PUBLIC SERVICE COMMISSION
OF WEST VIRGINIA
CHARLESTON

Case No. 07-0508-E-CN

TRANS-ALLEGHENY INTERSTATE LINE COMPANY

Application of Trans-Allegheny Interstate Line Company for a certificate of public convenience and necessity under W. Va. Code § 24-2-11a authorizing the construction and operation of the West Virginia segments of a 500 kV electric transmission line and related facilities in Monongalia, Preston, Tucker, Grant, Hardy, and Hampshire Counties, and for related relief

REBUTTAL TESTIMONY OF DR. JAY ZARNIKAU

January 4, 2008

I. INTRODUCTION

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is Jay Zarnikau. My business address is 1515 Capital of Texas Hwy, South, Suite 110, Austin, Texas, 78746.

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

A. I am the president of Frontier Associates LLC. We provide consulting assistance to energy consumers, electric and gas utilities, and government agencies on topics related to energy economics and pricing, utility cost allocation and rate design, forecasting, resource planning, energy efficiency program design and evaluation, and energy and regulatory policy. We also manage a number of energy efficiency programs, including new home construction energy efficiency programs and air conditioner replacement programs for utilities, and lighting retrofit projects for hotel chains around the country.

Q. PLEASE STATE BRIEFLY YOUR EDUCATIONAL BACKGROUND AND PROFESSIONAL QUALIFICATIONS.

A. I have a Ph.D. degree in Economics from the University of Texas. I completed undergraduate studies in Business Administration and Economics at the State University of New York and McGill University in Canada.

From 1983 through 1991, I was employed by the Public Utility Commission of Texas, where I served as the Manager of Economic Analysis from 1985 through

1988; as the Assistant Director of the Electric Division from 1987 to 1988; and as the Director of the Electric Utility Regulation from 1988 to 1991. From 1991 through 1993, I held a faculty-level research position at The University of Texas College of Engineering Center for Energy Studies. I served as a vice president at Planergy, Inc. from 1992 to 1999. Since 1999, I have been president of Frontier Associates LLC.

I have written a number of reports and journal articles on the topics of energy policy, rate design, energy efficiency, demand response, and electric utility restructuring. I currently teach graduate-level classes in statistics at the University of Texas as a part-time Visiting Professor at the LBJ School of Public Affairs and in the College of Natural Sciences.

My resume, which is attached to this rebuttal testimony as TrAILCo Rebuttal Exhibit JZ-1, describes in greater detail my educational background and prior work experience.

Q. ON WHOSE BEHALF ARE YOU APPEARING IN THIS PROCEEDING?

A. I am appearing on behalf of Trans-Allegheny Interstate Line Company ("TrAILCo").

Q. WHAT IS THE PURPOSE OF YOUR REBUTTAL TESTIMONY IN THIS PROCEEDING?

A. My rebuttal testimony explores whether the transmission facilities (i.e., the 502 Junction to Loudoun line) proposed by TrAILCo in this proceeding and similar proceedings in Virginia and Pennsylvania could be displaced if Allegheny Power were to aggressively implement demand side management ("DSM") programs. Specifically, my testimony rebuts certain statements contained in the testimony of Sierra Club witness Hale Powell, Staff of the Public Service Commission of West Virginia ("Staff") witnesses Dr. Michael Ileo and William Lewis, and pro se intervenor Thomas Hildebrand. In addition, my testimony addresses statements made at various public hearings regarding the ability to displace the proposed transmission facilities through DSM.

Q. WILL THE USE OF VARIOUS TERMS IN YOUR REBUTTAL TESTIMONY BE CONSISTENT WITH THE DEFINITIONS ASSIGNED TO THOSE TERMS IN THE TABLE OF NOMENCLATURE ATTACHED TO TRAILCO'S APPLICATION?

A. Yes. In addition, I may define other terms in my rebuttal testimony.

II. SUMMARY OF CONCLUSIONS

Q. PLEASE SUMMARIZE YOUR CONCLUSIONS.

A. I have concluded that the aggressive implementation of a comprehensive set of energy efficiency and DSM programs by Allegheny Power would not be a

reasonable substitute for the planned transmission line from the 502 Junction Substation to Loudoun County, Virginia, in light of the level of demand reduction that would be required and the timeframe in which these transmission facilities are needed.

Q. PLEASE DESCRIBE THE ORGANIZATION OF YOUR REBUTTAL TESTIMONY IN THIS PROCEEDING.

A. My testimony is organized as follows:

- Section III explores both the value and the limitations of relying upon DSM as an alternative to transmission facilities.
- Section IV demonstrates that it would not be feasible to displace the transmission facilities proposed by TrAILCo in this proceeding through an aggressive implementation of DSM programs, due to the timing and magnitude of the resource need.
- Section V comments on some specific statements contained in the testimonies of various witnesses.

