Feasibility Study Update

COPPER VALLEY INTERTIE

November 1995

CH2M HILL

Executive Summary

Background

In 1993, the Alaska State Legislature appropriated $35 million for a zero-interest, 50-year loan for construction of a power transmission line (referred to as the "Intertie") linking Alaska's Railbelt region to the service area of the Copper Valley Electric Association (CVEA). The Intertie is intended to create a power supply infrastructure that would allow power suppliers in the Railbelt region to offer long-term, relatively low-cost power to CVEA.

The state loan for the Intertie was contingent upon the results of a feasibility study "satisfactory to the State of Alaska Department of Community and Regional Affairs (DCRA) as set out in former AS 44.83.181." The enabling legislation associated with this statute required that all reasonable alternatives to construction of the Intertie be evaluated in terms of their long-term resource cost and the cost of power. Both of these cost perspectives are discussed below.

The required study was completed in April 1994, and results were presented in the *Copper Valley Intertie Feasibility Study* (referred to as the 1994 Intertie Study). The resource cost analysis compared power supply alternatives based on the natural, human, and capital resources needed to develop and operate the facilities. This includes all direct resource costs including those that may be paid by the state. The cost of power analysis compared the "wholesale cost per kilowatt-hour to CVEA of generating and/or purchasing power delivered to the CVEA distribution system . . . excluding costs that are common" to all power supply alternatives. Since the state loan for the Intertie would reduce the cost of power to CVEA, it was considered in the cost of power analysis.

The purpose of this report is to provide updated information upon which the State of Alaska can decide whether the Intertie is still feasible. This report updates the 1994 Intertie Study on the basis of significant, documented changes that have occurred since the report was completed. Data from the 1994 Intertie Study were reviewed and updated to reflect these changes.

This update includes a resource cost analysis and a cost of power analysis of the power supply alternatives. As in the 1994 Intertie Study, resource costs for each alternative were evaluated on the basis of a benefit-cost analysis. Benefits of each alternative were defined as the avoidance of diesel generation costs defined in the 1994 Intertie Study. Alternatives with the highest benefit-cost ratio were considered to be feasible. Because the Intertie had the highest benefit-cost ratio under many of the scenarios tested, a cost of power analysis was conducted. The cost of power analysis only evaluated alternatives that were considered feasible based on the resource cost analysis. Unlike the 1994 Intertie Study, the cost of power analysis in this update includes generation and purchased power costs that are common to all power supply alternatives. By taking these costs into account, differences among alternatives can be translated into differences in CVEA rates.

Findings

On the basis of the documented data available for this study, the Intertie and the All Diesel alternatives are the most viable of the alternatives considered in this study.[1] These alternatives are therefore the primary focus of this Executive Summary. Other alternatives are listed in the Analytical Approach and Results section of the Executive Summary and discussed in the body of the report.

Key findings of this update to the 1994 Intertie Study are discussed below. Findings from the resource cost analysis are presented first, followed by findings from the cost of power analysis. Analysis of the sensitivity of these findings to certain assumptions is included in the body of this report.

Resource Cost

1. **The Intertie and All Diesel alternatives are both viable from a resource cost standpoint assuming medium-low to medium-high load growth and system designs specified in the 1994 Intertie Study.** The Intertie, All Diesel, or Allison Lake alternative have the highest benefit-cost ratios of all alternatives. However, because the Allison Lake alternative would have a high cost of power relative to the Intertie (see Finding 6 under CVEA Cost of Power, below), its resource cost is not further considered in this Executive Summary.

2. **The economics of the Intertie are dependent upon continued load growth.** If loads were to remain at 1994 levels or if CVEA's largest customer, the Petro Star refinery in Valdez, were to cease buying power from CVEA, the benefit-cost ratio for the Intertie would show that costs exceed benefits by a substantial margin and that the alternative is therefore not feasible. The benefit-cost ratio would be significantly lower than that for the All Diesel alternative regardless of the All Diesel configuration.

   With substantial load growth, the Intertie clearly has the highest benefit-cost ratio. For example, even with the loss of Petro Star, if Alyeska's Marine Terminal in Valdez were to purchase power from CVEA rather than self-generate, the benefit-cost ratio of the Intertie would be substantially higher than the All Diesel alternative regardless of its configuration.

3. **The benefit-cost ratio for the Intertie would be about the same as that for a modified version of the All Diesel alternative defined in CVEA's 1995 Power Supply Study.**[2] (The All Diesel alternative defined in CVEA's Power Supply Study is referred to as the "1995 All Diesel" alternative, and the original All Diesel alternative outlined in the 1994 Intertie Study is referred to as the "1994 All Diesel" alternative.) Because the basis for the 1995 All Diesel

[1] There are two All Diesel alternatives: one from the 1994 Intertie Study and one from the 1995 CVEA Power Supply Study, described in Finding 2 under Resource Cost.

[2] Interim Final Report, Evaluation of Power Supply Alternatives. R.W. Beck. June 1995.

alternative was inconsistent with the basis for the power supply alternatives evaluated in the 1994 Intertie Study, another alternative–the "Modified 1995 All Diesel" alternative–was defined for this update to allow for a more direct comparison with the other power supply alternatives.

The benefit-cost ratio for the Modified 1995 All Diesel alternative would marginally exceed that for the Intertie with medium-low load growth and be marginally exceeded by that for the Intertie with medium-high load growth.

4. **The economics of Alyeska or Petro Star generating power for sale to CVEA diminish substantially once the Intertie is constructed.** Prior to Intertie construction, the market price for generation from these potential sources would be 7 cents per kilowatt-hour (kWh) or more. After construction of the line, the market price would be less than 4 cents per kWh. It is unlikely that either firm could generate and market power at that price.

5. **Since completion of the 1994 Intertie Study, the forecast for the Trans-Alaska Pipeline or the Trans-Alaska Gas System (TAGS) that affects the outlook for CVEA loads is unchanged.** The economics of the Intertie relative to the All Diesel alternative would improve if TAGS were to be constructed as planned. This would be the case even if TAGS construction were delayed until 2010.

6. **Silver Lake and Valdez Coal alternatives are more costly than the All Diesel and Intertie alternatives under all scenarios tested.** The decrease in oil and gas prices since completion of the 1994 Intertie study make these alternatives less competitive against both oil-fired generation in the All Diesel alternatives and gas-fired generation associated with the Intertie alternative.

7. **The discount rate used in the analysis has a significant impact on these findings.** The enabling legislation for the Intertie required that the 1994 Intertie Study compare power supply alternatives on the basis of the present worth (or present value) of future costs for each alternative with "a discount rate representing the estimated long-term real cost of money." In the 1994 Intertie Study, the state's 4.5 percent real discount rate[3] was calculated on the basis of real interest rates for long-term taxable bonds. In this update, this rate was recalculated on the basis of current data and found to be unchanged. If a lower discount rate were used, the benefits of the Intertie would be higher relative to those for the All Diesel alternatives. For example, at a 3 percent discount rate, the Intertie has clear benefits compared to both the 1994 All Diesel alternative and the Modified 1995 All Diesel alternative.

[3] The "real discount rate" ignores the effects of future inflation. A real discount rate of 4.5 percent is equivalent to a nominal discount rate of about 8 percent.

CVEA Cost of Power

1. **Primarily because of the $35 million loan for the Intertie, CVEA's cost of power would be lowest with the Intertie alternative assuming load growth, system designs, and ownership arrangements outlined in the 1994 Intertie Study.** During the first 15 years of Intertie operation, CVEA rates with a firm power supply provided through the Intertie would be an average of 1.2 to 1.4 cents per kWh less than with the 1994 All Diesel alternative, assuming medium-high and medium-low load growth, which is described in Analytical Approach and Results section.

2. **CVEA cost of power with the Intertie increases if CVEA loads decrease and decreases if CVEA loads increase.** For example, if CVEA were to lose Petro Star loads, CVEA rates during the first 15 years of Intertie operation would be an average of 0.2 to 0.4 cent per kWh higher than with the 1994 All Diesel alternative. On the other hand, if Alyeska were to replace Petro Star as a customer of CVEA, CVEA rates during the first 15 years of Intertie operation would be substantially lower than with the 1994 All Diesel alternative. CVEA and Petro Star are currently discussing an agreement that would make Petro Star a full requirements customer of CVEA in return for a lower rate.

3. **CVEA cost of power with the Intertie is also the lowest when the Modified 1995 All Diesel alternative is included in the comparison.** During the first 15 years of Intertie operation, CVEA rates would average 0.3 to 0.6 cent per kWh less than with the Modified 1995 All Diesel alternative, assuming medium-high and medium-low load growth.

4. **If Chugach Electric Association (CEA) and CVEA reach a power sales agreement whereby costs of the Intertie are shared between CEA and CVEA, CVEA is assured of lower rates than with the All Diesel alternative regardless of its configuration.** CEA and CVEA have agreed in principle on sharing the cost of the Intertie, with CEA responsible for 80 percent of the cost and CVEA responsible for 20 percent of the cost. (This alternative is referred to as the "80/20 Integrated Intertie," because CEA would "integrate" its share of the costs into its overall cost of doing business. CVEA ownership of the Intertie without sharing of costs with another utility is referred to as the "Base Intertie.") With the 80/20 Integrated Intertie, CVEA rates would be an average of 2.0 to 2.3 cents per kWh less expensive than with the 1994 All Diesel alternative during the first 15 years of diesel operation, assuming medium-high and medium-low load growth. Compared to the Modified 1995 All Diesel alternative, CVEA's rates would be 1.1 to 1.5 cents per kWh lower with the 80/20 Integrated Intertie alternative.

   CEA's portion of the Intertie cost is spread over a customer base that is much larger than CVEA's. As a result, while CVEA's share of the transmission cost represents about 0.5 cent per kWh during the Intertie's first 15 years, the

impact on CEA rates is minimal. The integrated sales agreement would require the approval of the Alaska Public Utilities Commission.

5. **If the Intertie is built, the risk of a CVEA rate increase resulting from the loss of Petro Star as a customer of CVEA is significantly reduced assuming the 80/20 Integrated Intertie alternative.** Under this power supply arrangement, discontinuation of service to Petro Star would increase CVEA's cost of power by only about 0.1 cent per kWh.

6. **Even assuming the $35 million loan could be reauthorized to be made available for construction of the Allison Lake Project, the cost of power associated with this alternative is significantly higher than that for the Intertie.** This is because of a large generation charge associated with the Allison Lake alternative. More specifically, about half of the output from this alternative would be subject to a charge that is currently 6.4 cents per kWh.[4]

Analytical Approach and Results

Following is a review of the analytical approach and results to this update of the 1994 Intertie Study. Results are presented in terms of both resource cost and the cost of power to CVEA.

This update reevaluates the relative costs of power supply alternatives for CVEA using the same procedures and analytical model used in the 1994 Intertie Study. The effects of the following seven factors are evaluated: (1) the potential loss of CVEA's largest customer, the Petro Star refinery in Valdez, (2) the potential addition of a larger industrial customer, the Alyeska Marine Terminal in Valdez, (3) future options for the Trans-Alaska Gas System and the High Altitude Auroral Research Project becoming customers of CVEA, (4) changes in current and projected fuel oil prices paid by CVEA, (5) changes in current and projected costs of generation in the Railbelt, (6) the possibility of an economy energy, rather than a firm energy, power supply from the Railbelt to CVEA,[5] and (7) a different power generation plan if CVEA were to continue relying on local diesel-fired power generation within its service area. As noted above, this update relies on information provided in the 1994 Intertie Study, with revision to the study made only on the basis of significant and documented changes that have occurred since the 1994 Intertie Study was completed.

The 1994 Intertie Study evaluated five power supply and conservation options:

- All Diesel–Diesel power generation with retirement and replacement of CVEA's older diesel units

- Intertie–138-kilovolt transmission line between Sutton and Glennallen with power supplied by generation in the Railbelt

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[4] This charge is based on the Long-Term Power Sales Agreement Four-Dam Pool–Initial Project of the Alaska Power Authority.

[5] Firm energy is energy that is supplied continuously to the customer; economy energy is interruptible at any time for any reason and is therefore less expensive than firm energy.

- Allison Lake–Hydroelectric generation at Allison Lake with continued flow to Solomon Gulch for additional generation there
- Silver Lake–Hydroelectric generation
- Valdez Coal–Coal-fired cogeneration producing steam for district heating and electricity
- Conservation–Energy efficiency programs designed to reduce energy requirements among CVEA customers and thereby reduce the need for new generation capacity.

This report updates the above-listed alternatives and evaluates two additional options:

- Petro Star cogeneration
- Alyeska cogeneration

Based on documented data available for this study, Allison Lake, Silver Lake, and Valdez Coal are not viable alternatives,[6] as noted above in the Findings section. Also, data were not available on the cost of developing and operating cogeneration resources at either Petro Star or Alyeska. However, maximum rates that Petro Star or Alyeska could charge for generation were calculated in this update and are summarized at the end of the Resource Cost section. Detailed descriptions of each of the alternatives are provided in the body of this report.

Resource Cost Analysis

Updated life-cycle costs and benefit-cost ratios for the All Diesel and Intertie alternatives are shown in the Summary Table. This analysis was conducted from the standpoint of the natural, human, and capital costs required by each alternative regardless of who pays the cost. For example, the $35 million loan is not included in this analysis since it is simply a transfer of funds to pay for a portion of construction costs. The loan is considered in the cost of power analysis, below.

The Summary Table is divided into three sections. The first section–Present Value of Costs–compares the costs associated with each of the alternatives. These costs are shown graphically in Figures S-1 and S-2. The next section–Savings Compared to Diesel–presents the difference in cost between the 1994 All Diesel alternative and two other alternatives, the Modified 1995 All Diesel alternative and the Intertie alternative. The final section–Benefit-Cost Ratio–identifies conditions under which the Intertie alternative and the Modified 1995 All Diesel alternative would be more beneficial than the 1994 All Diesel alternative: A ratio over 1 indicates that the alternative is more beneficial than the 1994 All Diesel alternative; a ratio less than 1 indicates that the alternative is less beneficial than the 1994 All Diesel

[6] Developers of two alternative resources, Allison Lake and Silver Lake hydroelectric projects, have indicated that they are developing new approaches to these resources. These new approaches may significantly reduce the costs of these projects. However, documented cost data associated with these plans were not available for this study.

alternative.[7] The 1994 All Diesel alternative is used as a baseline in this study because it was the baseline in the 1994 Intertie Study.

Summary Table
Present Value of Costs and Benefit-Cost Ratios for Intertie and All Diesel Alternatives

Alternatives	Low Fuel-Cost Escalation				High Fuel Cost Escalation			
	With Petro Star		Without Petro Star		With Petro Star		Without Petro Star	
	Med. High Load Fct.	Med. Low Load Fct.	M-H/M-L[1] Load Fct.	M-H/M-L[1] Fct. w/ Alyeska	Med. High Load Fct.	Med. Low Load Fct.	M-H/M-L[1] Load Fct.	M-H/M-L[1] Fct. w/ Alyeska
	Present Value of Costs ($000)[2]:							
1994 All Diesel	60,483	55,924	35,573	81,263	67,632	61,697	39,984	92,414
Modified 1995 All Diesel	56,955	49,592	35,706	75,772	65,054	55,893	40,373	87,853
Intertie[3]	56,088	54,227	47,685	59,740	59,101	56,603	49,296	64,293
	Savings Compared to Diesel ($000):							
1994 All Diesel	0	0	0	0	0	0	0	0
Modified 1995 All Diesel	3,528	6,332	-133	5,491	2,578	5,804	-389	4,561
Intertie[3]	4,395	1,697	-12,112	21,523	8,531	5,094	-9,312	28,121
	Benefit-Cost Ratio:							
1994 All Diesel	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Modified 1995 All Diesel	1.06	1.13	1.00	1.07	1.04	1.10	0.99	1.05
Intertie[3]	1.08	1.03	0.75	1.36	1.14	1.09	0.81	1.44

1 M-H/M-L = Medium-High/Medium Low. Since the difference between the medium-high and medium-low forecasts is only the length of time Petro Star's Valdez refinery is in operation, these forecasts are identical if Petro Star is assumed to leave the CVEA system.
2 1993 dollars based on a 4.5 percent discount rate.
3 Assumes power supply from the Railbelt will be provided from surplus generation capacity throughout the life of the Intertie.

The Summary Table and Figures S-1 and S-2 compare the All Diesel and Intertie alternatives under different sets of assumptions regarding two important parameters to the analysis: fuel costs and energy requirements. Since the cost of fuel for CVEA affects the overall cost of each alternative differently, two scenarios for fuel cost were used in comparing the alternatives: low fuel-cost escalation (an annual rate of change in fuel cost of -1.18 percent) and high fuel-cost escalation (an annual rate of change in fuel cost of 0.45 percent).[8] Another factor that affects the overall cost of the power supply alternatives is the amount of energy requirements that are placed on the system. As for fuel costs, changes in CVEA's energy requirements affect the cost of each alternative differently. Four energy requirement scenarios were included in this study update and are presented in the Summary Table:

- With Petro Star–Assumes Petro Star will continue to purchase energy from CVEA for the long term. Under this assumption, two energy requirement forecasts from the 1994 Intertie Study were used in this update:
  - Medium-High Load Forecast
  - Medium-Low Load Forecast

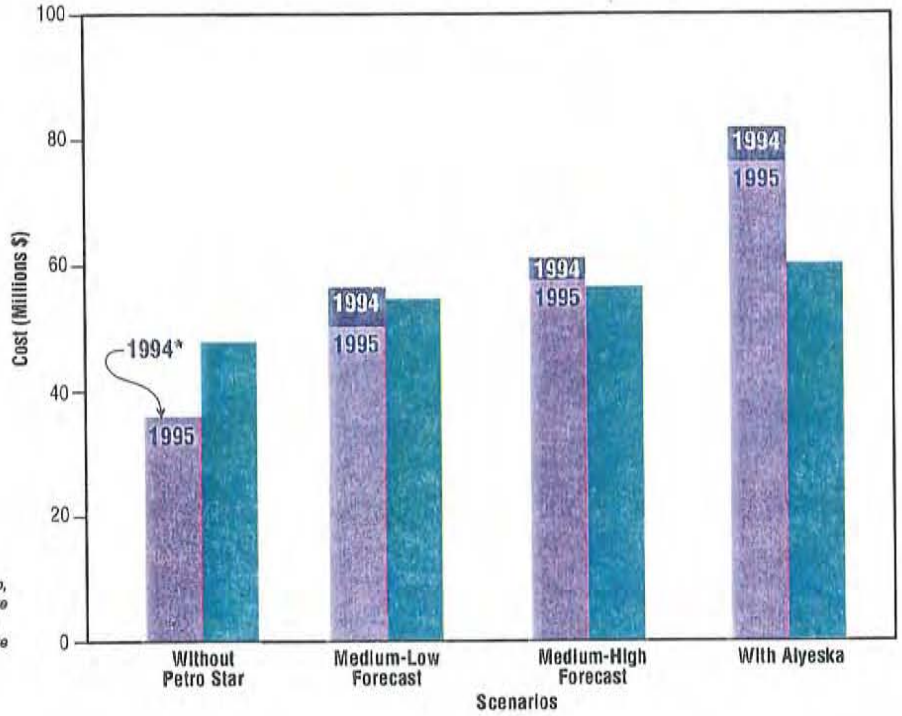
[7] Data shown in the Summary Table are estimates. As such, they are not precise; small differences between alternatives are not considered significant.

