Ratepayer Impacts of Proposed Transmission Projects Final Report

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Stephen Haas

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Includes Chugach Comments

What Is the Background of Today's Discussion

- DFI•Aeronomics was engaged by Chugach to provide an analysis of the benefits of two proposed transmission projects, the Northern Intertie Project and Southern Intertie Project, to their ratepayers
- Chugach selected DFI•Aeronomics because they wanted an analysis which would be
  - Independent and unbiased
  - Performed by a group with experience in analyzing the benefits of energy projects in general, and power transmission projects in the Alaska Railbelt in particular
  - completed rapidly (2 months)
- This presentation gives the results of our analysis

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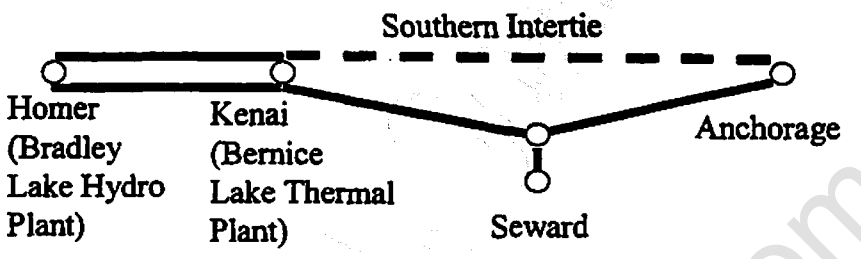
We have taken very seriously our pledge to be independent and unbiased, and we think both the extensive model development efforts and the resulting conclusions we will be presenting here, many of which differ from previous work, reflect that pledge.

Includes Chugach Comments

What Is the Southern Intertie Project?

- Would provide an alternative to the existing Quartz Creek Transmission line between Kenai and Anchorage
- Would provide enough transmission capacity to operate Bradley Lake Hydro plant at full capacity
- Chugach would act as manager of the project



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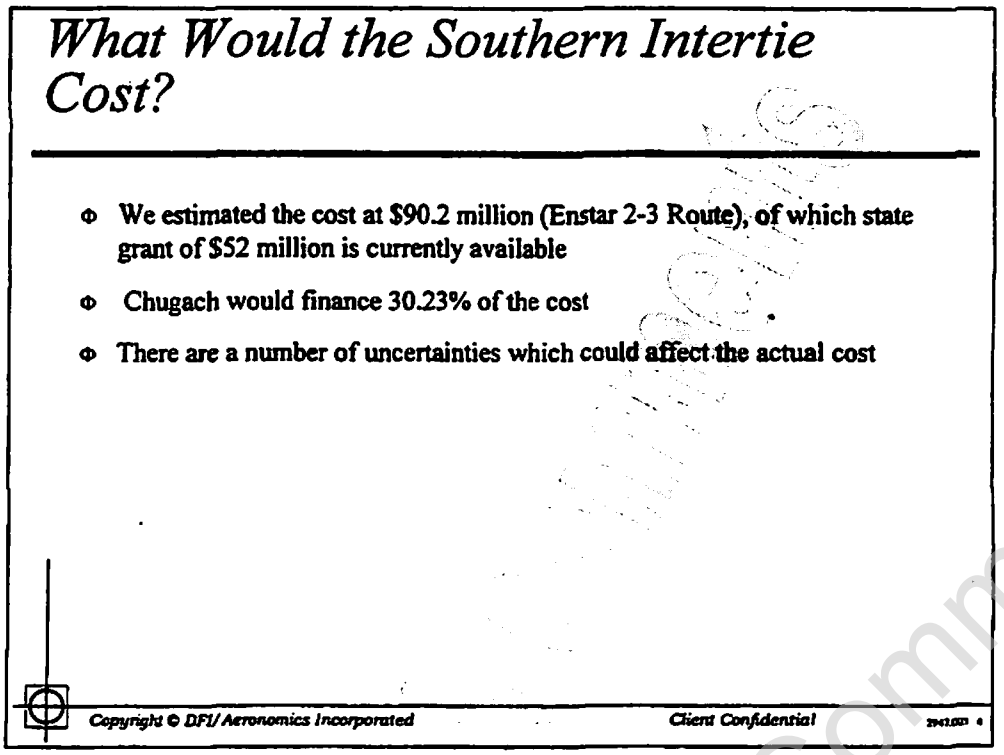
Just to review, the Southern Intertie is designed to provide an alternative transmission routing between Kenai and Anchorage. There are already two transmission routings available between Homer and Kenai.

The new line would allow a more reliable connection between Anchorage and the Kenai Peninsula, since currently, when the existing line is out of service, no connection is possible.

The new line would also increase the Kenai to Anchorage transmission capacity, permitting operation of the Bradley Lake hydro plant at its full capacity. Operations at Bradley Lake are currently limited by the available transmission capacity.

As manager of the Southern Intertie project, Chugach has a large influence over all of the decisions affecting the project.

Includes Chugach Comments



We assumed the cost of the Southern Intertie to be $90.2 million, corresponding to the most recent cost estimate for the most likely of the four possible routes under study. This route happens to be the lowest cost of the four routes.

A state grant would cover much of the construction cost of the Southern Intertie. The state grant money is currently being held in a trust account and is valued at about $52 million dollars. Because the state grant will continue to accrue interest until it is actually expended on construction, the state grant would cover about 75% of the cost of the line.

All six Railbelt utilities have agreed to share responsibility for the costs of the line not covered by the state grant. Chugach has agreed to own 30.23% of the line.

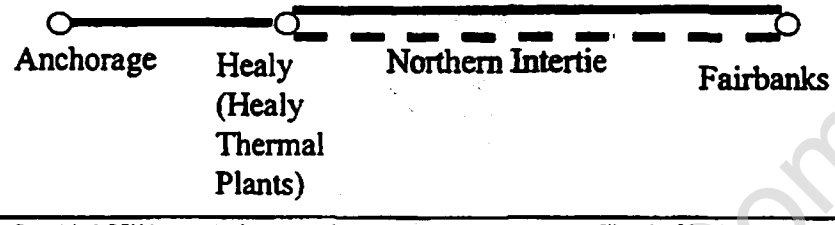
There are a number of uncertainties which could affect the actual construction costs. Chugach recently received a bid on another transmission project that includes an option to build the underwater portion of the Southern Intertie at an unexpectedly low cost. This savings has not been reflected in our estimates. On the other hand, there are many other factors which could raise the cost of the line, such as selection of one of the other three routes under study.

Chugach Review Comment -	The $90.2 million is for the Enstar Route. The Tesoro route has been selected. Note, ATLAS does not include any submarine cable replacements.

Includes Chugach Comments

What Is the Northern Intertie Project?

- Would provide an alternative to the existing line between Healy and Fairbanks
- Would provide enough transmission capacity to operate the new Healy Clean Coal plant at full capacity and still allow Fairbanks to import power from Anchorage
- The project would include a Battery Energy Storage System in Fairbanks to provide spinning reserve



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The Northern Intertie would provide an alternative transmission routing between Healy and Fairbanks. Anchorage to Healy would continue to be served by a single line.

Golden Valley owns two major coal-fired generating plants at Healy, one of which is the new experimental Healy Clean-Coal plant. Without the Northern Intertie, Golden Valley faces a choice of operating their own Healy plants OR importing power from Anchorage (read Chugach). There is not currently sufficient transmission capacity to do both.

The new line would also allow a more reliable connection between Healy and Fairbanks, since currently, when the existing line is out of service, Golden Valley must rely exclusively on relatively expensive Fairbanks area generating plants to supply its customers.

Included in the Northern Intertie would be a Battery Energy Storage System in Fairbanks, which could provide power for short periods of time in the event of a sudden generation or transmission failure. The benefits of the battery would be that it would save Railbelt utilities the cost of having to keep extra units on-line and spinning to provide reliable service in the event of a generation or transmission outage.

Chugach Review Comment - GVEA does not own HCCP.

Includes Chugach Comments

What Would the Northern Intertie Cost?

- We estimated the cost at $87 million, of which state grant of $48 million is currently available
- Chugach would pay 30.23%
- However, Golden Valley has made it clear that they will build the line regardless of whether other utilities participate
  - Golden Valley's willingness to "backstop" the line changes the nature of the decision facing Chugach
- Chugach is contractually obligated to participate in the Northern Intertie until 1 year after its completion
  - Withdrawal after that date is possible, with Chugach's capital contribution to be paid back over 25 years

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We assumed the cost of the Northern Intertie to be $87 million, corresponding to the most recent cost estimate we have. A state grant is would cover much of the construction cost of the line. The state grant money is currently being held in a trust account and is valued at about $48 million dollars.

The current agreement between utilities is a joint one for both the Northern and Southern Interties. All six Railbelt utilities have agreed to share responsibility for the costs of the Northern Intertie not covered by the state grant in the same proportions as the Southern Intertie. Chugach has, therefore, agreed to finance 30.23% of the line.

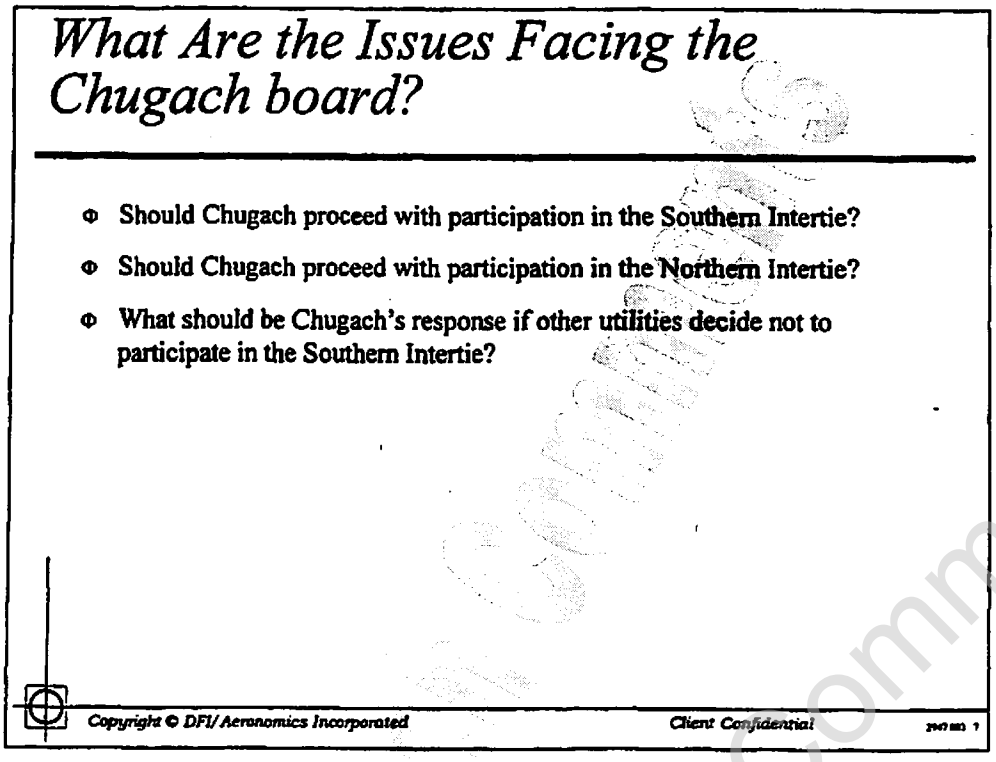
It is clear that this line provides the greatest benefits for Golden Valley, since it connects their generating units to their customers. For this reason, Golden Valley has made it clear that they will build the line regardless of whether or not other utilities participate.

Golden Valley's willingness to "backstop" the line changes the way Chugach has to look at a decision to participate. A previous analysis would have to consider the possibility that if Chugach did not participate, the Northern Intertie would not get built, and Chugach would have to do without the potential sales to Golden Valley that the new line would allow. Now it seems certain that the Northern Intertie is going to get built whether or not Chugach participates. So the issue for Chugach becomes whether there are still benefits to participating that exceed the costs.

Chugach is contractually obligated to participate in the Northern Intertie until at least one year after its completion. After that date, withdrawal is possible, however, Chugach would get its capital contribution back over a period of 25 years. So Chugach will incur some Northern Intertie costs regardless of whether it chooses to participate or not.

Chugach Review Comment - The IPG agreement was amended to remove Chugach's obligation to participate in the Northern Intertie.

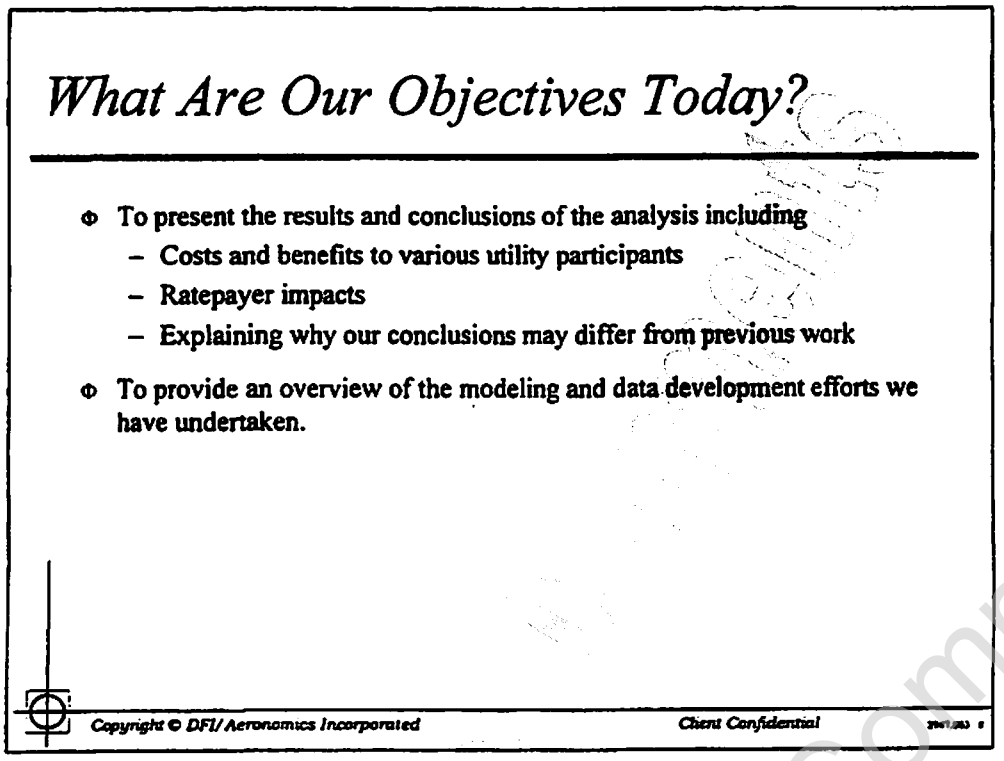
Intervenor Chugach Comments



The decisions facing the Chugach board are shown on this slide. Clearly, there are many factors that will go into your decision, including Chugach's long-term relationships with other utilities, the state government, and the union, as well as your insights into the preferences of your customers, all of which go well beyond the scope of our study.

We hope we can help you with this decision, however, by shedding some light on the basic economics of both projects.

Includes Chugach Comments



Our goal is to share with you what we have learned about the benefits and costs of the two projects, and what they would mean for your ratepayers.

We have also included in our slide presentation a description of the model we have developed for this project, and the assumptions behind it. We may or may not have time to go through that today. However, it is included in the printed copies you all received.

Some of our results and conclusions differ significantly from those of previous work, including those of our own firm. Where our conclusions differ, we want to explain why. Of course, reasonable people may disagree on critical assumptions about major projects like these, where the analyst must, by necessity, be looking at a highly complex system many years into the future. Where there are differences of opinion, we will highlight them, and the effect that different assumptions might have on our conclusions.