III. DSM AS A RESOURCE

Q. PLEASE DEFINE THE TERM "DSM" PROGRAMS AS USED IN THIS REBUTTAL TESTIMONY.

A. DSM refers to actions taken by a utility to manage the demand for electricity. Such actions might include programs or pricing strategies designed to affect the level or temporal pattern of electricity consumption. While Mr. Hildebrand, Staff witness Dr. Ileo, and I use the phrase DSM, Mr. Powell uses the phrase demand side resources or "DSR" in his testimony. For the most part, DSM and DSR are synonymous, but Mr. Powell's inclusion of programs sponsored by the U.S. Department of Energy, the U.S. Environmental Protection Agency, and independent system operators might make his definition of DSR broader than DSM as some of the other witnesses in this proceeding are using the phrase.

DSM encompasses the concepts of "energy efficiency" and "demand response." "Energy efficiency" may be thought of as improvements in the technical efficiency of end use devices or systems, while "demand response" efforts are designed to foster the shifting or cycling of loads.

Q. DO YOU AGREE WITH THE GENERAL CONTENTION THAT THERE ARE OPPORTUNITIES TO REDUCE DEMAND IN THE AREAS WHICH WILL BE SERVED BY THE TRANSMISSION FACILITIES PROPOSED BY TRAILCO IN THIS PROCEEDING, AS SUGGESTED BY WITNESSES POWELL, ILEO, AND HILDEBRAND?

A. Yes. I have no doubt that there are numerous opportunities for demand reduction and energy conservation in the areas to be served by these facilities and in the PJM

market in general. However, as discussed later in my testimony, I am concerned that some information provided by these witnesses may overstate the potential for DSM, or that they may fail to fully appreciate the difficulties in establishing significant and effective programs.

Q. WITNESSES POWELL, ILEO, AND HILDEBRAND ALL SUGGEST THAT DSM CAN BE USED TO COST-EFFECTIVELY DISPLACE THE NEED FOR TRANSMISSION FACILITIES. DO YOU AGREE WITH THIS CONTENTION?

A. I agree that, in many situations, DSM can play a valuable role in reducing the rate of growth in the demand for electricity, thus sometimes potentially delaying or deferring the need for additional transmission infrastructure. This is not one of those times, however. Moreover, there are a number of limitations to the use of DSM as an alternative to transmission investments that also must be considered.

Q. PLEASE IDENTIFY THOSE LIMITATIONS.

A. These limitations include:

- The "lead time" required to plan and "build up" a DSM program.
- The uncertainties inherent in relying upon customer behavior and customer participation in voluntary programs to meet a resource need.

Q. PLEASE COMMENT ON THE LEAD TIME NECESSARY TO PLAN, IMPLEMENT, AND BUILD UP A DSM PROGRAM INTO A SIGNIFICANT SYSTEM RESOURCE.

A. Just as transmission investments involve some planning, permitting, and construction time, DSM programs require lead time for market research, planning, regulatory approval, and start-up activities. One significant difference between the two resources is that the full capacity of a transmission line or substation may be available once the project is complete. DSM programs, on the other hand, normally require some "ramp up" time and some time for the cumulative effects of the program to build up into a significant system resource. Some programs can be implemented fairly quickly. But some programs take longer than others to achieve significant impacts. Consequently, it can take a number of years for a comprehensive set of programs to contribute a significant level of demand reduction.

The following steps would normally be required:

- Market research to identify specific energy efficiency opportunities.
- Cost-benefit analyses, to determine which energy efficiency opportunities might be exploited through a utility program in a cost-effective manner (e.g., at a cost lower than comparable supply-side investments).
- Review of program design and program delivery options.

- Program design to establish incentive levels or promotional mechanisms, targeted levels of participation and impacts, marketing channels, and evaluation plans. This may involve further cost-benefit analyses.
- Staffing and program management, including the establishment of databases, contracts, and internal procedures.
- Program rollout, including marketing and outreach.

Of course, these steps are in addition to any regulatory review processes, such as approval by this Commission, which is uncertain as to process, timing and outcome.

As an example of the time needed, consider the fact that a demonstration project conducted in 1992 and 1993 within the Pacific Gas & Electric Company service area in California assessing whether DSM programs could displace the need for transmission and distribution upgrades in an area found that, even for an aggressive campaign, "it requires at least 3 to 5 years to plan and implement the initial stages of a fully integrated plan for a single distribution planning area. . . it takes at least 3 years to mount a highly concentrated DSM effort in a single area."[1]

[1] Targeting DSM for Transmission and Distribution Benefits: A Case Study of PG&E's Delta District, R. Orans, et. al., Energy and Environmental Economics with Pacific Gas & Electric for the Electric Power Research Institute, EPRI TR-100487, May, 1992, p. ES-5.

Page 15 of Mr. Powell's testimony makes this point. While his table reports some very large hypothetical impacts from DSM programs (based on studies, rather than actual experiences), it also notes that it would take from 8 to 20 years to achieve demand reduction of this magnitude.

It is my understanding that the regulatory timetable for approving DSM programs proposed by utilities in West Virginia is open-ended, and that obtaining the necessary approvals through either a rulemaking or a utility-specific regulatory proceeding could easily take over one year. As noted in Mr. Powell's testimony on p. 24, lines 7 through 29, there is a very long list of barriers that must be eliminated by regulatory and other policymakers before DSM programs can be fully utilized in West Virginia and some neighboring states. Section 7.0 of Dr. Ileo's testimony similarly presents a long list of barriers. This further implies that it would be difficult, if not impossible, to achieve significant demand reduction through DSM programs by 2011.

