

**BEFORE THE PUBLIC UTILITIES COMMISSION  
OF THE STATE OF COLORADO**

---

**DOCKET NO. 07A-447E  
IN THE MATTER OF THE APPLICATION OF  
PUBLIC SERVICE COMPANY OF COLORADO  
FOR APPROVAL OF ITS  
2007 COLORADO RESOURCE PLAN**

---

**ANSWER TESTIMONY OF CARL E. HUNT**

1 **Q. PLEASE STATE YOUR NAME AND ADDRESS.**

2

3 A. My name is Carl E. Hunt. My business address is 2542 Pine Street, Boulder,  
4 Colorado, 80302.

5

6

7 **Q. BY WHOM ARE YOU EMPLOYED AND IN WHAT CAPACITY?**

8

9 A. I am employed by Carl Ellis Hunt as an Economic Consultant. I am testifying on  
10 behalf of Interwest Energy Alliance in this docket.

11

12

13 **Q. PLEASE GIVE A BRIEF DESCRIPTION OF YOUR EDUCATION AND**  
14 **QUALIFICATIONS.**

15

1 A. I received a Ph.D. in economics from the University of Colorado at Boulder with a  
2 major field in industrial organization and public utility regulation. I have more  
3 than 25 years experience in public utility regulation. I worked at the Federal  
4 Communications Commission (FCC) as an Industry Economist for approximately  
5 two years. I was Chief Economist for the Colorado Public Utilities Commission  
6 (PUC) for ten years. I have been an independent consultant since February  
7 1991. During this time I have been involved in a large number of projects relating  
8 to public utility regulation in the areas of telecommunications, energy and water.

9  
10 In addition, I was Chairman of the National Association of Regulatory Utility  
11 Commissioners' (NARUC) subcommittee on Economics and Finance and I have  
12 taught several courses that include public utility regulation in undergraduate and  
13 graduate programs as well as for NARUC and the National Regulatory Research  
14 Institute.

15  
16 I have prepared and supervised a number of studies pertaining to issues in the  
17 area of public utility regulation. I have published a number of articles and  
18 monographs pertaining to public utility regulation and also have been involved in  
19 numerous public utility rate cases, inquiries, court cases, legislative action and  
20 public policy decisions.

21  
22 I have attached a copy of my background and qualifications as Appendix A.

23

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23

**Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?**

A. The purpose of my testimony is to determine the consumer benefits, if any, that result from displacement of combined-cycle natural gas turbine plants (CCGT) by electric power generation from wind resources. I measure consumer benefits in terms of dollars saved. To accomplish this task, I developed a model to compare costs of electric power generation from each of those resources.

I compared the costs of generating electric power from CCGTs and wind resources using two different prices for wind energy and a conservative natural gas price forecast. I ran two different versions of the model. One version looked at Public Service Company of Colorado's (PSCo) solicitation of 800 MW of wind power between 2010 and 2015. My analysis spanned the decade of 2010 to 2020. The second version looked at the marginal gain or loss of a 100 MW of additional wind power on PSCo's system to displace electric power generated from a CCGT over that same decade. In each instance, I found that electric power generation produced by wind energy had a cost advantage over CCGTs when environmental considerations were taken into account.

As a result, consumers will benefit from a greater reliance on wind resources. Given the outcome of my analysis, I recommend that PSCo extend its reliance on

1 wind power beyond that required by 40-2-123(1) C.R.S. Not only will consumers  
2 benefit by additional reliance on wind power but the environment also will benefit  
3 through a reduction in the emission of greenhouse gases.

4  
5  
6 **Q. DID YOU EXPLICITLY LOOK AT PSCO'S PREFERRED RESOURCES PLAN?**

7  
8 A. Yes. As I understand PSCO's preferred resource plan, PSCO intends to solicit  
9 bids to purchase 800 MW of wind power between 2010 and 2015. It intends to  
10 purchase 100 MW each year between 2010 and 2013. It will purchase an  
11 additional 200 MW in each of the two remaining years for a total of 800 MW.

12  
13 The basic structure of the model I used to analyze PSCO's preferred wind  
14 resource plan was developed in August, 2006 by Jane E. Pater and Ron Binz for  
15 Interwest Energy Alliance, "Wind on the Public Service Company of Colorado  
16 System: Cost Comparison to Natural Gas" (see [www.interwest.org/backcast.htm](http://www.interwest.org/backcast.htm)). I  
17 examined the cost differences between wind energy resources and electric  
18 power produced by CCGTs between the years 2010 and 2020. I ran the model  
19 using two different prices for wind energy and PSCO's forecast for natural gas  
20 prices. The assumptions are shown in CEH Exhibit 1, which contains amounts of  
21 wind to be acquired from 2010 to 2015 on page one and the sources of the  
22 assumed values on page 2. CEH Exhibit 2 shows the data from exhibit one to  
23 determine consumer benefits derived from wind power verses CCGTs. The

1 results are summarized in the table below. Each case shows significant  
2 consumer savings over the 10 year period.

3 **CONSUMER BENEFITS OF 800 MW OF WIND POWER COMPARED TO CCGT**

|                                  | Price of Wind @ \$0.061 Per kWh | Price of Wind @ \$0.041 Per kWh |
|----------------------------------|---------------------------------|---------------------------------|
| <b>Consumer Benefits of Wind</b> | \$247,617,169                   | \$590,395,969                   |

4  
5 At a price of 6.1 cents per kWh, wind energy produces consumer benefits when  
6 greenhouse gases are taken into consideration. However, at 4.1 cents per kWh,  
7 wind energy produces considerable consumer benefits without taking  
8 greenhouse gases into account.

9

10

11 **Q. WHY DID YOU LOOK ONLY AT A 10 YEAR PERIOD BETWEEN 2010 AND**  
12 **2020?**

13

14 Forecasting is risky business. Actually, risky is not the appropriate term to apply  
15 to forecasting. Uncertainty is a more appropriate term. The longer the forecast  
16 is the greater are the opportunities for the occurrence of unanticipated events.

17 Unanticipated events can blow a forecast out of the water. For instance, in 1999  
18 with crude oil prices hovering around \$10.00 a barrel virtually no one would have  
19 made forecasts that included crude oil prices hovering around \$100.00 in 2008.