Includes Chugach Comments

Chugach Review Comment -	The costs and benefits discussed in this report are based on revenue requirement projections. Revenue requirement projections and the benefit/cost ratios shown in this report should not be compared to other studies that show benefit/cost ratios of cash flows. Changes in revenue requirements measure ratepayer impact; changes in cash flows measure economic value.

What Is Our Overall Analytical Approach?

- Chugach sought from DFI•Aeronomics not only a one-time analysis of the proposed transmission projects, but also a model which could be used by the Chugach staff to update and extend the analysis
- Chugach therefore needed an approach which would
  - be comprehensive in scope
  - require only a moderate effort to update and use
- Several existing models of the Alaska Railbelt (including one by DFI•Aeronomics) address various transmission benefits issues, however, our review suggested that none met both of these requirements
- Despite the tight schedule, we have therefore sought to develop a new model from the ground up

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Developing a new model added substantially to the effort. We thought, however, that it would greatly improve our chances of being able to give you new insights on this analysis, and results that were independent of and unbiased by previous work.

The new model will also give you a valuable tool for further analysis. You may, for example, want to see how things work out under assumptions which differ from those we have used. Using the approach we have developed, getting those answers should be fairly straightforward.

Chugach Review Comment -	The model does not accommodate the changes that occurred in the Railbelt system since 1998. For example, the Nikiski unit now operates at full capacity to meet an industrial customer's needs; ATLAS does not have the capability to model this mode of operation.

Includes Chugach Comments

How Is the New Model Constructed?

- The Alaska Transmission Line Analysis Spreadsheet (ATLAS) has been built in Microsoft Excel, with VisualBasic macros used for the more complicated calculations
- Each page of the ATLAS notebook has a distinct purpose
  - initial pages allow users to enter data on demands, construction costs, generating units, etc.
  - middle pages calculate different types of benefits (operating, generation capital investment, reliability, etc.)
  - final pages summarize individual utility and ratepayer impacts
- Our goal has been to combine the easy "what if" capability of a spreadsheet with the sophisticated modeling required to address the full range of transmission benefits

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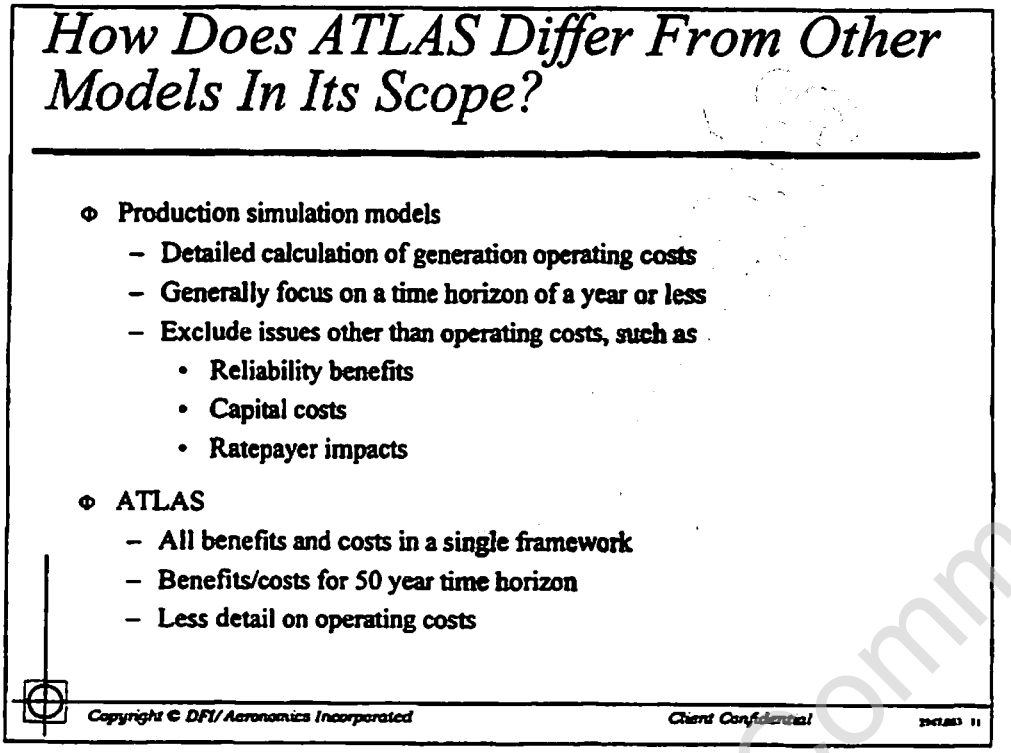
Our efforts have been greatly aided by the rapid development of computer technology and software over the past few years, which, despite the limited time and budget, has enabled us to go well beyond what was done in previous analysis.

Includes Chugach Comments



The approach that has been taken in the other work that has been done on the Interties is to use production simulation models. These are highly detailed models of utility operations, intended primarily for short-term planning. Because of their limited scope in both types of benefits and costs considered, and time horizon, and their complexity, these models are difficult to use for long term planning issues. When they are used, one must usually generalize about the long term from short-term studies.

ATLAS, on the other hand, is designed for long-term planning, including representing long time horizons and all types of benefits and costs. ATLAS does, however, pay a price for this greater breadth--its representation of utility operations is less detailed than the production costing models. Where ATLAS points up issues of significant importance, it is, therefore, appropriate to use a production costing model to examine those specific issues in greater detail. This analysis will point to at least one such issue.

Chugach Review Comment -	The lack of detail of ATLAS's calculation on operating cost (fuel and O&M expense) understates production cost savings, which is a primary benefit of project. See December 5, 2002 memo: Ratepayer Impacts of Proposed Transmission Projects Final Report, February 16, 1998 and Chugach Staff Review.

Includes Chugach Comments

How Does ATLAS Differ from Other Models In Its Assumptions?

- Since production costing models are designed primarily for short-term analysis, they usually assume the current market structure of independently operating utilities will continue
  - In fact, the production costing models used by the Railbelt utilities generally model only one utility at a time
- We assumed that the Railbelt will be operated so as to minimize costs for the entire system (as opposed to each utility individually); mechanisms that could contribute to this outcome include
  - Pooling or other cooperative agreements between utilities
  - An efficiently operating wholesale market for power, spinning reserves, and other ancillary services

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Production costing models, since they are designed for short-term analysis, generally assume the existing structure of independently operated utilities will continue. This means that individual utilities may make decisions that are not the most efficient from a Railbelt perspective. For example, an individual utility may decide to produce energy with its own generating units, when an idle unit at another utility could have produced the same energy at lower cost.

We assumed the Railbelt would be operated so as to minimize costs for the entire system as a whole. Such cost minimizing behavior could be brought about through greater cooperation between utilities, such as a pooling arrangement. It could also be brought about through an efficiently operating market for electric power, spinning reserves, and other utility services.

Chugach Review Comment -	Chugach disagrees that "Production costing models, since they are designed for short-term analysis, generally assume the existing structure of independently operated utilities will continue." - Standard production costing models have the flexibility to be used for either short or long-term analysis.

Includes Chugach Comments

Why Did We Make This Railbelt System-Optimizing Assumption?

- Our charter was to look at the benefits of the proposed Interties to all of the Railbelt utilities, as they are might unfold over the next 50 years, not as they are today
  - The regulatory environment faced by electric utilities in the U.S., and all over the world, is being restructured to give utilities more incentives to reduce costs
  - Although the kind of elaborate power markets now being set up in the Lower-48 are probably not appropriate for the Railbelt, some type of power pool is certainly a possibility
- It does not seem appropriate to count as benefits of the Interties any benefits which could be achieved at lower cost through more efficient operation of the existing Railbelt infrastructure

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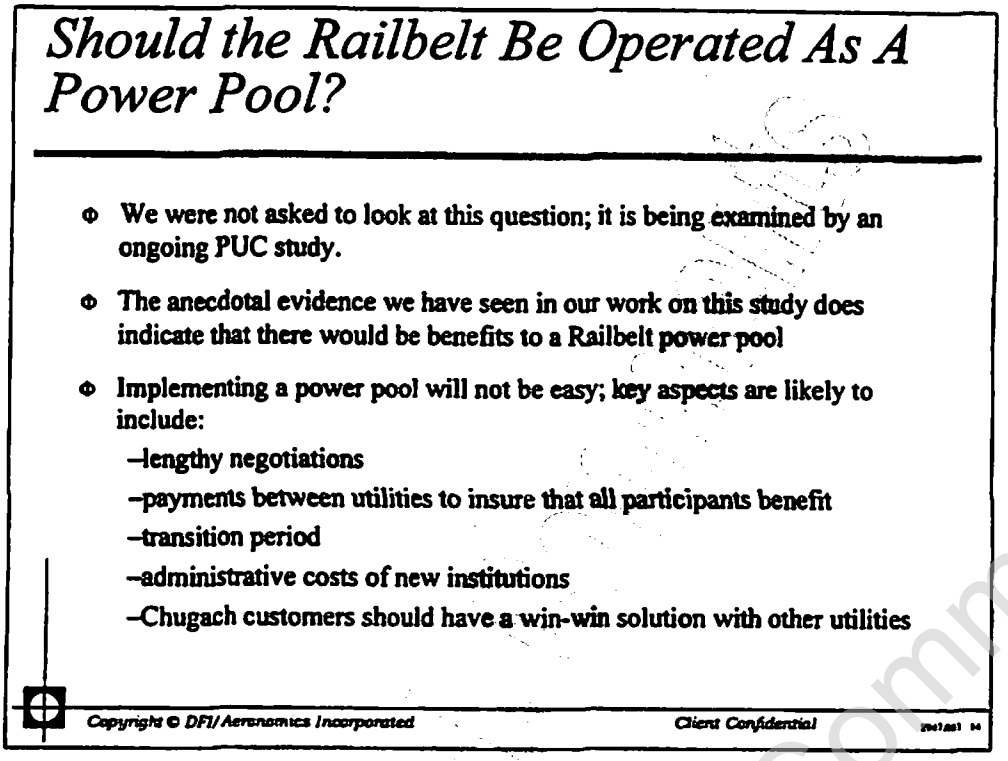
There are two good reasons to make the system optimizing assumption.

The first, and most important, is that it will probably happen, one way or another. All over the world, the electric utility industry is being restructured for a more competitive market environment, which will drive participants to minimize costs. Although the kind of elaborate power markets now being implemented in the Lower-48, which may include Independent System Operators (ISO's) and Power Exchanges, are probably not practical in the Railbelt, some type of power pool probably is practical.

This brings us to the second reason for our assumption. By assuming system-optimizing behavior in the Railbelt, we avoid confusing true benefits of the Interties with other benefits which could be achieved without necessarily having to build the Interties. The system-optimizing assumption gives us a clear apples-to-apples comparison, showing how much more efficient Railbelt operations could be if the Interties were available.

Includes Change Comments



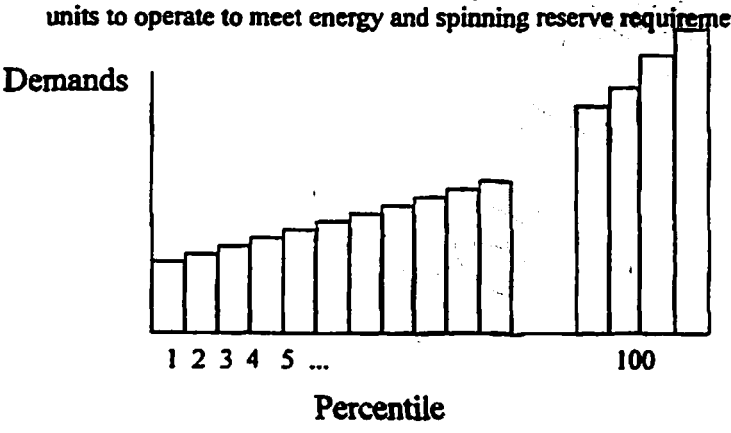
You did not hire us to investigate this question, but one theme that keeps emerging anecdotally in comparing ATLAS to current operations is that there are significant opportunities in the Railbelt to reduce costs through system optimizing operations. Alaskans will be under strong pressure to find ways to take advantage of these opportunities if they want to remain competitive with other states and regions.

Implementing a power pool in the Railbelt may not be easy. Each utility involved has a big stake in the outcome, and the negotiations are likely to be lengthy. Chugach itself has an important stake here, since it is the lowest cost producer in the Railbelt. Unless some type of side payment were received from other utilities, Chugach customers would lose, and the customers of other utilities would win, from a power pool. Since there is an overall savings in cost, however, it should be possible to negotiate a power pool arrangement in which customers of all utilities would win.

Includes Chugach Comments

How Does ATLAS Deal With Hour-by-Hour Changes in Demand?

- We break the year in 100 demand 'percentiles', each representing 87.6 hours with roughly similar demand; for each percentile, ATLAS determines which units to operate to meet energy and spinning reserve requirements



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Since demand varies from hour to hour, we in effect run the operating model 100 times for each year of each scenario, to capture the full range of demands expected throughout the year.

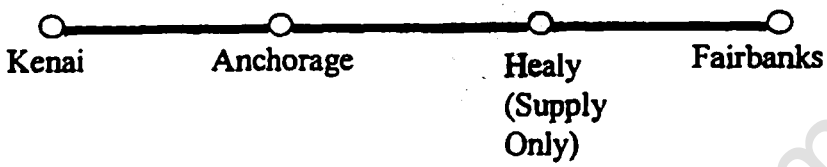
Here we have made one simplifying assumption not generally made by production costing models--that each hour can be modeled separately from the hour that came before it. We believe this assumption is appropriate for the Railbelt, with its heavy dependence upon quick-starting combustion turbine units. This assumption would be less appropriate in a system heavily dependent upon steam units, which have boilers that must be started some hours before the unit goes into production.

Chugach Review Comment -	The simplifying assumption "that each hour can be modeled separately from the hour that came before it" underestimates production cost by ignoring hourly unit commitment constraints. For example, although gas turbines are quick starting, it is not economic to start and stop them hourly. ATLAS does not capture this cost.

Includes Chugach Comments

How Does ATLAS Represent the Railbelt Transmission Network?

- We assume three transmission segments connecting four producing regions, three of which are also consuming regions
- Each transmission segment has a maximum capacity, and a loss at that capacity
- Actual loss rates vary in proportion to the flow (Watt's Law)



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We have focused on the three links of the transmission network of interest to this analysis.

Most other modeling efforts have not captured the fact that loss rates vary in proportion to flow.

Chugach Review Comment -	The three segment representation of the Alaska transmission system ignores major ties. For example, Chugach-ML&P transmission constraints are not captured.

Chugach Review Comment -	The ATLAS transmission network model under represents congestion and limited flows; generating unit availability (forced and scheduled outages) are not modeled discretely. Rather, an unavailability rate is applied to de-rate capacity over all hours throughout the study period. The effect is under representation of unavailable line capacity in any given hour.

Chugach Review Comment -	Losses are proportional to the square of the flow.

Includes Chugach Comments

How Does ATLAS represent the Railbelt Generating Capacity?

- Each existing unit is separately listed in the spreadsheet, which calculates its effective capacity (net of forced and scheduled outages)
- Hydro units also have specified annual energy limits and limits on the amount of spinning reserves they may supply
- Unit retirements and available dates for firmly planned units are a user input
- Future additional capacity additions are determined by the generation capacity benefits part of ATLAS, and are assumed to be generic combined cycle units

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Our representation of the Railbelt's generating capacity is quite detailed, with each unit represented individually.