Q. PLEASE COMMENT ON THE UNCERTAINTIES INHERENT IN RELYING UPON CUSTOMER BEHAVIOR AND CUSTOMER PARTICIPATION IN VOLUNTARY PROGRAMS TO MEET A RESOURCE NEED.

A. Because DSM programs tend to rely upon voluntary participation by energy consumers, there is considerable uncertainty inherent in estimating or projecting future program impacts. Some of this uncertainty can be minimized through

careful market research and planning. However, the performance of a demand reduction program that relies upon consumer behavior is likely to remain much more uncertain than the performance of transmission infrastructure.

Q. WHAT HAS BEEN THE TRACK RECORD OF OTHER UTILITIES THAT HAVE ATTEMPTED TO RELY UPON DSM PROGRAMS AS A MEANS OF DISPLACING THE NEED FOR TRANSMISSION INVESTMENTS?

A. The record has been mixed at best. The Pacific Gas and Electric Company's "Delta project" cited earlier produced 2.3 MW of demand reduction and was initially considered successful in demonstrating the benefits of using DSM to defer transmission and distribution system investments. But while it was originally hoped that the targeted DSM would defer a substation by about 8 years,[2] it only succeeded in deferring the substation project by about 2 years.[3] Other programs have been implemented in Connecticut and Long Island with some success but at great cost. In 2006, two efforts in Texas met with little success. American Electric Power sought to reduce demand in a transmission-constrained area of the Rio Grande Valley by 5 MW, but only achieved a 1 MW demand reduction

[2] See Targeting DSM for Transmission and Distribution Benefits: A Case Study of PG&E's Delta District, R. Orans, et. al., Energy and Environmental Economics with Pacific Gas & Electric for the Electric Power Research Institute, EPRI TR-100487, May, 1992, Figures ES-1 and ES-2.

[3] Martin Kushler, Dan York, and Edward Vine, "Energy-Efficiency Measures Alleviate T&D Constraints," April 1, 2005.

through a load management program (all from a single customer). CenterPoint Energy sought demand reduction in a transmission-constrained portion of its network in Houston, but failed to sign up any customers to its targeted load management program.

Commenting on the potential for DSM to displace or defer transmission and distribution system investment in PJM, recent analysis by the Brattle Group, included as Attachment 4 to Mr. Powell's testimony, is appropriately cautious: "In some circumstances, reducing peak loads could enable utilities to delay upgrading distribution transformers and other T&D equipment that is stressed by peak loads." (From p. 28 of that report.)

Q. ARE THERE OTHER PROBLEMS INHERENT IN ANY ATTEMPT TO USE DSM TO DISPLACE THE NEED FOR THE TRANSMISSION FACILITIES PROPOSED BY TRAILCO HERE?

A. Yes. The demand for electricity outside of areas served by Allegheny Power is partially responsible for the need for the proposed transmission facilities. Consequently, the growth in demand and DSM efforts of a number of utilities has an effect on the need for the proposed line. Yet, TrAILCo has little or no influence on the DSM efforts of those neighboring utilities.

Q. WOULD INITIATIVES TO LAUNCH DSM PROGRAMS BY OTHER UTILITIES THAT MIGHT BENEFIT FROM THIS LINE FACE CHALLENGES SIMILAR TO THOSE THAT YOU HAVE REPORTED HERE?

A. Yes. New DSM programs undertaken by other utilities would require planning and a ramp-up period. For many utilities, regulatory approvals are required before a utility can undertake a new program.

Q. CAN TRAILCO AFFECT THE GOVERNMENT-SPONSORED PROGRAMS MENTIONED IN MR. POWELL'S TESTIMONY AS A POTENTIAL SOURCE OF DEMAND SIDE RESOURCES OR DSR?

A. I suspect that TrAILCo's influence over programs offered by the U.S. Department of Energy, the U.S. Environmental Protection Agency, and other government agencies is quite limited.

IV. DEMAND SIDE MANAGEMENT INITIATIVES WITHIN THE ALLEGHENY POWER SERVICE AREA CANNOT AFFECT THE NEED FOR THE 502 JUNCTION TO LOUDOUN LINE

Q. BASED ON YOUR REVIEW OF THE TESTIMONY OF WITNESSES POWELL, HILDEBRAND, LEWIS, AND ILEO, DO ANY OF THESE WITNESSES CONCLUDE THAT DSM CAN FULLY DISPLACE THE NEED

FOR THE TRANSMISSION FACILITIES PROPOSED BY TRAILCO IN THIS PROCEEDING?

A. No. Witnesses Powell and Hildebrand highlight the important role that DSM can play and argue for greater recognition of DSM opportunities in the planning process at either PJM or Allegheny Power. However, neither of these witnesses has even attempted to demonstrate that DSM could displace the need for TrAIL. In fact, Mr. Powell describes the numerous regulatory challenges and other problems that would be faced if DSM were to be pursued as an alternative to TrAIL, given present regulatory practices.