[8] These escalation rates are based on the Alaska Department of Revenue's spring 1995 forecasts.

FIGURE ES-1

Resource Costs

(Low Fuel-Cost Forecast)

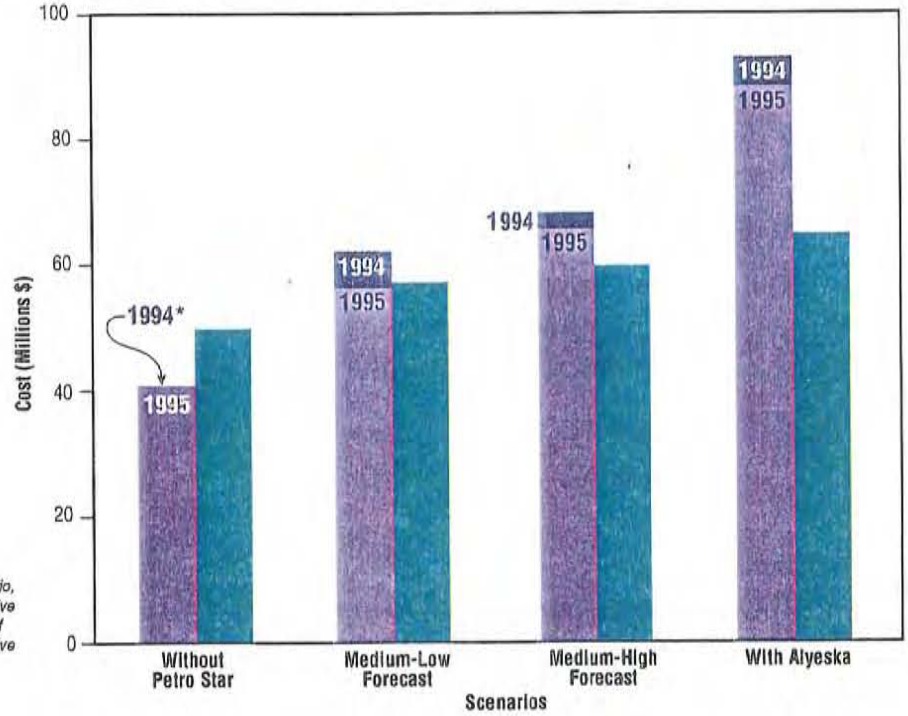


*For the "Without Petro Star" scenario, the cost of the 1994 All Diesel alternative is approximately equal to the cost of the Modified 1995 All Diesel alternative

FIGURE ES-2

Resource Costs

(High Fuel-Cost Forecast)



*For the "Without Petro Star" scenario, the cost of the 1994 All Diesel alternative is approximately equal to the cost of the Modified 1995 All Diesel alternative

These forecasts are for 1.0 percent annual load growth between 1995 and 2018. The medium-low forecast assumes that Petro Star discontinues its purchase of power in 2019, and CVEA's other loads remain unchanged at their

2018 level for the remainder of the 50-year study period. The medium-high forecast assumes that loads remain at their 2018 level for the remainder of the study period without the loss of Petro Star loads.

- Without Petro Star–Assumes Petro Star will no longer purchase energy from CVEA beginning in 1996. Two energy requirements forecasts were used for evaluation under this scenario:

  - Medium-High/Medium-Low Load Forecast (Referred to in the Summary Table as "M-H/M-L Load Fct.)–Since the only difference between the medium-high and the medium-low forecasts is the length of time Petro Star continues operation, these forecasts are the same if Petro Star is assumed to no longer purchase power from CVEA beginning in 1996.

  - With Alyeska–Assumes Petro Star loads are more than replaced by the addition of Alyeska as a customer of the CVEA system beginning in 1999.

The Summary Table shows the following:

- Under the medium-high and medium-low load forecasts, the Intertie and the Modified 1995 All Diesel alternative have benefit-cost ratios that are in the same range.

- Generally, increases in future loads beyond those forecast improve the relative economics of the Intertie alternative; increases in future loads less than those forecast or load decreases improve the relative economics of the All Diesel alternatives. Therefore, if Petro Star were to discontinue purchase of power from CVEA in 1996, the benefit-cost ratio for the Intertie would be significantly lower than those for the All Diesel alternatives: The Intertie would cost $9 to $12 million more than the All Diesel alternatives. Conversely, if the substantial load requirements of Alyeska's Marine Terminal were added to the CVEA system, more than replacing Petro Star loads, the benefit-cost ratio for Intertie would be significantly greater than those for the All Diesel alternatives: The Intertie would cost $16 to $28 million less than the All Diesel alternatives.

- Increases in future oil prices marginally increase the benefit-cost ratio for the Intertie alternative; decreases in future oil prices marginally decrease the benefit cost ratio for the Intertie alternative. The benefit-cost ratio for the

Intertie alternative is 6 percentage points higher for the high fuel-cost forecast than it is for the low fuel-cost forecast.

Data were not available on the cost of developing and operating cogeneration resources at either Petro Star or Alyeska; however, maximum rates that these firms could charge for generation were calculated in this update. In order to be cost competitive, the cost of generation from these facilities would need to be less than the cost CVEA would otherwise incur over the long term. Without the Intertie, these costs are estimated to be about 8 cents per kWh. If the Intertie were constructed, the market price for output from Petro Star or Alyeska would be limited to about 4 cents per kWh.

Cost of Power Analysis

Analysis of the cost of power supply alternatives was also conducted from the standpoint of costs directly paid by CVEA. Since the $35 million loan would reduce the cost of the Intertie to CVEA, it was included as part of this analysis. However, because the loan was specifically for construction of the Intertie, state loans were not assumed to be available for the All Diesel alternatives.

Summary results projected of CVEA cost of power per kWh are shown in Figures S-3 and S-4 for the 1994 All Diesel alternative, the Modified 1995 All Diesel alternative, and the Intertie alternative. The Intertie alternative is evaluated under assumptions of the power supply from the Railbelt being provided under two alternative financing arrangements. First, CVEA's cost of power was calculated assuming the Base Intertie as defined in the Findings section of this Executive Summary. Second, CVEA's cost of power was calculated assuming the 80/20 Integrated Intertie, also defined in the Findings section.

Figures S-3 and S-4 show the following:

- The 1994 All Diesel alternative is substantially more expensive than the Intertie alternatives under both the low and high fuel-cost forecasts.
- The Modified 1995 All Diesel alternative is also more expensive except for the first 3 or 4 years when compared to the Base Intertie.
- The 80/20 Integrated Intertie alternative is the least expensive option shown.

As noted above, CVEA's projected cost of power with the 80/20 Integrated Intertie alternative averages 1.2 to 1.6 cents per kWh less than the Modified 1995 All Diesel alternative and 2.0 to 2.4 cents per kWh less expensive than the 1994 All Diesel alternative. This alternative also provides a cost of power to CVEA that is 0.8 to 1.0 cent per kWh less expensive than a firm power supply through the Base Intertie alternative.

The 80/20 Integrated Intertie alternative also reduces CVEA's risk associated with Intertie ownership and operation.

FIGURE ES-3

CVEA Cost of Power

Low Fuel-Cost
Medium-High/Medium-Low Load Forecast

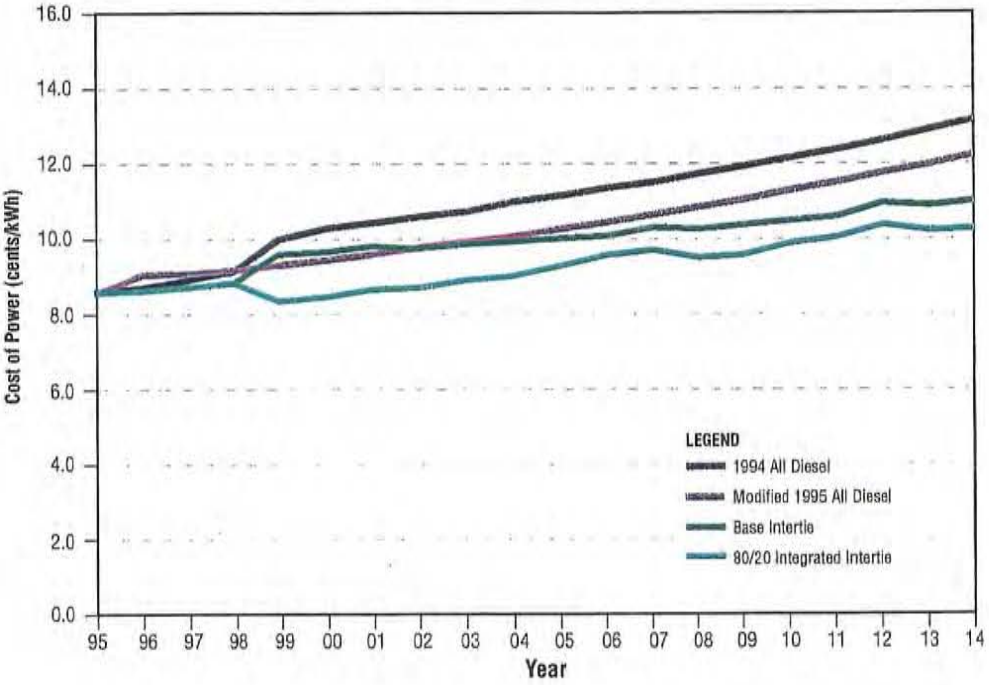
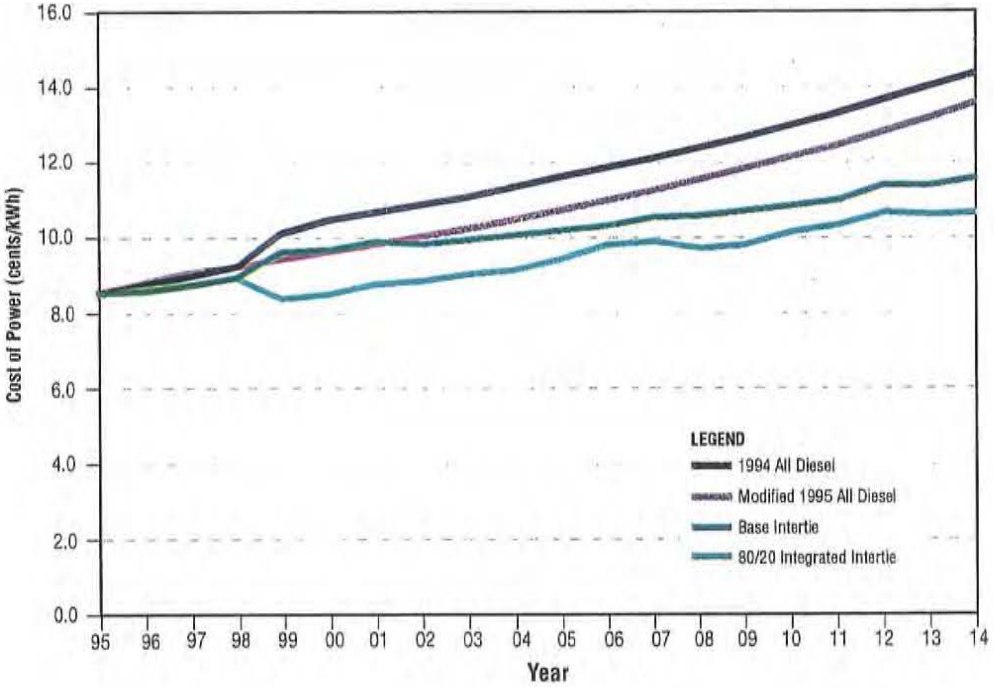


FIGURE ES-4

CVEA Cost of Power

High Fuel-Cost
Medium-Low/Medium-High Load Forecast



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1. Introduction

Study Background

In May 1993, the Alaska State Legislature appropriated $35 million for a zero interest, 50-year loan to utilities participating in the design and construction of a 138-kilovolt (kV) transmission line between Sutton and Glennallen, known as the "Copper Valley Intertie" (see Figure 1). The purpose of this transmission line is to provide the power supply infrastructure necessary to make long-term, relatively low-cost power from Alaska's Railbelt region available within the service area of Copper Valley Electric Association (CVEA), thereby promoting economic development within the Copper River Valley. CVEA is a rural electric cooperative that provides electric service to approximately 3,000 member-customers in Valdez, Glennallen, and other communities in the Copper River Valley.

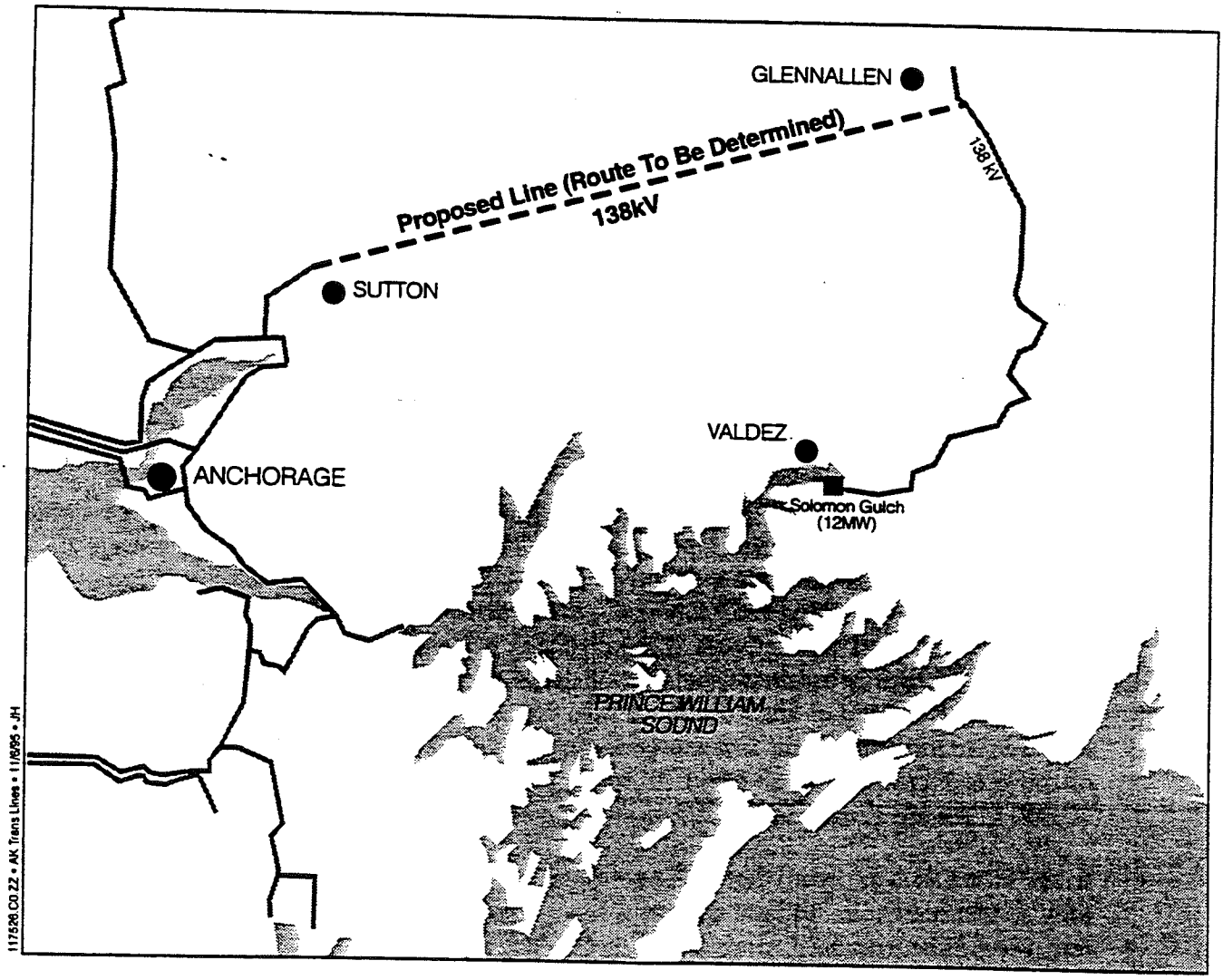

Figure 1
Proposed Copper Valley Intertie

Appropriation of the $35-million loan was contingent in part upon a feasibility study that evaluated "all reasonable alternatives to construction of the proposed project." This requirement specified that the evaluation of alternatives consider economic, environmental, and technical factors and that future costs to meet long-term power requirements of CVEA be estimated and compared. The State of Alaska Department of Community and Regional Affairs, Division of Energy, was charged with preparing this comparative analysis. This agency contracted with the firm of R.W. Beck to conduct the analysis. R.W. Beck completed its analysis and, in April 1994, submitted the report entitled *Feasibility Study—Copper Valley Intertie* (referred to as the 1994 Intertie Study).

In July 1994, the Commissioner of the Department of Community and Regional Affairs issued a finding that the required studies for the Intertie were satisfactory and directed the Division of Energy to issue the Copper Valley Intertie loan. However, a number of changed conditions since mid-1994 led Governor Tony Knowles to appoint a working group to review key economic issues in connection with the Copper Valley Intertie. The working group consists of the Commissioner of the Department of Community and Regional Affairs, the Commissioner of the Department of Natural Resources, the Executive Director of the Alaska Industrial Development and Export Authority, and a Deputy Commissioner for the Department of Transportation and Public Facilities. As part of this working group's review, this update was made to reflect documented, significantly changed conditions that have developed since the 1994 Intertie Study was completed.