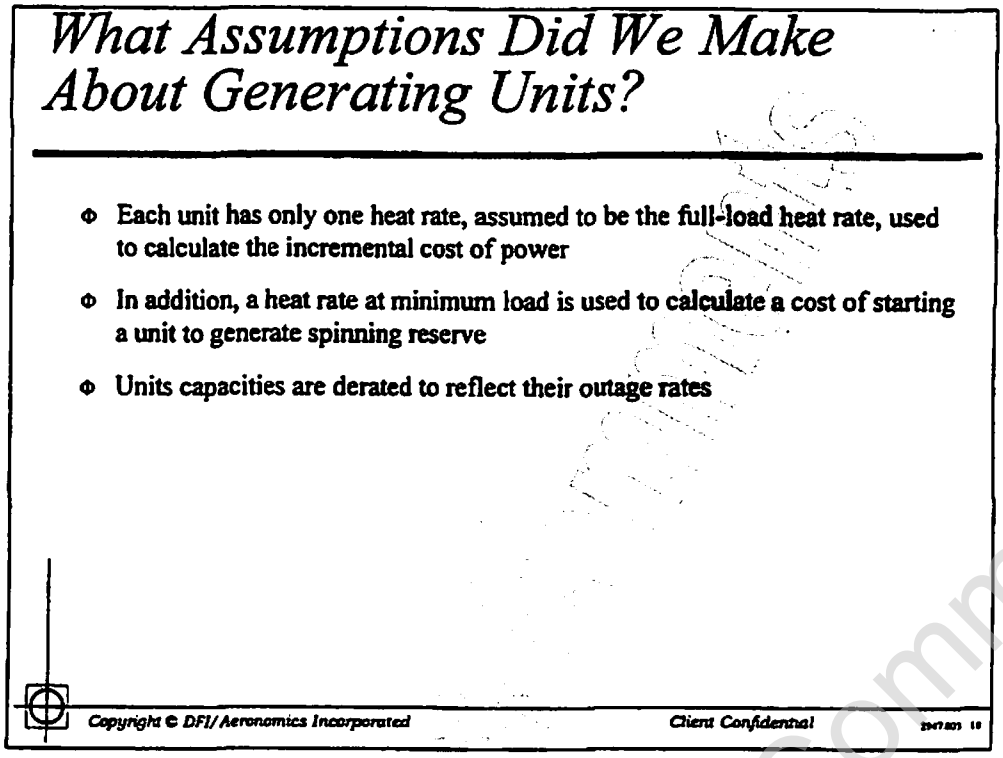
The integration of capacity addition logic with operating logic is a feature found in very few other models.

Chugach Review Comment -	Use of "effective capacity" (net of forced and scheduled outages) is very misleading: treats 100MW unit as 85MW unit all the time instead of 100MW 85% of time and zero MW 15% of the time, which ignores the 15% of time when the unit is not available. Many transmission constraints and use of inefficient units happen during this 15% of the time. This substantially underestimates the savings of the Southern Intertie.

Chugach Review Comment -	Chugach disagrees that "the integration of capacity addition logic with operating logic is a feature found in very few other models" as standard production models do integrate capacity addition logic with operating logic.

Chugach Review Comment -	See December 5, 2002 memo: Ratepayer Impacts of Proposed Transmission Projects Final Report, February 16, 1998 and Chugach Staff Review.

Including Chugach Comments



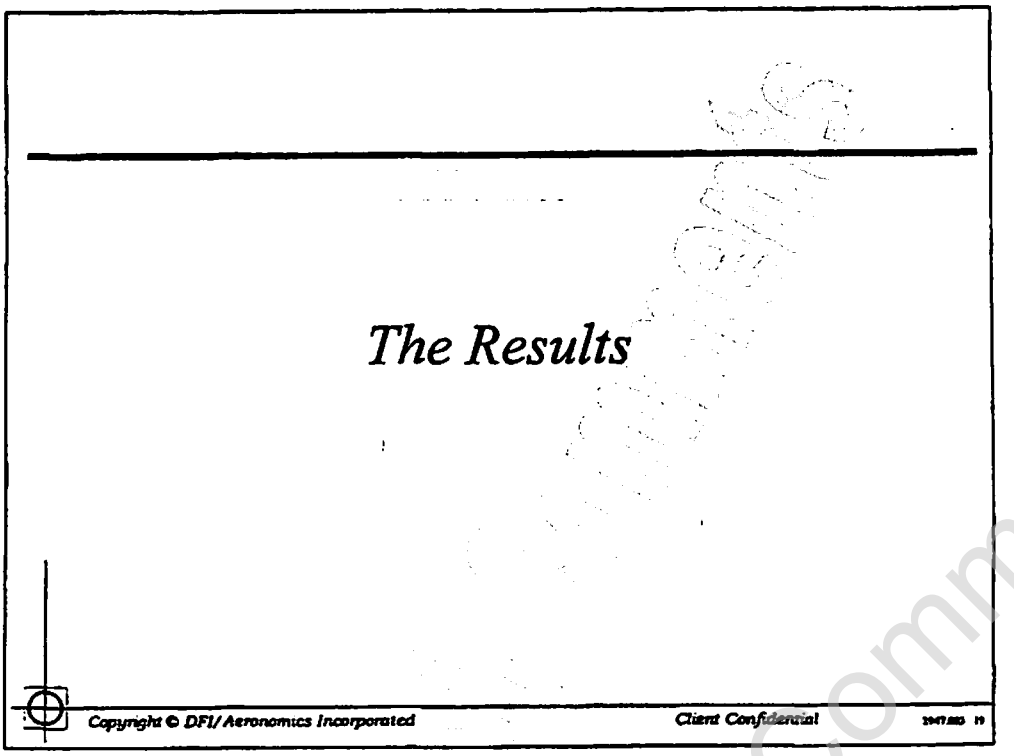
Production costing models assign each unit a heat rate curve, which allows the heat rate (the amount of fuel used per MWh generated) to vary with the output of the unit. We believe our assumption of a single heat rate is a reasonable simplification, since, for most units in the Railbelt, incremental heat rates do not differ by more than a few percentage points once a unit has been started. We do take the heat rate at minimum load into account in calculating the cost of starting a unit just to produce spinning reserves.

A more sophisticated operations model might also explicitly represent a variety of possible outage situations; this change which would drastically increases the size and complexity of the model (probably by a factor of 10 or more). Again, we believe this assumption is a reasonable simplification. The Chugach staff has pointed out, however, that it may cause ATLAS to understate spinning reserve costs somewhat, since operating without a single large unit a fraction of the time is more difficult than operating with the same unit derated by a fraction all of the time.

Chugach Review Comment -	Use of "effective capacity" (net of forced and scheduled outages) is very misleading: treats 100MW unit as 85MW unit all the time instead of 100MW 85% of time and zero MW 15% of the time, which ignores the 15% of time when unit is not available. Many transmission constraints and use of inefficient units happen during this 15% of the time. This substantially underestimates the savings of the Southern Intertie.

Chugach Review Comment -	The spinning reserve obligations for each utility were overstated, and the local spin requirements had no basis. There is no contract, regulation, or agreement among utilities that a given amount of spin must be produced within a given area. Further, the local spin obligation, as modeled, constrained inter-area spin transfers and limited economic dispatch.

Includes Chugach Comments



Includes Chugach Comments

Result #1: The Southern Intertie Appears to Be Cost Justified

- If all utilities participate as planned, the ratio of benefits to costs not covered by the state grant for the Southern Intertie would be 1.92 for the Railbelt as a whole and 2.46 for Chugach
- These benefits are direct ratepayer impacts only, and do not include the reliability benefits
- Adding the value of reliability benefits raises the ratio of benefits to costs to 3.38 for the Railbelt as a whole and 3.50 for Chugach

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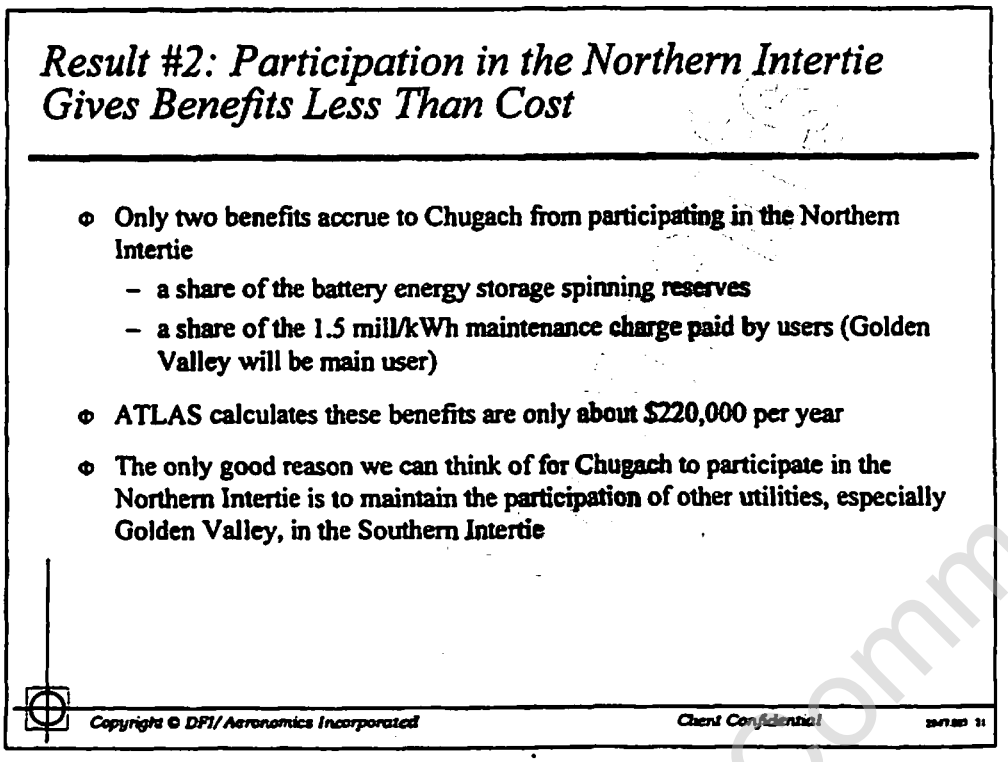
We'll start with the question that I am sure is at on the top of everyone's mind, and the major question addressed by our study. Given the basic assumptions we have made, the Southern Intertie by itself (and leaving out the costs and benefits of the Northern Intertie, but assuming that it is built) appears to be cost justified. There are, however, many factors which could potentially change this result that you will want to consider, as we will be discussing on later slides.

The benefits of the Southern Intertie come in two forms. The first are the direct cost savings, which would ultimately be passed through to customers in the form of lower rates. The second are the benefits of improved reliability. Although higher reliability does not lower rates to your customers, it does, presumably, increase the value of your services to them. The latter form of benefits are a much "softer" type of benefit, since everyone can have their own opinion on what reliability is worth. We assumed the standard values that have been adopted for analysis at Chugach. Under our basic assumptions, however, even without taking into account reliability benefits, the Southern Intertie can be cost-justified.

As I noted earlier, the state grant would cover about 75% of the construction cost of the Southern Intertie. Without the state grant, the line would be difficult, if not impossible, to cost justify.

Chugach Review Comment -	The benefit/cost ratios shown on this page are based on the present value of the operating savings (benefits) divided by the present value of the expenses of the Southern Intertie (O&M, depreciation, interest and margins). The benefit/cost ratio reflects the costs to ratepayers. It should not be used to compare to other studies that computed benefits and costs based on cash flow.

Includes Chugach Comments



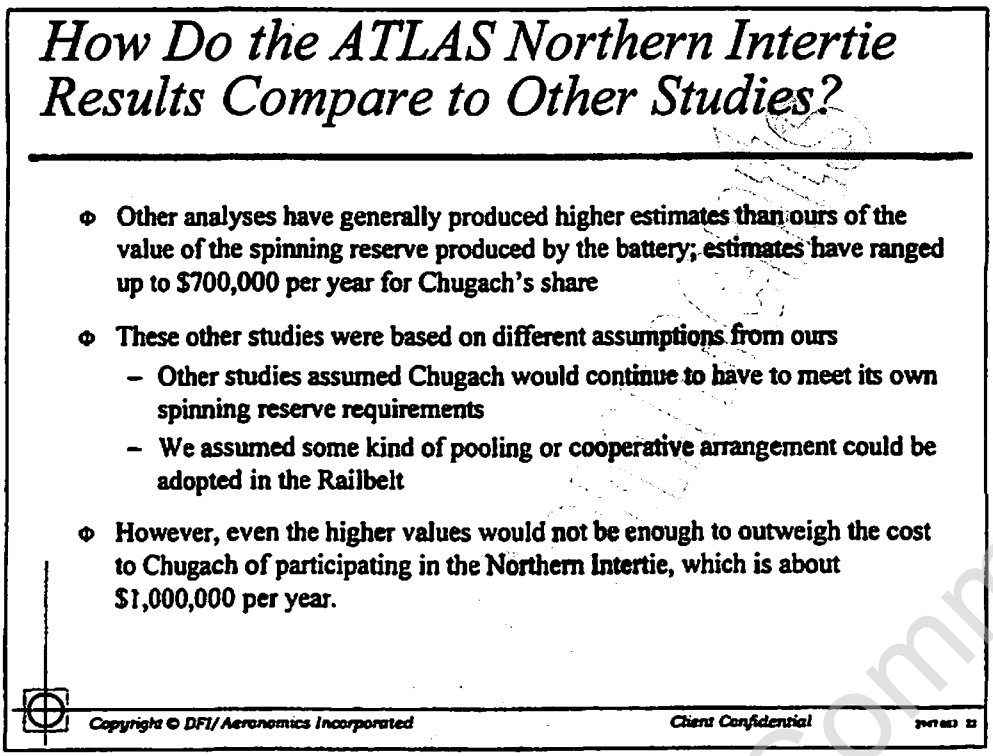
The Northern Intertie is a whole different story. If it is going to get built anyway, there appears to be little economic benefit to Chugach becoming a participant.

By participating in the Northern Intertie, Chugach would gain ownership of a share of the spinning reserves available from the Battery Energy Storage System to be built as part of that project. This is the primary benefit of Chugach's participation in the Northern Intertie.

The main reason Chugach might want to participate in the Northern Intertie is to maintain the participation of other utilities, especially Golden Valley, in the Southern Intertie. There is currently a rather complex web of legislation, agreements between utilities, and agreements between utilities and the State, which have taken a number of years to negotiate. All of it has been built on the premise that the Northern and Southern Interties were one package, in which all utilities would participate.

If Chugach were to withdraw from the Northern Intertie, it is likely that other utilities, especially Golden Valley, would attempt to withdraw from the Southern Intertie. In fact, a domino effect is possible: if the remaining utilities are forced pick up the costs of the utilities which have withdrawn, participation becomes less attractive to the remaining utilities, and further utilities may decide to withdraw.

Includes Chugach Comments



Other studies have calculated spinning reserve value as high as $700,000. The main difference between these studies and ours is that these studies assumed that Chugach would continue to operate more or less independently of other Railbelt utilities, and would have to provide essentially all of its own spinning reserves. We, on the other hand, have assumed that some kind of cooperative arrangement would be adopted between Railbelt utilities, where spinning reserves would be produced by the lowest cost producer, and bought and sold between utilities at a small markup over cost of production. Our assumption makes Chugach's ownership participation in a facility that produces spinning reserves--the battery--less attractive.

It is important to note, however, that even if we believe the benefits of the Northern Intertie to Chugach are as high as $700,000 per year, this would still not be enough to cover the cost of Chugach's participation in the Northern Intertie, which would run about $1,000,000 per year.

