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1 DIRECT TESTIMONY OF WILLIAM J. MURPHY ON BEHALF OF THE ARIZONA  
2 COGENERATION ASSOCIATION.  
3 (DOCKET No. E-01345A-03-0437)

Arizona Corporation Commission  
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AZ CORP COMMISSION  
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7 I. INTRODUCTION AND SUMMARY

9 Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS

10 A. My name is William J Murphy, and my business address is 2422 E. Palo Verde Drive,  
11 Phoenix, AZ 85016.

14 Q. BY WHO ARE YOU EMPLOYED AND WHO DO YOU REPRESENT IN YOUR  
15 TESTIMONY?

16 A. I'm with Murphy Consulting and am working on behalf of the Arizona Cogeneration  
17 Assn, (AzCA), DBA Distributed Energy Association of Arizona.

19 Q. WOULD YOU PROVIDE SOME INFORMATION ON THE AzCA AND  
20 DESCRIBE THEIR INTEREST IN THIS PROCEEDING?

21 A. The AzCA is a nonprofit coalition of interested parties organized for the purpose of  
22 exchanging information on distributed generation and advocating for policies that permit  
23 safe, reliable and economically viable use of distributed generation. AzCA members  
24 represent utilities customers, gas and electric utilities, environmental consultants,  
25 developers and energy industry consultants. AzCA has interest in this proceeding due to  
26 the impact the proposed rates would have on customers in terms of their energy budgets  
27 as well as their ability to effectively implement and derive economic and operational  
28 benefits from a wide range of distributed generation (DG) alternatives in Arizona.

30 Q. WOULD YOU DISCUSS YOUR EDUCATIONAL BACKGROUND AND  
31 BUSINESS EXPERIENCE.

1 A. I attended Grammar, High School, and College in Arizona. I received a BS in  
2 Engineering from the University of Arizona, after attending, Phoenix College, ASU.  
3 I worked for a number of small and large businesses in California and Arizona before  
4 joining APS. During my 16 years with I served on the various committees including the  
5 Totalizing Committee, the Load Forecast Committee, and the Cogeneration Committee.  
6 Then I operated an Energy consulting firm named Murphy Engineering for 16 years. ME  
7 provided energy and utility rate consultation services for many, business, governmental,  
8 and educational organizations including: Arizona Department of Administration, Arizona  
9 Corporation Commission, University of Arizona, Arizona Western College, ADOT,  
10 Arizona Interfaith Coalition on Energy, Anderson Clayton, Inc. Arizona Energy Office,  
11 Arizona Residential Utility Consumer Office (RUCO), Arizona School Boards  
12 Association, America West Industries, and others. I also was the “Energy Manager” for  
13 the City of Phoenix from 1992 until 2003.during this time I became familiar the Cities  
14 3,000 individually metered electric accounts.

15

16 Q. WERE YOUR TESTIMONY AND ACCOMPANING EXHIBITS PREPARED BY  
17 YOU OR UNDER YOUR DIRECTION?

18 A. Yes any and all were.

19

20 Q. WOULD YOU SUMMARIZE YOUR TESTIMONY?

21 A. My testimony will focus on the proposed APS General Service (GS) Rates,  
22 specifically E-32 and the inability of the proposed rates to effectively communicate  
23 pricing signals to the customer. My testimony will identify the negative impact the  
24 proposed rates would have on customers who may desire to alter their energy using a  
25 variety of technological and/or operational measures.

26

27 My belief is that the design of these GS rates will not result in clear and understandable  
28 prices for small, and medium sized customers to whom these rates must be applied. The  
29 existing and proposed rates provide incentives to increase the customers Load Factor,  
30 neither by using more energy nor by lowering the peak demand (the more difficult).  
31 Neither of these alternatives is automatically beneficial to other customers.

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Most importantly to small commercial customers who may chose to employ DG (solar, and combined heat and power (CHP)) whether to increase security and reliability, lower their costs and improve the environment, or any combination of the above, the proposed demand (kW) increases in rate E-32 (and therefore E-32R) will significantly inhibit these choices by doubling and tripling the cost of standby power over what this Commission previously approved.