CVEA's Existing Power Supply

Currently, CVEA's primary source of power supply is from the Solomon Gulch Hydroelectric Project located near Valdez. The Solomon Gulch project is owned by the State of Alaska with output sold exclusively to CVEA under a long-term power sales agreement. Under this agreement, CVEA must take or pay for all of Solomon Gulch's output up to the demand on CVEA's system.

The peak capacity of Solomon Gulch is 12 megawatts (MW) with average energy generation capability of 54.5-million kilowatt-hours (kWh). Because of limited available storage at Solomon Gulch, most generation is only available during the summer months of June through September, which is CVEA's off-peak period. During these 4-months, all of CVEA's energy requirements are met with Solomon Gulch generation. During this period, Solomon Gulch has average generation capability of about 28,600 megawatt hours (MWh). However, because CVEA summer loads are lower than this level, about 10,000 MWh are spilled as unused generation during this 4-month period in an average water year. During the remainder of the year (October through May), 25,900 MWh are generated by Solomon Gulch and about 32,000 MWh are generated by CVEA-owned diesel generators.

In the future, it is expected that Solomon Gulch generation will be reduced from October to May so that reservoirs will not be drawn down completely. With this change in operation, reserves will be increased, since Solomon Gulch reservoirs will be high enough to provide firm capacity on demand throughout the year. From October to May, Solomon Gulch power

supply is augmented by generation from 11 small diesel units (500 to 2,500 kilowatt) in Glennallen and Valdez. Each of these units is 20 or more years old. Generation from these units would be replaced by generation in the Railbelt if the Intertie is constructed.

The Study Update

This update to the 1994 Intertie Study reflects significant and documented changes in conditions since the original study was completed. The focus of this update is on the alternatives included in the 1994 study. Analysis for this update was directed by the Alaska Industrial Development and Export Authority and conducted by CH2M HILL with computer analysis and support from R.W. Beck. The reasonableness of changes included in this update was reviewed by CH2M HILL.

Power Supply Alternatives

This report updates the following power supply alternatives, which were part of the 1994 Intertie Study:

- All Diesel–Diesel power generation with retirement and replacement of CVEA's older diesel units. As described in Section 2, there are three All Diesel alternatives considered in this update:
  - One from the 1994 Intertie Study (referred to as the "1994 All Diesel" alternative)
  - One from CVEA's recent report entitled *Interim Final Report, Evaluation of Power Supply Alternatives* (this report is referred to as "CVEA's 1995 Power Supply Study," and the All Diesel alternative from this study is referred to as the "1995 All Diesel" alternative)
  - A modified version of the one from the 1995 CVEA Power Supply Study (referred to as the "Modified 1995 All Diesel" alternative)
- Intertie–138-kV transmission line between Sutton and Glennallen with power supplied by generation in the Railbelt
- Allison Lake Hydroelectric Project–Hydroelectric generation at Allison Lake with continued flow to Solomon Gulch for additional generation
- Silver Lake Hydroelectric Project–Hydroelectric generation
- Valdez Coal–Coal-fired cogeneration producing electricity and steam for district heating and electricity
- Conservation–Reductions in power requirements through conservation

This report also evaluates two new alternatives:

- Petro Star Cogeneration–The possibility of Petro Star developing cogeneration facilities and supplying CVEA with additional power
- Alyeska Cogeneration–The possibility of Alyeska developing cogeneration facilities and supplying CVEA with additional power

These alternatives are discussed in move detail in Section 3, Power Supply Alternatives.

2. Approach

Analyses were conducted using inputs from the 1994 Intertie Study with revisions discussed in this chapter. Two computer models developed by R.W. Beck were used in these analyses. These models were well designed for their purposes and provide useful analytical results. The first model was used in the 1994 Intertie Study to evaluate the resource cost of power supply alternatives. It was used for the same purpose in this update with 1993 used as the base year, all prices set in constant 1993 dollars, and a real discount rate of 4.5 percent.

The second model was developed to evaluate power supply costs used in preparing CVEA's 1995 Power Supply Study. The model contained improvements to the model used in the 1994 Intertie Study. Assumptions included a general inflation rate of 3.5 percent per year and an interest rate on CVEA borrowings of 5 percent. The interest rate is based on the assumption in CVEA's 1995 Power Supply Study that CVEA would be able to secure a loan from the Rural Utility Service at this rate. In the cost of power analysis, this rate is applied to all loans needed other than the $35 million state loan which is interest-free.

Two types of analyses were performed of this update: a base analysis, which evaluated each of the alternatives based on fuel costs, power requirements, and financial arrangements for the Intertie, and a sensitivity analysis, which evaluated the effects of various scenarios on the alternatives. Both the base and sensitivity analyses were considered from two analytical perspectives: resource cost and cost of power supply to CVEA. These analyses and the perspectives are discussed below.

Base Analysis

The power generation and conservation alternatives previously described were compared in a base analysis by evaluating the following:

- Fuel Costs–Both high fuel-cost and low fuel-cost scenarios were considered.

- Power Requirements–Four different power requirement scenarios were considered:

    1. The medium-high forecast from the 1994 Intertie Study
    2. The medium-low forecast from the 1994 Intertie Study
    3. The potential loss of Petro Star, CVEA's largest customer
    4. The potential combination of the loss of Petro Star and addition of Alyeska, an industry with large energy demands, as customers of CVEA

    As part of this analysis, the effects of two potential CVEA customers–the Trans-Alaska Gas System and the High Altitude Auroral Research Project–were also considered.

- Financial Arrangement for the Intertie–The cost of power to CVEA was evaluated on the basis two possible financial arrangements for paying the cost of the Intertie:

    1. CVEA finances the Intertie and buys power from a source in the Railbelt on a competitive basis. This is referred to as the "Base Intertie" alternative.

    2. CVEA and Chugach Electric Association (CEA), a Railbelt power supplier, complete a cost-sharing agreement that the two utilities are currently discussing. Under this agreement, the cost of the Intertie would be shared by CEA and CVEA on an 80/20 basis, respectively. Because most of the costs associated with the Intertie would be integrated into CEA's overall costs, this financial arrangement is referred to as the "80/20 Integrated Intertie" alternative.

Sensitivity Analysis

In addition to the base analysis, this update includes seven sensitivity analyses, which consider the effects of the following scenarios and conditions:

1. Implementation of the 1995 All Diesel Alternative as defined in CVEA's Power Supply Study

2. No load growth on CVEA's system beyond 1994

3. Departure of Petro Star from the CVEA system in 1995, followed by its return in 2003

4. The potential need for new generation capacity in the Railbelt to meet CVEA power requirements

5. Lower real discount rates

6. CVEA purchase of economy energy, rather than firm energy, from a Railbelt utility[1]

7. Delay in the scheduled construction and operation of the Intertie

The first five scenarios were evaluated from a resource cost perspective; the first three and last two were evaluated from a cost of power perspective.[2] These two analytical perspectives are discussed below.

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[1] Firm energy is energy that is supplied continuously to the customer, as opposed to economy energy, which is interruptible at any time for any reason and is therefore less expensive than firm energy.

Analytical Perspectives

In both the base and sensitivity analyses, the alternatives were considered from two different perspectives:

- Resource Cost–The cost of an alternative based on the direct natural, human, and capital resources needed to develop and operate the facilities.

- CVEA's Cost of Power–The cost of an alternative based on CVEA's overall cost of power supply for its customers.[3]

As in the 1994 Intertie Study, this update presents resource cost data in terms of constant 1993 prices (referred to as 1993 dollars). That is, data were adjusted to exclude the effects of general inflation on prices beyond 1993. However, data on CVEA's cost of power is presented in "nominal" prices, unless otherwise noted. (Nominal prices include the effects of inflation.) This is also consistent with the approach used in the 1994 Intertie Study. "Real" price escalation, or price changes for specific commodities beyond general inflation, was included in this analysis for diesel fuel and natural gas.

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[2] From a resource cost perspective, sensitivity analysis for scenario 6 is covered by scenario 4. From a CVEA cost of power perspective, scenarios 4 and 5 are not applicable.

[3] One of the primary differences between these two perspectives is that the resource cost does not consider the $35 million state loan, while the CVEA's cost of power takes the loan into consideration.

3. Power Supply Alternatives

In the 1994 Intertie Study, six power resource alternatives were considered: All Diesel, the Intertie, Allison Lake Hydroelectric, Silver Lake Hydroelectric, Valdez Coal Cogeneration, and Conservation. Two resource possibilities that have arisen since the 1994 Intertie Study are also considered in this report: Petro Star Cogeneration and Alyeska Cogeneration. The current status of each of these resource alternatives follows.

All Diesel

The All Diesel alternative assumes that the Intertie is not constructed and that diesel generators are added to meet CVEA's generation and reserve needs beyond what is being met by Solomon Gulch. In this update, the 1994 All Diesel alternative is reevaluated based on its definition in the 1994 Intertie Study. Two other versions of the All Diesel alternative are also evaluated in this update.

As noted above, CVEA's 1995 Power Supply Study includes plans defined as the 1995 All Diesel alternative. These plans differ from those for the 1994 All Diesel alternative in terms of plant, equipment, and labor. The largest difference between these two alternatives is in the number of people employed to operate and maintain the generation facilities. With the 1994 All Diesel alternative, three new operators were assumed to be added in 1997, while with the 1995 All Diesel alternative, five operators were assumed to be terminated in the same timeframe. The differences in these two All Diesel alternatives for overall retirement and replacement of the generating plant are shown in Appendix A.

CVEA conducted its 1995 Power Supply Study to assure itself that even under the most optimistic plan for the All Diesel alternative, a power supply provided through the Intertie would yield the lowest cost of power for the utility. The All Diesel alternative developed for CVEA's study was an optimum plant, equipment, and labor plan. As such, it is not directly comparable to the other alternatives, which have not been adjusted for least-cost configuration. However, a modified version of the All Diesel alternative was developed for this update that takes into account the plan for generation equipment in CVEA's 1995 Power Supply Study. This modified version, called the "Modified 1995 All Diesel" alternative excluded reductions in labor costs assumed in CVEA's 1995 All Diesel alternative.

The Modified 1995 All Diesel alternative was evaluated as part of the base analysis to this update; the 1995 All Diesel alternative was evaluated as part of the sensitivity analysis.

Intertie

Basic plans for construction of the Intertie remain unchanged from the 1994 Intertie Study. However, two conditions associated with the Intertie have changed: First, the marginal cost of generation by Railbelt utilities for power supply to CVEA is now estimated at 1.67 cents per kWh (1.60 cents per kWh in 1993 dollars) compared with a 1993 cost of 2.35 cents per kWh assumed in the 1994 Intertie Study. The current 1.67 cents per kWh estimate includes a

fuel cost of 1.5 cents per kWh and a variable operations and maintenance (O&M) cost of 0.17 cents per kWh. The fuel cost estimate is consistent with the fuel cost component of current economy energy sales by both CEA[4] and Anchorage Municipal Light & Power (ML&P), two Railbelt power suppliers.

The second changed condition is the potential for the 80/20 Integrated Intertie alternative between CEA and CVEA, which is discussed in Section 2. These two utilities are working on an agreement under which CEA would pay 80 percent of the Intertie cost and sell power to CVEA at the same rate it charges its other wholesale customers. CVEA would pay for 20 percent of the Intertie cost and purchase all of its power requirements beyond those provided from Solomon Gulch from CEA. It was assumed that CVEA would pay for 100 percent of the operation and maintenance cost.

Both firm and economy energy would be available to CVEA in the Base Intertie alternative. The firm energy supply scenario was based on ML&P's 1994 proposal to provide a power supply to CVEA. This proposal was for a cost of power supply averaging 4 cents per kWh in 1998 decreasing in real terms with time (adjusted for assumed inflation). Economy energy is currently available in the Railbelt at a cost of 2.5 cents per kWh.

Allison Lake Hydroelectric Project

The Allison Lake alternative evaluated in the 1994 Intertie Study included hydroelectric generation from a connection between Allison Lake and Solomon Gulch. In addition to generation at the connection, greater flows from Allison Lake into Solomon Gulch from October to May would increase generation at Solomon Gulch during this period. This alternative would have a high cost to CVEA ratepayers because contractual arrangements for generation at Solomon Gulch require that an energy generation charge be paid for all generation at the project. Currently that charge is 6.4 cents per kWh.

However, developers associated with the Allison Lake project indicate that the original configuration has changed, making this alternative more financially feasible. The preliminary permit filed with the Federal Energy Regulatory Commission (FERC) in December 1994 included a proposed configuration with "stand-alone" generation at tidewater north of Allison Lake. This configuration would be fundamentally different than the one considered in the 1994 Intertie Study in that it would have no connection to Solomon Gulch.

Costs associated with the new configuration have not yet been developed. Therefore, changes in cost estimates have not been included in this update to the 1994 Intertie Study.

Silver Lake Hydroelectric Project

Developers associated with the Silver Lake Hydroelectric Project believe that the project can be developed at a cost substantially lower than those included in the 1994 Intertie Study.

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[4] CEA's arrangement with Golden Valley Electric Association (GVEA) allows CEA to use GVEA's share of the Bradley Lake Hydroelectric Project for load following and thereby create added efficiencies in operating CEA's gas-fired turbines. CEA and CVEA could arrange for similar efficiencies in operation of CEA's turbines by allowing CEA to also follow load with Solomon Gulch generation.

However, no documented updates to the plans associated with the Silver Lake project have been made since the 1994 Intertie Study was completed. Therefore, as with Lake Allison, changes in cost estimates for the Silver Lake project were not included in this update.

Valdez Coal Cogeneration

The 1994 Intertie Study included evaluation of a coal-fired cogeneration project with output of 22 MW of electricity and steam for district heating. The project is planned to be constructed at Valdez by Alaska Cogeneration Systems, Inc. (ACSI). ACSI meets the requirements of being a "qualifying facility" under the terms of the Public Utility and Regulatory Policies Act of 1978 (PURPA), and the Alaska Public Utilities Commission has ordered CVEA to negotiate terms of a power supply agreement. To date, the parties have not come to an agreement.

The 1994 Intertie Study estimated the cost of the ACSI project to be $36.6 million. This estimate is $10 million or 37 percent higher than ACSI's $26.7 million estimate. ACSI continues to believe that its own cost estimates are correct and that the project is therefore the least-cost alternative for CVEA. CH2M HILL's reconnaissance-level review of these cost estimates found that data developed by R.W. Beck in the 1994 Intertie Study are the more reasonable estimates and accordingly these data were used in this update.

Conservation

The 1994 Intertie Study found that the potential exists for cost-effective conservation but that the amount of capacity and energy that could be saved was small compared to CVEA power requirements. As a result, this resource alternative can be combined with any other resource alternative but by itself is not a viable power supply option.

Petro Star and Alyeska Cogeneration

Costs of generation at Alyeska or Petro Star were not available or estimated for this update to the 1994 Intertie Study; therefore, they are not included in the base analysis. However, as a basis for understanding the potential feasibility of these supply possibilities, CVEA's avoided costs were estimated under the assumption that firm supplies were available from either Petro Star or Alyeska to meet all CVEA load requirements beyond those provided by Solomon Gulch. Avoided costs are those long-term costs that CVEA would avoid if it received power from either Petro Star or Alyeska. Knowing avoided costs helps to define the price at which, theoretically, CVEA would be indifferent between continuing to meet power requirements with diesel generation or obtaining comparable supplies from either Petro Star or Alyeska. This information may be helpful in future discussions with these firms regarding the feasibility of providing power supplies to CVEA.

A brief discussion of Petro Star and Alyeska Cogeneration follows and the results of the avoided-cost analysis are included at the end of Section 5, Results of Resource Cost Analysis.

Petro Star Cogeneration

In 1995, Petro Star announced plans to install cogeneration facilities at its refinery in Valdez with operation beginning in mid-1996. According to company representatives, the current plan is to install a 3.9-MW turbine to generate electricity and heat exchange equipment to use waste heat from the turbine to heat crude oil in its refining process. The company has evaluated a 4- to 7-year lease. Such financing would allow Petro Star to avoid a long-term capital commitment and retain the flexibility to purchase power from CVEA at a later date. This overall cogeneration plan has not yet been approved by Petro Star's board of directors.

Petro Star loads are currently about 1.8 MW, so it would have about 2 MW of capacity to sell to CVEA. Because this power supply would be from a cogeneration process, CVEA would be obligated to purchase this output at CVEA's avoided cost under the terms of PURPA. CVEA's current avoided cost for June through September is zero since it is obligated to buy as much output as possible from Solomon Gulch and, during this time of year, Solomon Gulch is able to supply all of CVEA's demands. However, during the remainder of the year, CVEA's current avoided costs for firm power as filed with the Alaska Public Utilities Commission (APUC) is currently 6.5 cents per kWh.

Over the long term, Petro Star is considering the addition of one or two additional 3.9-MW turbines. Therefore, Petro Star conceivably could develop as much as 9.8 MW of energy for sale to CVEA. The feasibility of these extra units would obviously depend on CVEA's future avoided cost.

Petro Star's net cost of generation is confidential. However, company representatives indicate that if power supply were available in the range of 8 cents per kWh, there would be minimal financial incentive to pursue the cogeneration project. The fact that Petro Star has chosen to defer investment in supplemental turbines is an indication that its generation costs are either greater than or not significantly lower than CVEA's avoided cost.

Alyeska Cogeneration

Alyeska operates the Valdez Marine Terminal. From a power supply standpoint, it operates as a stand-alone facility: It is not connected to any power supply system. Connection with a remote power supply, including the Intertie if it were built, would require the construction of a 2-mile transmission line.

Alyeska operates three steam-powered generation systems fired by a combination of diesel fuel and hydrocarbon vapors from its tanker vapor control system. Each of the three generating units has a capacity of 12.5 MW for a total capacity of 37.5 MW. Alyeska currently generates between 6 and 9 MW for its operations by running two of the three units at all times. Although this provides a high degree of reliability, running these units at a low load is inefficient and therefore costly.

Alyeska expects its power requirements to increase to be between 7 and 11 MW when its tanker vapor control system is completed at the end of 1997. The company stresses that its

generation and vapor control systems are highly integrated. Steam and inert exhaust gas associated with power generation are directly used in its vapor control system.