Includes Chugach Comments

Result #3: Participation in Both Northern and Southern Interties Is Difficult to Justify

- Because of the low benefits of the Northern Intertie to Chugach, the combined package of participation in both Northern and Southern Interties is less attractive than participation in the Southern Intertie alone.
- if Chugach participates in the Northern Intertie, Chugach's benefit/cost ratio for the combined package drops to .92 without considering reliability benefits
- Even including reliability benefits, Chugach's benefit/cost ratio for the combined package would be only 1.27.

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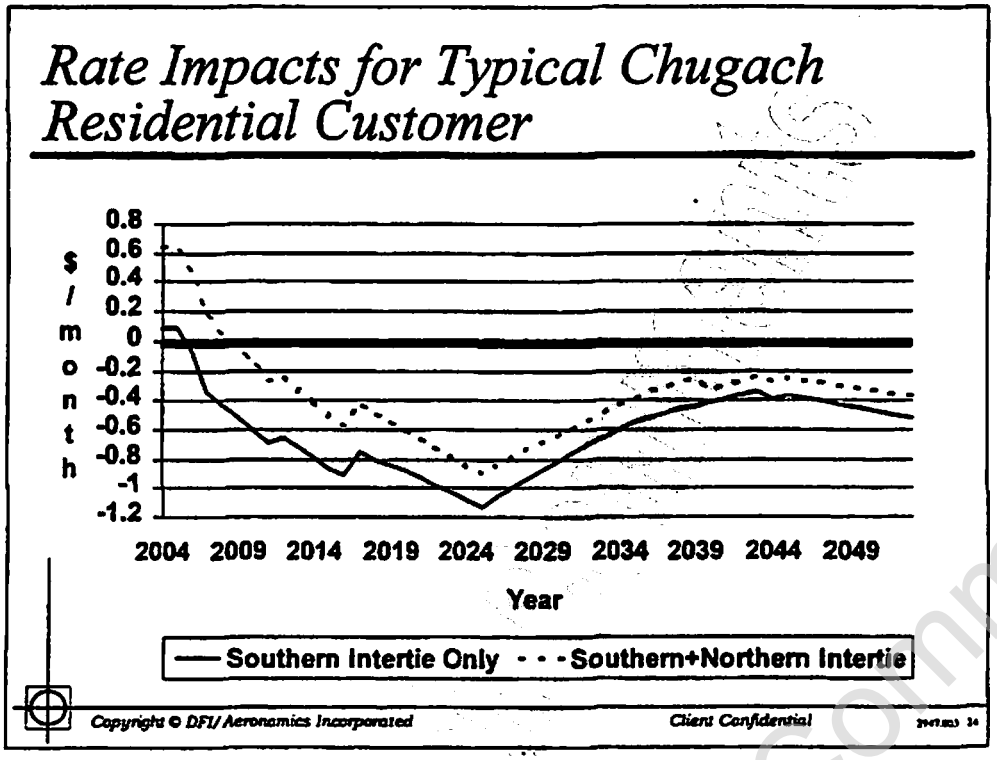
We do not show ratios for the Railbelt as a whole since we assume the Northern Intertie will be built in any case, so total Railbelt benefits and costs are unaffected by whether or not Chugach participates.

Participation in the Northern Intertie actually has higher costs for Chugach than participation in the Southern Intertie, since it will be built sooner and the state grant does not have as much time to earn interest. So participating in the combined package is considerably less attractive than participating in the Southern Intertie alone.

Includes Chugach Comments



The financing of the Intertie work much like a mortgage. The payments are more or less fixed over time, but the benefits grow with inflation and growing demand. So the ratepayer impacts tend to look better over time, at least until around 2025, when the existing Railbelt thermal generating units would be retired.

What happens after 2025 depends upon what we assume about the units that replace the existing units. We made the simple assumption that they would all be replaced by generic combined cycle units. In retrospect, this may not have been the best assumption, since without variation in the efficiency of generating units, the benefit of the Southern Intertie is reduced. However, technology is changing so rapidly that it is impossible to say what kind of generating units will be available in 2024 in any case, so an assumption that leads to a low level of benefits for the Intertie after that date is probably prudent. The time is so far out that it had little impact on our cost/benefit calculations in any case.

I show figures on rate impacts in terms of the typical 750 kWh residential customer, not because those customers are necessarily the ones who should drive your decision making, but simply because these are figures we can all relate to.

It can be seen that the Southern Intertie alone starts to reduce ratepayers costs within about two or three years of completion. The combination of Northern Intertie participation and the Southern Intertie would not start to reduce ratepayer costs until around 2010.

Includes Chugach Comments

Result #4: Chugach's Southern Intertie Benefits Correspond to Its Ownership

	Direct Benefits	Reliability Benefits	Total Benefits	Ownership Share
Chugach	38.6%	21.6%	31.3%	30.23%
Seward	0%	17.4%	7.4%	1.44%
MEA	9.4%	0%	5.4%	14.19%
ML&P	21.0%	21.6%	21.2%	22.43%
GVEA	8.3%	0	4.7%	20.11%
Homer	22.8%	39.4%	~~20.0%~~ 30.0%	11.6%

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Not surprisingly, Chugach, ML&P and Golden Valley gain direct benefits from access to their Bradley Lake hydro. The most surprising direct benefit number to me was the large Homer share. It turns out that without the Southern Intertie, the relatively expensive Soldotna thermal unit will have to be operated more over the years. We assumed that Homer would receive 60% of the cost savings from not having to run this unit as much. As the primary Kenai utility, Homer also gains a major share of the reliability benefits of the Southern Intertie.

Comparing shares of benefits to ownership shares in the Southern Intertie, Homer and Seward appear to be getting the best deal, with a benefit shares that far exceed their ownership shares. MEA and Golden Valley, appear to have ownership shares significantly larger than their benefit shares. Benefits and ownership shares are in the same ballpark for Chugach and ML&P.

Chugach Review Comment -	ATLAS assumes no reliability benefits for MEA and GVEA. This is incorrect. GVEA and MEA currently suffer outages (underfrequency load shedding) when the Kenai 115kV line trips during heavy export from the Kenai. The Southern Intertie would prevent these outages.
Chugach Review Comment -	The comments regarding Soldotna Unit are no longer applicable. The unit has been moved to Nikiski and mode of operation changed.
Chugach Review Comment -	The value for Homer's "Total Benefit" is reported incorrectly. The value should be 30%. The benefits shown in Result #4 table may change significantly if key assumptions such as local area operating reserves, fuel price projection, utility load forecasts and existing 115 kV line outage cost are changed. Production costing model issues identified on page 15 and 17 also materially change the benefits each utility receives. Also see review comments on page 20.

Includes Chugach Comments

Result #5: The Southern Intertie Is Less Attractive If Other Utilities Drop Out

	Chugach Direct Benefits /Cost	Chugach Direct+Reliability Benefits /Cost
As Planned	**2.46**	**3.50**
Golden Valley Out	1.96	2.79
Chugach/ML&P/Homer Only	1.58	2.25
Chugach Only	.74	1.06

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We know that the ratio of benefits to costs drops below one if Chugach participates in the Northern Intertie as well as the Southern Intertie, but is substantially greater than one if Chugach participates only in the Southern Intertie. The only problem is that Golden Valley may drop out of the Southern Intertie if Chugach drops out of the Northern Intertie. Would the Southern Intertie still look attractive under these conditions?

This table shows that it would still look attractive. The Southern Intertie by itself would still be economic for Chugach even if Golden Valley drops out. In fact, as long as ML&P and Homer remain participants in the Southern Intertie, the Southern Intertie maintains a benefits to cost ratio greater than one. However, the more utilities drop out, the harder it becomes to cost-justify the Southern Intertie. It would appear to be quite difficult to cost-justify if Chugach has to go it alone.

These figures assume the remaining participants pick up the departing participants shares in proportion to their original participations, but do not charge non-participants for the benefits they receive.

Includes Chugach Comments

Chugach Review Comment -	As noted on page 15 and 17 of the review comments, the benefits computed in this study are understated. The benefit/cost ratio is actually the change in revenue requirement benefits and costs and should not be compared to the benefit/cost ratios from other reports that show the benefit/cost ratio of cash flows.

Result #6: Higher Construction Costs Make the Southern Intertie Hard to Cost-Justify

[All figures assume only Chugach, ML&P, and Homer participate in the Southern Intertie]

	Chugach Direct Benefits /Cost	Chugach Direct+Reliability Benefits /Cost
Costs $10 Million Below Plan	2.43	3.46
Costs as Planned	**1.58**	**2.25**
Costs $10 Million Above Plan	1.17	1.66

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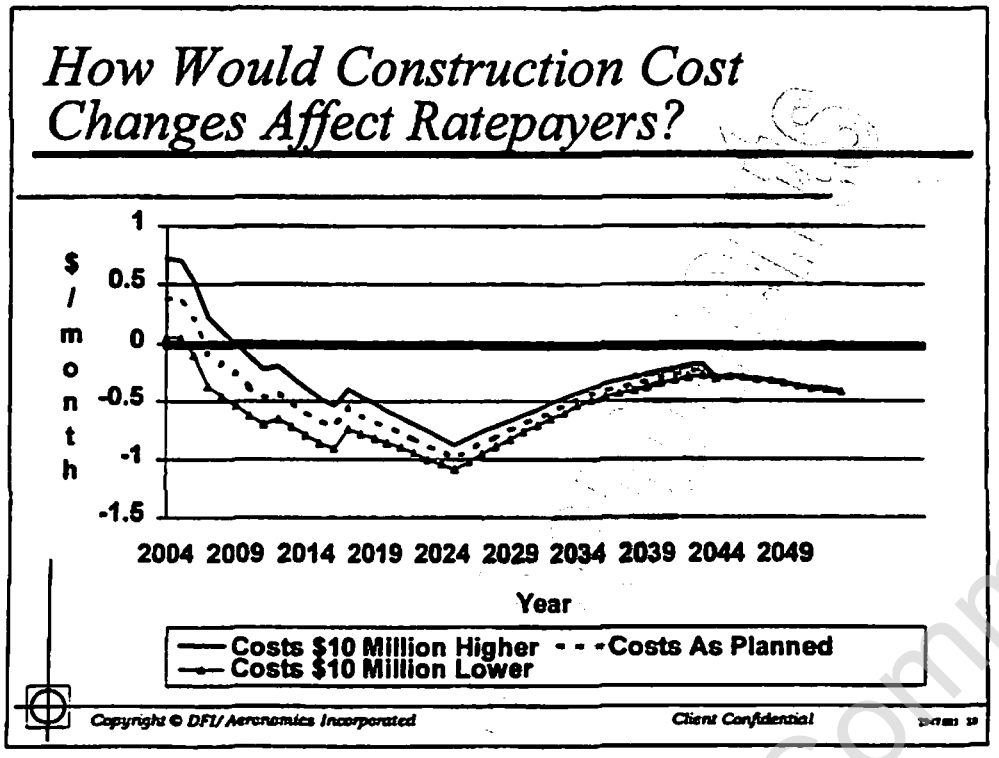
Note that this slide assumes that Golden Valley, MEA and Seward have dropped out. All the figures would be higher if these utilities stayed in, but we were trying to be realistic about what might happen if Chugach drops out of the Northern Intertie.

Changes in the construction costs of the Southern Intertie have a disproportionately large impact on the economics of the project to Chugach. The reason is that the size of the state grant is fixed. So any changes in cost will be borne by Chugach and other utility participants.

This slide shows the effect of a $10 million dollar increase or decrease in the construction costs of the line. This is only about a 12% increase or decrease--certainly well within the normal bounds of error in estimating the cost of major construction projects. Yet, as the slide shows, they cause the project to range from marginally economic to (direct benefits to cost ratio of about one) to highly attractive (direct benefits to cost ratio of about two).

Includes Chugach Comments

Chugach Review Comment -	As noted on page 15 and 17 of the review comments, the benefits computed in this study are understated. The benefit/cost ratio is actually the change in revenue requirement benefits and costs and should not be compared to the benefit/cost ratios from other reports that show the benefit/cost ratio of cash flows.



This graph shows the impacts on the typical monthly residential bill of construction costs $10 million higher or lower. Again, we assume that only Chugach, ML&P, and Homer participate.

The change in construction costs can shift the project from one with immediate benefits to ratepayers to one that won't start to pay off until around 2010. The impacts of changes in construction costs on ratepayers tend to fade over time, as the bonds used to finance the project are retired.

Chugach Review Comment -	As noted on page 15 and 17 of the review comments, the benefits computed in this study are understated.

Includes Chugach Comments

Result #7: The Interties Are Not Major Issues for Chugach Ratepayers

- Assuming all utilities participate, the cost of the two Interties combined (ignoring any benefits) to Chugach ratepayers would be about $1.5 million per year--about 2% of total Chugach ratepayer expenses
- The cost to the average residential ratepayer (again, ignoring any benefits) would be about $1/month; of this, the Southern Intertie would be about $.50/month, and the Northern Intertie would be about $.50/month
- The reason for the low impact is that about 3/4 of the cost of the two lines would be covered by the state grant

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We've seen that we can certainly find assumptions under which the Southern Intertie would not justify its cost. However, the chances that building it would turn out to be a big mistake appear to be rather small. This holds true even if participation in the Northern Intertie comes as part of the package. A big construction cost overrun is about the only outcome I can think of that would make it a big mistake from a ratepayer perspective.

Chugach Review Comment - These values are out-of-date.

Includes Chugach Comments

Where Do the Benefits of the Southern Intertie Come From?

	Chugach Benefits (million $ NPV)	Railbelt Benefits (million $ NPV)
Energy+Spinning Reserve	11.32	15.48
Transfer Payments-Energy and Spin	(4.46)	0.00
Transfer Payments-Capacity	(0.70)	0.00
Life Extension	0.00	0.00
Avoided and Deferred Generation	0.00	4.18
Reduced Reconstruction Costs on Existing Line	1.50	3.01
Avoid Zero Loading for Maintenance	2.38	4.76
Avoid Zero Loading for Other Reasons	2.42	4.85
Total Savings	12.46	32.27
Reliability Benefits	5.27	24.42
Total Benefits	17.73	56.69

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From a Chugach perspective, the benefits come from operating savings (energy and spinning reserve), reduced maintenance on the existing line, and not having to shut down the existing line for maintenance, bad weather, and construction near the line. Partly offsetting these benefits to Chugach are reductions in payments from other utilities for energy, spinning reserve, and capacity.

From a Railbelt perspective, the story is much the same. There are, however, benefits to other utilities from deferring the addition of new generation. Since sales between Railbelt utilities net out to zero for all utilities combined, there are no transfer benefits for the Railbelt as a whole.

For both Chugach and the Railbelt as a whole, reliability benefits are large enough to rival the direct ratepayer benefits.

We will now discuss each of these specific types of benefits in more detail.

Includes Chugach Comments

Chugach Review Comment - As noted on page 15 and 17 of the review comments, the benefits computed in this study are understated.

Result #8: Southern Intertie Operating Cost Savings Are Modest but Significant

- Most of this savings appears to be a reduction in fuel costs due to the increased ability to use Bradley Lake hydro power at peak hours, when it replaces the most expensive thermal generation
- Operating cost savings to all Railbelt utilities would be on the order of $1,000,000 per year in 2005
- However, this savings is limited by the fact that the number of peak hours when savings can be obtained is relatively small, and because the thermal units used in peak hours are not that much more expensive than the shoulder units
- There is also some savings in spinning reserve costs and transmission losses

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All available Bradley Lake hydro energy will generally get used, with or without the Southern Intertie, the main question is when. The major energy production benefit of the Southern Intertie is the ability to deliver more Bradley Lake energy to Anchorage during peak hours, when it could replace the most expensive thermal production.