20 However, due to unforeseen events, crude oil prices now are hovering at or in  
21 excess of \$100.00.

22

1 As a result of uncertainty, forecasts should be made to extend only as far out as  
2 necessary. By 2020, we can assess adequately consumer benefits of  
3 substituting wind energy for CCGTs. Extending the analysis farther into the  
4 future simply subjects the analysis to a greater level of uncertainty without  
5 providing any additional information.

6

7

8 **Q. YOU MENTIONED MODEL ASSUMPTIONS EARLIER. WHY ARE THESE**  
9 **IMPORTANT?**

10

11 A. Model assumptions are important because they are the basic drivers of the  
12 model. If an assumption is changed, model results will change. Assumptions for  
13 the model I present are shown at Exhibit CEH 1. The assumptions are fairly  
14 conservative and consistent with the general body of literature and with PSCo's  
15 application.

16

17

18 **Q. WHY DID YOU USE A 35 PERCENT WIND CAPACITY FACTOR?**

19

20 A. The capacity factor for wind turbines has been increasing rapidly in recent years.  
21 As the average size of wind turbines has increased so has their capacity factor.  
22 According to the Annual Report on U. S. Wind Power Installation, Cost and  
23 Performance Trends: 2006, published by the U. S. Department of Energy, the

1 average capacity factor for projects installed in 2004 through 2005 was 36  
2 percent. The average installed capacity factor is expected to increase to 40  
3 percent. Because Colorado has a number of prime wind locations, a 35 percent  
4 average installed capacity factor should be achievable. In addition, PSCo  
5 assumes a 35 percent capacity factor for wind energy in its application.  
6  
7

8 **Q. WHY HAVE YOU INCLUDED WIND INTEGRATION COSTS AND**  
9 **INCREMENTAL TRANSMISSION COSTS IN YOUR STUDY?**  
10

11 A. I included a wind integration cost of \$0.005 per kWh and an incremental  
12 transmission cost of \$0.0021 per kWh because these are necessary costs in the  
13 production of wind energy.  
14

15 Any generation plant technology whether it is wind, CCGT or other type of plant  
16 has impacts on the power system. These costs are separate from costs related  
17 to incremental transmission and need to be taken into account in estimating the  
18 cost of wind energy. According to the U. S. Department of Energy, wind  
19 integration cost is approximately \$5 per MWh. PSCo states that its studies  
20 indicate that wind integration costs are \$4.77 per MWh up to a 15 percent  
21 penetration.  
22

1 Any new generation plant may require additions to its transmission system. Wind  
2 developers will bear the cost of adding any radial transmission from their plant to  
3 the transmission grid. This cost is included in the cost and in the price of wind  
4 energy to consumers. I did not assume costs for any additions to the  
5 transmission grid itself because Xcel has provided testimony that these costs are  
6 network costs that will be spread to all ratepayers under its interpretation of  
7 SB07-100.

8  
9 PSCo plans to accommodate additional wind power with various additions to the  
10 transmission grid in response to their SB07-100 obligations. As a result, any  
11 incremental transmission costs for wind projects are likely to be small. I used the  
12 \$0.0021 figure developed by Pater and Binz in their wind study prepared for  
13 Interwest Energy Alliance.

14  
15  
16 **Q. WHY DID YOU CHOOSE A PRICE OF WIND OF 6.1 CENTS PER KWH IN**  
17 **ONE VERSION OF THE MODEL AND 4.1 CENTS PER KWH IN ANOTHER**  
18 **VERSION OF THE MODEL?**

19  
20 **A.** We don't know what the bid price of wind will be per kWh when PSCo actually  
21 accepts bids for 800 MW of wind power between 2010 and 2015. As a result, I  
22 used conservative current calculations of the cost of wind energy. For example,  
23 the National Renewable Energy Laboratory (NREL) presentation titled Wind

1 Powering American, 2006 indicates that the unsubsidized cost of wind energy  
2 was 5 to 8 cents per kWh in 2006. I accepted this as the unsubsidized cost of  
3 wind per kWh. Because the price that PSCo will pay includes the subsidy, I  
4 subtracted the PTC of 1.9 cents from a high price of 8 cents per kWh. This  
5 results in a ceiling price of 6.1 cents per kWh. The 6.1 cents establishes a critical  
6 upper boundary because if prices rise above this range, consumer benefits may  
7 be eliminated if natural gas costs fall well below the projected range. However, if  
8 they rise above the projected range, wind prices above 6.1 cents will provide  
9 consumer benefits.

10  
11 I very conservatively established a lower boundary of 4.1 cents. This is  
12 considerably above NREL's estimate of 5 cents, less the PTC. That would  
13 establish a 3.1 cents per kWh price for wind energy. Most estimates indicate that  
14 wind power will fall below 3.0 cents per kWh by 2010.

15  
16 Prices and costs for wind power have been falling dramatically over the last two  
17 decades. Between 1982 and 2001 the average cost per kWh of wind generated  
18 electricity fell from 38 cents to 5 cents. According to the U. S. Department of  
19 Energy, Annual Report on U. S. Wind Power Installation, Cost and Performance  
20 Trends: 2006, published May 2007, the average price of wind power fell to 3.6  
21 cents per kwh in 2006. However, installed cost per KW reached a nadir in 2005.  
22 As a result of the increase in installed cost in 2006, prices per kWh also  
23 increased in 2006. It is highly likely that turbine costs and installed costs will

1 increase somewhat over the next several years. The increase in costs may be  
2 offset somewhat by increases in capacity factors and increases in economic  
3 efficiency. Some forecasts indicate that the price per kWh for wind power could  
4 be as low as 3 cents. As a result, I consider a range of 4.1 cents to 6.1 cents per  
5 kWh to be reasonable.

6  
7  
8 **Q. WHY HAVE YOU COMPARED THE COST OF WIND POWER WITH CCGTs?**

9  
10 A. Wind power most likely will replace existing or future CCGTs or other less  
11 efficient natural gas plants. Thus, CCGTs are the most appropriate plants to use  
12 when discussing the viability of wind power.

13  
14  
15 **Q. ARE MANY OF THE FACTORS THAT YOU USED TO DEVELOP THE CCGT**  
16 **COSTS THE SAME AS THOSE USED BY PSCO IN ITS APPLICATION?**

17  
18 A. Yes. I used a CCGT capital cost of \$766 per KW with a heat rate of 7353. I  
19 used a capacity factor of 40 percent, a cost of capital of 8 percent and a book life  
20 of 30 years. In addition I used a CO2 cost of \$20 per ton. PSCO used a 2.5  
21 percent annual escalation factor for the CO2 costs. I did not include the  
22 escalation factor in my analysis.