Alyeska cogeneration might be a source of reduced power costs to the CVEA system. However, it is unlikely that the Intertie would create an opportunity for Alyeska to generate power for sale to the Railbelt. This is because the marginal generation cost in the Railbelt is so low: less than 4 cents per kWh for firm energy generation. Line losses for deliveries from Valdez to the Railbelt would make it even more difficult for Alyeska generation to be used to justify construction of the Intertie.

Alyeska representatives have stated that they will decide on the possibilities of buying or selling power only after a decision is made regarding construction of the Intertie.

4. Parameters for Base and Sensitivity Analyses

Base Analysis Parameters

The parameters for the base analysis in this update–fuel costs, power requirements, and financial arrangements for the Intertie–are described below.

Fuel Costs

This update evaluates the effects of world crude oil prices on each of CVEA's alternative power supply options. Fuel costs to CVEA were based on oil price forecasts, both of which are described below. Because of the uncertainty of the world oil market, two scenarios were used in this analysis: low fuel-price escalation and high fuel-price escalation.

Besides affecting projected diesel fuel costs to CVEA, changes in oil prices affect gas supply costs for generation in the Railbelt. Since the cost of gas supplies to both CEA and ML&P are indexed to oil price parameters, changes to oil price forecasts result in changes to the projected cost of potential Railbelt generation for CVEA.

Fuel Costs to CVEA

The price CVEA pays for diesel fuel used in its generators has decreased since the 1994 Intertie Study was conducted. This decrease, which began in 1993, has primarily resulted from the startup of the Petro Star refinery in Valdez. Given its proximity to CVEA, Petro Star was able to successfully outbid CVEA's previous fuel supplier because of lower transportation costs.

For purposes of the base analysis, the 1995 fuel cost to CVEA is 59 cents per gallon at Valdez and 61 cents per gallon at Glennallen (1993 dollars).[5] In comparison, the 1994 Intertie Study's fuel costs for 1993–the base year of the analysis–were 70 cents per gallon in Valdez and 75 cents per gallon in Glennallen. The 1994 Intertie Study's projected fuel prices for 1995 were 72 cents per gallon at Valdez and 78 cents per gallon at Glennallen (1993 dollars).

Oil Price Forecasts

Projected growth rates in crude oil prices, which are a basis for diesel fuel costs to CVEA and natural gas prices on the Railbelt, have lowered since the 1994 Intertie Study was prepared. In the original study, real escalation (price changes in addition to general inflation) in fuel costs paid by CVEA were projected to increase at average rates ranging from 1.7 percent per year for the high fuel-price escalation scenario to 0.4 percent for the low fuel-price escalation scenario. In this update, CVEA's fuel costs were projected to increase from 1995 at an average annual rate of 0.45 percent in the high fuel-price escalation scenario and -1.18 percent in

[5] This is equivalent to prices currently paid in 1995 dollars: 63 cents per gallon at Valdez and 65 cents per gallon at Glennallen.

the low fuel-price escalation scenario. In the 1994 Intertie Study and in this update, fuel costs to CVEA were projected to increase at 2/3 the rate of escalation in real world oil prices.

In the 1994 Intertie Study, the high fuel-price escalation scenario was based on the Alaska Energy Authority's (AEA) medium forecast for oil prices (dated December 22, 1992), and the low fuel-price escalation scenario was based on the medium forecast for oil prices prepared by the Alaska Department of Revenue in its *Revenue Sources Book*, dated November 15, 1993. AEA no longer prepares oil cost forecasts; however, the Department of Revenue continues to publish high, medium, and low fuel-price forecasts twice a year. For this update, high and low forecasts from its spring 1995 *Revenue Sources Book* were used as the bases for the high and medium fuel-price escalation scenarios, respectively.

The Department of Revenue forecasts a reduction in its medium forecast for oil prices from that reported in November 1993. Decreases in the Department of Revenue's forecast in world oil prices over the past 2 years are shown in Appendix B.

CVEA Power Requirements

A forecast of future power requirements on the CVEA system was prepared as part of the 1994 Intertie Study. This forecast included high, medium-high, medium-low, and low power requirements. This update also looks at power requirements, but the high and low forecasts have been replaced by the scenarios that Alyeska becomes a CVEA customer and that Petro Star discontinues its service with CVEA. The medium-high and the medium-low forecasts are the same in this update as they were in the 1994 Intertie Study.

Each of the four power requirement forecast scenarios is described below, as well as the addition of Trans-Alaska Gas System (TAGS) and the High Altitude Auroral Research Project (HAARP) as CVEA customers.

Medium-High/Medium-Low Forecasts

The medium forecasts assume moderate economic and demographic growth during the forecast period based on a slowly declining oil industry, increasing seafood processing activity, and continued development of tourism. The difference between the medium-low and the medium-high forecast is that in the medium-low forecast, the Petro Star's load was projected to terminate as of 2019, and in the medium-high forecast, Petro Star's load would continue through the forecast period. The forecasts are summarized in Appendix C.

Loss of Petro Star as a CVEA Customer

As noted above, the effect of the loss of Petro Star as a CVEA customer was evaluated in this study.[6] If Petro Star proceeds with its plan to generate its own power supply, CVEA's projected energy requirements would be reduced by about 25 percent. Based on the medium-high and medium-low forecasts, loss of Petro Star would translate into reductions in peak

[6] Although Petro Star loads are large relative to CVEA's overall energy requirements, they are not particularly large by industrial standards. One new industrial customer or even a major tourist development could replace Petro Star loads.

load of 2.85 MW starting in 1997. Reductions in the forecast of CVEA energy requirements would be 22.5-million kWh starting in 1997. This would translate into corresponding reductions in the use of Solomon Gulch generation during the summer months and diesel generation during the winter months.

Addition of Alyeska as a CVEA Customer

Potential power sales to Alyeska Marine Terminal in Valdez were not included in any of the 1994 Intertie Study forecasts. Alyeska has indicated that purchase of energy from CVEA would be considered only after a decision was made to proceed with the Intertie. Therefore, the possible addition of the Alyeska Valdez Marine Terminal as a CVEA customer was evaluated in this update. For this case, 50-million kWh per year were added to CVEA's energy power requirements starting in 1999. The addition of this load would more than offset the loss of Petro Star loads by nearly doubling CVEA's other loads.

Among the factors critical to Alyeska's decision to purchase power from CVEA are the price of energy from CVEA, the cost of retrofitting Alyeska's operation to separate this power supply from steam and inert gas generation for its operation, and the reliability of supply. Alyeska is particularly concerned about reliability of supply and would need a high degree of confidence in its power supplier, the supplier's sources of supply, and availability and reliability of back-up power sources, before committing to any outside source of power supply.

Addition of TAGS and HAARP as CVEA Customers

Possibilities for additional industrial loads beyond those included in the medium-high forecast include TAGS and HAARP. TAGS was included in the high forecast used in the 1994 Intertie Study; HAARP loads were not included in any of the 1994 Intertie Study load forecasts.

The feasibility of TAGS is continually under study by Yukon Pacific Corporation and other stakeholders in the project. TAGS would involve a pipeline system adjacent to the existing Trans-Alaska Pipeline to deliver natural gas from the North Slope to Anderson Bay near Valdez. At that location, the gas would be liquefied and loaded on ocean tankers for shipment to Pacific Rim destinations. According to the 1994 Intertie Study, TAGS would self-generate most of the power it requires at its liquefaction facility; direct demand on CVEA would be minimal or nonexistent. However, the impact of TAGS construction and operation on the Valdez economy would be significant.

It is uncertain when TAGS construction would begin. In July 1995, Arco Alaska and BP Exploration, two major owners of natural gas reserves on the North Slope, announced that gas exports through TAGS cannot start until at least 2005 and probably closer to 2010 because Asia's needs are satisfied until then (*Anchorage Daily News*, July 20, 1995). This is consistent with assumptions included in the 1994 Intertie Study high load forecast.

HAARP is being considered by the U.S. Government for development northeast of Glennallen near Gulkana. Full-scale development could require a power supply in the range of 12 to 13 MW according to the 1994 Intertie Study. However, there is still significant

uncertainty surrounding development plans, power requirements, and potential sources of power supply.

Financial Arrangements for the Intertie

This update evaluates CVEA's cost of power with the Intertie based on two possible financial arrangements for the cost of the Intertie. Both arrangements assumed that the $35 million loan to CVEA from the State of Alaska would be used in the financing. First, the cost of power was calculated assuming the Base Intertie alternative, described in Section 2, (CVEA finances the Intertie and purchases firm energy from a Railbelt supplier on a competitive basis). Second, the cost of power was calculated based on the 80/20 Integrated Intertie arrangement, discussed above. Details of the arrangement are currently being negotiated. For the purposes of this update, it was assumed that CEA would be responsible for 80 percent and CVEA would be responsible for 20 percent of the repayment of the state and any supplementary loans for the Intertie. It was assumed that CVEA would be responsible for all of the operation and maintenance cost of the Intertie.

Sensitivity Analysis Parameters

Seven sensitivity analyses conducted in this update provided a basis for measuring the effects of changes in assumptions regarding alternatives and base parameters. Each of these is briefly discussed below.

CVEA's 1995 All Diesel Alternative

The resource cost and CVEA cost of power savings that would result from successful implementation of CVEA's 1995 All Diesel alternative were measured by comparing the cost of the 1995 All Diesel alternative with the cost of the Intertie.

No Load Growth

Reliance on load growth to make individual alternatives viable was evaluated by simply measuring resource costs and CVEA's cost of power assuming no load growth beyond 1994 levels.

Temporary Loss of Petro Star Loads

Temporary loss of Petro Star loads was evaluated to determine impacts on the feasibility of the Intertie from Petro Star entering a 7-year lease agreement for cogeneration and returning as a customer of CVEA upon expiration of the lease.

Need for New Generation Capacity in the Railbelt

The 1994 Intertie Study and the base analysis to this update assumed that, given the substantial excess capacity in the Railbelt and the relatively small size of CVEA's power supply requirement from the Intertie, no new generation capacity would need to be added to meet

CVEA's firm power requirements. The base assumption was that the supplying utility would either have or be able to purchase the capacity needed to meet CVEA loads. The resource cost effect of adding new capacity to meet CVEA requirements was evaluated.

Discount Rates

The enabling legislation for the Intertie required that the 1994 Intertie Study compare power supply alternatives on the basis of the present value of future costs for each alternative with "a discount rate representing the estimated long-term real cost of money." For the 1994 Intertie Study, the state's 4.5 percent real discount rate[7] was calculated on the basis of real interest rates for long-term taxable bonds. In this update, this rate was recalculated on the basis of current data and found to be unchanged. As a test of the sensitivity of results to this discount rate, sensitivity analyses were conducted with this parameter equal to 3 percent, reflecting the state's cost of money for nontaxable financing, and equal to 0 percent.

Economy Energy Supply from the Railbelt

In the cost of power analysis for the Base Intertie, it was assumed that CVEA would enter into a firm power supply contract with a Railbelt utility. However, given the surplus capacity and 30 percent reserve margin in the Railbelt, low-cost economy energy is available with only slightly less availability than that for firm power. To evaluate potential savings from economy energy purchases, the cost of power was calculated assuming CVEA were to purchase economy energy over the Intertie. As described in Section 5, Results of Resource Cost Analysis, economy energy was assumed to be available at an average cost of 2.5 cents per kWh compared to 4.0 cents per kWh for firm energy.

Schedule Delays

The effect of schedule delays on the feasibility of the Intertie was evaluated by simply comparing the Intertie and All Diesel alternatives assuming a 3-year delay in the Intertie's on-line date from the base parameter of 1999 to 2002.

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[7] The "real discount rate" ignores the effects of future inflation. A real discount rate of 4.5 percent is equivalent to a nominal discount rate of about 8 percent.

5. Results of Resource Cost Analysis

As previously mentioned, the resource cost analysis was performed in two parts: (1) the base analysis, which compared resource costs of power supply alternatives based on revised analysis of fuel prices, power requirements, and financial arrangements associated with the Intertie, and (2) the sensitivity analysis, which looked at a number of scenarios and analyzed the effect of each of them on the power supply alternatives. Following are the results of the base analysis and the sensitivity analysis and a discussion of findings on Petro Star and Alyeska cogeneration.

Base Analysis

Updated present value calculations of life-cycle costs and associated benefit-cost ratios for each power supply alternative included in the 1994 Intertie Study are shown in Table 1 and in Figures 2 and 3. The table presents a range of results for each alternative based on uncertainties associated with future fuel costs and future power requirements on CVEA's system.

Present value and benefit-cost results shown in the columns titled "With Petro Star" are based on future loads developing according to the medium-high and medium-low forecasts included in the 1994 Intertie Study and summarized in Appendix B. As discussed above, in the medium-high forecast, Petro Star loads are assumed to grow in the short term and remain on the CVEA system for the entire study period. The only difference between this forecast and the medium-low forecast is that in the medium-low forecast, Petro Star loads are assumed to terminate in 2019.

Results shown in the "Without Petro Star" columns are based on the assumption that Petro Star discontinues service with CVEA in 1996, and its demands on CVEA's system are not replaced by any other customer(s). Since the only difference between the medium-high and the medium-low forecasts relates to the long-term outlook for Petro Star, the forecasts are the same if Petro Star loads terminate in 1996; therefore, the results of the two forecasts are combined in Table 1 and are referred to as the "M-H/M-L Fct," the Medium-High/Medium Low Forecast.

Results shown in the "With Alyeska" column are based on the assumption that Petro Star discontinues service with CVEA but the lost loads are more than replaced by the addition of Alyeska as a customer starting in 1999.

Benefit-cost ratios shown in Table 1 were calculated with benefits for each resource alternative defined as the avoidance of continued reliance on diesel generation (as defined in the 1994 Intertie Study). Therefore, benefit-cost ratios were calculated as the present value of costs for the All Diesel alternative divided by the present value of costs for the given resource alternative.

Table 1
Present Value and Benefit-Cost Ratio for Power Supply Alternatives[1]

Alternatives	Low Fuel-Cost Escalation				High Fuel-Cost Escalation			
	With Petro Star		Without Petro Star		With Petro Star		Without Petro Star	
	Med. High Load Fct.	Med. Low Load Fct.	M-H/M-L[2] Load Fct.	M-H/M-L[2] Fct. w/ Alyeska	Med. High Load Fct.	Med. Low Load Fct.	M-H/M-L[2] Load Fct.	M-H/M-L[2] Fct. w/ Alyeska
Present Value of Costs ($000)[3]								
1994 All Diesel	60,483	55,924	35,573	81,263	67,632	61,697	39,984	92,414
Modified 1995 All Diesel	56,955	49,592	35,706	75,772	65,054	55,893	40,373	87,853
Intertie	56,088	54,227	47,685	59,740	59,101	56,603	49,296	64,293
Allison Lake [4]	59,972	55,606	44,168	77,933	63,223	57,520	44,781	85,249
Silver Lake	69,911	68,109	61,654	86,139	71,056	68,701	61,892	91,186
Valdez Coal	88,683	83,962	73,938	104,811	84,499	79,574	69,302	101,172
Savings Compared to Diesel ($000)								
1994 All Diesel	0	0	0	0	0	0	0	0
Modified 1995 All Diesel	3,528	6,332	-133	5,491	2,578	5,804	-389	4,561
Intertie	4,395	1,697	-12,112	21,523	8,531	5,094	-9,312	28,121
Allison Lake [4]	511	318	-8,595	3,330	4,409	4,177	-4,797	7,165
Silver Lake	-9,428	-12,185	-26,081	-4,876	-3,424	-7,004	-21,908	1,228
Valdez Coal	-28,200	-28,038	-38,365	-23,548	-16,867	-17,877	-29,318	-8,758
Benefit-Cost Ratio								
1994 All Diesel	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Modified 1995 All Diesel	1.06	1.13	1.00	1.07	1.04	1.10	0.99	1.05
Intertie	1.08	1.03	0.75	1.36	1.14	1.09	0.81	1.44
Allison Lake [4]	1.01	1.01	0.81	1.04	1.07	1.07	0.89	1.08
Silver Lake	0.87	0.82	0.58	0.94	0.95	0.90	0.65	1.01
Valdez Coal	0.68	0.67	0.48	0.78	0.80	0.78	0.58	0.91

1 Possible generation resources at Alyeska and Petro Star are excluded from this analysis because of lack of data on resource development costs.
2 M-H/M-L = Medium-High/Medium-Low. Since the difference between the medium-high and medium-low forecasts is only the length of time Petro Star's Valdez refinery is in operation, these forecasts are identical if Petro Star is assumed to leave the CVEA system.
3 1993 dollars based on a 4.5 percent discount rate.
4 Excludes 4-Dam Pool charge.