After modeling the impacts of some very large hypothetical demand reductions from hypothetical DSM efforts in targeted areas, Staff witness Lewis sees some opportunity to defer (but not displace) the proposed transmission facilities. However, Mr. Lewis is using an unrealistic estimate of the level of demand reduction achievable from DSM programs, as I explain below.

Dr. Ileo concludes that "DSM program impacts conceivably might eliminate the need for TrAIL in 2011." Yet, he characterizes his analysis as "highly limited and hypothetical." Indeed, I believe that his estimate of the amount of demand reduction that could be achieved through DSM programs by 2011 is greatly overstated, as discussed below.

Q. IS IT POSSIBLE TO DISPLACE THE NEED FOR THE PROPOSED LINE FROM THE 502 JUNCTION SUBSTATION TO THE LOUDON SUBSTATION IN LOUDOUN COUNTY, VIRGINIA?

A. No. According to the rebuttal testimony of TrAILCo witness Hozempa, a peak demand reduction of 36%, or 829.4 MW, in the Allegheny Power Transmission Zone would be required by 2011 to eliminate the need for this line. According to Mr. Hozempa's testimony, this is approximately one-third of the total Potomac Edison company load, plus some West Penn Power Company load in Pennsylvania.

Q. YOU CONTEND THAT THE DEMAND-SIDE MANAGEMENT SCENARIOS POSITED BY MR. POWELL AND DR. ILEO DO NOT PROVIDE ADEQUATE SAVINGS IN THE "ALLEGHENY ZONE" IN ORDER TO REPLACE THE NEED FOR TRAIL. WHAT SAVINGS COULD BE EXPECTED IN THIS ZONE UNDER THESE SCENARIOS?

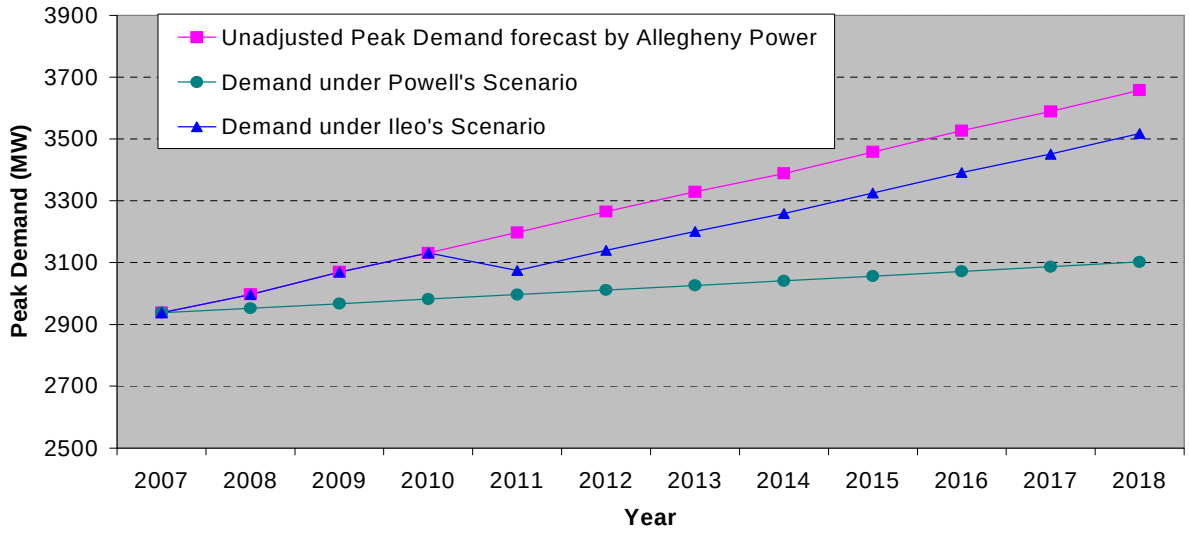
A. Mr. Powell mentions various estimates of the peak demand reductions that could hypothetically be achieved in various states. He claims that based on analysis sponsored by the State of Virginia, West Virginia and the PJM region could hypothetically achieve demand savings of 14% in ten years. He also cites a study by the ACEEE of the savings potential in the PJM region which claims that 15% reductions could be achieved by 2022. These estimates strike me as over-

optimistic, for the reasons explained in my testimony. Nonetheless, for illustrative purposes, I have plotted the peak demand in The Potomac Edison Company's service area under the more aggressive of Mr. Powell's estimates, a 14% reduction in ten years, in Figure 1, using the forecasted winter peak demand supplied to me by witness Hozempa. Also solely for illustrative purposes, I have calculated the demand under this scenario by reducing the compound annual growth rate of the projected demand by the appropriate constant amount each year, so that in the tenth year, the demand is 14% below what it would have been in the absence of DSM (Powell's scenario). In reality, the reductions due to the DSM program would vary from year to year, with smaller results (if any) likely in the first few years. This scenario results in a reduction in peak demand for the Potomac Edison service area of 201 MW in 2011 (3,197 MW minus 2,996 MW).