23

1 I used 8 percent cost of capital based on PSCo's rate of return of 7.88 percent,  
2 even though I believe that interest rates will be higher during the forecasted  
3 period than in the recent past.

4

5

6 **Q. WHY DID YOU USE 87.5 MW FOR CCTGTs TO COMPARE TO 100 MW WIND**  
7 **POWER?**

8

9 A. I used an 87.5 MW CCGT to compare to 100 MW wind power to compensate for  
10 the difference in capacity factors. A CCGT has a capacity factor of 40 percent  
11 and wind power has a capacity factor of 35 percent. As a result, an 87.5 MW  
12 CCGT at a 40 percent capacity factor will produce the same number of kWh as a  
13 100 MW wind resource.

14

15 I don't expect CCGTs to be installed in 87.5 MW increments. I simply am using it  
16 for comparison purposes.

17

18

19 **Q. WHAT DID YOU USE FOR THE NATURAL GAS PRICE FORECASTS?**

20

21 A. I used PSCo's natural gas price forecast for the years 2010 through 2020.

22

23

1 **Q. HOW MUCH CONFIDENCE DO YOU HAVE IN NATURAL GAS PRICING**  
2 **FORECASTS?**

3  
4 A. I have very little confidence in natural gas pricing forecasts. I don't say this as a  
5 negative reflection on PSCo's forecasting but rather as a general statement  
6 about forecasting natural gas prices. Natural gas prices can be highly volatile.  
7 As a result, the actual price tends to be significantly above or below the  
8 forecasted price for any given year. Also, natural gas price forecasts tend to  
9 underestimate price increases. This probably is related to the difficulty of  
10 statistical methods in dealing with volatility and sharp rates of increase.

11  
12 CEH Exhibit 3 shows a graph of natural gas prices between 1970 and 2006.  
13 During this period natural gas prices increased 3,665 percent in nominal terms.  
14 This is a strong upward trend. Between 2000 and 2006 natural gas prices  
15 increased 74 percent. However, the difference between the low price and the  
16 high price during this period was 149 percent. Moreover, natural gas prices  
17 increased a sharp 227 percent between 1998 and 2006.

18  
19 Even in the relatively stable decade of the 1980s, where the price only increased  
20 6.2 percent, the difference between the high price and the low price was 67  
21 percent. As a result, even in relatively stable decades, the price of natural gas is  
22 highly volatile and subject to forecast inaccuracies.

23

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23

**Q. DON'T MOST OFFICIAL U. S. FORECASTS SHOW A DOWNWARD TREND IN NATURAL GAS PRICES?**

A. Yes. Most official U. S. forecasts show a downward trend until around 2010 and then natural gas prices begin to trend upward again. Because of the statistical techniques used to forecast natural gas prices, the forecasts do not show the volatility inherent in natural gas pricing. Moreover, they most likely underestimate natural gas price increases.

A primary determinant of the price of natural gas is the cost to drill a natural gas well. These costs have increased at a rate equal to the price increases in natural gas. CEH Exhibit 3 also shows a graph of drilled well cost between 1970 and 2004 and compares these costs to the price of natural gas. The drilled well costs have increased 3,112 percent during this period. Between 1994 and 2004, the cost to drill a natural gas well increased 195 percent. Drilled well costs are one of the prime drivers of natural gas prices and thus, there is little reason to believe that there won't be strong upward pressures on natural gas prices.

**Q. DOES IT MATTER IF NATURAL GAS FORECASTS INCORRECTLY PROJECT PRICES THAT ARE TOO LOW?**

1 A. Yes, it matters to consumers. If natural gas prices are assumed incorrectly to be  
2 too low, too few renewable resources will be purchased. The result is that  
3 consumers will pay higher prices for energy due to the higher than anticipated  
4 increase in gas price through the Energy Cost Adjustment. Under forecasting the  
5 price of natural gas has been a basic planning error that has caused Xcel  
6 customers to suffer from high natural gas prices.

7  
8 Greater reliance on the fixed costs associated with wind energy would protect  
9 consumers from forecasting errors and the consequent increase in gas prices  
10 through the Energy Cost Adjustment.

11  
12

13 **Q. WHAT HAPPENS IF THE FORECASTED PRICE OF NATURAL GAS IS**  
14 **HIGHER THAN THE ACTUAL PRICE?**

15

16 A. In general consumers will still benefit from greater reliance on renewables unless  
17 the price of natural gas falls to a very low level. Even then because of the  
18 volatility of natural gas prices, any price advantage that natural gas might have  
19 over renewables is likely to be short lived.

20

21 In fact, consumers are likely to benefit generally from a high natural gas forecast  
22 because it will lead to greater reliance on renewables and efficiency. This will

1 moderate demand pressures and provide consumers protection against the next  
2 spike in natural gas prices.

3  
4  
5 **Q. WHY HAVE YOU ALSO INCLUDED A 100 MW WIND POWER VERSION OF**  
6 **THE MODEL?**

7  
8 A. The 800 MW version of the model shows that consumers gain when wind power  
9 displaces CCGTs. This analysis supports PSCo's preferred resource plan.  
10 PSCo stated that a 20 percent penetration of alternative energy is not necessarily  
11 a cap. As a result, I included the 100 MW version to show gains to consumers  
12 with each additional 100 MW increase in wind power that might occur beyond  
13 PSCo's recommended 800 MW option. It is based on the same model structure  
14 as the 800 MW version but it provides a less cluttered view. The 100 MW model  
15 clearly shows gains to consumers with each addition of wind power.

16  
17 I used the same assumptions with the 100 MW model as I did with the 800 MW  
18 model, except that I increased wind integration costs to \$0.008 per kWh. I did  
19 this to take into account potentially higher integration cost with a wind penetration  
20 beyond 15 percent. The results are shown in CEH Exhibit 4 and summarized in  
21 the table below.

22 **CONSUMER BENEFITS OF AN ADDITIONAL 100 MW OF WIND POWER**

|                                  | Price of Wind @ \$0.061 Per kWh | Price of Wind @ \$0.041 Per kWh |
|----------------------------------|---------------------------------|---------------------------------|
| <b>Consumer Benefits of Wind</b> | \$29,780,851                    | \$97,232,851                    |

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23

Based on these results, the PUC should encourage PSCo to increase its reliance on wind resources beyond the minimal amounts required by legislation. Both consumers and the environment will benefit with greater reliance on wind power.