Figure 2

Present Value of Power Supply Alternatives

(Low Fuel Cost Forecast)

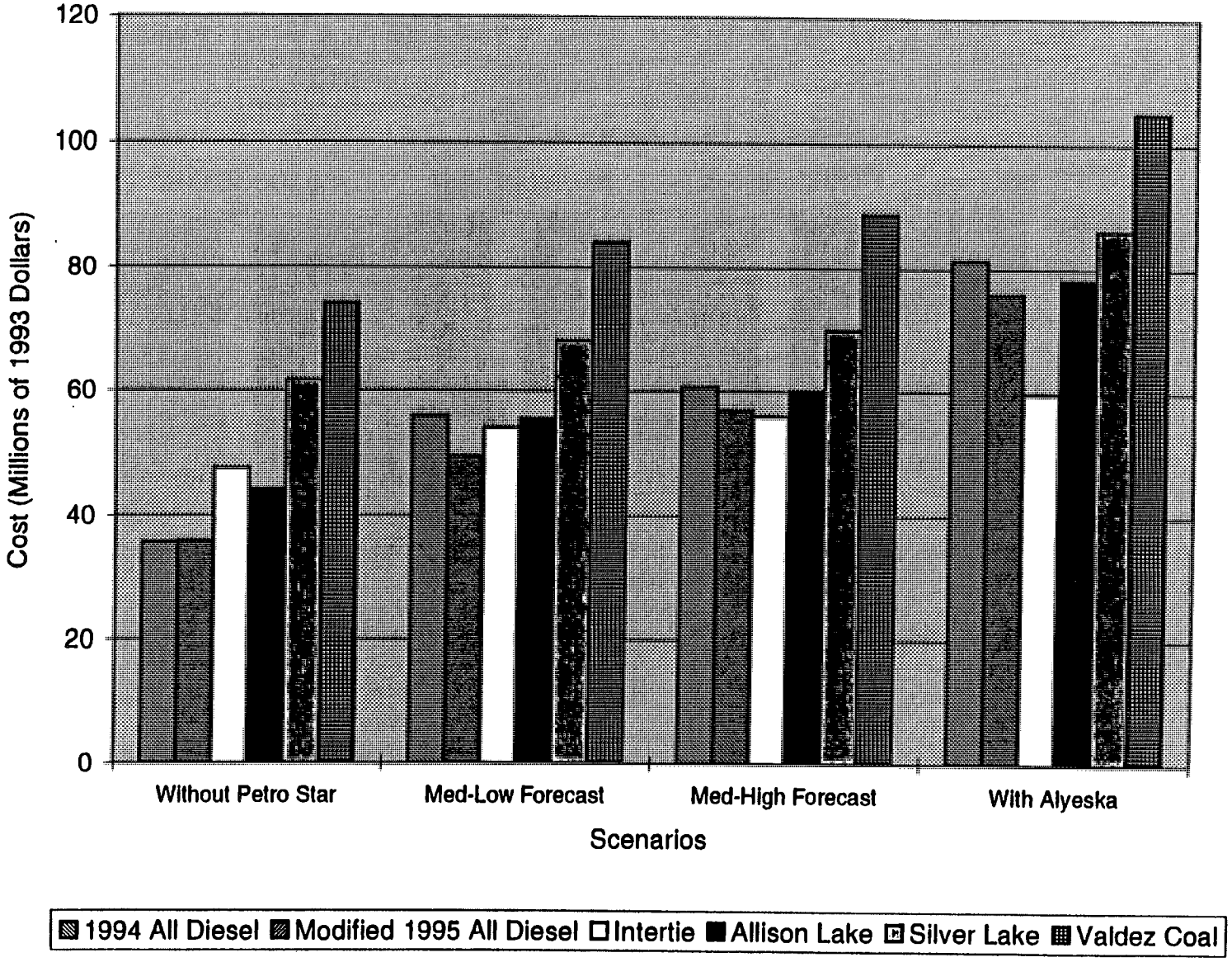
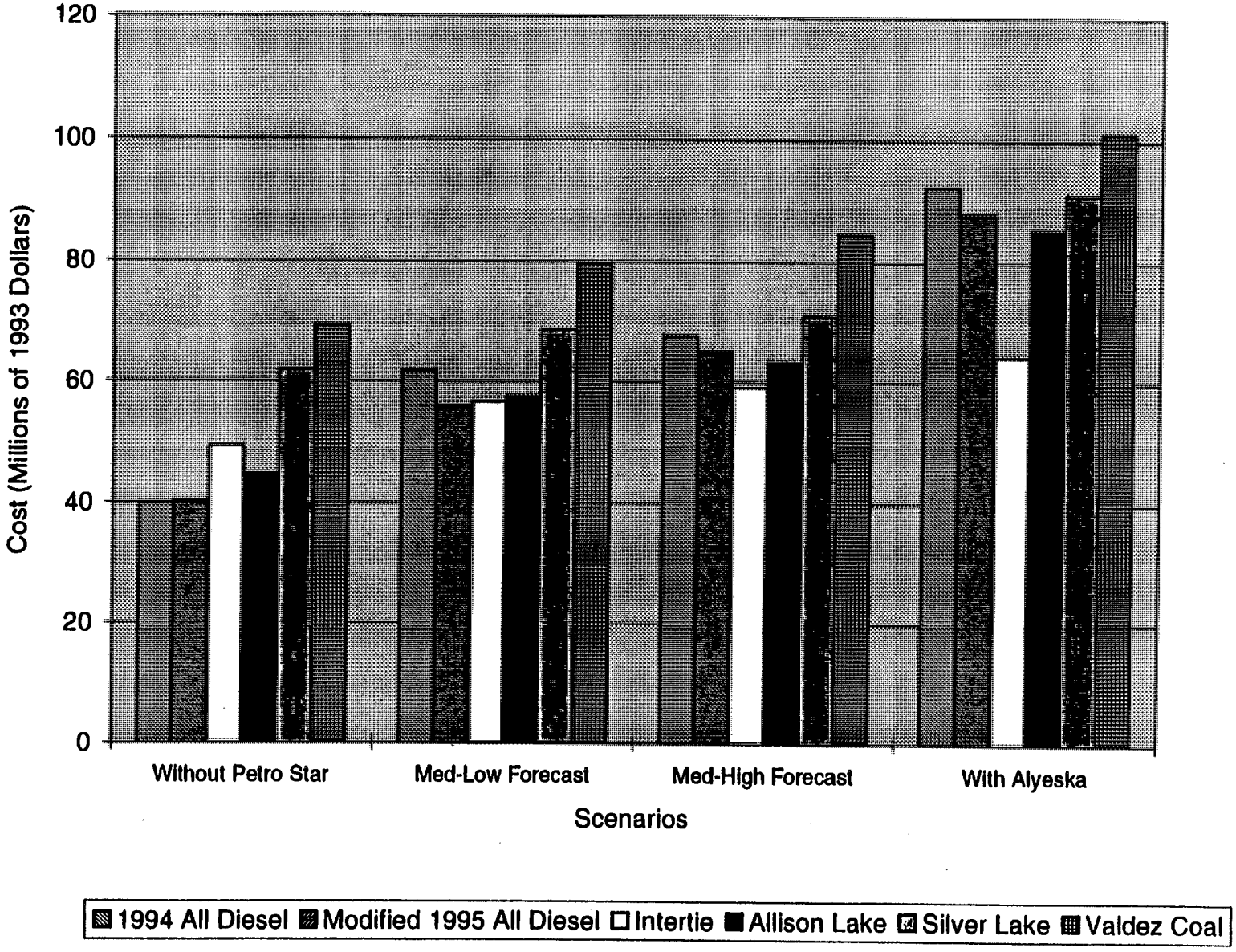


Figure 3

Present Value of Power Supply Alternatives

(High Fuel Cost Forecast)



Results in Table 1 are summarized as follows:

1. The Intertie and Modified 1995 All Diesel alternatives have the highest set of benefit-cost ratios assuming Petro Star remains a CVEA customer. Under the medium-high and medium-low load forecasts, the Intertie has benefit-cost ratios that are 3 to 14 percentage points higher than the 1994 All Diesel alternative, and the 1995 Modified All Diesel alternative has benefit-cost ratios that are 4 to 13 percentage points higher than the 1994 All Diesel alternative.

2. If Petro Star leaves the CVEA system permanently and is not replaced, continuation of an All Diesel alternative would have the highest set of benefit-cost ratios by a significant margin. The Intertie would be $9 million to $12 million more expensive than either the 1994 All Diesel alternative or the Modified 1995 All Diesel alternative.

3. The Intertie would have the highest benefit-cost ratios by a substantial margin if Alyeska were to join the CVEA system as a customer.

4. Allison Lake has benefits compared to the 1994 All Diesel alternative. However, as mentioned in Section 3, Parameters for Base and Sensitivity Analyses, an energy generation charge, not reflected in Table 1, makes this alternative financially infeasible.

5. Although developers associated with Allison Lake, Silver Lake, and Valdez Coal projects are working on configurations that they believe make these projects viable power supply resources for the region, new cost data since the 1994 Intertie Study were not available. Based on data available from the 1994 Intertie Study, these projects do not appear to be viable.

6. Generally, increases in future loads greater than those forecast improve the relative economics of the Intertie alternative; increases in future loads less than those forecast or load decreases improve the relative economics of the All Diesel alternatives.

7. Increases in future oil prices marginally increase the benefit-cost ratio for the Intertie alternative; decreases in future oil prices marginally decrease the benefit-cost ratio for the Intertie alternative. Depending on the load forecast, the benefit-cost ratio for the Intertie alternative is 6 to 8 percentage points higher for the high fuel-cost forecast than it is for the low fuel-cost forecast.

A comparison of results for analytical cases that were common to both the 1994 Intertie Study and those shown in Table 1 is provided in Appendix D.

Sensitivity Analysis

As discussed in Section 2, sensitivity analyses were conducted to evaluate the effects of the following scenarios and conditions:

1. Implementation of CVEA's All Diesel alternative as defined in CVEA's 1995 Power Supply Study
2. No load growth on CVEA's system beyond 1994
3. Departure of Petro Star from the CVEA system in 1995, followed by its return in 2003
4. The potential need for new generation capacity in the Railbelt to meet CVEA power requirements
5. Lower real discount rates

Results of each of these sensitivity analyses are described below.

CVEA's All Diesel Alternative

As noted in Section 3, Power Supply Alternatives, the 1995 All Diesel alternative conceived by CVEA is substantially less expensive than the 1994 All Diesel alternative. The decrease in labor costs combined with reduced capital cost assumed in the CVEA's 1995 Power Supply Study makes the present value of the lifecycle costs for the 1995 All Diesel alternative substantially less than those for the 1994 All Diesel alternative. As shown in Table 2, CVEA's All Diesel alternative is 16 to 36 percent more beneficial than 1994 All Diesel alternative. The benefit/cost ratios for the 1995 All Diesel alternative are greater than those for the Intertie by 6 to 33 percentage points assuming medium-high to medium-low load growth.

No Load Growth Beyond 1994

The Intertie is not feasible without load growth. As shown in Table 3, the benefit-cost ratio of the Intertie without load growth ranges from 0.74 to 0.79 depending on fuel price escalation rates.

Petro Star Off the CVEA System until 2003

Loss of Petro Star from the CVEA system for the 7 year period from 1996 to 2003 is projected to slightly reduce the benefit-cost ratio of the Intertie. As shown in Table 3, under the medium-low load forecast, the benefit-cost ratio for the Intertie would be between 0.98 and 1.05. This compares to benefit-cost ratios of 1.03 and 1.09 for the same scenario without this temporary loss of Petro Star loads (Table 1).

Table 2
Sensitivity Analysis of All Diesel and Intertie Alternatives

Alternatives	Low Fuel-Cost Escalation				High Fuel-Cost Escalation			
	With Petro Star		Without Petro Star		With Petro Star		Without Petro Star	
	Med. High Load Fct.	Med. Low Load Fct.	M-H/M-L[1] Load Fct.	M-H/M-L[1] Fct. w/ Alyeska	Med. High Load Fct.	Med. Low Load Fct.	M-H/M-L[1] Load Fct.	M-H/M-L[1] Fct. w/ Alyeska
Present Value of Costs ($000)[2]								
1994 All Diesel	60,483	55,924	35,573	81,263	67,632	61,697	39,984	92,414
1995 All Diesel	48,426	41,064	27,178	67,709	56,527	47,365	31,845	79,791
Intertie	56,088	54,227	47,685	59,740	59,101	56,603	49,296	64,293
Intertie--New Generation Capacity in 2005	60,235	57,429	49,910	66,281	63,247	59,805	51,521	70,833
Savings Compared to Diesel ($000)								
1994 All Diesel	0	0	0	0	0	0	0	0
1995 All Diesel	12,057	14,860	8,395	13,554	11,105	14,332	8,139	12,623
Intertie	4,395	1,697	-12,112	21,523	8,531	5,094	-9,312	28,121
Intertie--New Generation Capacity in 2005	248	-1,505	-14,337	14,982	4,385	1,892	-11,537	21,581
Benefit-Cost Ratio								
1994 All Diesel	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1995 All Diesel	1.25	1.36	1.31	1.20	1.20	1.30	1.26	1.16
Intertie	1.08	1.03	0.75	1.36	1.14	1.09	0.81	1.44
Intertie--New Generation Capacity in 2005	1.00	0.97	0.71	1.23	1.07	1.03	0.78	1.30

1 M-H/M-L = Medium-High/Medium-Low. Since the difference between the medium-high and medium-low forecasts is only the length of time Petro Star's Valdez refinery is in operation, these forecasts are identical if Petro Star is assumed to leave the CVEA system.
2 1993 dollars based on a 4.5 percent discount rate.

Table 3
Sensitivity Analysis of Low Load Risks

Alternatives	Low Fuel-Cost Escalation		High Fuel-Cost Escalation	
	No Load Growth beyond 1994	P.S.[1] Off Until 2003/ M-L Fct.	No Load Growth beyond 1994	P.S.[1] Off Until 2003/ M-L Fct.
Present Value of Costs ($000)[2]				
1994 All Diesel	37,846	49,340	41,457	54,823
Intertie	50,821	50,128	52,665	52,290
Savings Compared to Diesel ($000)				
1994 All Diesel	0	0	0	0
Intertie	-12,975	-788	-11,208	2,533
Benefit-Cost Ratio				
1994 All Diesel	1.00	1.00	1.00	1.00
Intertie	0.74	0.98	0.79	1.05

1 P.S. = Petro Star
2 1993 dollars based on a 4.5 percent discount rate

Required Additional Capacity in the Railbelt

If additional capacity was needed in the Railbelt to meet CVEA power requirements on the Intertie, the benefit-cost ratio for the Intertie would be 3 to 14 percentage points lower than if additional capacity is not needed. Assuming medium-high to medium-low load growth, the Intertie would have benefit-cost ratios that on average only slightly exceed those for the 1994 All Diesel alternative. As shown in Table 2, with the need for new generation capacity, the benefit-cost ratio for the Intertie would range from 0.97 to 1.07 assuming medium-high and medium-low load growth. With the addition of Alyeska loads, the Intertie would still have substantial benefits despite any need for new Railbelt generation capacity to meet CVEA power requirements.

Discount Rates

As mentioned above, a 4.5 percent real discount rate was used to calculate the present value of resource costs for each power supply alternative. As shown in Table 4, lower discount rates result in substantially greater benefits from the Intertie. This is because the proportion of costs that occur in the future is much higher for the All Diesel alternatives than it is for the Intertie. Therefore, higher discount rates result in higher benefit-cost ratios for the All Diesel alternatives relative to the Intertie, and conversely, lower discount rates result in higher benefit-cost ratios for the Intertie relative to the All Diesel alternatives.

Assuming medium-high load growth, high escalation of future fuel costs, and a 3 percent real discount rate, the Intertie benefits would be 34 percentage points higher than the 1994 All Diesel alternative and 32 percentage points higher than the Modified 1995 All Diesel alternative. Under the same assumptions, except with a 0 percent real discount rate, the Intertie benefits would be 95 to 97 percent higher than the 1994 and Modified 1995 All Diesel alternatives, respectively.

Petro Star and Alyeska Cogeneration

As discussed above, cost data on possible power supply alternatives from Petro Star and Alyeska were not available for this study. Instead of attempting to estimate these costs, calculations were made for long-term costs that CVEA would avoid if, instead of generating power, it were to receive all power, beyond that supplied by Solomon Gulch, from either Petro Star or Alyeska. This avoided cost was calculated for the projections from both the 1994 All Diesel alternative and the 1995 All Diesel alternative. Results of the avoided-cost calculations are shown in Table 5. The nominal costs shown in this table were calculated assuming a 3.5 percent inflation rate and a 5.0 percent interest rate. This interest rate was assumed by CVEA in its 1995 Power Supply Study based on a hardship loan available from the Rural Utility Service.

Table 4
Sensitivity Analysis of Discount Rates
(Based on High Fuel-Cost Forecast and Medium-High Load Forecast)

Alternatives	Discount Rates 5%	3%	0%
	Present Value of Costs ($000)[1]		
1994 All Diesel	67,632	90,150	188,752
Modified 1995 All Diesel	65,054	88,223	191,974
Intertie	59,101	67,473	96,935
	Savings Compared to Diesel ($000)		
1994 All Diesel	0	0	0
Modified 1995 All Diesel	2,578	1,927	-3,222
Intertie	8,531	22,677	91,817
	Benefit-Cost Ratio		
1994 All Diesel	1.00	1.00	1.00
Modified 1995 All Diesel	1.04	1.02	0.98
Intertie	1.14	1.34	1.95

[1] In 1993 dollars

Table 5
CVEA Avoided Diesel Generation Cost
(cents per kWh)

Year	Based on 1994 All Diesel Alternative Nominal	Real 1995$	Based on 1995 All Diesel Alternative Nominal	Real 1995$
1997	8.63	8.06	7.45	6.95
1998	9.23	8.32	7.72	6.96
1999	9.54	8.31	8.01	6.98
2000	9.86	8.30	8.31	7.00
2001	10.20	8.30	8.62	7.01
2002	10.55	8.29	8.94	7.03
2003	10.91	8.29	9.28	7.05
2004	11.30	8.29	9.63	7.07
2005	11.70	8.29	9.99	7.08
2006	12.11	8.29	10.38	7.11
2007	12.55	8.31	10.78	7.13
2008	13.00	8.31	11.19	7.15
2009	13.47	8.32	11.63	7.18
2010	13.96	8.33	12.08	7.21
2011	14.47	8.34	12.55	7.24
2012	15.00	8.36	13.04	7.27
2013	15.55	8.37	13.55	7.29
2014	16.12	8.38	14.08	7.32

Once CVEA commits to a major power supply alternative, the utility's avoided cost would decrease and with it Petro Star and Alyeska's opportunity to market power. Given the low generating costs in the Railbelt (less than 4 cents per kWh including the capital cost of new generation), no realistic prospect exists for Petro Star or Alyeska selling power there. CVEA's avoided cost would either be nonexistent, because of a full-requirements set of power supply contracts (assumed for an integrated scenario like that proposed by CEA), or only as high as about 4 cents per kWh for firm power supplies as recently proposed by ML&P.

6. Results of CVEA Cost of Power Analysis

This section provides an analysis of power supply alternatives from the perspective of CVEA and its customers. This update evaluates costs of alternatives in terms of CVEA's total cost of power supply per kWh. Although the 1994 Intertie Study considered cost of power, it excluded costs common to all alternatives, such as the purchase of Solomon Gulch energy and costs associated with existing equipment. This update has included common costs in evaluating the alternatives so that the impacts to ratepayers of each alternative can be considered. By calculating the total cost of power per kWh, differences among alternatives and among scenarios can be directly translated into resulting differences in CVEA rates. Currently, CVEA's total cost of power per kWh is about 8.6 cents or about 57 percent of the utility's total cost (or revenue requirement) per kWh including transmission, distribution, customer, and administrative costs.