Our operating benefits are significantly less than previous studies, including the 1989 DFI work. The previous work was quite different from ours in that it built separate small models for each source of operating savings (energy, spinning reserve, hydro use, transfer losses) in isolation for the others. We believe our comprehensive approach is much more accurate.

We assume the Northern Intertie will be built in all cases, so we did not need to look at any operating benefits of the Northern Intertie.

Chugach Review Comment -	Fuel savings are understated because of load representation (page 15) and effective capacity (page 17). The model misses many occasions of transmission constraints. Due to the "effective capacity" approach for generating units used by ATLAS, the model understates power transfers in any given demand segment percentile. The result is a misrepresentation of power flows, economic dispatch, and associated production costs.

Includes Chugach Comments

Result #9: The Cost of Being Required to Operate a Kenai Thermal Unit is Low

- Chugach's (Kenai region) Bernice Lake units, which are used to meet this requirement, are nearly as efficient as the (Anchorage region) Beluga units which might otherwise be used
- Taking into account transmission losses generally makes the difference even smaller, and may even make the Kenai units more economic

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One operating benefit of the Southern Intertie is that it would relieve Chugach of its current obligation to operate a combustion turbine unit on the Kenai Peninsula to maintain reliability for Homer. However, all indications we've seen are that it does not cost Chugach very much to do this.

We believe the differences between this result and previous studies may be due to the fact that previous studies did not account for the transmission losses, which make it more efficient to use Kenai units to serve Kenai demand. Also, our assumption of optimal dispatching for the entire Railbelt, rather than individual utility dispatching, make additional operation of Chugach's low cost units, including the Kenai units, more attractive.

Chugach Review Comment -	The cost of being required to operate a Kenai thermal unit is not applicable today because of the Nikiski mode of operation has changed.

Includes Chugach Comments

Result #10: Chugach Would Lose on Energy and Spinning Reserve Sales

- The Southern Intertie would cause Chugach to lose in energy and spinning reserve sales to other utilities an amount equivalent to a major portion of what it gained in operating savings
- The losses are for two reasons:
  - The Southern Intertie would allow ML&P to become more competitive with Chugach's Bernice Lake units for serving Kenai load
  - The Southern Intertie makes the Railbelt operate more efficiently, depressing power prices, which is bad for sellers, like Chugach, and good for buyers, like Golden Valley

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Chugach currently controls the only transmission line between Anchorage and the Kenai, and, according to our discussions with the Chugach staff, has the power to control how it is used. If the Southern Intertie is built, Chugach would lose this advantage.

The conclusions on this slide, hinge on our assumption that the Railbelt is operated in an efficient, system-optimizing manner, as well as our assumption that energy sales are transacted at the average cost of energy production plus a fixed markup. We may, therefore, want to take this result with an extra large grain of salt.

We believe, however, that the risk that ML&P will become more competitive, and that power prices could fall slightly, as a result of the Southern Intertie is real, and should be considered.

Chugach Review Comment -	The assumption that Chugach controls use of the intertie between Anchorage and Kenai may not continue over the next 40 years in today's regulatory environment.

Includes Chugach Comments

Result #11: Chugach Would Also Lose on Capacity Sales

- Without the Southern Intertie, ML&P access to their own Bradley Lake hydro generating capacity will be limited
- Chugach would, therefore, be able to sell them replacement capacity or access, through the existing line, to reach their own
- Once the Southern Intertie is built, this Chugach advantage would disappear, since ML&P will have full access to their own Bradley Lake capacity
- Golden Valley faces a similar constraint on access to their Bradley Lake hydro, although it is not as clear from the model results that Chugach is in a position to gain from it

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Again, we have assumed that Chugach has first rights to capacity on the existing line. This implies that ML&P and Golden Valley have more to gain from a capacity standpoint than Chugach.

Chugach Review Comment -	The assumption that Chugach has "first rights to capacity on the existing line" may not continue over the next 40 years considering today's regulatory environment.

Includes Chugach Comments

Result #12: The Southern Intertie Provides No Life Extension Benefits

- Operations of the two Chugach units which are candidates for life extension, Beluga 3 and 5, as well as Golden Valley's North Pole 1 and 2, and ML&P 8, are not affected much by construction of the Southern Intertie

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Previous studies have suggested that the projects would reduce the number of hours per year that certain generating units would operate, allowing the life of these units to be extended. Beluga 3 and 5 would appear to be the most likely Chugach units to operate few hours, according to past studies. However, our results suggest that this would not be the case.

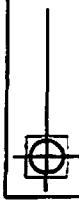
Beluga 3 and 5 should not be confused with Beluga 6 and 7, which are currently being considered for repowering.

Chugach Review Comment -	As noted on page 15 and 17 of the review comments, the benefits computed in this study are understated.

Includes Chugach Comments

Result #13: The Deferred Generation Benefits Accrue to ML&P and Golden Valley

- The Southern Intertie would provide ML&P and Golden Valley with better access to their Bradley Lake capacity, allowing them to defer construction of new capacity
- There are no such benefits to Chugach, since Chugach is assumed to have first call on its own existing Kenai-Anchorage transmission capacity



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Recall our assumption that Chugach, as the owner of the existing line, gets first priority on its use. Once again, that tends to make building a new, jointly-owned line, less attractive for Chugach.

Chugach Review Comment -	The assumption "that Chugach, as the owner of the existing line, gets first priority on its use" may not continue over the next 40 years considering today's regulatory environment.

Includes Chugach Comments

Result #14: The Cost of Unloading the Existing Line May Be Modest

- ATLAS does show significant extra fuel consumption on days when the existing line must be shut down --on the order of $14,000 per day
- However, we can view this extra fuel consumption as energy put into storage at Bradley Lake, since Bradley Lake hydro usage is reduced on those days.
- According to ATLAS, the net cost of shutting down the existing line for a day, after adjusting for the value of the hydro saved, is quite modest

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Previous analyses of the Southern Intertie have assumed that it cost $13,000/day to shut down the existing line, based on work with Chugach's own Pro-Screen model. Since the existing line tends to get shut down quite a bit, avoiding this cost becomes a significant benefit of building the Southern Intertie.

ATLAS gave a similar result when we simply looked at the extra fuel burned on a typical day when the existing line was shut down. However, as we thought about this result, we realized that on these days when the line was shut down, we were using correspondingly less hydro energy from Bradley Lake. This hydro energy could be used instead on some other day. So the real, long-term cost of shutting down the existing line may be far less than $13,000/day.

Chugach Review Comment -	The Chugach PROSCREEN production costing model accounts for the later use of hydro. The $13,000/day cost to shut down the existing line is valid.

Includes Chugach Comments

How Does the Cost of Taking the Line Out of Service Affect Our Results?

[all figures assume all six utilities participate in the Southern Intertie]

	Chugach Direct Benefits /Cost	Chugach Direct+Reliability Benefits /Cost
At $1000/day	1.64	2.68
At $3000/day	1.90	2.94
At $7300/day	2.46	3.50
At $13,0000/day	3.20	4.23

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As you can see, the cost of taking the existing line out of service turns out to be relatively important.

Our ATLAS results suggested that this cost was quite low--one the order of $1,000/day. However, ATLAS was designed to address the issue of a new line, and not really designed to address taking the existing line out of service.

John Cooley of the Chugach staff helped us out with some quick analysis, and came up with a figure of $7,300/day, which is what we used in the results you have seen. However, this is certainly an issue that could use some additional analysis.

Chugach Review Comment -	DFI used $7,300 for the cost of unloading the existing line based on a "quick analysis". The correct amount should have been $13,000/day based on Chugach's PROSCREEN production costing model (page 37).

Chugach Review Comment -	As noted on page 15 and 17 of the review comments, the benefits computed in this study are understated.

Includes Chugach Comments

Result #15: Reconstruction Savings Are Significant

- The Southern Intertie would reduce the cost of reconstructing the existing line by an average of $500,000 per year over an eight year period
- This amount is especially significant for Chugach, since we assume 50% of this benefit would accrue to Chugach

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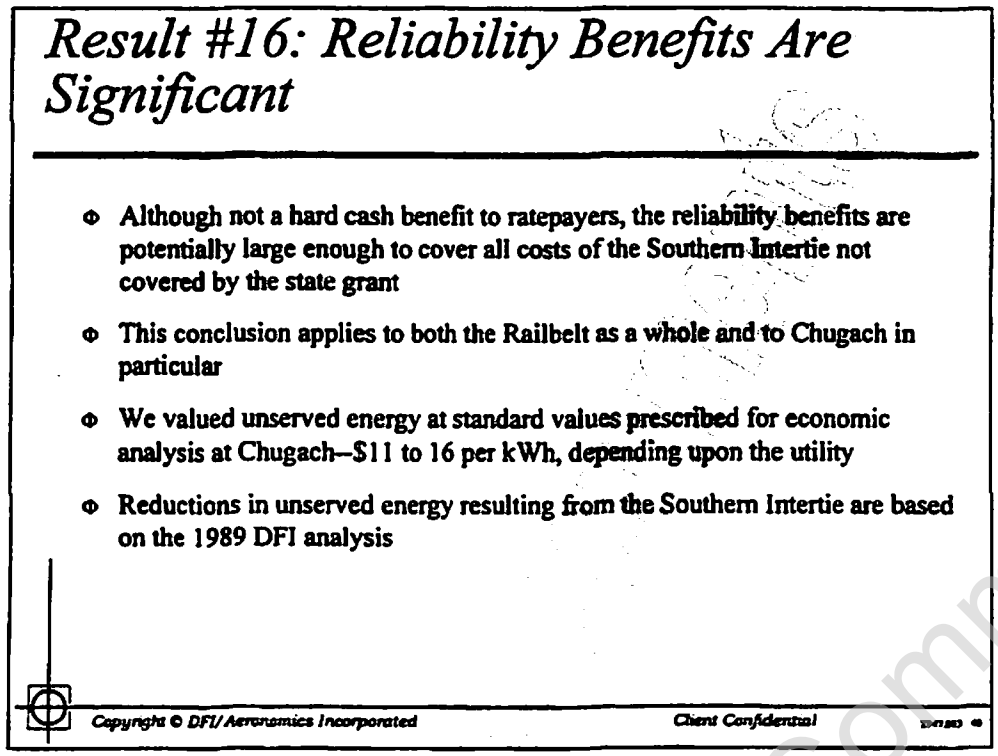
The existing line will need to be reconstructed over the next few years. Having an alternative line available would ease the scheduling constraints on this reconstruction work, and allow the cost of reconstruction to be reduced by about 10%. We assumed half this savings would accrue to Chugach.

Current plans are to defer reconstruction of the existing line until the Southern Intertie is complete. Chugach staff members tell us that in the event the Southern Intertie were canceled, they would want to move ahead with reconstruction of the existing line right away. However, we assumed the line would be rebuilt beginning in 2005 regardless of whether or not the Southern Intertie was built. The reason is that simply deferring reconstruction of the existing line gives some substantial benefits which are not a direct result of building the Southern Intertie. If we were to count these deferral benefits, we would be biasing our analysis in favor of the Southern Intertie.

Chugach Review Comment - The ability to defer reconstruction of the existing 40+ year-old line is a direct result of building the Southern Intertie. Omitting this benefit understates the overall benefits.

Includes Chugach Comments



Reliability benefits run around $500,000 per year for Chugach and $2.2 million per year for the Railbelt as a whole in year 2000 dollars, but grow with inflation. On a present value basis, this is greater than the cost of the Southern Intertie.

We are told by the staff that Chugach has improved its reliability somewhat since 1989, which might tend to suggest that the improvement in reliability due to the Southern Intertie may have decreased since then. On the other hand, we are told that taking out the existing line for 60 days per year to rebuild it if the new line is NOT built will probably degrade Chugach's reliability back to 1989 levels or less. So we made no adjustment to the 1989 unserved energy estimates.

Includes Chugach Comments

Result #17: A Kenai Cogeneration Project Would Not Have a Big Impact

[All figures assume only Chugach, ML&P, and Homer participate in the Southern Intertie]

	Chugach Direct Benefits /Cost	Chugach Direct+Reliability Benefits /Cost
No Cogen Project	**1.58**	**2.25**
Bernice Lake 3 and 4 Cogen	1.78	2.45
Soldotna Cogen	1.11	1.78

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There are currently proposals to build a cogeneration project on the Kenai, using either Chugach's Bernice Lake units, or the Homer-owned but Chugach-operated Soldotna unit. The projects would use what is now waste heat from these units to produce steam needed by an industrial customer.

The Bernice Lake units are relatively low-cost gas-fired units. We assumed that if these units became cogeneration units, there would be a payment from the steam customer equivalent to increasing the fuel efficiency of the units by one-third [implemented as a 25% reduction in fuel used per MWh produced].

When these units become more efficient, capacity to export the production of these units to the Anchorage area becomes more valuable. Hence, we see that the cost/benefit ratio of the Southern Intertie would rise if the Bernice Lake units were used for a cogeneration project.

The Soldotna unit, on the other hand, is a relatively high-cost unit, which ATLAS says should be used primarily for spinning reserve production. We assumed that if Soldotna became a cogeneration unit, there would be a payment from the steam customer equivalent to lowering the cost of this unit to the same level as a Bernice Lake cogeneration unit. This means, from a system perspective, that we have essentially added a new low-cost unit to the Railbelt.

Adding the Soldotna cogeneration unit has two offsetting impacts on the benefits of the Southern Intertie. First, as with the Bernice Lake units, it makes capacity to export the production to Anchorage more valuable. On the other hand, it cuts the cost of producing the spinning reserve needed on the Kenai if the Southern Intertie is NOT built. This makes the benefits of building the Southern Intertie less. It is the second effect which appears to be the dominant one.

Chugach Review Comment - These scenarios are not applicable because of the current Nikiski arrangement.

Includes Chugach Comments

Result #18: Not Counting Bradley Lake Spinning Reserve Has Little Impact on These Results

- Recent engineering studies suggest that the Bradley Lake hydro plant cannot be counted on as a provider of spinning reserves, even though up to 27 MW of Bradley Lake spinning reserve production is currently counted toward Railbelt spinning reserve requirements
- If the rules were changed, and Bradley Lake spinning reserve could no longer be counted toward Railbelt spinning reserve requirements, our results would not be significantly affected

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Currently, the agreements among Railbelt utilities allow up to 27 MW of spinning reserve from Bradley Lake to be counted toward Railbelt spinning reserve requirements. Recent engineering studies suggest that the Bradley Lake units cannot respond quickly enough to pick up for another unit in the event of an outage. Since the whole idea of spinning reserves is to be able to pick up for other units in the event of a sudden outage, this means that Bradley Lake probably should not be allowed to contribute toward the spinning reserve requirements. A change in the rules would therefore appear to be likely at some point in the not too distant future.

If the rules were changed, and Bradley Lake was not allowed to contribute toward the spinning reserve, we might think that would make spinning reserve from the battery more valuable, and, therefore, increase the value of the Northern Intertie to Chugach.

Our results indicate that not counting Bradley Lake spinning reserve would, indeed, make the spinning reserve from the battery more valuable. However, the effect is not very significant. The benefits of the Northern Intertie increase from about $180,000 per year to $190,000 per year. There would still be other low cost sources of spinning reserve available in the Railbelt, including two other hydro plants and the battery itself.