**Q. ARE THERE ADDITIONAL REASONS THAT THE PUC SHOULD CONSIDER INCREASING THE RELIANCE ON WIND POWER?**

A. Yes. The models that I have presented here clearly indicate that consumers and the environment will benefit with greater reliance on wind power. Looking at these models, however, is like looking at the trees in a forest. The trees are important but the forest is also important. In other words, the PUC also should look at the broader picture when approving PSCo’s resource plan. I am talking here about economics and not just the environment.

Global warming clearly is an issue that we need to face, and we need to adjust our means of production to reduce greenhouse gases. However, the economics of fossil fuels also portends a change to our means of production. The price for oil and natural gas is trending up. Although we likely will see volatility such that at times prices may be well below those we face today, the long-run trend will show significant price increases. Some are now predicting \$200 a barrel for oil.

1 World economics does not foretell a decreasing price for fossil fuels. It foretells  
2 greater competition for these scarce resources. China, India, Indonesia, Latin  
3 America and others are trying to become fully industrialized nations. Their  
4 increasing industrialization will place greater demands on basic resources such  
5 as oil and natural gas. As competition for these scarce resources increase, so  
6 will the price. Thus, the long-term prognoses are for significant upward pressure  
7 on prices.

8  
9 On the other hand, prices for wind energy, solar and other renewables are  
10 trending downward. During the same period that natural gas prices have  
11 skyrocketed, the price of wind energy has plummeted.

12  
13 The price of wind energy may have bottomed out for the present, due to  
14 production restraints for wind turbines. However, as production capacity  
15 increases, prices for wind turbines should remain steady or decline slightly. Even  
16 if wind turbine prices increase, they likely will increase at a slower rate over the  
17 long term than the price of natural gas.

18  
19 The result of this broad economic picture is that the PUC should push the  
20 envelope in terms of reliance on wind energy. Even though CCGTs may look  
21 cost competitive with wind at certain price points and points in time, the overall  
22 trend is such that wind energy will provide greater consumer benefits in the long  
23 term.

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22

**Q. WHAT ARE YOUR CONCLUSIONS AND RECOMMENDATIONS?**

A. Wind energy provides consumer benefits when compared to CCGTs based on the estimated range of wind prices and natural gas prices presented in my analysis of 800 MW of additional wind energy. Given the conservative nature of the range of wind prices, natural gas prices and other assumptions used in my analysis, the predicted consumer benefits are highly likely to be realized. As a result, I recommend that the PUC adopt the section of PSCo's preferred resources plan to purchase 800 MW of wind power by 2015 as a minimum, requiring the Xcel bid process to be open to larger amounts if bid prices justify them.

Consumers also can benefit by additional purchases of wind energy as shown by my analysis of each additional 100 MW of wind energy as compared to CCGTs. PSCo states that its reliance on wind energy does not need to be capped at 20 percent. As a result, I recommend that the PUC require that PSCo secure additional bids for wind energy. PSCo should be required to accept additional bids for wind energy if the bids justify it and meet other contract conditions. I have not recommended a specific level of additional wind energy but rather I suggest that the PUC and PSCo consider at least an additional 500 MW of wind

1 power for the 2010 through 2015 time frame contingent on reliability conditions  
2 and integration costs.

3  
4 All of the results and recommendations in this docket are based on estimates of  
5 future events. As such, they are subject to forecasting errors. None of the  
6 estimates are going to be precisely accurate. However, it is more important to be  
7 approximately correct than precisely accurate. I recommend that the PUC take  
8 into account broader economic trends to ensure that it is approximately correct.

9  
10 The Commission needs to be most concerned about high natural gas prices and  
11 high costs for constraining carbon created by the PSCo fossil fuel generation  
12 fleet. Higher than expected prices are the threat to consumers not lower than  
13 expected prices. If prices are lower than expected, consumers will benefit.

14  
15 That said, the broader economic trends indicate that the price of natural gas is  
16 volatile and trending sharply upward. Conversely, the historic price trend for  
17 wind energy has been a sharp decline. The price trend for wind energy will not  
18 decline as precipitously as in the past but should level out at worst or show a  
19 continuing slight decline. What results from the above observations are two  
20 resources with distinctly different price trends. Because of the broad economic  
21 trends, I recommend that the PUC give greater weight to the resource with the  
22 more stable and declining costs.

23

1

2 **Q. DOES THAT CONCLUDE YOUR TESTIMONY?**

3

4 A. Yes.

5

## **Carl Ellis Hunt, Ph.D.**

**2542 Pine Street  
Boulder, Colorado 80302  
(303) 449-1137**

### **EDUCATION**

University of Colorado, 1974-1980. Ph.D., Economics.

Fields: Industrial Organization, Social Economics, Urban Economics and Economic Education.

Dissertation: Competition in Telecommunications: A Surcharge as a Method to Promote Competition in Private Line Services

University of Colorado, 1972-1974. M.A., Economics.

Fields: Macroeconomic theory and Microeconomic theory.

University of Tulsa, 1964-1968. B.A., Business Administration.

Fields: Economics and Philosophy.

### **PROFESSIONAL EXPERIENCE**

1991-Present. Carl Ellis Hunt, Consulting Economist. Areas of expertise: public utility regulation, antitrust, telecommunications, energy, competition and regulation, market structure, industry studies, economic forecasting, energy forecasting, demand studies, integrated resource planning, regional economic forecasting and simulations.

1981-1991. Chief Economist, Colorado Public Utilities Commission, Denver, Colorado.

Responsibilities included supervision of the Economics Division; preparing and conducting economic studies pertaining to the regulation of public utilities such as cost of service, energy forecasting, demand side management programs, economic forecasting, integrated resource planning programs, and market structure studies; preparation and presentation of oral testimony in proceedings before the Commission related to economic considerations (please see attachment for specific testimony); and providing expert advice and assistance on the economics of public utility regulation and general economic matters to the Commissioners, section chiefs and professional personnel.

Responsibilities also included supervising and directing studies prepared by outside consultants and contract employees.

1980-1981. Economic Analyst, Department of Commerce and Economic Development, State of Washington, Olympia, Wash. Responsibilities included analysis and studies in public finance, business regulation, and regional economic development, among others. Two major studies undertaken were Unemployment Issues in Washington State, which investigated unemployment in Washington and was an initial attempt to formulate a framework for determining effective state unemployment policy; and The Economic Consequences of the Mt. St. Helens Eruptions, which investigated the economic consequences of this natural hazard. Both macro (state) and micro (sub-state sector) analysis were undertaken in the latter study.