Silver Lake Hydroelectric and Valdez Coal alternatives were not considered in the cost of power analysis because they were determined to be infeasible in the resource analysis. The Allison Lake Hydroelectric alternative was ruled out because the energy generation charge associated with this project makes this alternative financially infeasible.

For the All Diesel and Intertie alternatives, CVEA's overall cost of power per kWh was projected in nominal prices for 1995 through 2014 for the base and sensitivity analyses performed in this update. "Levelized" or average costs per kWh for these alternatives were also calculated for the first 15 years of the Intertie (1999 through 2013). These levelized costs are shown in Table 6.

Projections of CVEA's cost of power per kWh for both base and sensitivity analyses are shown in Figures 4 through 18. An index to these figures is shown in Table 7 which precedes Figures 4 through 18 at the end of this section. (Since the medium-high and the medium-low load forecasts are the same for the years shown in Figures 4 through 18, they are described in the figures as the "Medium-High/Medium-Low Load Forecast." This is the same as abbreviated as "M-H/M-L Load Fct." in Tables 1 and 2.)

In these analyses, the cost of power for Intertie alternatives was calculated with the Intertie financed in part by the $35 million, 0-interest rate, 50-year loan from the State of Alaska. The cost of power calculated for the All Diesel alternatives did not include such a loan in its assumed financing.

Base Analysis

CVEA's projected cost of power for the 1994 All Diesel, Modified 1995 All Diesel, Base Intertie, and 80/20 Integrated Intertie alternatives are shown in Figures 4 and 5 for low and high fuel-cost projections, respectively, assuming medium-high/medium-low load growth.

These figures show the following:

Table 6
Levelized Cost per kWh for CVEA Power Supply Alternatives, 1999 through 2013

Alternatives	Cost of Power (cents per kWh)	
	Low Fuel-Cost Forecast	High Fuel-Cost Forecast
Base Analysis		
1994 All Diesel	11.24	11.71
Modified 1995 All Diesel	10.38	10.91
Base Intertie	10.09	10.31
80/20 Integrated Intertie	9.24	9.39
1994 All Diesel without Petro Star	11.17	11.55
Modified 1995 All Diesel without Petro Star	11.22	11.63
Base Intertie without Petro Star	11.56	11.74
80/20 Integrated Intertie without Petro Star	9.97	10.10
Base Intertie without Petro Star/with Alyeska	9.22	*
80/20 Integrated Intertie without Petro Star/with Alyeska	8.63	8.81
Sensitivity Analysis		
1995 All Diesel	9.62	10.15
1994 All Diesel with No Load Growth beyond 1994	10.95	11.34
Modified 1995 All Diesel with No Load Growth beyond 1994	10.89	11.34
Base Intertie with No Load Growth beyond 1994	10.95	11.14
80/20 Integrated Intertie with No Load Growth beyond 1994	9.69	9.84
1994 All Diesel without Petro Star for 1996 through 2002	11.29	*
Base Intertie without Petro Star for 1996 through 2002	10.53	*
Base Intertie with Economy Energy	9.15	9.36
Base Intertie with Firm Energy–Delayted until 2002	10.73	10.95

*Not calculated

- The 80/20 Integrated Intertie alternative is the least costly of the alternatives under both low and high fuel-cost projections.

- The 1994 All Diesel alternative has the highest cost of power of the alternatives shown.

- Except for the first few years of the Intertie, the Base Intertie has a lower cost of power than the Modified 1995 All Diesel alternative.

The 80/20 Integrated Intertie alternative has a cost of power that averages 1.1 to 1.5 cents per kWh less than that for the Modified 1995 All Diesel alternative during the first 15 years of the Intertie's operation.

As shown in Figures 6 and 7, the 80/20 Integrated Intertie also provides the lowest cost of power if Petro Star were to cease buying power from CVEA and not have its load requirements replaced on CVEA's system by some other customer. On the other hand, the Base Intertie alternative is the highest cost alternative for the period shown. This is because CVEA's cost of the Intertie would be spread over significantly fewer kWh with loss of Petro Stars loads, thereby increasing CVEA's average cost per kWh of its power supply. With the 80/20 Integrated Intertie only 20 percent of the Intertie cost would be spread over significantly fewer kWh, while with the Base Intertie, the full cost of the Intertie would be spread over significantly fewer kWh.

Figures 8 and 9 show the effect replacement of Petro Star by a larger customer like Alyeska would have on CVEA's cost of power. As the figure shows, the 80/20 Integrated Intertie would still provide the lowest cost of power. Compared to the cost of power with medium-high/medium-low load growth forecast, the cost of power under the assumption that Alyeska replaces Petro Star as a CVEA customer, CVEA's cost of power with the 80/20 Integrated Intertie would be an average of 0.6 cents lower during the first 15 years of Intertie operation.

Sensitivity Analysis

As noted in Section 1, Introduction, five sensitivity analyses were conducted from a cost of power perspective:

1. Implementation of the 1995 All Diesel alternative as defined in CVEA's Power Supply Study

2. No load growth on CVEA's system beyond 1994

3. Departure of Petro Star from the CVEA system in 1995, followed by its return in 2003

4. CVEA purchase of an economy, rather than firm, power supply from a Railbelt utility

5. Delay in the scheduled construction and operation of the Intertie

1995 All Diesel Alternative

A comparison of CVEA's cost of power with the 1995 All Diesel alternative versus that for the 80/20 Integrated Intertie and the Base Intertie is provided in Figures 10 and 11 for the low and high fuel-cost escalation scenarios, respectively. This comparison shows that, if the 1995 All Diesel alternative could be implemented, it would actually have a lower cost of power than the Base Intertie alternative during the first 9 to 12 years of Intertie operation. However, the 80/20 Integrated Intertie would still be the least expensive alternative. During the first 15 years of Intertie operation, the 80/20 Integrated Intertie would be an average of 0.4 to 0.8 cents per kWh less expensive than the 1995 All Diesel alternative.

No Load Growth

The effects of no growth in CVEA loads beyond 1994 levels are shown in Figures 12 and 13 for low and high fuel-cost escalation scenarios, respectively. Again, the 80/20 Integrated Intertie would provide the lowest cost of power to CVEA. Under this scenario, there is little difference in the cost of the other three base power supply alternatives (1994 All Diesel, Modified 1995 All Diesel, and Base Intertie). During the first 15 years of Intertie operation, CVEA's cost of power with the 80/20 Integrated Intertie would average 1.2 to 1.5 cents per kWh less than the Modified 1995 All Diesel alternative.

Loss of Petro Star Loads, 1996 through 2002

Figure 14 shows CVEA's cost of power assuming Petro Star does not buy power from CVEA between 1996 and 2002, compared to the cost of power assuming Petro Star continues uninterrupted service from CVEA. Analysis shown in this figure is based on the assumed low fuel-cost escalation rate. This figure shows that during the 4 years that the Intertie would be operational and Petro Star would not be buying power (1999 through 2002), the cost of power associated with the Base Intertie would be about 1.5 cents per kWh higher than if Petro Star continued to buy CVEA power during this period. Loss of Petro Star loads during the 1996 through 2002 period would have a relatively small impact on CVEA's cost of power associated with the 1994 All Diesel alternative.

Economy Energy Supply from the Railbelt

In Figures 15 and 16, CVEA's cost of power with the Base Intertie and economy energy purchases in the Railbelt is compared with the cost of power assuming firm power supply purchases with the Base Intertie alternative and with the cost of power assuming the 80/20 Integrated Intertie alternative. As these figures show, the cost of power with the 80/20 Integrated Intertie alternative is similar to that with the Base Intertie and economy energy purchases for the 15 years of Intertie operation shown in the figures. With both low and high

fuel-cost forecasts, the 80/20 Integrated Intertie alternative has a cost of power that is somewhat lower than that for the Base Intertie with economy energy purchases in the first 4 to 6 years of Intertie operation. Thereafter, the cost of power with the Base Intertie and economy energy purchases would be somewhat lower.

Delay in Intertie Construction

As shown in Figures 17 and 18, if construction of the Intertie were to be delayed by three years, CVEA's cost of power would be lower during the delay period but then be higher during the remainder of the period shown. This assumes that CVEA would not make any significant capital additions during this period and that repayment of the loans associated with the Intertie would also be delayed until start of Intertie operation in 2003. The delay in construction is assumed to increase the cost of the Intertie because of general price inflation. Repayment of associated loans would also reflect a higher cost than would be incurred without the construction delay. Accordingly, CVEA's cost of power would be higher than the cost of power without the delay as shown in the figures.

Table 7
Index to CVEA Cost of Power Figures 4–18

Figure No.			
Low Fuel-Cost Forecast	High Fuel-Cost Forecast	Power Supply Alternatives Included in Figure	Load Forecast
4	5	1994 All Diesel, 1995 Modified All Diesel, Base Intertie, 80/20 Integrated Intertie	M-H/M-L
6	7	1994 All Diesel, 1995 Modified All Diesel, Base Intertie, 80/20 Integrated Intertie	M-H/M-L without Petro Star
8	9	Base Intertie, 80/20 Intertie	M-H/M-L without Petro Star/with Alyeska M-H/M-L
10	11	1995 All Diesel, Base Intertie, 80/20 Integrated Intertie	M-H/M-L
12	13	1994 All Diesel, 1995 Modified All Diesel, Base Intertie, 80/20 Integrated Intertie	No load growth beyond 1994
14		1994 All Diesel, Base Intertie	M-H/M-L less Petro Star for 1996-2002 M-H/M-L
15	16	1994 All Diesel, Base Intertie, Base Intertie with Economy Energy	M-H/M-L
17	18	1994 All Diesel, Base Intertie with 3-Year Construction Delay	M-H/M-L