Includes Chugach Comments

A Strategic Suggestion: Don't Backstop the Southern Intertie

- The main benefit other utilities will derive from participation in the Southern Intertie is to assure that it actually gets built
- If Chugach announces that it will build the line regardless of participation by others, it throws away its best bargaining chip
- If Chugach decides it wants to go ahead with the line, our suggestion would be to take the position that you expect other utilities to participate as planned or it may not get built; in addition, make it clear that if other utilities drop out and the line does still get built, Chugach will aggressively attempt to find ways to charge them for its use

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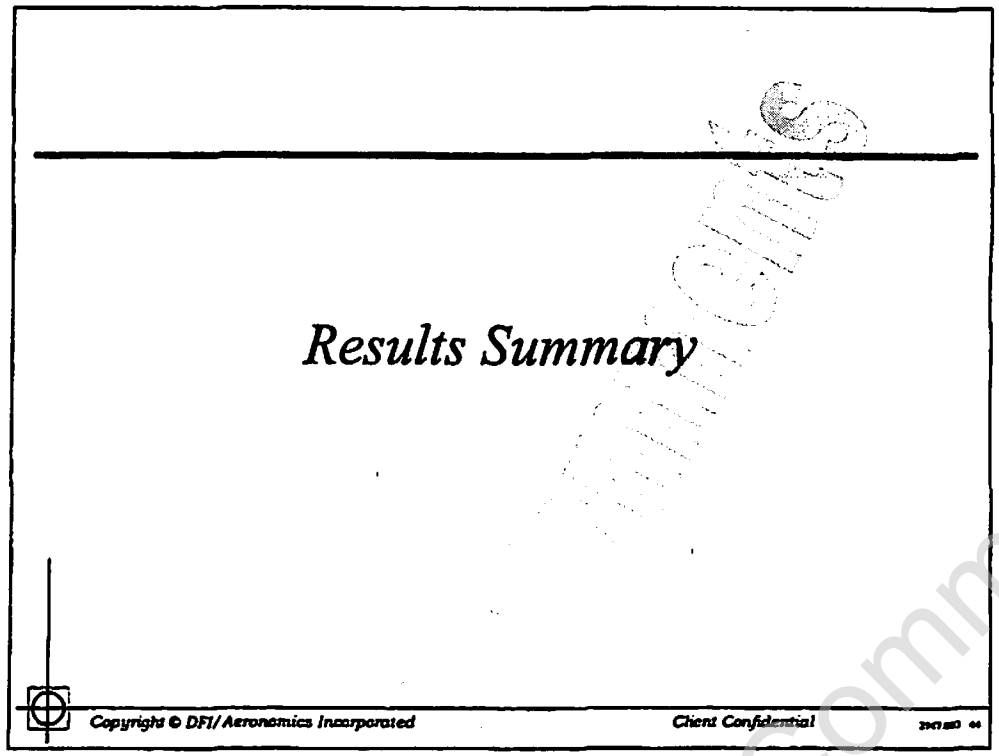
The situation with the Southern Intertie is quite different from the Northern Intertie, which has one primary user and beneficiary. All Railbelt utilities will benefit from the Southern Intertie, and it is fair and reasonable to expect them all to pay their share.

Includes Chugach Comments



Includes Chugach Comments

Summary: What Are NOT Good Reasons to Participate in the Two Interties?

- Would they produce large operating savings? *Probably not.*
- Would they give Chugach a competitive advantage? *Probably not, in fact, the Southern Intertie may do the opposite.*
- Would they allow Chugach to postpone generation investments? *Probably not.*
- Without the state grant, would they be cost-justified? *Probably not.*

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As we have seen, the Southern Intertie would probably not provide large operating savings.

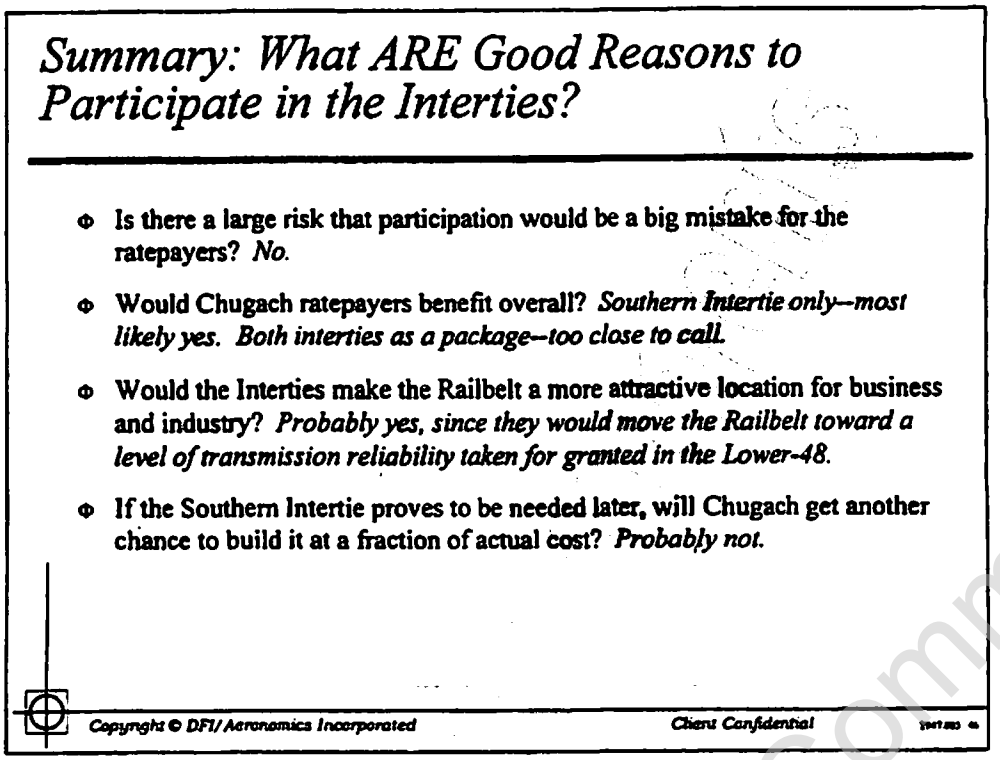
It would probably not give Chugach a competitive advantage, in fact, it would give ML&P better access to Kenai customers and their own Bradley Lake energy.

It would probably not allow Chugach to postpone any generation investments.

The state grant would cover about 75% of the cost. It is clear from the cost-benefit ratios we have presented that if the costs were multiplied by a factor of four, it is unlikely that the Southern Intertie could be cost-justified.

Chugach Review Comment -	The operating savings are much larger than shown in this study as noted in other review comments.

Includes Chugach Comments



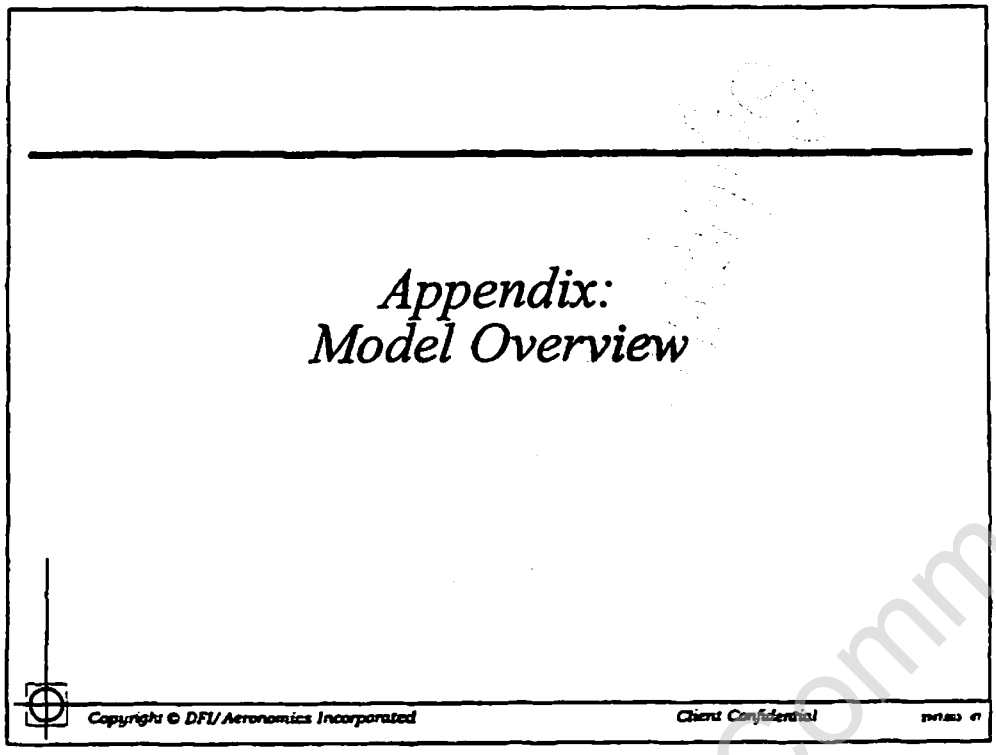
The projects have a small impact on Chugach ratepayers. Even assuming NO benefits at all, the two Interties combined would raise Chugach's costs by about 2%, or $1 per month for residential customers.

The projects resemble a home mortgage in the sense that payments in the early years exceed benefits; however, benefits rise with inflation while costs remain largely fixed. Our analysis suggests that, in the long run, the Southern Intertie would most likely provide ratepayer benefits which exceed costs. Bundled as a package with participation in the Northern Intertie, it is simply too close to call.

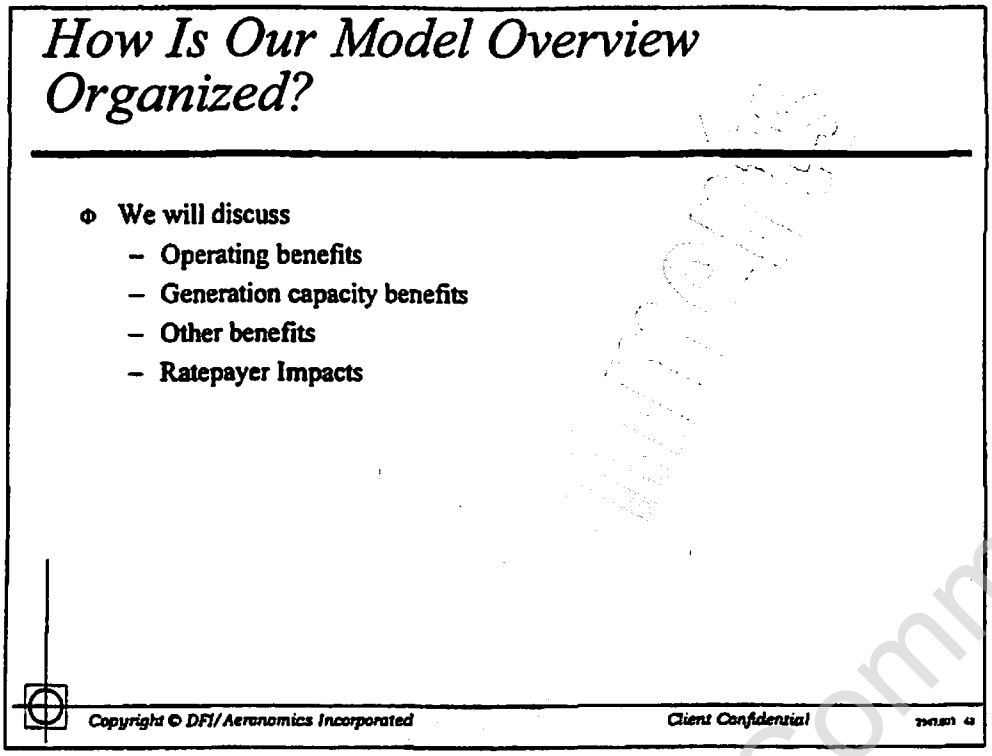
The Interties would raise transmission reliability, and bring it closer to Lower-48 standards. In this way, it would make the Railbelt a more attractive place to locate electricity-dependent businesses.

The availability of the state grant provides a unique opportunity to build the Southern Intertie at a low-cost to Chugach ratepayers. This opportunity probably will not arise again if the project is scuttled.

Includes Chugach Comments



Includes Chugach Comments



Our discussion of the ATLAS model breaks down fairly neatly into four components.

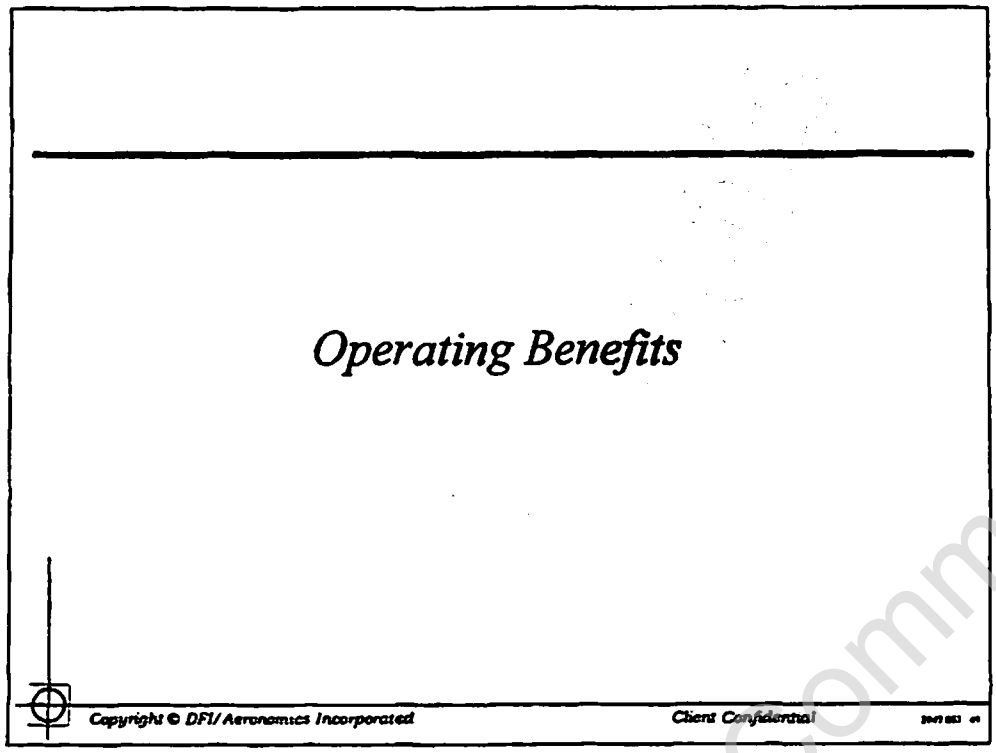
Operating benefits, including energy and spinning reserve costs, and energy and spinning reserve transfers between utilities, are all interrelated, and require a quite sophisticated model.

Generation capacity benefits, including capacity deferral and capacity transfers between utilities, are interrelated, and require modest-size model reflecting growth in demand, retirements, and transmission constraints.

