time-frame of 1984-85, which is to unscrew their oil from the West Coast market, this is the time when the shortages, or the surpluses, appear to be diminishing. And if we further diminish it by 150,000, which is hypothetically injected into that under your scenario, doesn't that have to drive the price back up?

DR. TUSSING:

Well, as long as there's a surplus, there is no force driving the price back up; that is, there's a surplus now that is having downward pressure on the price. And that downward pressure is being resisted by the fact that the oil is moving in controlled channels. So long as the surplus exists, I don't think there can be any upward pressure on the price on a price structure that's been established previously by competition.

Secondly, I don't think we can count on, say, 1985 being the time in which the surplus is diminished. All we can do is say with confidence that the surplus will increase until 1985. After 1985 we don't know whether it will level off or diminish or what. So the.... I'm not trying to forecast the future.

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I'm just.... The case I've established, with respect to the erosion of the price, is a worse case. As I said, I think there is a substantial possibility there will be some export outlet. For example, they could....the Federal Government could go half-way on it by allowing the export of residual oil from the West Coast. And it's the heavy high-sulfur resid which is creating a good deal of the glut. The top-end of the barrel can be used. If the California refiners could export their heavy fuel oil to the Far East, that would take a lot of.... There are things that would minimize the danger of the scenario, but the point I want to make is that the scenario which is worst for the state is best for ALPETCO in the sense that the best way of overcoming the Alaska disadvantage is with a lower price for crude. And that is one way I can see, without going dollar per dollar through their cost projections, and I'm not a chemical engineer or a cost engineer, and I can't assign costs to the various elements of their proposal, but just in broad general terms to overcome this cost differential, this is the only way I can see it working on the West Coast is they are relying on a West Coast price that's lower than the import equivalent price. And that is a way of overcoming the disadvantage. I want to repeat - I don't think that this is their game plan, because I've seen no evidence that there's been any long-term or any sophisticated view of the crude oil market on the part of their proponents. They certainly haven't put it on the record. And conversations with the participants over some time haven't betrayed any indication that this is what they are looking at. But I think that it is something the state really ought to take into consideration.

Now, if you have any more questions, I want to first ask how long you want to go.

UNIDENTIFIED SPEAKER:

I think we should just keep going.

DR. TUSSING:

Okay. One of the issues that was raised to me is....

UNIDENTIFIED SPEAKER:

Doctor, would you like to take a five-minute break?

DR. TUSSING:

Yes.

(FIVE-MINUTE BREAK)

DR. TUSSING:

I think the most important of the remaining questions is.... two of them that go together - is it possible or likely ALPETCO could get its project financed without overwhelming assurance of its commercial feasibility? And I address this one, in particular, because I think there has been an assumption all along, and certainly Commissioner Leresche stated this, that the ability to finance the project is a good test of its commercial viability and, although we of the state can't make a really accurate assessment of it, the financial community will, and their ability to put the financing together is probably the best test of its commercial viability. I would think that would be the conventional wisdom, and I address the problem only because Milton Lipton said to you that it was not necessary to demonstrate overwhelming likelihood of commercial feasibility in order to get the thing financed. But it is quite conceivable the thing could get financed and still go belly-up. I don't think he was talking about the fact that bankers and underwriters sometimes make bad judgment, but I think he was saying that it's not necessary to show that it would be profitable to get the....to obtain long-term debt. And this is true with certain assumptions about financing, with what we call conventional financing, where there's a big equity component.

The financial markets, the bond underwriters, and the insurance companies, and the other institutional investors are not interested in the profitability of the project, per se. They could care less about the health of the equity of the owners. The health of the owners....the financial health of the owners concerns them only to the extent it affects the ability of the enterprise to pay interest and to re-pay the debt.

So, in conventional financing, if there is a sufficient equity component - that is, if the owners put up enough of their own capital - it's quite possible for them to get financing. In the worst case their cash flow is going to be sufficient to cover debt service. Suppose we're going fifty percent equity and fifty percent debt - I'll just use round numbers and not say....and I'm not going to claim these are the numbers of the ALPETCO project, but just to show the principle. Suppose you have a one-billion-dollar facility. So it's \$500 million debt borrowed money. And the owner has put up \$500 million in equity. Suppose the interest is nine percent, so it's got to pay \$45 million here in interest. And it's got to pay.... Suppose it's got twenty-year life, and so it's got to pay \$25 million a year in depreciation - in amortization - in debt repayment. All right, so you've got a total of \$70 million that this company has to come up with in addition to its operating costs to pay off the debt. Now, to make money, to make it a worthwhile investment for the equity investors, they