Also my testimony will show how prices for utility purchase of electricity bought from DG are 1/5 to 1/2 of the price that the Company must pay for incremental energy at wholesale. This despite the fact that purchases from DG can be within the “load pocket”, thereby unloading the transmission/distribution system.

Also I would like to provide some comments on the need to create fair, cost-based interconnection standards.

Q. WHY HAVE YOU CHOSEN TO DIRECT YOUR TESTIMONY TOWARD GENERAL SERVICE RATES AND SPECIFICALLY E-32?

A. 94% of all GS customers are on Rate E-32. Of this large percentage, 98% are small and medium sized customers. Small Customers on E-32 rate include commercial and industrial operations, such as coffee shops, barber and hair salons, school buildings, machine shops, and government facilities. Medium customers include schools, government facilities, resorts, hospitals, manufacturers, and others.

Emerging technologies like DG, and to an extent DSM, can benefit this large population of APS ratepayers only if the rate design will allow it to happen. General Service customers pay more than their share of cost to serve them and the proposed rates will only add to that in equity by removing technology alternatives that could benefit them the most.

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Q YOU STATED THAT THE GENERAL SERVICE CUSTOMERS PAY MORE THAN THEIR SHARE OF THE COST TO SERVE THEM. ARE YOU SAYING THAT THE SMALL, MEDIUM , AND X-LARGE E-32 COMMERCIAL & INDUSTRIAL CUSTOMERS SUBSIDIZE ALL OTHER RATE CLASSES, AND IF SO TO WHAT EXTENT?

A. Yes, based on my understanding of APS own cost of service calculations, these GS customers pay over \$276,000,000 more per year than it costs to serve them.

Q. WHAT ARE THE BARRIERS TO THE CUSTOMERS RESPONDING TO THE PRICE SIGNALS CONTAINED IN THE E-32 RATE?

A. There are barriers to customers responding to price signals several, starting with the units of measure themselves. The pricing in E-32, like some other rates, is based on two units of measure; demand, as measured in kilowatts (kW), and energy, as measured in kilowatt-hours (kWh). Most customers do not understand the differences between these two engineering units. I find that most customers believe these two units of measure are the same thing, in other words kW= kWh. Their common misconception gets in the way of understanding how rate E-32 calculations result in a bill rendered in dollars.

Q. WHY DON'T CUSTOMERS UNDERSTAND THE FACT THAT THEY ARE BEING BILLED ON BOTH KW and KWH?

A. I believe that this is a very difficult concept and that most customers, and many within the industry, do not understand the distinction between the two.

Q. WHY IS THIS SO HARD TO UNDERSTAND?

A. I think because the best analogy (miles & MPH) falls apart because the units that include time are reversed. The total in the car analogy (miles) contains no time, while the rate of use in the car analogy (MPH) does contain time. This is the exact opposite of the electric comparison. Said another way -kW is to MPH- as – kWh is to miles – confusing huh?

1 The kilowatt is an engineering unit that we do not confront in our life away from the  
2 utility bill.

3

4 Q. ARE THERE OTHERS BESIDES CUSTOMERS WHO DO NOT UNDERSTAND  
5 THE DIFFERENCE BETWEEN KW and KWH?

6 A. Yes, many closely associated with the electric utility industry including many  
7 employees, plus some suppliers of DSM services, including suppliers who provide  
8 metering services.

9

10 Q. WHAT STANDARDS ARE THERE FOR PRINCIPLES TO GOVERN RATE  
11 DESIGN?

12 A. I believe Dr .James C. Bonbright's book best sets out 8 principles for measuring  
13 effectiveness of rates.

14

15 Q. WOULD YOU SUMMARIZE THE 8 PRINCIPLES FOR US?

16 A. His 1961 book lists the principles as follows:

17 1. Simplicity and understandability

18 2. Freedom from controversies

19 3. Effectiveness

20 4. Revenue stability

21 5. Rate stability

22 6. Fairness

23 7. No "undue discrimination"

24 8. Discourages "wasteful use"

25

26 Q. GIVEN THE BONBRIGHT PRINCIPLES OF RATE DESIGN YOU'VE LISTED,  
27 WHAT IS YOUR VIEW OF E-32 AND ITS ADHERENCE TO THESE PRINCIPLES?  
28 AND GIVEN THAT MOST OF DR. BONBRIGHT'S WORK WAS DONE BEFORE  
29 ENVIRONMENTAL AND CONSERVATION ISSUES CAME TO PROMINENCE,  
30 WHAT WOULD YOU CHANGE IN THE LIST OF PRINCIPLES?