1979-1980. Industry Economist, Federal Communications Commission, Washington, D.C.  
Responsibilities included independent preparation of economic and statistical studies relating to telecommunications. Studies conducted included an analysis of tariffs, tariff compliance, market structure, economics of regulation, and economic efficiency. (Please see attachment for project list.)

1976-1977. Consultant, U.S. Department of Commerce, Office of Telecommunications Policy, Boulder, Colorado. Responsibilities included developing and carrying out a program of economic research on pricing and demand for telecommunications services.

## **TEACHING EXPERIENCE**

1984-1996. University of Colorado, Boulder, Colorado.  
Graduate courses in microeconomics, macroeconomics and managerial economics in the Masters of Business Administration program and the undergraduate honors program.

1984-1988. University of Denver, Denver, Colorado.  
Graduate courses in microeconomics, macroeconomics and managerial economics, on an adjunct basis, in the Masters of Business Administration program.

1977-1978. Colorado Women's College, Denver, Colorado.  
Preparation and teaching of undergraduate economics courses.

1976-1977. Montana State University, Bozeman, Montana.  
Preparation and teaching of undergraduate economics courses.

1975-1976. Metropolitan State College, Denver, Colorado.  
Preparation and teaching of undergraduate economics courses.

## **COMMITTEES AND ADVISING BOARDS**

Chairman, National Association of Regulatory Utility Commissioner's Subcommittee on Economics and Finance.

Advisory Board, Colorado Statistical Abstract Study

Advisory Board, State of Kansas Telecommunications Cost Study

Advisory Board, University of Colorado Forecasting Center

Advisory Board, National Regulatory Research Institute Telecommunications Cost Study.

Federal Communications Commission Federal/State Joint Board.

## **CONTINUING EDUCATION**

AT&T Separations/Settlements seminar

AT&T Switching seminar

Electric Utility Rate Design study, Cost of Rates workshop

National Association of Regulatory Utility Commissioners' Annual Regulatory Studies program.

## **PUBLICATIONS, PROCEEDINGS AND STUDIES**

With John Sperling, et. al., *The Great Divide: Retro vs. Metro America*, PoliPoint Press, 2004.

Discussant, "Fully- Separated Subsidiaries as a Regulatory Tool in Telecommunications," The National Association of State Utility Consumer Advocates, 2001.

Discussant, "Energy Regulation in Transition," Transportation and Public Utilities Group, The American Economic Association, January, 1997.

Discussant, "Balancing Competition and Regulation for Energy and Telecommunications Utilities," The American Economic Association, January 5, 1994.

"Analysis of the Taxicab Market in the Denver Metropolitan Area and Forecast of Taxicab Demand" for the Colorado Public Utilities Commission, December 1994.

With PNR and Associates, "The Economic Development Implications of the Telecommunications Infrastructure of 11 South African Countries," Agency for International Development, January, 1993.

With Ed Rosenberg, et. al., Regional Telephone Companies: Structures, Affiliate Transactions, and Regulatory Options, Columbus, OH: National Regulatory Research Institute, March, 1993.

"Cable Rate Regulation," for Cole, Raywid and Braverman, April 20, 1993.

"Government Policy and Business Strategy: the case for price caps in telephony," Perspectives on Price Caps, the Public Utilities Commission of Ohio, May 20, 1993.

"Cost Studies, Separations Issues and Rates," the South Dakota Public Utilities Commission, August 30-31, 1993.

"The Use of Long-run Incremental Cost as a Strategic Pricing Tool for Telephone Utilities," The Atlantic Economic Conference, October 9, 1993.

Discussant, "Energy Demand, Supply and Conservation," The Atlantic Economic Conference, October 10, 1993.

Defining and Costing POTS: A Common Carrier Approach Using the Joint Products Method, Columbus, OH: National Regulatory Research Association, April 1992.

"Economic Development Implications of Public Fishing Access to Redhills Forest Ranch," for Redhills Forest Ranch, April 28, 1992.

"Issues in Determining a Fair Rate of Return Under Regulation," Canadian Association of Members of Public Utility Tribunals, Sixth Annual Regulatory Conference, May 11, 1992.

"Measurement of Market Structure and Competition in Telecommunications," National Association of Regulatory Utility Commissioners, subcommittee on Economics and Finance, August 2, 1992.

"Telecommuting and Its Economic Impacts in Rural Communities," 1992 Colorado Telecommuting Conference, August 19, 1992.

"Analysis of Proposed Federal Cable Legislation," for Tele-Communications, Inc., August 24, 1992.

"Defining POTS in the Information Age," Workshop on Telecommunications, Illinois Commerce Commission, October 24, 1992.

"A Cohort Survival Model of Population for Certain Nevada Counties," for Planning Information Corporation, April, 1991.

"Forecasting the Demand for Electricity in Colorado," the Colorado Public Utilities Commission, May, 1991.

"Telephone Penetration: A View of the Have Nots," Western Economics Association, July 1989.

"Rate of Return in the Information Age," Perspectives on the Telephone Industry, Cambridge: Ballinger Publishing Co., 1989.

"Customer Access: The Case for Joint Production," proceedings of the 1988 Rate Symposium, Missouri Public Service Commission, University of Missouri, Columbia, 1989.

"The Effect of Economic Development Rates in the Natural Gas Industry on a State Economy," Executive Education Program for the Gas Industry, University of Colorado, June 17, 1988.

"Why Rate Base Regulation?" Alternatives to Rate Base Regulation in the Telecommunications Industry, National Association of Regulatory Utility Commissioners, March 20, 1987.

Market Structure Criteria to Evaluate Lessening Telecommunications Regulation, National Association of Regulatory Utility commissioners, March 20, 1987.

"Potential Competition in the Long Distance Market," Technical Education Conference for Commissioners, National Association of Regulatory Utility Commissioners, February, 1984.

"Data Base Development and Energy Forecasting in the State of Colorado," Proceedings of the Workshop on Electric Demand Forecasting by State Agencies, Oak Ridge Laboratories, February, 1982.

The Short-Term Economic Consequences of the Mount St. Helens Volcanic Eruptions in May and June, 1980, with J. Scott MacCready, Washington State Department of Commerce and Economic Development, Olympia, Washington, August, 1980.