I have also plotted in Figure 1 the demand for this area under the scenario suggested by Dr. Ileo, which as I understand it, is a cumulative reduction in the peak demand in 2011 and every year thereafter equivalent to 4% of the net demand for the given year (Ileo's scenario). This scenario results in a peak demand reduction of 123 MW in 2011 (3,197 MW minus 3,074 MW). These scenarios produce savings due to DSM that are only 24% and 15% of the 829.4 MW of demand reduction needed to displace the need for the line as calculated by witness Hozempa. Clearly, it would be nearly impossible for DSM programs

undertaken by Allegheny Power to achieve a level of demand reduction anywhere near the level of demand reduction that Mr. Hozempa testifies would be required to displace these transmission facilities.

Figure 1:
Peak Demand for Potomac Edison Company's Service Area under Two Demand Side Management Scenarios



V. FURTHER COMMENTS ON THE TESTIMONY OF ILEO, LEWIS, POWELL AND HILDEBRAND

Q. DR. ILEO CONTENDS THAT PJM CAN ACHIEVE HIS AGGRESSIVE DSM SCENARIO (5,686 MW OF DEMAND REDUCTION BY 2011 IN PJM) AT A COST OF $100 MILLION OR LESS (P. 35, LINES 17-18). DO YOU AGREE WITH THIS ASSERTION?

A. No. That does not seem plausible. I agree with Dr. Ileo that "a considerable research effort would be necessary to estimate the cost of a more expansive DSM

program by PJM" (Ileo at 34) and I recognize that he is just offering this as a very crude estimate. Yet, this cost estimate seems very low to me based on my experience in planning, implementing, and evaluating DSM programs. As an example, in Texas about $75 million is spent by the investor-owned utilities each year to achieve 150 MW to 200 MW of incremental demand reduction. A summary of the program impacts prepared by my staff can be found at: http://www.texasefficiency.com/news.shtml. Thus, in Texas, we are (at best) paying about $375,000 for each MW of demand reduction. This suggest that (at best) 5,868 MW of demand reduction in PJM through implementing a set of programs similar to those implemented in Texas would cost over $2.2 billion (i.e., $375,000 per MW times 5,868 MW). Realistically, the cost would be much greater, since the marginal cost of achieving greater demand reduction will increase as the goal for demand reduction increases. While the DSM opportunities and the cost of demand reduction will likely be different in PJM than in Texas, I cannot image that such a level of demand reduction in PJM could be achieved 22 times cheaper in PJM than in Texas.

It is unclear whether Dr. Ileo is presenting this $100 million estimate as an "annualized" number. If this is intended as an annualized number and if we assume that the energy efficiency measures implemented through the Texas

programs have an average life of ten years, then Dr. Ileo's $100 million figure would still be at least two times too high.

Q. DOES MR. LEWIS' CONTENTION THAT ONLY "ACTIVE" DSM IS USEFUL AS A POSSIBLE MEANS OF DISPLACING TRANSMISSION INVESTMENTS IMPLY THAT SOME OF THE DSM MEASURES SUGGESTED BY OTHER WITNESSES HAVE LIMITED VALUE?

A. Yes. If only active DSM measures such as interruptible load programs, direct load control, and time-differentiated pricing are pursued, then the universe of DSM measures available to Allegheny Power would be extremely limited. Many of the candidate DSM programs identified by Dr. Ileo, Mr. Powell, and Mr. Hildebrand would apparently not be useful. This would make it even more difficult to displace or defer the proposed transmission line through DSM programs.

Q. DOES THIS CONCLUDE YOUR REBUTTAL TESTIMONY?

A. Yes. However, I reserve the right to file such additional testimony as may be necessary or appropriate.

Exhibit JZ-1: Résumé

Jay Zarnikau, PhD
President, Frontier Associates LLC
1515 S. Capital of Texas Hwy
Suite 110
Austin, TX 78746
Phone: (512) 372-8778
Fax: (512) 372-8932
email: jayz@frontierassoc.com

PROFESSIONAL EXPERIENCE

1999- President, Frontier Associates, Austin, Texas

Responsible for providing assistance in the design and implementation of energy efficiency programs, utility resource planning, electricity pricing, rate analysis/design, program evaluation, demand forecasting, and energy policy. Also assists industrial and commercial energy consumers in rate negotiations and energy procurement activities.

1992-1999 Vice President, Planergy, Austin, Texas

Responsible for providing assistance in the design and implementation of energy efficiency programs, and providing consulting assistance in the areas of utility resource planning, electricity pricing, program evaluation, demand forecasting, and energy policy.

1991-1993 Manager of Energy Strategies Research Program, The University of Texas at Austin Center for Energy Studies, Austin, Texas

Held faculty-level research position. Served on dissertation and thesis committees. Supervised independent study projects.

Responsible for the oversight of research projects in the areas of utility resource planning, regulation, electricity pricing, and policy analysis.

Coordinated a study of the technical and achievable potential for energy efficiency savings in Texas.

Program Manager for EPRI-sponsored effort to develop a new integrated resource planning framework and model.