1 A. In regard to E-32's adherence with the Bonbright principles, many conflicts exist. E-  
2 32 is neither simple nor understandable. Although "understandability" is first on  
3 Bonbright's list (as it should), most GS customers don't begin to understand the complex  
4 E-32 rate for two reasons: First, the difference between kW and kWh; and second, the  
5 phrase within rate E-32 that states "\$0.10201 per kWh for the next 100 kWh per kW over  
6 5". Most customers that I have discussed this with (the few who know the difference  
7 between kW and kWh) can't grasp the meaning.

8

9 E-32, I contend, is not free from controversy either. A rate that is free from controversy  
10 would be a rate any customer can apply to his/her own billing determinants to quickly  
11 and accurately verify their utility bill. The imbedded demand charge in the previously  
12 referenced phrase is confusing and prevents E-32 customers from proving to themselves  
13 that they are being billed properly. In addition, as my previous testimony regarding  
14 subsidization reveals, E-32 cannot be considered fair or non-discriminatory.

15

16 In regard to conservation I would suggest that Dr. Bonbright's admonishment to  
17 "discourage wasteful use" could be more prominent. While the Bonbright principles  
18 indeed list conservation as a criterion for rate design, I suggest that its 'last place' ranking  
19 in the order of principles should not be interpreted to mean that it is of least importance.  
20 The proposed E-32 rate, with its significant shift toward higher demand costs, will  
21 discourage the use of distributed generating resources and certain DSM measures and  
22 will actually inhibit conservation.

23

24 Q. BESIDES THE PRINCIPLES DEFINED BY DR. BONBRIGHT, HAVE ANY  
25 POLICY MAKING BODIES ATTEMPTED TO CHANGE THE WAY UTILITIES  
26 PRICE ENERGY TO CUSTOMERS?

27 A Yes, more recently in the 1980's the United States Department of Energy (DOE)  
28 supported the Public Utility Regulatory Policies act of 1978 (PURPA). This National law  
29 for the first time created what I consider a "bill of rights" for electricity customers.  
30 PURPA, and its related rules, provided guidance that discouraged declining block rates  
31 (like E-32) and instead attempted to encourage Time of Day (TOD) rates. DOE also

1 appeared as witnesses in an APS rate case around that same time to advocate for TOD  
2 rates and in opposition to declining block rates.

3  
4 One of the more interesting features of DOE's suggested approach was an incentive to  
5 provide a readout device within the home or business that would read out how much the  
6 next unit of energy would cost the consumer.

7 Currently the DOE is advocating the use for larger GS customers of "real time pricing"  
8 (RTP) with the billing kWh varying hourly. A Time of Day rate with realistic time  
9 periods utilizing kWh units.

10  
11 Q WHAT FURTHER COMMENTS DO YOU WANT TO PROVIDE ON HOW THE  
12 PRESENT, AND OR PROPOSED, E-32 RATES AFFECT GS CUSTOMERS?

13 A. The biggest unknown, and most vexing problem, for any customer on E-32 is, "When  
14 exactly was the 15-minute period during the previous billing month when the peak  
15 demand was set?". Knowing this helps the customer begin to know how to lower peak  
16 demand and reduce costs. But, alas in the case of E-32, even the utility does not know  
17 when it occurred due to the fact that the current meters used by the utility cannot record  
18 the time that, the peak demand occurred. This can be easily solved. To make matters  
19 worse, the proposed E-32 shifts more emphasis to the peak demand (kW) portion of the  
20 bill, no matter when it occurs!

21  
22 In addition to the fact that demand is not generally understood by consumers, a  
23 significant portion of the charges in E-32 arise from demand charges imbedded (hidden?)  
24 in the energy cost component of the rate due to the billing phrase mentioned in my  
25 previous testimony. This billing mechanism by its complexity and imbedded nature  
26 reduces the customer's ability to determine the impact demand has on their final bill and  
27 leaves them hard pressed to accurately modify their usage in an effort to lower their costs.  
28 Add to that the fact that the utility bill can arrive almost six weeks after the customer may  
29 have attempted to change his peak, or consumption, and he has a hard time relating the  
30 outcome of his actions to this limited feedback – late as it is.