Unemployment Issues in Washington State, with Terry Sacks and Ron Woodard, Washington State Department of Commerce and Economic Development, Olympia, Washington, August, 1980.

Welfare Impact of Changes in Residential Telephone Prices, U.S. Department of Commerce, Office of Telecommunications, Policy Research Division, 1977.

With Vinson Snowberger, "Economics, an Aid to Lawyers," *Trial Talk*, Vol. XI, No. 7, July, 1976.

## **EXPERT TESTIMONY**

Docket No. 04D-440T in the matter of reclassification and deregulation of certain Part 2 products and services and deregulation of certain Part 3 products and services, February, 2004.

Docket No. 00R-285T, in the matter of regulating and pricing operator service for telecommunications service providers before the Colorado Public Utilities Commission, September, 2001.

Docket No. RPU-01-06, in the matter of costing and pricing of unbundled network elements for Qwest before the Iowa Utilities Board, September, 2001.

Docket No. 99A-549E in the matter of the application of Public Service Company of Colorado IRP, December, 2000.

Docket No. RPU-00-01, in the matter of deaveraging statewide average wholesale rates for unbundled loop network elements across the geographic zones for Qwest before the Iowa Utilities Board, September, 2000.

Docket No. NOI-99-1, in the matter of establishing an Iowa universal service fund, before the Iowa Utilities Board, ongoing.

Docket No. INU-99-3, in the matter of U S West's request to deregulate certain services in sub-state regions, before the Iowa Utilities Board, October, 1999.

ICC Docket No. 98-9555 - Re-Opening, the merger of SBC Communications and Ameritech Corporation before the Illinois Commerce Commission, July, 1999.

ICC Docket No. 98-0555, the merger of SBC Communications and Ameritech Corporation, before the Illinois Commerce Commission, November, 1998.

Docket No. RPU-96-7, In the Matter of GTE Midwest Total Element Long Run Incremental Cost Studies for Interconnection, Unbundled Network Elements and Avoided Costs, Before the Iowa Utilities Board, in progress.

Docket No. RET-97-1, South Slope Cooperative Telephone Company, Request for Rural Exemption from the Telecommunications Act of 1996, Before the Iowa Utilities Board, November, 1997.

Docket No. RPU-96-9, In the Matter of U S West Communication, Inc. Total Long Run Incremental Cost Studies for Interconnection, Unbundled Network Elements and Avoided Costs, Before the Iowa Utilities Board, July, 1997.

Docket No. RPU-96-2, In the Matter of U S West Communications, Inc. Single Line ISDN Service Tariff Filing and Supporting Total Service Long Run Incremental Cost Study, Before the Iowa Utilities Board, November, 1996.

Docket No. UM 773, In the Matter of U S West Communication, Inc's UM 351 Cost Study Summaries, Before the Public Utility Commission of Oregon, June, 1996.

Docket Nos. 95-2206-01, 94-2202-01, 94-99-01, Investigation into Collocation and Expanded Interconnection, and Authority to Provide Intrastate Telecommunications Services for Phoenix Finberlink and Electric Lightwave, Inc., Before the Public Service of Utah, April, 1996.

Case No. USW-S-95, In the Matter of Improving or Replacing U S West Communications' Revenue Sharing Plan for Southern Idaho, April, 1996.

Docket No. PSC-96-32, Adoption of New Rules Relating to the Development of Total Service Long Run Incremental Cost Studies, Before the Wyoming Public Service Commission, January, 1996.

Docket Nos. 95-2206-01, 94-2202-01, 94-99-01, Investigation into Collocation and Expanded Interconnection, and Authority to Provide Intrastate Telecommunications Services for Phoenix Finberlink and Electric Lightwave, Inc., Before the Public Service of Utah, December, 1995.  
Case No. USW-S-95-1, In the Matter of Reviewing U S West Communications' Southern Idaho Revenue Sharing Plan for the Completed 1994 Sharing Year, November, 1995.

Docket No. 70000-TR-95-238, In the Matter of the Rate/Price Plan Application of U S West Communications, Inc., September, 1995

Docket No. UM 351, Phase II, The Cost of Providing Telecommunications Services, Before the Oregon Public Utilities Commission, August, 1995.

Case No. USW-S-94-4, Sale of Exchanges in Idaho, Before the Idaho Public Utilities Commission, June, 1995.

Case No. USW-S-94-3, In the Matter of the Evaluation of U S West Communications' Revenue Sharing Plan for the First Five Years of Operation, August, 1994.

Case No. 93-487-TP-ALT, Application of Ohio Bell Telephone Company for Approval of an Alternative Form of Regulation, Before the Public Utilities Commission of Ohio, May, 1994.

Case No. 93-230-TP-ALT, Application of Western Reserve Telephone Company for Approval of an Alternative Form of Regulation, Before the Public Utilities Commission of Ohio, December 1993.

Case No. 93-432-TP-ALT, Application of Cincinnati Bell Telephone Company for Approval of an Alternative Form of Regulation, Before the Public Utilities Commission of Ohio, March, 1994.

Cause No. 39705, Petition of Indiana Bell Telephone Company to Utilize Alternative Regulatory Procedures, Before the Indiana Utility Regulatory Commission, January, 1994.

Docket No. 90A-665T, Application of US West for Approval of a Five Year Plan for Rate and Service Regulation, Before the Colorado Public Utilities Commission, September, 1991.

Docket No 92I-039T, Costing and Pricing for Telephone Services of US West, Before the Colorado Public Utilities Commission, February, 1992.

Case No. 92-CV-30, Linda Baessler v. Morgan County Rural Electric Association and Robert D. Pflager, Before the Morgan County District Court.

Docket No. 5563, Tariff Filing of Twin State Cable TV for an Increase in Rates, Before the Vermont Public Service Board.

Docket No. 5591, Investigation into Taft Cable Partners TV Rates, Before the Vermont Public Service Board.

Docket No. 93I-199EG, Investigation of Incentive Regulation and Demand Side Management Incentives for Public Service Company of Colorado, Before the Colorado Public Utilities Commission.

Docket No. 91I-685T, Investigation of Services Offered by US West to Certain Business Users, Shared Tenant Service Providers and Payphones Concerning Mandatory Measure Service, Before the Colorado Public Utilities Commission.

Docket No. UT-910776, Petition of Digital Direct of Seattle, Inc. for Classification as a Competitive Telecommunications Company, Before the Washington Utilities and Transportation Commission.