Figure 4

Projected CVEA Cost of Power

Low Fuel Cost

Medium-High/Medium-Low Load Forecast

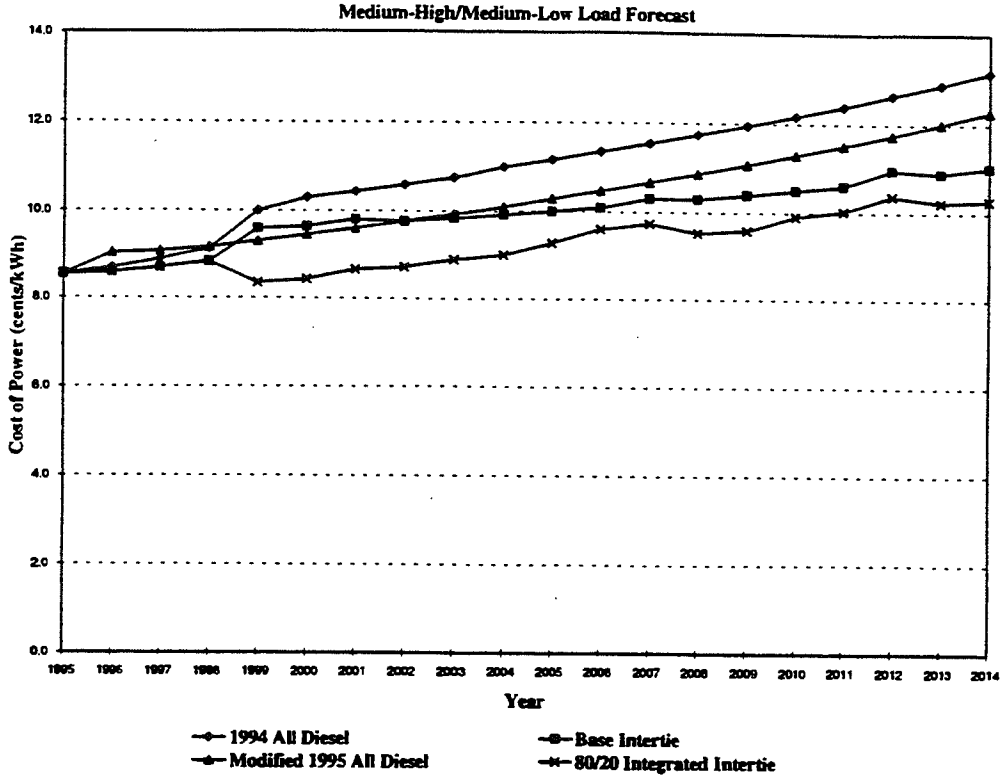


Figure 5

Projected CVEA Cost of Power

High Fuel Cost

Medium-High/Medium-Low Load Forecast

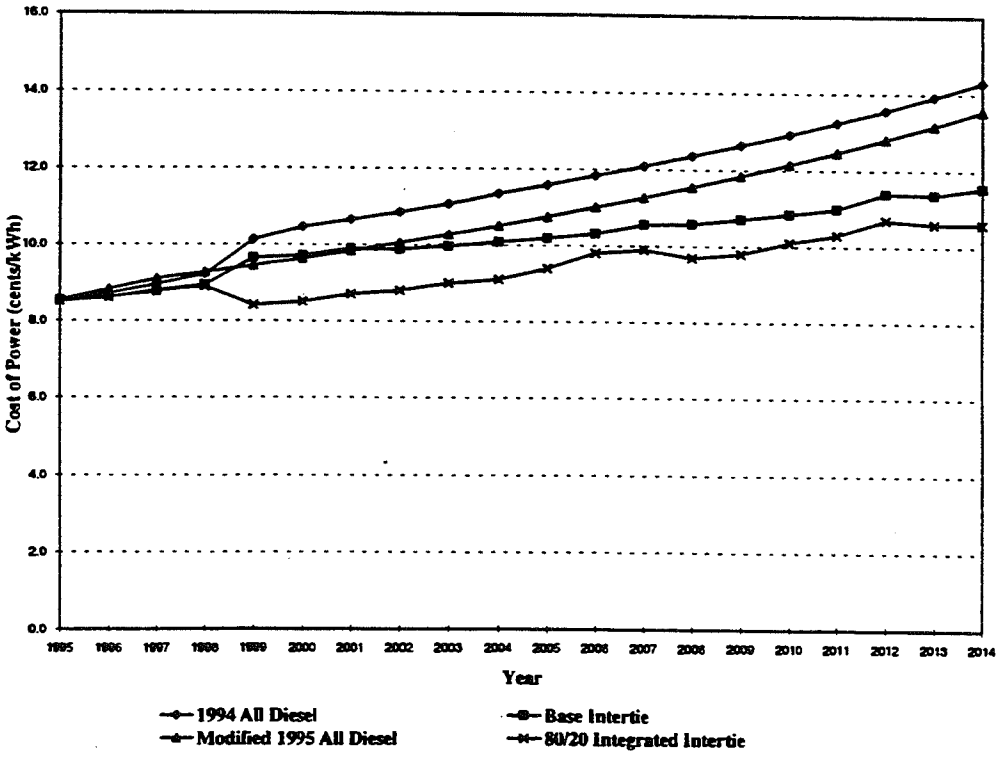


Figure 6

Projected CVEA Cost of Power

Low Fuel Cost

Medium-High/Medium-Low Load Forecast

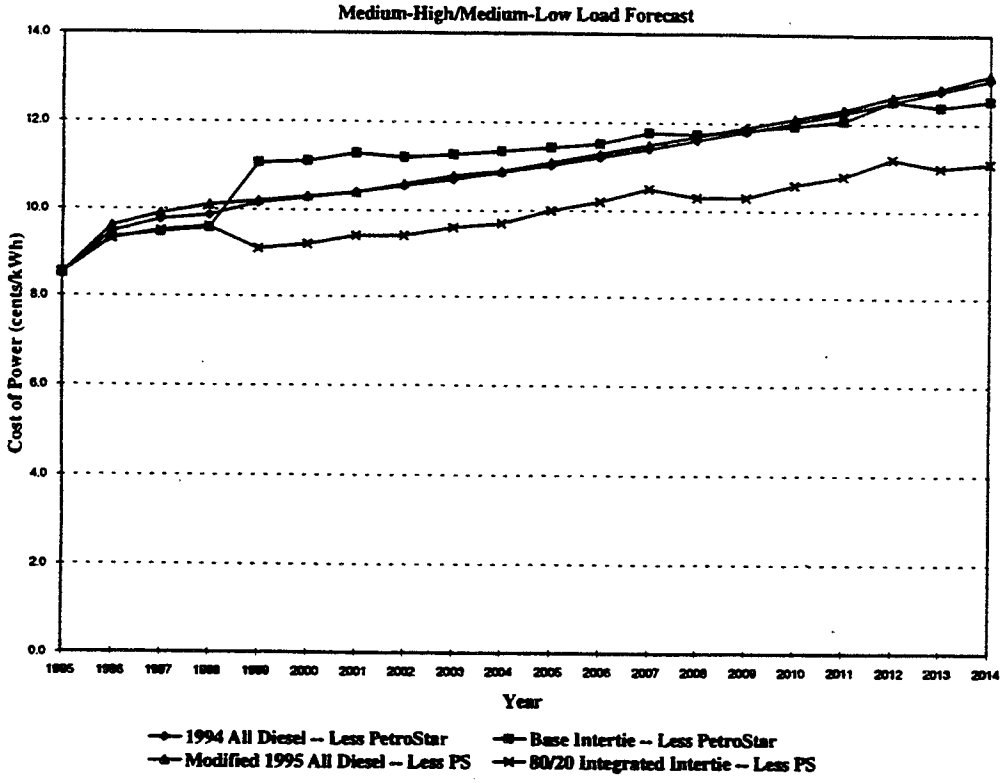


Figure 7

Projected CVEA Cost of Power

High Fuel Cost

Medium-High/Medium-Low Load Forecast

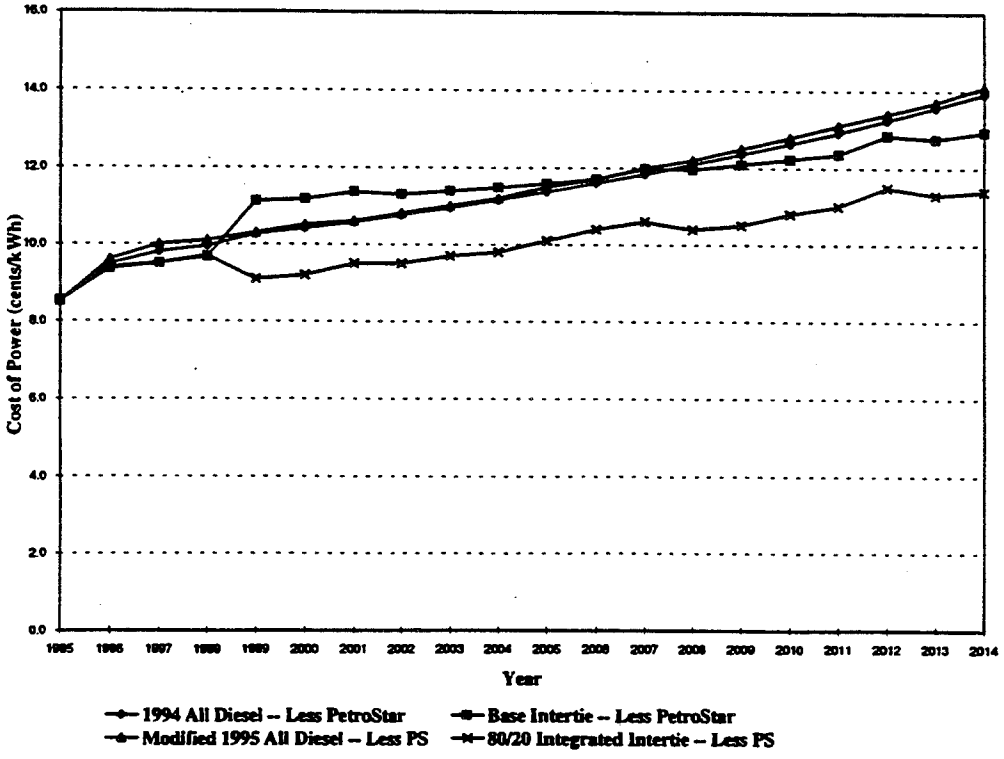


Figure 8

Projected CVEA Cost of Power

Low Fuel Cost

Medium-High/Medium-Low Load Forecast

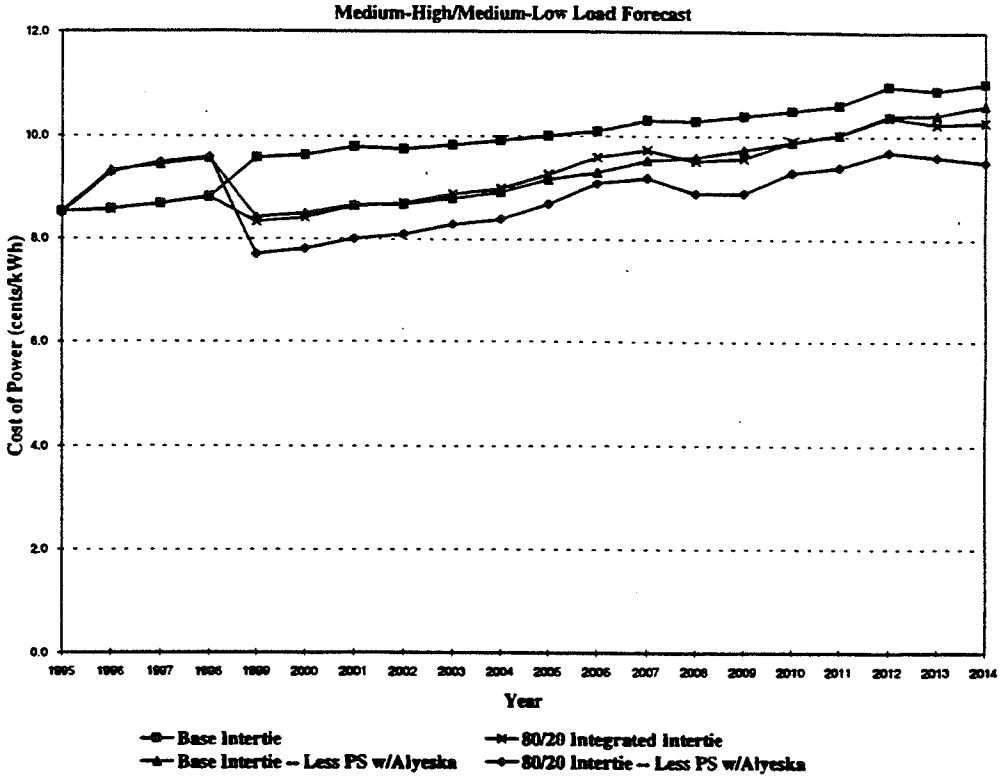


Figure 9

Projected CVEA Cost of Power

High Fuel Cost

Medium-High/Medium-Low Load Forecast

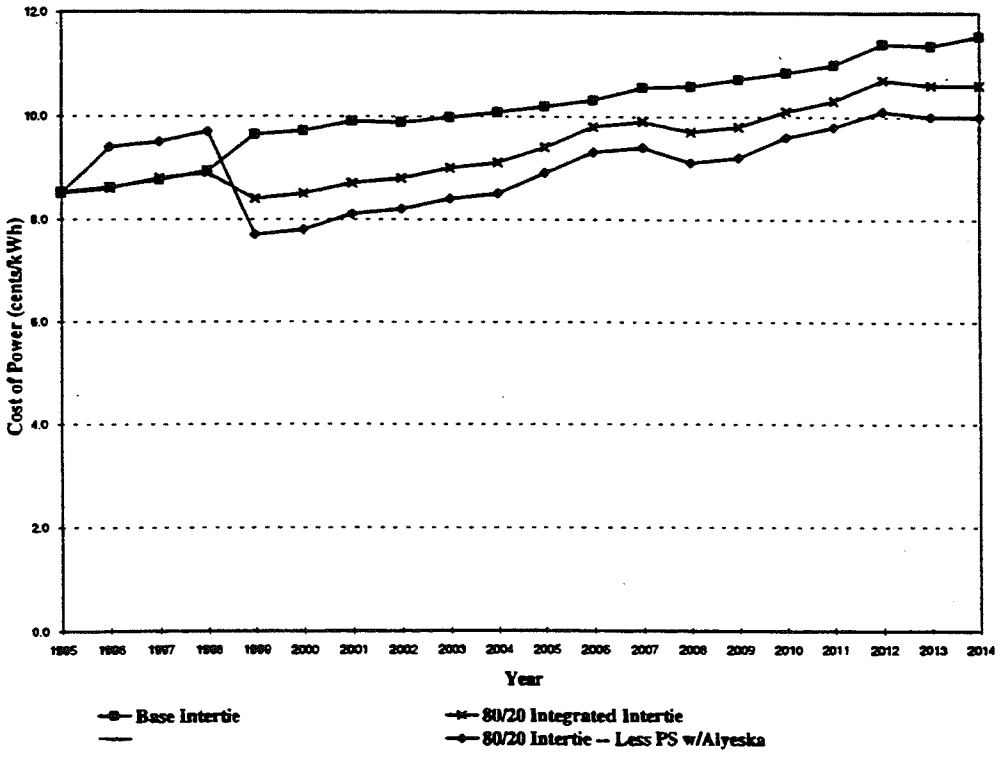


Figure 10

Projected CVEA Cost of Power

Low Fuel Cost

Medium-High/Medium-Low Load Forecast

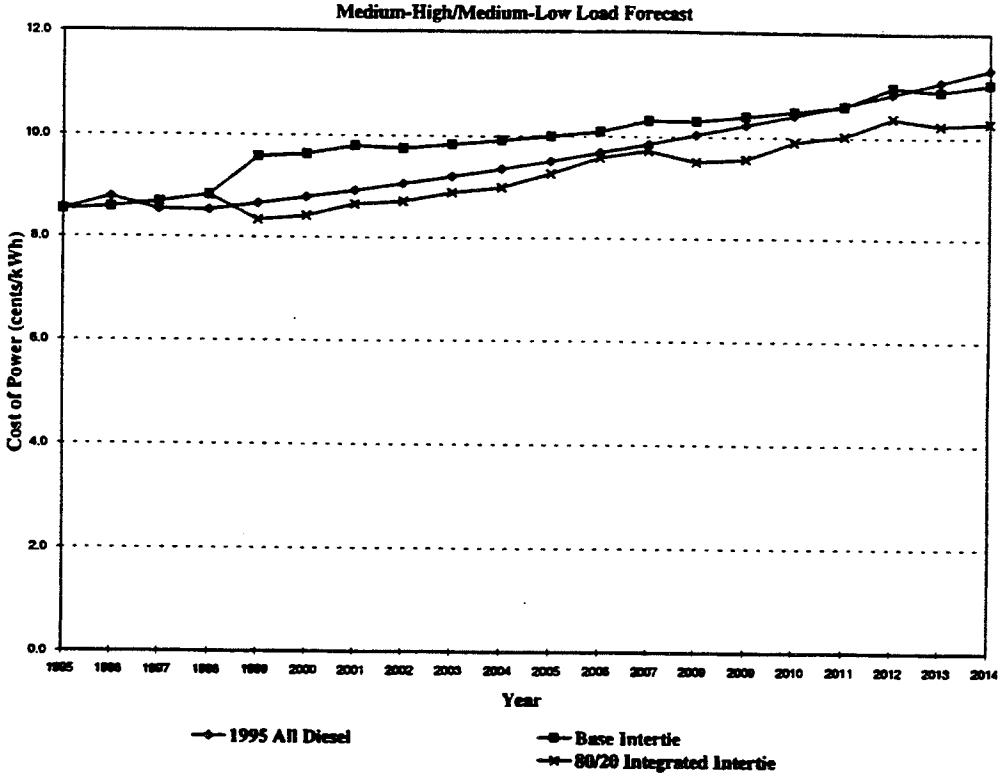


Figure 11

Projected CVEA Cost of Power

High Fuel Cost

Medium-High/Medium-Low Load Forecast

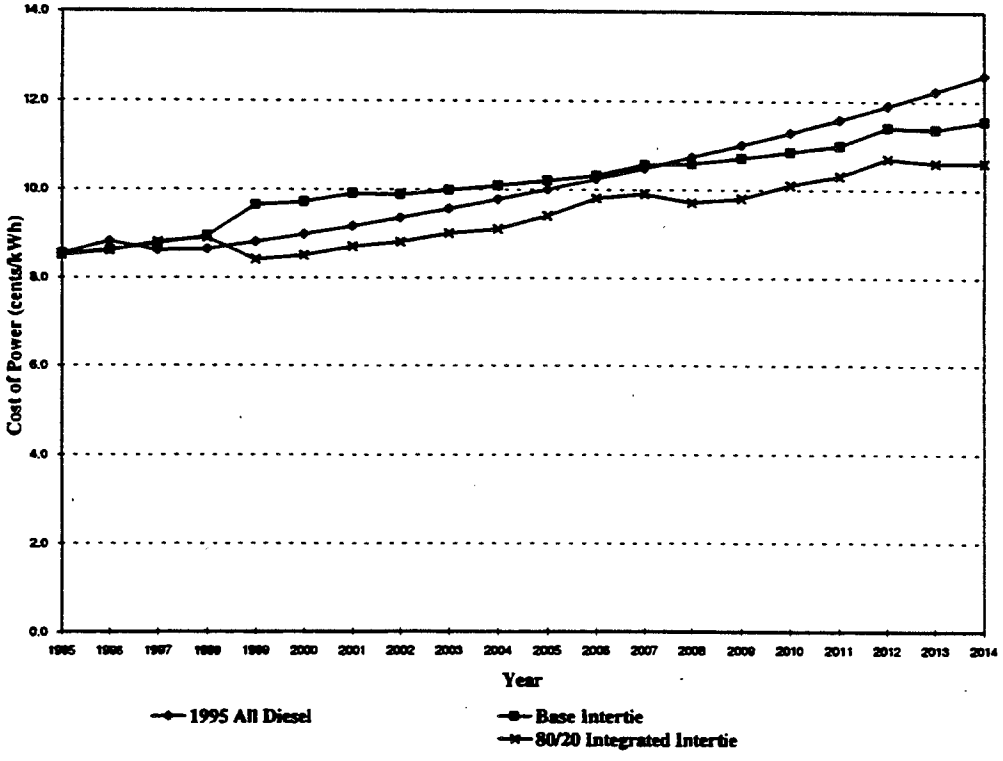


Figure 12

Projected CVEA Cost of Power

Low Fuel Cost

No Load Growth Beyond 1994

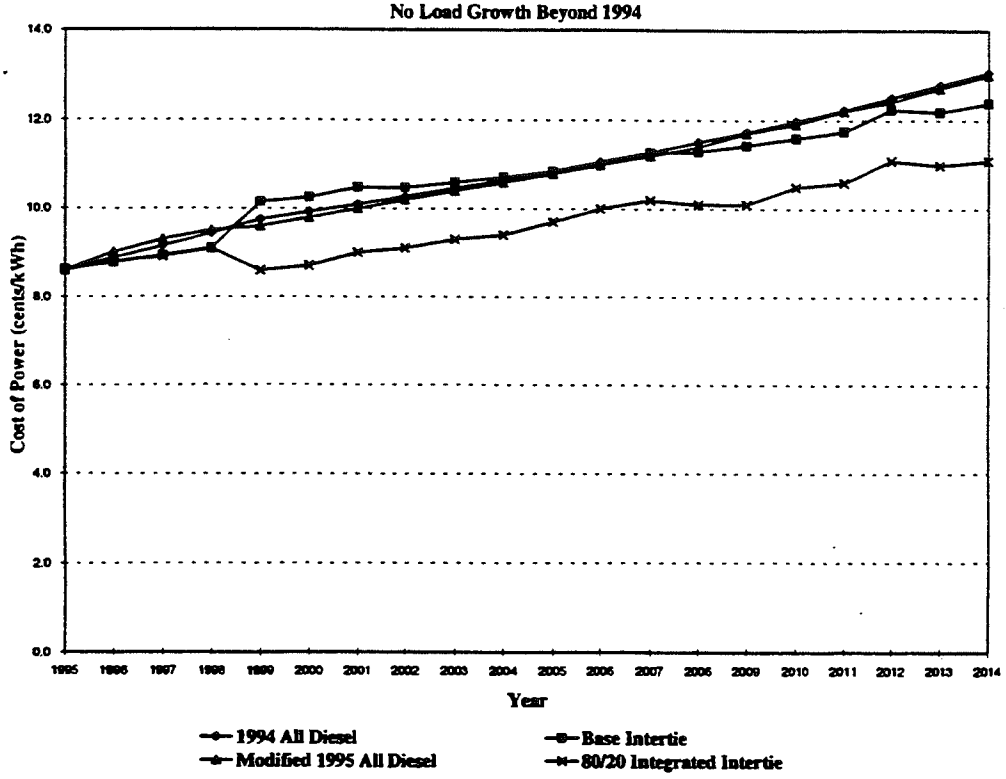


Figure 13

Projected CVEA Cost of Power

High Fuel Cost

No Load Growth Beyond 1994

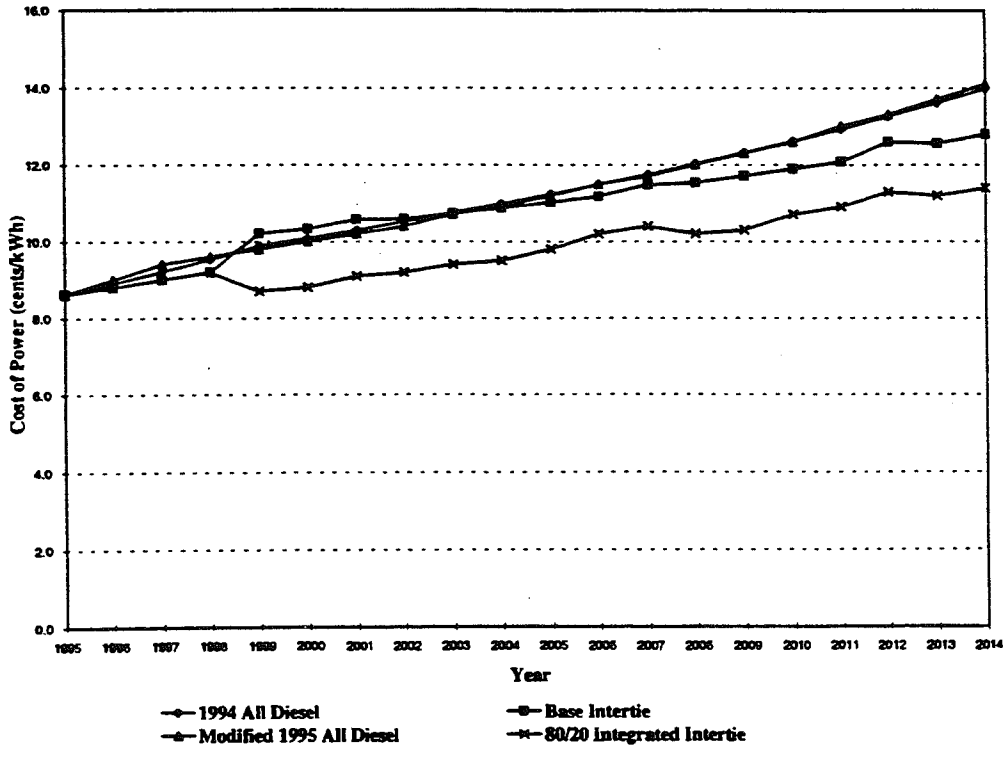


Figure 14

Projected CVEA Cost of Power

Low Fuel Cost

Medium-High/Medium-Low Load Forecast

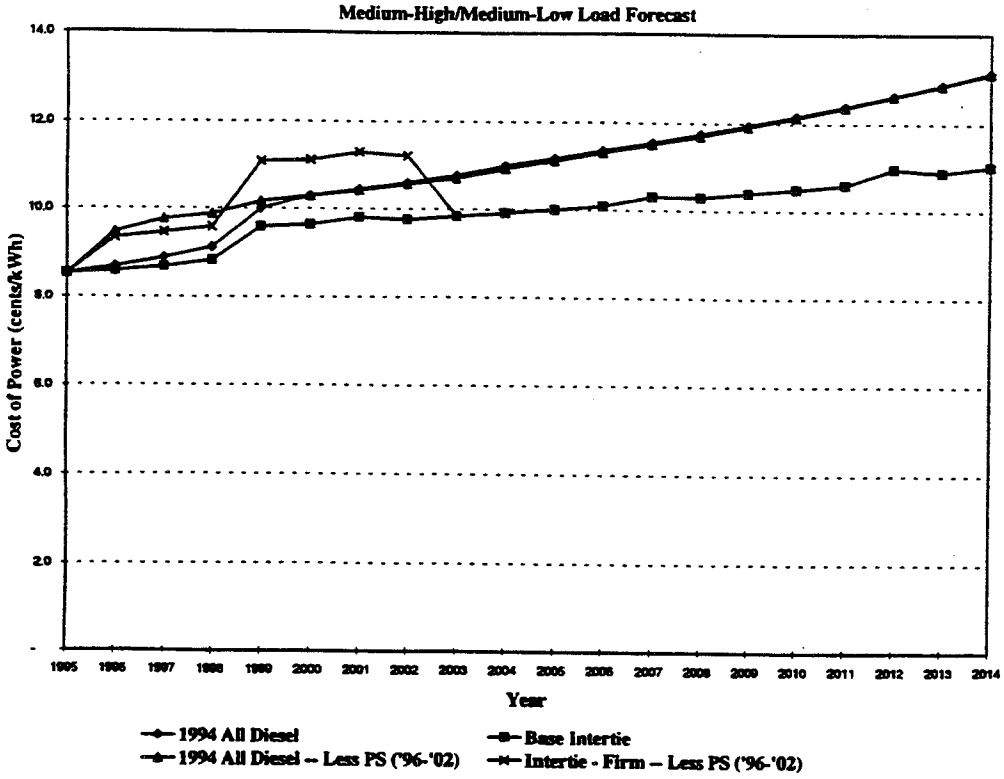


Figure 15

Projected CVEA Cost of Power

Low Fuel Cost

Medium-High/Medium-Low Load Forecast

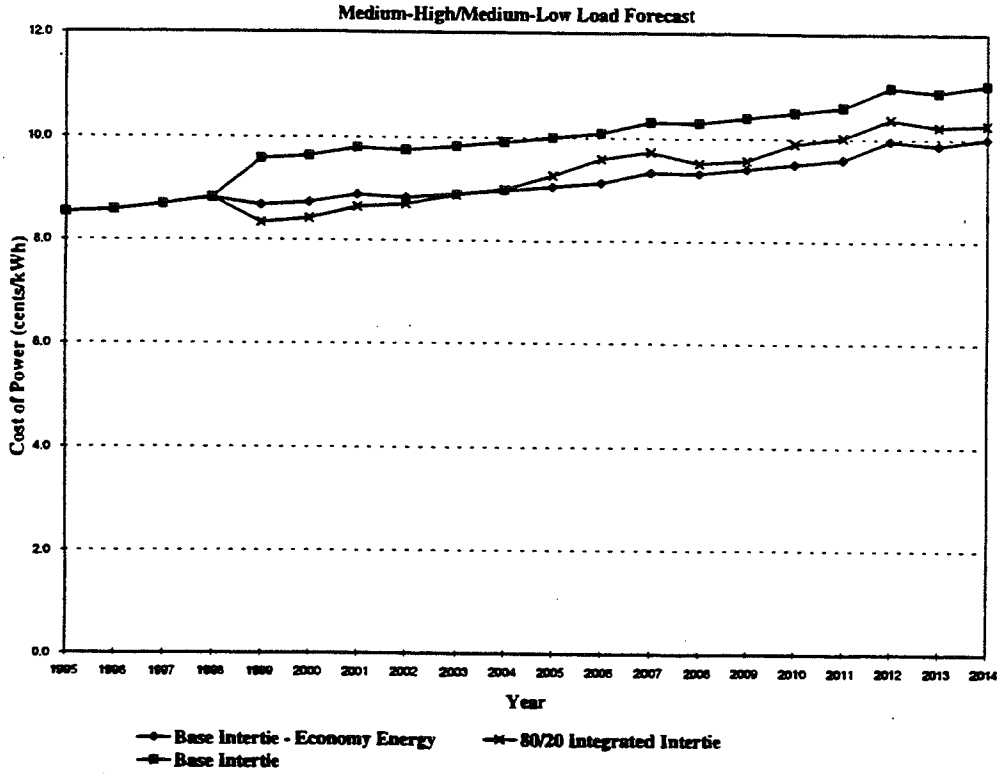


Figure 16

Projected CVEA Cost of Power

High Fuel Cost

Medium-High/Medium-Low Load Forecast

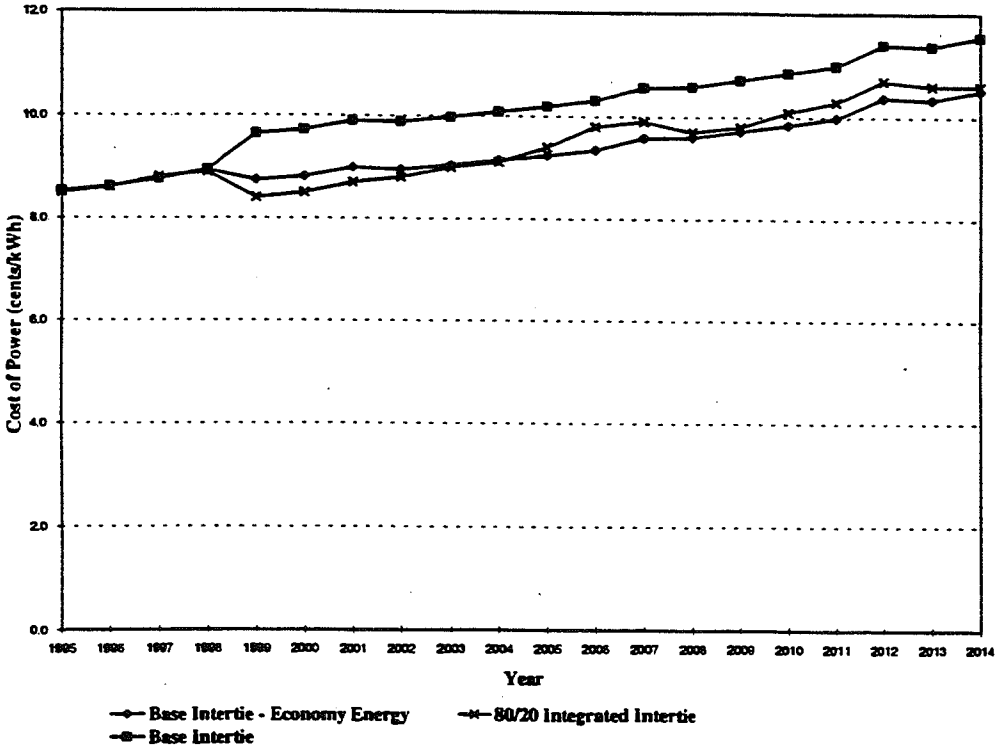


Figure 17

Projected CVEA Cost of Power

Low Fuel Cost

Medium-High/Medium-Low Load Forecast

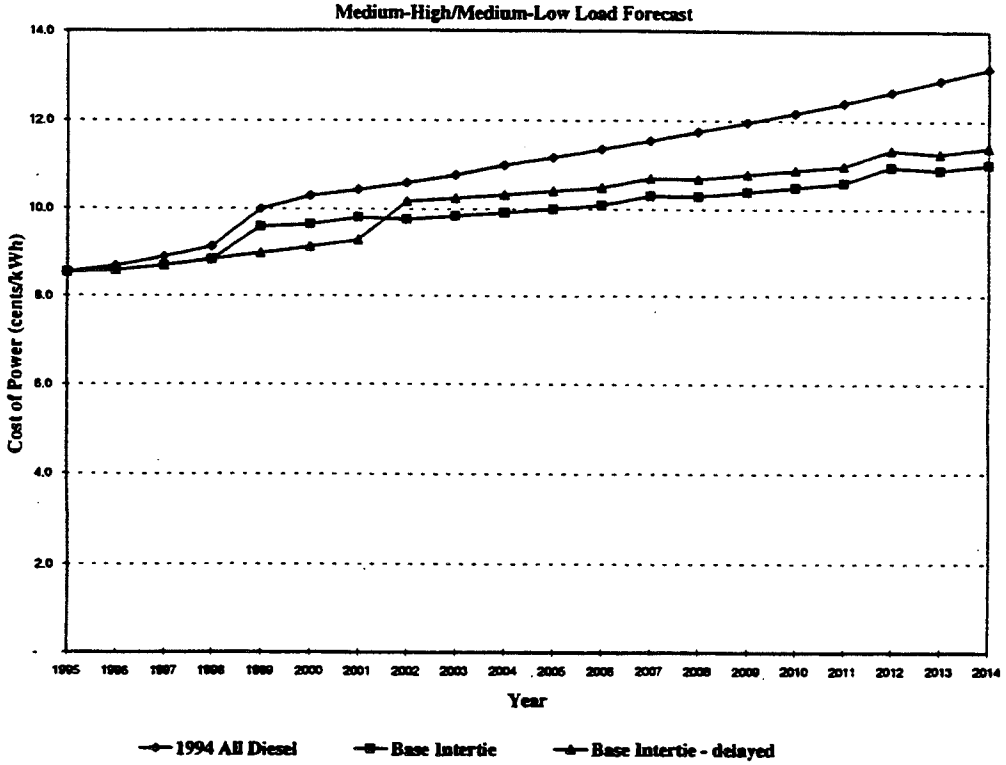
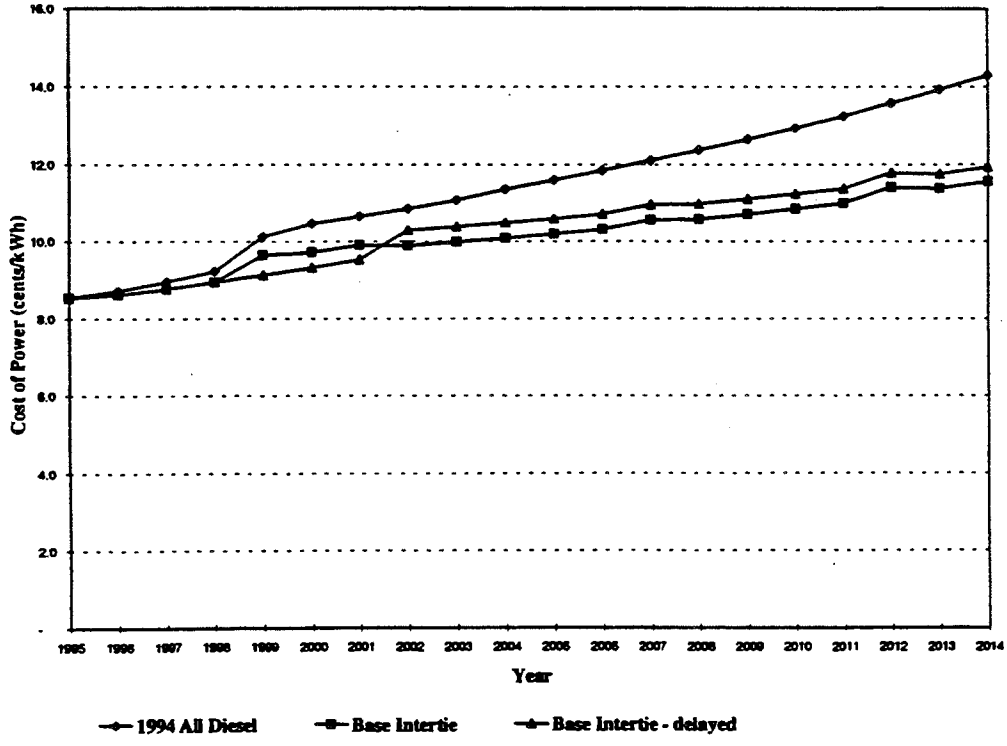


Figure 18

Projected CVEA Cost of Power

High Fuel Cost

Medium-High/Medium-Low Load Forecast



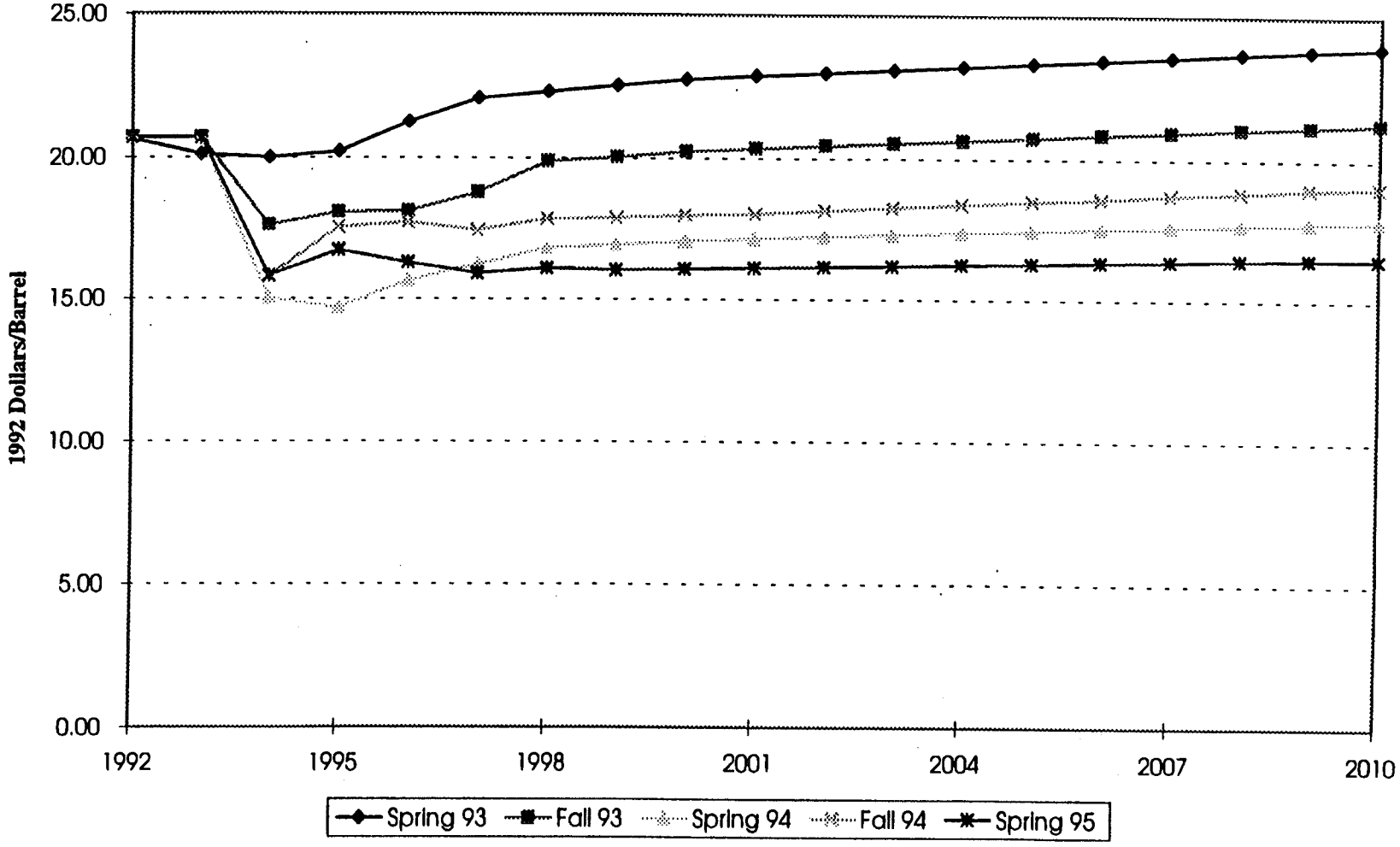