1983-1991 Director of Electric Utility Regulation (from 1988 to 1991), Economist (1983 to 1988) Public Utility Commission of Texas, Austin, Texas

Supervised a professional staff of over fifty accountants, economists, and engineers responsible for analyzing regulatory and technical issues and providing recommendations to the Commission. Prepared and defended testimony in over twenty proceedings on topics including: load forecasting, rate design, cogeneration, system planning, demand-side management program impacts, billing determinants, wheeling, and computer modeling.

1982-1983 Research Associate, Bureau of Business Research, University of Texas at Austin, Austin, Texas

Assisted in maintenance of statewide economic-demographic forecasting model, prepared projections for state legislature and state agencies, and conducted studies to determine the value of various mineral resources in Texas.

EDUCATION

Ph.D. (1990) and M.A. (1983) in Economics, University of Texas at Austin

Fields completed in Econometrics, Resource Economics, and Micro Modeling

B.S. in Business Administration and Economics, State University of New York, Oswego, New York, May 1981

McGill University, Montreal, Quebec, 1979-1980

PUBLICATIONS AND RESEARCH PAPERS

Refereed Journals:

"Aggregate Consumer Response to Wholesale Prices in the Restructured Texas Electricity Market," forthcoming in Energy Economics. 2007. With Ian Hallett.

"Industrial Energy Consumer Response to Wholesale Prices in the Restructured Texas Electricity Market," with Greg Landreth, Ian Hallett, and Subal Kumbhakar. Energy -- the International Journal. 2007.

"Trends in Prices to Commercial Energy Consumers in the Competitive Texas Electricity Market," Energy Policy. 2007. With Marilyn Fox and Paul Smolen.

"Testing Functional Forms in Energy Modeling: An Application of the Bayesian Approach," Energy Economics, 2006. With Ni Xiao and Paul Damien.

"Consumer Demand for 'Green Power' and Energy Efficiency," Energy Policy, 2003.

"Functional Forms in Energy Demand Modeling," Energy Economics, 2004.

"When Different Types of Energy Resources are Aggregated for Use in Econometric Studies, Does the Aggregation Approach Matter?," Energy Economics, 1999.

"Will Tomorrow's Energy Efficiency Indices Prove Useful in Economic Studies?," The Energy Journal, 1999.

"A Re-examination of the Causal Relationship between Energy Consumption and GDP," Journal of Energy and Development, 1996.

"Can Different Energy Resources be Added or Compared?," Energy - The International Journal, 1995, Vol. 21, No. 6; with Philip Schmidt and Sid Guermouche.

"Advanced Pricing in Electrical Systems," IEEE Trans. on Power Systems, 1995; with Martin Baughman and Shams Siddiqi.

"Integrating Transmission into IRP," IEEE Trans. on Power Systems, 1995; with Martin Baughman and Shams Siddiqi.

"Customer Responsiveness to Real-Time Pricing of Electricity," The Energy Journal, December 1990, Vol. 11, No. 4.

"Spot Market Pricing of Electricity," Forum for Applied Research and Public Policy, Winter 1990, Vol. 5, No. 4; with Martin Baughman and George Mentrup.

Non-Refereed Journals, Proceedings, and Research Reports:

"The Quest for Competitive Electricity Markets," forthcoming in LBJ Journal of Public Affairs.

"Fostering Demand Response in Restructured Markets," forthcoming in Competitive Electricity Markets: Design, Implementation and Performance, edited by Fereidoon P. Sioshansi.

"Will the Texas Market Succeed, Where So Many Others Have Now Failed?," With Parviz Adib. Proceedings of the US Energy Association Conference. Houston. August 2007.

"Has Texas Achieved Too Much Demand Response?" 17th National Energy Services Conference Proceedings. January 2007.

"A Look Inside the Most Successful Restructured Electricity Market in North America: Texas," Proceedings of IAEE Conference. Potsdam, Germany. May 2006.

"Texas: The Most Robust Restructured Electricity Market in North America," in Electricity Market Reform: An International Perspective, Ed. Pereidoon Sioshansi and Wolfgang Pfaffenberger, Elsevier, 2007.

"Changing Installation Practices of A/C Installers – Three Years of Results, " ACEEE Summer Study on Energy Efficiency in Building, 2006. With Mike Stockard and Phil Audet.

"Using Demand Response Programs to Provide Operating Reserves in Wholesale Power Markets: A Case Study of the ERCOT Market," US Energy Association's Dialogue, 2006.

"Do Industrial Energy Consumers Respond to Price Signals in the Restructured Texas Electricity Market?," 15th National Energy Services Conference Proceedings, December 2004.

"Will Tomorrow's Restructured Markets Provide Opportunities to Better Determine the Value Of Demand-Side Resources?" 14th National Energy Services Conference Proceedings, December 2003.

"Energy Efficient Windows in the Southern Residential Windows Market," ACEEE Summer Study Proceedings, with Alison Tribble, Kate Offringa, Bill Prindle, Dariush Arasteh, Arlene Stewart, and Ken Nittler. 2002.