Case No. 91-CV-2528, Jack J. Grynberg v. Rocky Mountain Natural Gas Co., et al, Before Division 4, Jefferson County District Court.

JAG #91-863, Bear Creek Development Corporation and United Cable of Colorado, Before the Judicial Arbitrator Group.

Docket No. 90A-655T, "Incentive Regulation: History, Purpose and the Development of the Colorado Incentive Regulation Plan," Before the Colorado Public Utilities Commission, September 1991.

Docket No. 90A 031T, "Market Power, Market Structure and Relaxed Regulation for U.S. West," Before the Colorado Public Utilities Commission, June, 1990.

Docket No. 89I-082T, "Analysis of IntraLATA Interexchange Telecommunications Markets in Colorado,"

Before the Colorado Public Utilities Commission, December, 1989

Case No. 6722, "Changes to Emerging Telecommunications Service Rules," Before the Colorado Public Utilities Commission, January, 1989.

Application No. 38771, "Methods and Criteria for Small Power Producer/Cogenerator Electric Supply Bidding Structure," Before the Colorado Public Utilities Commission, March, 1988.

Case No. 5323, "Structure for Flexible Regulation of Telecommunications Firms," Before the Colorado Public Utilities Commission, May, 1987.

I&S 1720, "Rate Making Cost Methodology and Competitive Issues and Measurement of Competitive Market," Before the Colorado Public Utilities Commission, December, 1986.

I&S 1700, "Concept of a Test Year, Competition and Rate of Return, Directory Publishing and Other Issues Pertaining to Mountain Bell Rate Request," Before the Colorado Public Utilities Commission, April, 1986.

Application No. 36247, "Electric Load Adjustment Clauses," Before the Colorado Public Utilities Commission.

Application No. 36247, "Economic Issues of Directory Publishing and the Contribution to Local Exchange Ratepayers," Before the Colorado Public Utilities Commission.

Case No. 6467, "Public Access Line Tariff Issues," Before the Colorado Public Utilities Commission, November, 1984.

Case No. 6386, "Telecommunications Market Structure and Carrier Reporting Requirements," Before the Colorado Public Utilities Commission, October, 1984.

I&S Docket No. 1655, Case Nos. 6360 and 6361, "Evaluation of Mountain Bell's Future Test Year, Interim Rate Request, Productivity Study and BellCorp Expenditures," Before the Colorado Public Utilities Commission, April, 1984.

Case Nos. 6223 through 6237, "Avoided Cost Methodologies for Small Power Producers and Cogeneration and Calculation of Avoided Cost Rates for Colorado-Ute Electric Association, Inc.," Before the Colorado Public Utilities Commission, July, 1983.

I&S Docket Nos. 1603 and 1604, "Avoided Cost Methodologies for Small Power Producers and Cogeneration and the Calculation of Avoided Cost Rates for Public Service Company of Colorado," Before the Colorado Public Utilities Commission.

I&S Docket No. 1575, "Surrebuttal to Mountain Bell Rebuttal Witness Alfred Kahn," Before the Colorado Public Utilities Commission, April, 1983.

I&S Docket No. 1575 Phase II, "Cost Methodologies for Rate Setting in Telecommunications and a Review of Costing Methodologies in Rate Filings by Mountain Bell," Before the Colorado Public Utilities Commission, April 1983.

I&S Docket No. 1575, "License Contract and Affiliated Interest Payments," Phase I, Before the Colorado Public Utilities Commission, September, 1982.

Application No. 34444, "Economic Issues in Public Service Company of Colorado Line Extension Policy," Before the Colorado Public Utilities Commission, August, 1982.

I&S Docket No. 1504, "The Economics of Pricing Methodology in the Provision of Enhanced 911 Telecommunications Services," Before the Colorado Public Utilities Commission, June, 1982.  
I&S Docket No. 1550, "Discrimination, Competition and Resale of Telecommunications Services," Before the Colorado Public Utilities Commission, March, 1982.

I&S Docket No. 1544, "Forecasting Methodology and the Use of a Future Test Year by Peoples Natural Gas Company," Before the Colorado Public Utilities Commission, March, 1982.

I&S docket No. 1542, "Applicability of a Future Test Year in a Natural gas Rate Case," Before the Colorado Public Utilities Commission, January 1982.

I&S Docket No. 1525, "Forecasting the Demand for Energy in Colorado and the use of a Future Test year by Public Service Company of Colorado," Before the Colorado Public Utilities Commission, May, 1981.

I&S Docket Nos. 1462-1466, "Value of Service Pricing in Telecommunications and Realignment of Rate Groups in Colorado," Before the Colorado Public Utilities Commission, March, 1981.

## **STUDIES PREPARED UNDER MY DIRECTION**

Study of Telecommunications Market Structure in Colorado, June 2006

Electric and Natural Gas Demand in Colorado; prepared biennially 1981-1991.

Colorado Forecasting and Simulation Model.

Fully Distributed Cost Model of Mountain Bell, April, 1983.

The Cost Effectiveness of Power Pooling in Colorado, July, 1985.

The Potential of Conservation as an Alternative to New Generation Plant in Colorado, July, 1985.

A Study of Intrastate Telecommunications Including the Means Available to Enhance Intrastate Telecommunications Competition, July, 1986.

Implementation of the Colorado Telecommunications of 1987: An Evaluation, June, 1988

.

Model Assumptions 800MW

| Year                               | 2010     | 2011 | 2012 | 2013 | 2014 | 2015 |
|------------------------------------|----------|------|------|------|------|------|
| MW of Wind Installed               | 100      | 100  | 100  | 100  | 200  | 200  |
| Wind Capacity Factor (1)           | 35%      |      |      |      |      |      |
| Cost of Wind per kwh (2)           | \$0.061  |      |      |      |      |      |
| Wind Integration Costs (3)         | \$0.005  |      |      |      |      |      |
| Incremental Transmission Costs (4) | \$0.0021 |      |      |      |      |      |

Natural Gas Avoided Costs

|                         |         |
|-------------------------|---------|
| Heat Rate MMBTU/kwh (5) | 0.00735 |
|-------------------------|---------|

Emissions Costs

|                         |      |
|-------------------------|------|
| Dollars per Ton CO2 (6) | \$20 |
| Tons CO2 per GWh (7)    | 411  |