Appendixes

Appendix A
Alternative Plans for All Diesel Scenario
(Rated kW)

	1994 Intertie Study				CVEA 1995 Power Supply Study			
	Glennallen		Valdez		Glennallen		Valdez	
Year	Additions	Retirements	Additions	Retirements	Additions	Retirements	Additions	Retirements
1996	2150	--	--	--	5730[a]/SCADA[b]	5000 (Units 6 and 7)	SCADA[b]	--
1997	--	--	2150	1700 (Unit 4)	4000[c]	--	2500[d]	--
1998	--	--	2150	950 (Unit 6)	--	--	--	--
1999	2150	2500 (Unit 6)	--	--	--	--	--	--
2000	--	--	2150	2500 (Unit 5)	--	--	--	--

[a]Two 2865 kW units.
[b]SCADA for remote operation of generating units.
[c]Combustion turbine for back-up and quick-start peaking.
[d]Glennallen Unit 7 would be removed from the Glennallen power plant in 1996 and installed in the Valdez Power Plant in 1997.

Appendix B
Alaska Department of Revenue
Projected WTI Crude Oil Prices
Base (Mid) Case



c:\aidea\GRAPHS.XLS>Crude Oil Prices

Appendix C

CVEA Load Forecast Included in the 1994 Intertie Study				
	Load Forecast Scenarios			
	High	Medium-High	Medium-Low	Low
Fiscal Year	Peak Demand (MW)			
1992	10.9	10.9	10.9	10.9
1997	16.4	15.2	15.2	13.8
2002	18.1	16.0	16.0	13.6
2013	22.0	17.2	17.2	9.4
Average Annual Growth Rate, 1992-2013 (%)	3.4	2.2	2.2	-0.7
Fiscal Year	Energy Requirements (MWh)			
1992	59,227	59,227	59,227	59,227
1997	95,107	88,141	88,141	79,215
2002	104,492	92,400	92,400	77,734
2013	126,369	99,453	99,453	49,360
Average Annual Growth Rate, 1992-2013 (%)	3.7	2.5	2.5	-0.9

Appendix D

Comparison of Base Results–April 1994 Study vs. August 1995 Update

Alternatives	Med-High Load Projection/ High Fuel-Cost Escalation		
	April '94 Study	Aug. '95 Update	Difference
Cumulative Present Value in 1993 ($000)			
All Diesel	84,771	67,632	17,139
Intertie	72,604	59,101	13,503
Allison Lake*	71,989	63,223	8,766
Silver Lake	74,929	71,056	4,218
Valdez Coal	76,567	84,499	(7,932)
Benefit/Cost Ratio			
All Diesel	1.00	1.00	NA
Intertie	1.17	1.14	NA
Allison Lake–w/o 4/dp charge	1.18	1.07	NA
Silver Lake	1.13	0.95	NA
Valdez Coal	1.11	0.80	NA
*Without 4-Dam–Pool charge.			