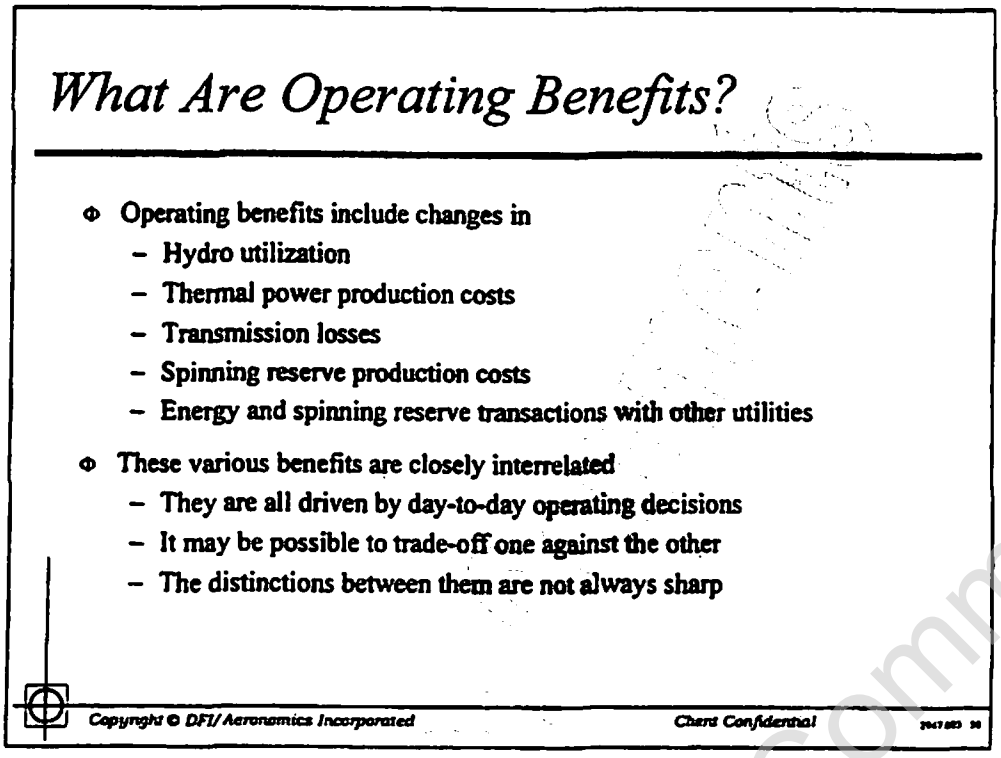
Other benefits, including reduced maintenance on the existing line, the costs of taking the existing line out of service, and reliability, are dealt with separately, and quite simply.

Once we know the aggregate costs and benefits of the Southern Intertie, translating them into impacts on rates becomes a separate exercise.

Includes Chugach Comments



Includes Chugach Comments



What we call operating benefits encompasses a fairly wide range of benefits related to day-to-day operations, sales, and purchases. Although these benefits are closely interrelated to each other, they are quite distinct from the other types of benefits which will be looking at.

Includes Chugach Comments

Why Are Operating Benefits Hard to Understand?

- Because the various operating benefits are all interrelated, we need to consider them all together
- Operating benefits will vary moment-by-moment, depending upon current demands and the state of the system
- At any moment, a variety of operating decisions are possible; we must try to represent how the decisions should be made or, at least, most likely will be made

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Operating benefits are, by far, the most complicated type of potential benefits of the transmission lines to analyze, and development of the operating benefits model has taken perhaps half the efforts of this project.

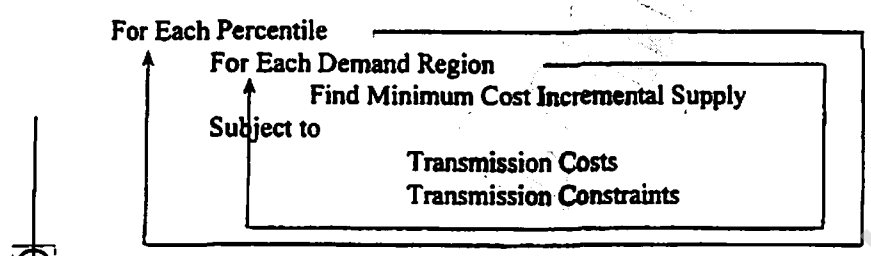
Operating benefits are complicated because before we can understand how operating costs change when a new transmission line is built, we have to understand how Railbelt operating practices should, or at least would, change under a variety of conditions. It is essentially impossible to understand the operating benefits of a new transmission line without a fairly sophisticated model.

Chugach Review Comment -	The lack of detail of ATLAS's calculation on operating cost (fuel and O&M expense) understates production cost savings, which is a primary benefit of project. See December 5, 2002 memo: Ratepayer Impacts of Proposed Transmission Projects Final Report, February 16, 1998 and Chugach Staff Review.

Includes Chugach Comments

How Does ATLAS Dispatch Thermal Units?

- Incremental demand at each percentile in each region is met by units with the lowest variable operating cost available to that region, taking into account transmission losses and transmission capacity constraints
- Each thermal unit is represented separately, but for purposes of power production, has only one variable operating cost



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The basic idea is that each region seeks the lowest cost source of supply, which may be in its own region or elsewhere (transmission constraints permitting).

Chugach Review Comment -	ATLAS's approach to dispatching thermal units understates benefits. See review comments on pages 15, 17 and 31, and December 4, 2002 memo: See December 5, 2002 memo: Ratepayer Impacts of Proposed Transmission Projects Final Report, February 16, 1998 and Chugach Staff Review.

Includes Chugach Comments

What About Hydro Units?

- Hydro units are subject to additional constraints on total annual energy production, due to water availability
- We assume the hydro operating constraint to take the form of a rule that says "only use hydro as incremental supply in a given supply region (Kenai or Anchorage) when demand is in the nth percentile, or higher"
- Subject to this "minimum percentile" rule, hydro is dispatched just like the thermal units

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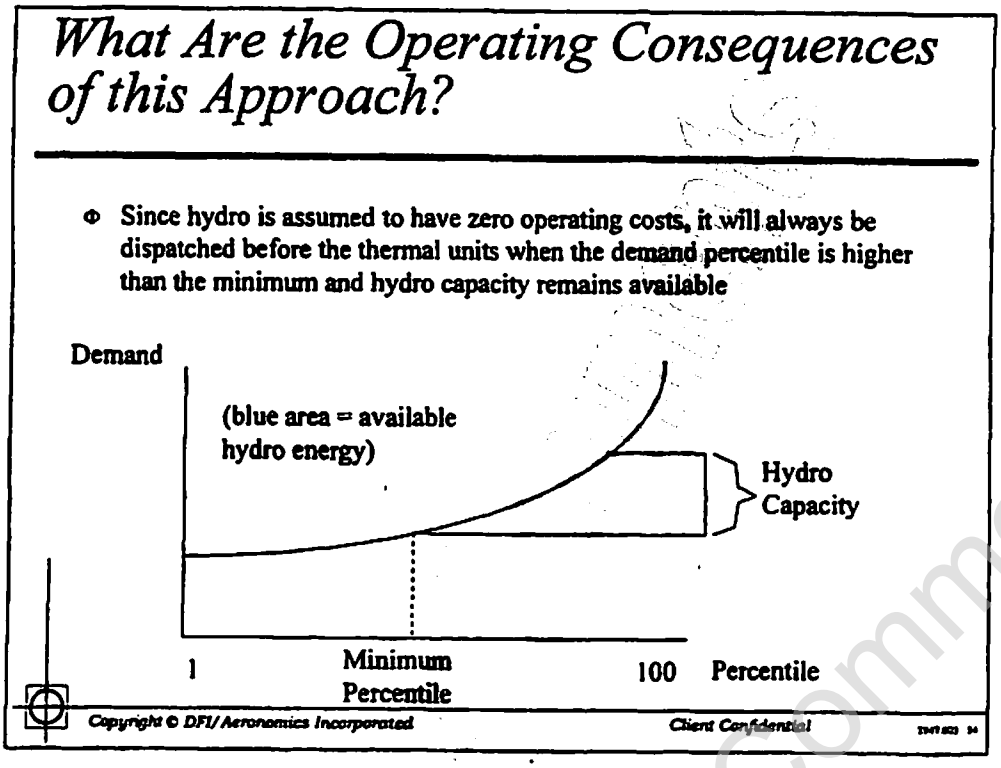
These rules have some consequences which are discussed on the next slide.

Chugach Review Comment -	The dispatch of hydro units in the ATLAS model is too simplistic and understates production costs. Pages 53 and 54 taken together with the "percentile" nonchronological approach fail to cycle hydro to allow operation of thermal units in their more efficient, fully loaded range, and to avoid unnecessary thermal unit startups.

Includes Chugach Comments



These rules generally correspond to how hydro should be most efficiently dispatched. Another way to look at this approach is that it uses hydro to replace all thermal production with a cost higher than a certain level until the hydro capacity has been fully utilized.

Chugach Review Comment -	The dispatch of hydro units in the ATLAS model is too simplistic and understates production costs. Pages 53 and 54 taken together with the "percentile" nonchronological approach fail to cycle hydro to allow operation of thermal units in their more efficient, fully loaded range, and to avoid unnecessary thermal unit startups.

Includes Chugach Comments

So How Does ATLAS Determine the Minimum Percentile for Hydro?

- Before calculating results for each percentile in each region, ATLAS simulates the effect of letting that percentile be the minimum percentile for hydro in that region
- The current percentile will become the minimum percentile for hydro in a region if the simulation indicates that the annual energy produced by hydro will be within limits
- It is actually a little more complicated than this, since we have hydro in two regions, and sometimes must actually simulate various combinations of minimum percentiles in the two regions

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The hydro minimum percentage is basically determined by simulating various percentages until we find the ones that just use the available water. This was the most complex part of the operating model.

Includes Chugach Comments

How Does ATLAS Represent Spinning Reserve Requirements?

- Two types of spinning reserve requirements (in MW's) may be specified in each demand region in ATLAS
  - "General" spinning reserves which may be procured anywhere, subject to transmission constraints (primarily to guard against generating unit outages)
  - "Local" spinning reserves which must be procured locally (primarily to guard against transmission outages)
- Since the local spinning reserve requirement is designed to protect against the loss of transmission capacity used to import power, it only applies to the extent that the region is importing power
- A local spinning reserve requirement may be specified for the combined Fairbanks-Healy region.

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There are many ways reserve requirements could be set in the Railbelt. We have tried to keep our representation general enough that it could be used to represent a variety of ways of setting spinning reserve requirements.

Chugach Review Comment -	The spinning reserve obligations for each utility were overstated, and the local spin requirements had no basis. There is no contract, regulation, or agreement among utilities that a given amount of spin must be produced within a given area. Further, the local spin obligation, as modeled, constrained inter-area spin transfers, and limited economic dispatch.

Includes Chugach Comments

How Does ATLAS Meet the Local Spinning Reserves Requirement?

- For each demand percentile, ATLAS calculates a spinning reserve cost for each generating unit
  - spinning reserves are available for free from all operating units (thermal or hydro), up to the smaller of
    - the unused capacity of the unit
    - a user-specified limit
  - spinning reserves are available from non-operating thermal units at a cost equal to

    [minimum unit operating cost - value of minimum unit energy production]/unit capacity
- ATLAS then ranks units by spinning reserve cost, and selects the minimum cost units to meet the local spinning reserve requirement

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This process is repeated in each region.

Now for the effect of assuming a single heat rate that I promised to explain a few slides back. Because ATLAS assumes a single heat rate, it sometimes turns on more units than needed to produce energy, since it does not recognize that it is most efficient to operate with just a few heavily-loaded units. However, in both the real world and in ATLAS, additional units must usually be turned on to meet the spinning reserve requirements in any case, even if they are not strictly necessary to produce energy. So ATLAS still gets the right answer overall, although it may overstate energy production costs and understate spinning reserve costs. The net result is that we cannot distinguish energy production benefits from spinning reserve benefits very well, we just know the total operating benefits.

Chugach Review Comment -	Per the Alaska Intertie Agreement, the Railbelt spin requirement should cover for the loss of the largest unit on-line. In 1997 this value was 101MW; ATLAS assumed 125MW. ATLAS overstated the spinning reserve commitments. ATLAS's local spin requirements had no basis. There is no contract, regulation, or agreement among utilities that a given amount of spin must be produced within a given area. Further, the local spin obligation, as modeled, constrained inter-area spin transfers, and limited economic dispatch.

Chugach Review Comment -	Use of "effective capacity" (page 17) makes these calculations highly suspect.

Includes Chugach Comments

How Does ATLAS Meet the General Spinning Reserve Requirements?

- ATLAS again uses the unit spinning reserve costs decide how to meet any additional general spinning reserve requirement beyond the local spinning reserve requirement
- Since the general spinning reserve requirements may be met by any Railbelt unit, ATLAS considers units in other regions as well as local units
- Spinning reserve capacity may be taken from other regions only to the extent that transmission capacity is available above and beyond that needed for energy
- ATLAS tracks the 'flows' of spinning reserves through the transmission lines just as it does for power, taking into account transmission capacity constraints and losses

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The logic for meeting the general spinning reserve requirement is similar to the logic for meeting the energy requirement. ATLAS seeks the lowest cost source, regardless of where it may be located, as long as the transmission constraints are met.

Chugach Review Comment -	ATLAS only counts "needed" spinning reserve against available transmission capacity. For example, on the Kenai there is a limited amount of transfer capacity. ATLAS will put more Kenai generation on the transmission line than there is tie capacity.

Includes Chugach Comments

What Are the Outputs of the Operating Benefits Part of ATLAS?

- Power and spinning reserve production by demand percentile for each Railbelt generating unit
- Power and spinning reserve production costs by demand percentile for each Railbelt generating unit
- Power and spinning reserve transmission flows by demand percentile for each Railbelt transmission link
- All generating unit results listed above are summarized by utility and region by demand percentile
- Power and spinning reserve production net of demand for each utility by demand percentile
- All results by utility or region by demand percentile are also summarized annually

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ATLAS gives a lot of operating detail. Enough that for users willing to take the time, you can really see what is happening and why it gave the results that it did.

Includes Chugach Comments

How Does ATLAS Evaluate Inter-Utility Payments?

- Energy and Spinning Reserve
  - The operating model determines the production of individual generating units
  - It can therefore easily determine the net sales and purchases of energy and spinning reserves for each utility
  - Utilities selling energy are credited with benefits equal to the number of MWh's sold times the average generating cost per MWh's plus a $3/MWh markup
  - Utilities selling spinning reserve are credited with benefits equal to the number of MW's x hours sold times the average spinning reserve cost per MW x hours plus a $1 markup
  - Energy and spinning reserve buying utilities incur a corresponding cost
- Generation Capacity: Discussed in previous section

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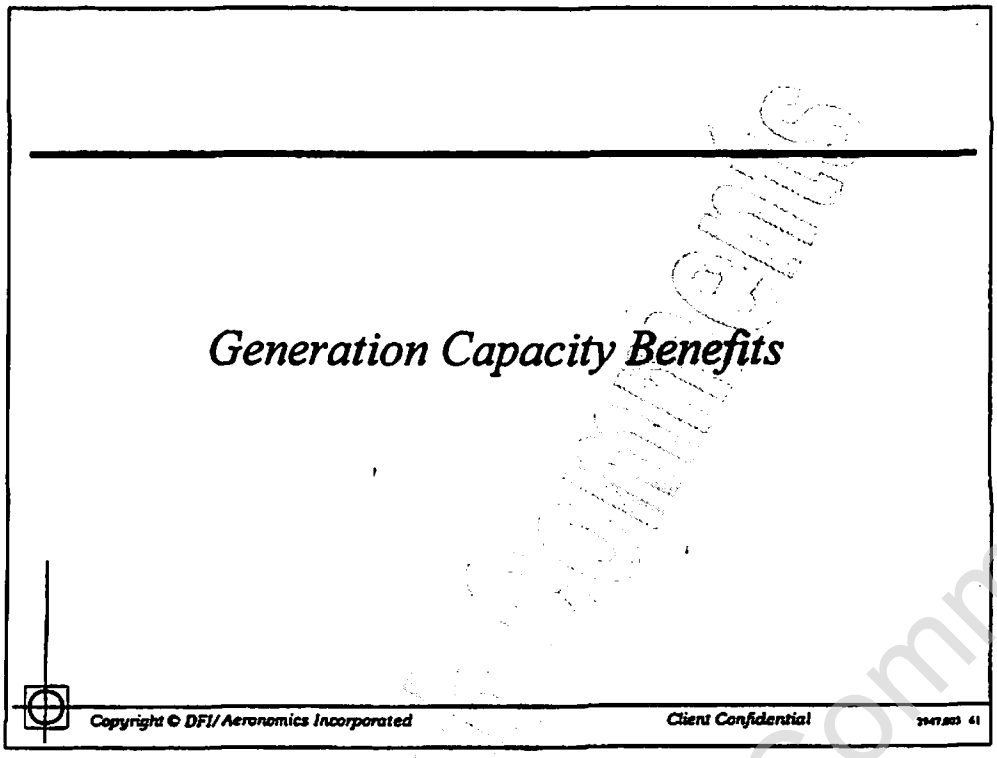
All purchases and sales affect only individual utility results. For the entire Railbelt, they sum to zero and do not affect net benefits of the new line.