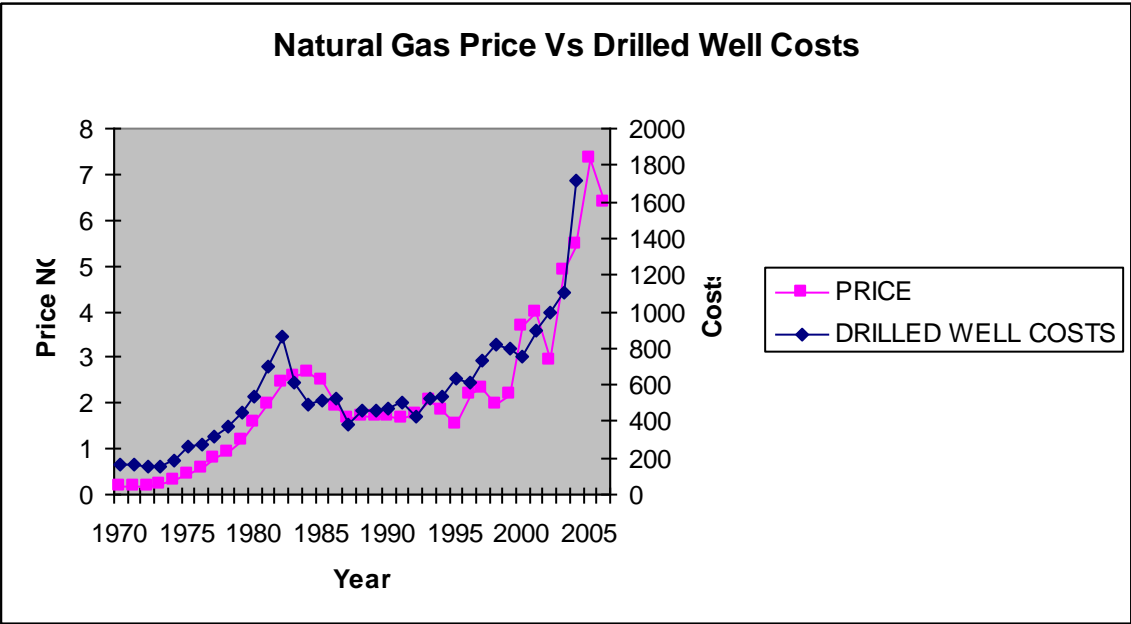
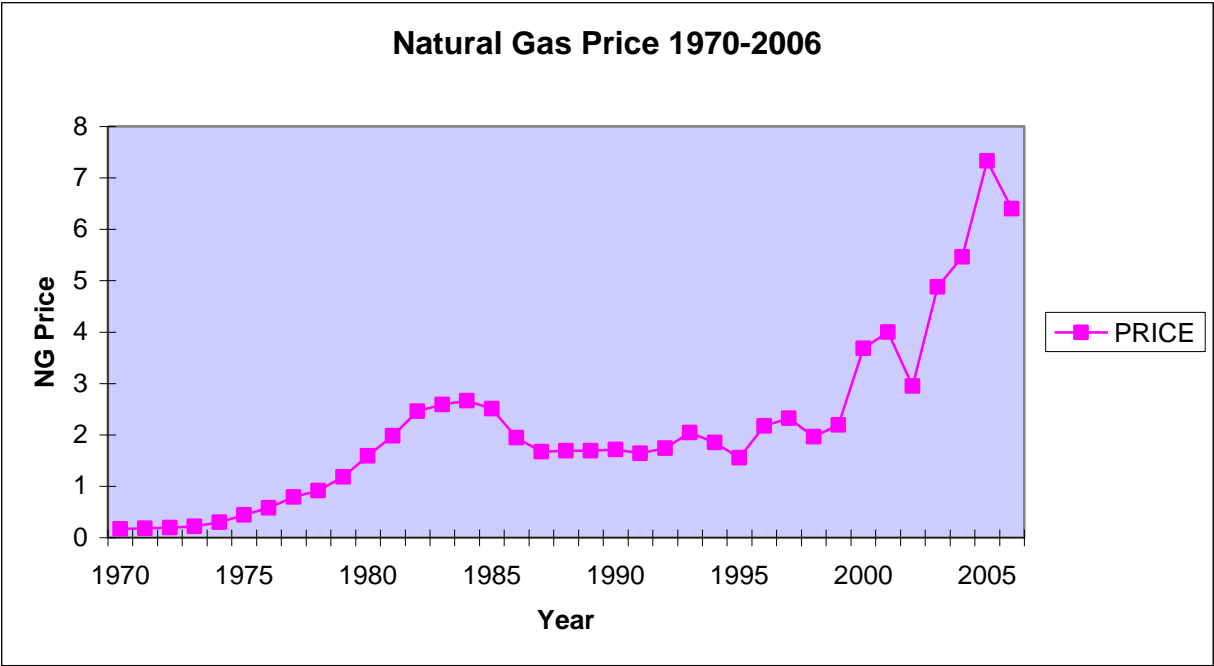
Natural Gas Combined Cycle Assumptions

|                       |       |
|-----------------------|-------|
| Required MW (8)       | 87.5  |
| Cost per KW (9)       | \$766 |
| Heat Rate (10)        | 7353  |
| Capacity Factor (11)  | 40%   |
| Discount Rate (12)    | 8%    |
| Years in Service (13) | 30    |

- (1) Based on U. S. Department of Energy, Annual Report on U. S. Wind Power Installation, Cost and Performance Trends 2006 and PSCo Application.
- (2) Based on U. S. Department of Energy, Annual Report on U. S. Wind Power Installation, Cost and Performance Trends 2006 and National Renewable Energy Laboratory cost estimates.
- (3) Based on PSCo Application estimated integration costs of \$4.77 per mwh.
- (4) Based on incremental transmission costs in Wind on Public Service Company of Colorado System: Cost Comparison to Natural Gas, August 2006, by Jane E. Pater and Ron Binz prepared for Interwest Energy Alliance.
- (5) Based on PSCo Application.
- (6) Based on PSCo Application.
- (7) Value established between estimates by the National Renewable Energy Laboratory and those presented in PSCo's application
- (8) Based on 40 percent capacity factor for CCGTs in PSCo Application
- (9) Based on PSCo Application.
- (10) Based on PSCo Application.
- (11) Based on PSCo Application.
- (12) Based on PSCo Application cost of capital of 7.88 percent.
- (13) Based on PSCo Application.







Docket No. 07A-447E

CEH Exhibit 3

Carl E. Hunt

Page 1 of 1