"The Window Market in Texas: Opportunities for Energy Savings and Demand Reduction," Symposium on Improving Building Systems in Hot & Humid Climates, with Lauren Campbell, May 2002.

"The Treatment of Demand-Side Resources in ERCOT's Restructured Markets," 12th National Energy Services Conference Proceedings, December 2001.

“Electricity Resource Planning in Korea,” Discussion Paper, with Y.H. Kwun, 1999.

“Agriculture: An Often-Overlooked Opportunity for Energy Conservation,” Strategic Planning for Energy and the Environment, with Alex Lee, 1997.

“Energy Efficiency Opportunities in the Industrial Sector,” Energy Engineering, Vol. 93, No. 3, 1996; with Alex Lee.

"Taking Advantage of Real-Time Pricing Programs to Reduce Energy Costs in Manufacturing," ACEEE Summer Study on Energy Efficiency in Industry Proceedings, August 1997.

“Should Your Facility be Served Under a Real-Time Pricing Tariff?,” Energy Buyer’s Guide, December 1996.

"Opportunities for Energy Efficiency in the Texas Industrial Sector," ACEEE Summer Study on Energy Efficiency in Industry Proceedings, August 1995; contributor.

“Measuring Negawatts,” presentation to the Institute for Statistics and Decision Sciences, Duke University, 1994.

"Integrated Resource Planning in the United States," Proceedings of World Energy Council, Neptune, Romania, June 1994.

"Design and Implementation of a Demand Cooperative," Conference Proceedings: Demand-Side Management Opportunities and Perspectives in the Asia-Pacific Region, International Energy Agency, Seoul, November 1993.

"Real-Time Pricing of Electricity: An Assessment," in Proceedings of the Eleventh Annual Industrial Energy Technology Conference, Houston, September 1989; with Martin Baughman.

Opportunities for Energy Efficiency in the Texas Industrial Sector, for the Sustainable Energy Development Council, 1995; contributor and project leader.

Neoelectrification of Industry in the Information Age, for the Edison Electric Institute, 1994; with Philip Schmidt, Frederick T. Sparrow, and John Vanston.

Advanced Pricing in Electrical Systems, CES Discussion Paper, October, 1992; with Martin Baughman and Shams Siddiqi.

Comprehensive Electrical Systems Planning, Center for Energy Studies for the Electric Power Research Institute, 1994; with Martin Baughman and Shams Siddiqi.

Opportunities for Energy Efficiency in Texas, Center for Energy Studies, May 1992; with Bruce Hunn and other contributors.

OTHER ACTIVITIES

Adjunct Lecturer and Visiting Professor, University of Texas LBJ School of Public Affairs. Taught graduate-level statistics classes during six of last nine semesters.

ERCOT Working Group on Demand Side Resources, Founder and Co-Chair (2001)

Board Member and Vice President for Publications, Association of Energy Services Professionals

Retail Energy Aggregators of Texas, Director, 2001-2003

State of Texas Energy Policy Partnership, Member, 1992

National Association of Regulatory Utility Commissioners Staff Subcommittee on Wheeling and Transmission, Member, 1990

Member of American Economic Association and International Association for Energy Economics (Vice President of local chapter).

Reviewer for International Energy Review, ACEEE Summer Study, Power Engineering Society, IEEE Transactions on Power Systems, Energy Economics, Energy Policy, and The Energy Journal

TESTIMONY

Public Utility Commission of Texas (PUCT) Docket No. 334126: Constellation NewEnergy Inc.'s Appeal and Complaint of ERCOT Decision to Approve PRR 676 and PRR 674 and Request for Expedited Treatment. Supported appeal to remove certain wholesale market penalties. Testimony sponsored by Chaparral Steel.

PUCT Docket No. 31540: Proceeding to Consider Protocols to Implement a Nodal Market in the Electric Reliability Council of Texas Pursuant to PUC Subst. R. 25.501. Testimony before the Public Utility Commission of Texas (PUCT) on behalf of Nucor Steel and Chaparral Steel on demand side issues.

Public Service Commission of South Carolina, Docket No. 2005-1-E: Progress Energy Carolinas, Inc. Annual Review of Base Rates for Fuel Costs. Reviewed the utility's fuel costs and rates on behalf of a large industrial customer of the utility.

Railroad Commission of Texas, Docket No. 9400: Application of TXU Gas Company for a Rate Increase. Provided cost allocation and rate design testimony on behalf of a group of cities. Also provided testimony in a district court to support a Writ of Mandamous.

U.S. Bankruptcy Court, Southern District, In re. Texas Commercial Energy, LLC, Case No. 03-20366-C-11. Testified in support of a claim.

Public Utility Commission of Texas (PUCT) Docket No. 23950: Petition of Reliant Energy to Establish Price to Beat Fuel Factor. Presented (on the utility's behalf) a forecast of the Company's future sales of electricity.

PUCT Docket No. 22537: *Application of Reliant Energy HL&P to Implement Wholesale Power Service – General Land Office Rate Schedule*. Testified in support of tariff approval.