The assumed prices for sales of capacity and energy are a judgment call.

We assume that no wheeling charges would be levied on utilities who do not participate in a transmission line, although Chugach's wholesale customers may be required to pay as if they were participants. These assumptions are, of course, another judgment call.

Chugach Review Comment -	Wheeling charges would likely be charged to non-participants. The benefits to Chugach may be understated.

Includes Chugach Comments



Includes Chugach Comments

How Does ATLAS Evaluate the Benefits of Deferring Generation Capacity Additions?

- Deferral of generation capacity additions may be possible with new transmission capacity due to
  - Greater ability to share capacity between regions
  - Life extension on some units which will be less used if the new transmission capacity is built
- Since we understand that planning reserve margins will not change with the construction of the new transmission capacity, no capacity avoidance benefits are expected through reduced reserve margin requirements

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Without adequate transmission capacity, one region may have surplus capacity while another region may have a shortage. The ability to share this capacity is one significant benefit of new transmission capacity.

We originally suspected that with better integrated transmission network, the amount of needed reserve capacity (capacity needed above normal requirements) could be reduced. However, we are told there are no plans to reduce the reserve requirements regardless of whether or not the proposed transmission projects are built and, therefore, did not consider this potential source of benefits.

Chugach Review Comment -	Unit retirement dates used in ATLAS are outdated. ATLAS allows incremental additions of new capacity to "just meet" the 30% reserve margin requirement. Also, retired units aren't removed from the model; they can be, and are, dispatchable after retirement date. See December 5, 2002 memo: Ratepayer Impacts of Proposed Transmission Projects Final Report, February 16, 1998 and Chugach Staff Review.

Includes Chugach Comments

How Does ATLAS Value the Benefits of Sharing Capacity Between Regions?

- Each utility is assumed to buy or build enough generation capacity to meet a 30% reserve margin requirement (above peak demand)
- No utility will build new capacity when excess capacity can be bought from other utilities
- Excess capacity can only be purchased, however, when adequate transmission capacity is available to access the capacity
- ATLAS calculates the extent to which new transmission capacity increases this access
- Benefits accrue to utilities that defer building

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These calculations are performed for each year.

Includes Changes Recommended by Commenters

Do Purchases of Capacity Between Utilities Affect Benefits?

- Although the costs and revenues of capacity sales/purchases between utilities do not affect the benefits of new transmission lines for the Railbelt as a whole, they do affect the benefits to individual utilities such as Chugach
- We count revenues from the sale of capacity as a benefit to the utility making the sale, and as a cost to the utility making the purchase
- We assume the price of capacity for a year to be one-half the cost of ownership of new capacity for a year
- We call these benefits "Transfer Payments-Capacity", as distinct from the "Transfer Payments-Energy and Spin" discussed previously

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Our assumption about the price of capacity is a judgment call, since there have been few, if any, of these capacity trades so far. The price of capacity will certainly be greater than zero and almost certainly less than the cost of new capacity (otherwise the buying utility would build their own).

Note that it is possible for the capacity transfer revenues to an individual utility to drop when we build a new transmission line, if the transmission line gives a utility who would have been a buyer better access to their own capacity.

Includes Chugach Comments

How Does ATLAS Value the Benefits of Extending the Life of Existing Units?

- Retirement of existing units is a critical driver of new generating capacity requirements; retirement is linked to number of operating hours
- New transmission lines, and especially the proposed Battery Energy Storage System, may reduce the hours for some units enough to defer retirement
- This reduction in hours may be determined from the results of the operating benefits part of ATLAS
- Benefits go to owners of units whose retirement is deferred
- Our analysis focused on five units which are potential candidates for life extension: Beluga 3 and 5 (Chugach), ML&P 8, and North Pole 2 (Golden Valley)

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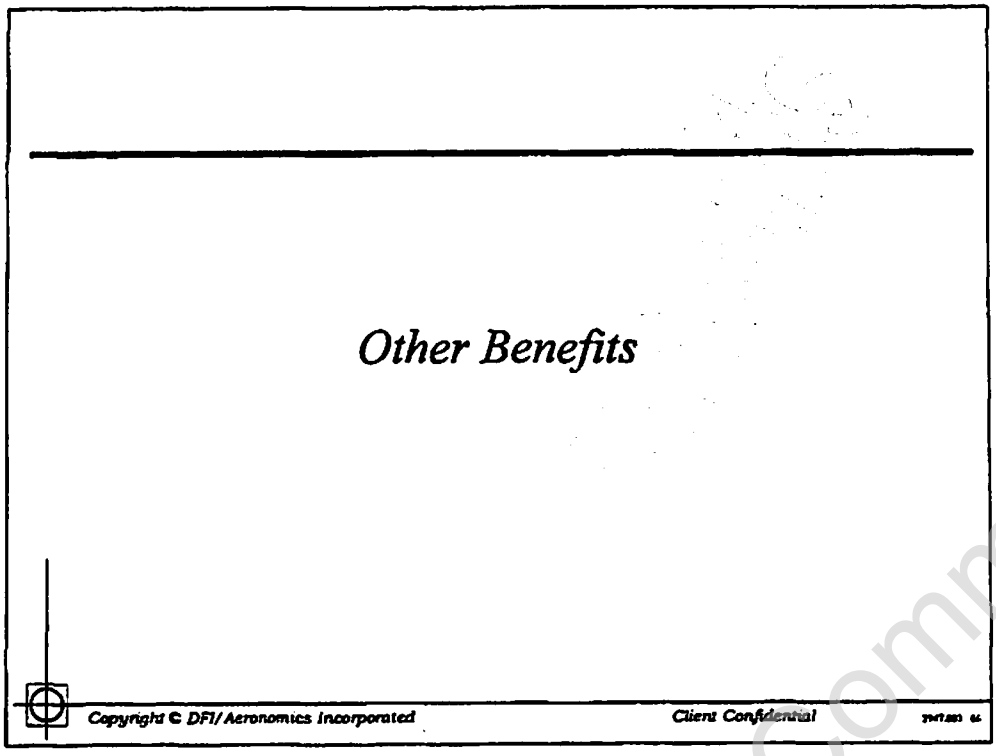
To summarize, we have three categories of capacity-related benefits in ATLAS

-capacity deferral benefits to any utility able to defer building new capacity by purchasing it from another utility

-capacity transfer benefits (or costs) to utilities selling (or buying) additional excess capacity

-life extension benefits accruing to utilities who defer building new capacity through extending the life of existing units

Includes Chugach Comments



Includes Chugach Comments

How Does ATLAS Value the Benefits of Not Having to Unload the the Existing Kenai-Anchorage Line for Maintenance?

- The existing Kenai-Anchorage line will have to be taken completely out of service 60 days a year for 8 years while the line is reconstructed; in addition, the line will be out of service 25 days every year for routine maintenance
- With the Southern Intertie, an alternative route would be available as a backup, and this loss of transfer capability would no longer be necessary
- We can estimate the cost per day of lost transfer capability from Chugach's ProScreen model, or the operating benefits part of ATLAS itself
- The allocation of this savings among utilities will be a user input

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As discussed in the Results section, the cases we examined assume a $7,300 cost per day for taking the line out of service.

Chugach Review Comment -	DFI used $7,300 for the cost per day for taking the line out of service based on a "quick analysis". The correct amount should have been $13,000/day based on Chugach's PROSCREEN production costing model.

Includes Chugach Comments

How Does ATLAS Value the Benefits of Not Having to Unload the the Existing Kenai-Anchorage Line for Other Reasons?

- The existing Kenai-Anchorage line must be left unloaded about 40 days per year during extreme weather conditions or construction near the line
- These unloaded days are in addition to the maintenance days discussed on the previous slide
- The approach to estimating the cost is, however, identical to the approach discussed on the previous slide

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The existing line is normally shut down when during avalanche warnings, to avoid the possibility of a sudden outage. The existing line is also shut down during highway and other construction near the line for the safety of the workers.

Includes Chugach Comments

How Does ATLAS Value the Benefits of Reduced Maintenance/Rebuilding Costs of the Existing Kenai Line?

- The existing Kenai-Anchorage line will be reconstructed over an 8-year period at a cost of about $40 million, in addition to routine maintenance expenses
- The desire to minimize the time the line is out of service imposes scheduling constraints on both the reconstruction and routine maintenance
- With the Southern Intertie, an alternative route would be available as a backup, and these scheduling constraints would no longer be necessary
- The Southern Intertie would reduce the cost of the reconstruction by about 10%
- The allocation of this savings among utilities will be a user input

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As with the cost of unloading the existing line, we assumed that 50% of the reconstruction savings on the existing line would accrue to Chugach, 25% to MEA, and 25% to Homer.

If the Southern Intertie is built, Chugach plans to defer reconstruction of the existing line for four years until the new line is completed. In our model, however, we assumed that the rebuilding schedule would be the same. The reason is that, if we assumed a delay in rebuilding if the Southern Intertie is built, with no corresponding costs, the delay itself would have significant present value benefits. In fact, delaying the rebuilding of the existing line by four years could provide enough benefits to justify the Southern Intertie all by itself! Since the delay is in no way made possible by the Southern Intertie, we made the reconstruction schedules the same, permitting an apples-to-apples comparison.

Chugach Review Comment -	The ability to defer reconstruction of the existing line is a direct result of building the Southern Intertie.

Includes Chugach Comments

How Does ATLAS Value the Benefits of Increased Reliability?

- The new interties should reduce the number of generation- and transmission-related outages
- The change in the number of megawatt-hours of outages may be specified by the user
- These outages are valued at levels specified by the user; for this analysis, they are set to EPRI-suggested levels, as adopted by Chugach
- Reliability does not have an impact on rates, but it does have an economic impact on ratepayers

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We assumed the Southern Intertie would reduce the MWh's of unserved energy by the amounts assumed in the 1989 DFI Reconnaissance study.

Includes Chugach Comments

Are there Benefits that ATLAS does NOT Address?

- Changes in gas royalty/severance tax payments to the state (a negative benefit)
- Environmental benefits (both positive and negative)

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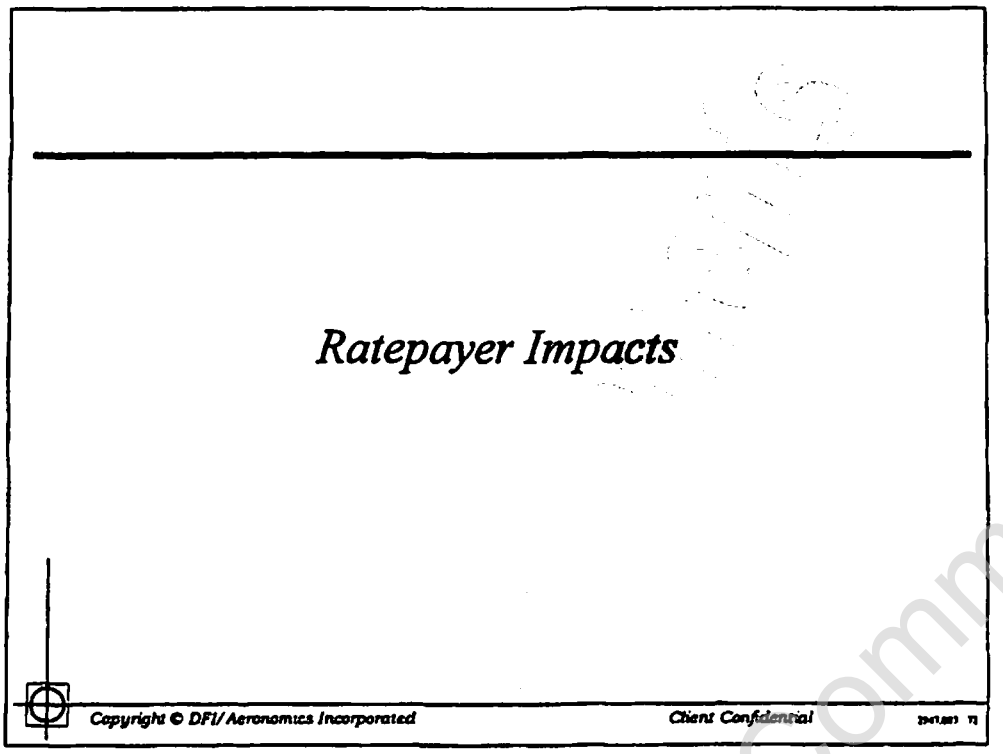
Includes Chugach Comments



Includes Chugach Comments

What Is the ATLAS Approach to Analyzing Individual Utility Impacts?

- For each benefit category, calculate the benefits accruing to each utility
- Estimate the changes in inter-utility payments
- Assign each utility its share of the ownership costs based on its participation in the line
- For each utility, sum the benefits and costs changes

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We are very interested in the impacts of the line on individual utilities for two reasons. First, because understanding how each utility benefits or loses from participating will be important to understanding Chugach's bargaining position. Second, because we would like to understand the impacts of participation in these lines for one utility in particular--Chugach.

Chugach Review Comment -	The benefit/cost calculated in this report are based on the present value of the operating savings (benefits) divided by the present value of the expenses of the Southern Intertie (O&M, depreciation, interest and margins). The benefit/cost ratio reflects the costs to ratepayers. It should not be used to compare to other studies that computed benefits and costs based on cash flow.

Includes Chugach Comments

How Do Our Analyses of the Northern and Southern Interties Differ?

- For the Northern Intertie, our status quo assumption was that the line would be built and that Golden Valley would own it 100%
- Alternative cases for the Northern Intertie looked at the impacts of ownership participation by Chugach and other utilities
- For the Southern Intertie, our status quo assumption was that the line would NOT get built
- Alternative cases for the Southern Intertie looked at the impacts of building the line with ownership participation by Chugach and other utilities

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It appears that the Northern Intertie will be built by Golden Valley even if no other utilities participate. Therefore, our status quo assumption was that Golden Valley builds and owns the line.

Construction of the Southern Intertie is less certain. Therefore, the status quo assumption was that it does not get built.

Includes Chugach Comments

How Does ATLAS Evaluate Ratepayer Impacts?

- As part of last fall's work, DFI•Aeronomics built a spreadsheet financial model to evaluate the impacts of the Southern Intertie on Railbelt ratepayers each year, given user supplied aggregate benefits and costs
- An expanded version of this spreadsheet is included in ATLAS, which shows ratepayer impacts for each Railbelt utility of both the Northern and Southern Intertie, given user supplied assumptions about individual utility participation
- Since the rest of ATLAS will provide benefits and costs to individual utilities, the ratepayer impact model can be linked directly to the these results
- ATLAS presents both $/kWh impacts and $/month impacts on a typical 750 kWh/month residential customer

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The ratepayer impacts are on a year-by-year basis.

Includes Chugach Comments