PUCT Docket No. 22355: Application of Reliant Energy HL&P for Approval of Unbundled Cost of Service Rate. Examined competitive opportunities that might be available to commercial and residential customers under various parties' rate design proposals.

PUCT Docket No. 22349: Application of Texas-New Mexico Power Company for Approval of Unbundled Cost of Service Rate. Requested (on behalf of the utility) funding for energy efficiency programs and system benefit fund programs.

PUCT Docket No. 21527: Application of TXU Electric Company for Financing Order to Securitize Regulatory Assets. Evaluated application on behalf of Nucor Steel.

PUCT Docket No. 17942: Application for Approval of Time-of-Use Rate Options for TU Electric Company. Analyzed utility proposal on behalf of Nucor Steel Company.

PUCT SOAH Docket No. 473-96-0333: Application of TU Electric Company for Real-Time Pricing Proposal in Compliance with the Commission's Order in Docket No. 14570. Analyzed the utility's filing on behalf of Nucor Steel Company.

PUCT Docket No. 9491: Texas-New Mexico Power Company rate case. Described applicable prudence standards and explored purchased power, cogeneration, and conservation as alternatives to the completion of the TNP One power plant project. Analyzed the utility's filing on behalf of PUCT Staff.

PUCT Docket No. 6992 Remand: Texas-New Mexico Power Company power plant certification case. Projected the costs of standby, wheeling, purchased power and cogeneration over a forty-year horizon, and explored purchased power, cogeneration, and conservation as alternatives to the completion of the TNP One power plant project. Analyzed the utility's filing on behalf of PUCT Staff.

PUCT Docket No. 9300: TU Electric rate case. Recommended changes to proposed tariffs for interruptible service and explored other rate design and system planning issues. Analyzed the utility's filing on behalf of PUCT Staff.

PUCT Docket No. 8425: Houston Lighting and Power Company rate case. Analyzed proposed tariffs for interruptible service, standby service, economic development rates and wheeling services, and recommended alternative rates and calculation methodologies. Analyzed the utility's filing on behalf of PUCT Staff.

PUCT Docket No. 8422: Rita Blanca Cooperative tariff application. Proposed some modifications to the design of a proposed economic development tariff. Analyzed the utility's filing on behalf of PUCT Staff.

PUCT Docket No. 8363: El Paso Electric Company rate case. Provided recommendations regarding future generation mix and total fuels expenses. Analyzed the utility's filing on behalf of PUCT Staff.

PUCT Docket No. 7460: El Paso Electric Company rate case. Reviewed the demand forecasts upon which the utility relied in its decision to participate in the Palo Verde nuclear project. Analyzed the utility's filing on behalf of PUCT Staff.

PUCT Docket No. 7195/6755: Gulf States Utilities Company rate case. Reviewed the demand forecasts upon which the utility relied in it decision to initiate the River Bend nuclear project. Analyzed the utility's filing on behalf of PUCT Staff.

PUCT Docket No. 6992: Texas-New Mexico Power Company power plant certification case. Projected the availability of purchased power and confirmed its viability as an alternative to the proposed TNP One power plant. Analyzed the utility's filing on behalf of PUCT Staff.

PUCT Docket No. 6184: Economic Viability for South Texas Unit 2. Analyzed the capabilities of various resource planning models to assist in selecting an appropriate means of determining the reasonableness of completing a nuclear power plant construction project. Analyzed the utility's filing on behalf of PUCT Staff.

PUCT Docket No. 8191: Cherokee County Electric Cooperative rate case. Reviewed adjustments to test-year sales, demand, and numbers of customers data. Analyzed the utility's filing on behalf of PUCT Staff.

PUCT Docket No. 6375: Central Power and Light Company rate case. Reviewed adjustments to test-year sales, demand, and numbers of customers data. Critiqued the utility's long-term load forecast. Analyzed the utility's filing on behalf of PUCT Staff.

PUCT Docket No. 6105: Central Power and Light Company Avoided Cost calculation. Recommended rejection of the utility's long-term load forecast for the purpose of calculating long-run avoided costs. Analyzed the utility's filing on behalf of PUCT Staff.

PUCT Docket No. 6064: Houston Lighting and Power Company Avoided Cost calculation. Reviewed the utility's demand projections. Analyzed the utility's filing on behalf of PUCT Staff.

PUCT Docket No. 5994: Inquiry into the rates paid by Houston Lighting and Power Company to Qualifying Facilities. Projected future demand for electricity on the utility system and the need for firm cogeneration capacity. Analyzed the utility's filing on behalf of PUCT Staff.

PUCT Docket No. 8015: Amendment to TU Electric's certificate for the Comanche Peak nuclear plant. Reviewed the utility's future demand and capacity needs. Analyzed the utility's filing on behalf of PUCT Staff.

PUCT Docket No. 6526: TU Electric Company power plant certificate case. Reviewed the utility's demand projections. Analyzed the utility's filing on behalf of PUCT Staff.

PUCT Docket No. 5568: Texas-New Mexico Power Company rate case. Reviewed adjustments to test-year sales, demand, and number of customers data, and miscellaneous operations and maintenance expenses. Analyzed the utility's filing on behalf of PUCT Staff.