1 Finally, billing periods can vary from 33 to 27 days. This is due to the fact that the  
2 billing process is dependant on a meter reader physically reading the customer meter  
3 every month, often times on a different day of the month- exactly the same way it was  
4 done in Edison's time over 100 yrs ago. When combined, these shortcomings of E-32 and  
5 how APS implements that rate leave E-32 customers lacking timely, understandable, and  
6 actionable information.

7

8 Q. HAS THE COMPANY PROPOSED ANY CHANGES TO INCREASE THE  
9 USEFULNESS OF THE CURRENT BILLING SYSTEM?

10 A. Not that I know of – I have tended to focus my efforts on the increase in the  
11 complexity of E-32 because it applies to 94% of all commercial and industrial customers.

12

13 Q. DO THE X-LARGE CUSTOMERS HAVE RATES MORE COMPLEX THAN THE  
14 CURRENT E-32 RATES?

15 A. No, extra large GS customers (demand greater than 3,000 kW) have relatively simple  
16 three part rates – Customer charges, demand charges, and energy charges. These  
17 customers generally have a person dedicated to understanding of rates, or they can afford  
18 to employ consultants to advise them on energy rate issues.

19

20 Q. WHAT IS THE MAJOR IMPACT OF THE CHANGES IN THE PROPOSED E-32?

21 A. The proposed rates significantly increase (double and triple) the component of the bill  
22 that is demand (kW) related. These demand charges are the least understood part of the  
23 bill, and the confusion is compounded by the fact that these demand charges are hidden in  
24 the “expanding block” (energy) portion of the bill.

25

26 Q. WHAT DIFFERENCE DOES IT MAKE IF ONLY RATE EXPERTS (NERDS) CAN  
27 UNDERSTAND THESE CHANGES?

28 A. Most customers do want to know what they use, when they used it, and most  
29 importantly how to reduce their peak demand. Not only is peak reduction beneficial to  
30 the individual customer, if the reduction is also coincident with the utility peak, all  
31 customers will benefit by decreasing the need for more peak capacity and peak energy.

1 If a customer's actions can contribute to a reduction in coincident peak demand it will  
2 ultimately lower the need to invest in new capacity whose costs would be borne by all  
3 ratepayers. If their peak reduction is not coincident with the utilities peak there is no  
4 across-the-board benefit, and certainly less revenue to the utility, but there is still benefit  
5 to the customer. Also, with the proper information, the customer could figure out that  
6 rather than cut the peak they could add energy usage away from their peak because it is  
7 cheaper to them, though not as beneficial to the system.

8

9 Without a clear understanding of the rates, an understanding that most small and medium  
10 commercial customers do not possess, customers can not economically reduce energy use  
11 by conservation and use of small scale renewable distributed energy resources. If only a  
12 few customers, with hired or on-staff rate experts, can understand the rates, then most of  
13 the GS population is left with little ability to make a difference. If such a large  
14 percentage of the utilities load is incapable of reducing their peak demand and energy  
15 consumption then ultimately all ratepayers are affected.

16

17 Q. DOES THE EXISTING E-32 PROVIDE PRICE SIGNALS FOR DECREASING  
18 THE SUMMER PEAK DEMAND AND ENERGY USAGE?

19

20 A. No, for the customer that understands the demand/energy details of the rate it provides  
21 the price signal that summer usage is not a major concern. It provides incentives to  
22 increase the load factor (whether beneficial to the system or not). The reason for these  
23 reactions is that the difference between summer and winter pricing is less than 10% (if  
24 the usage is the same). But if there is more air conditioning usage in the summer (duh) it  
25 will easily overcome this and result in lower costs in the summer. This provides an  
26 inappropriate signal that summer energy use is approximately the same (or lower) cost  
27 than winter use.

28

29 Q. IS THERE A BETTER WAY TO MODIFY E-32 TO SIMPLIFY AND PROVIDE  
30 PROPER PRICE SIGNALS?

1 A. Yes, E-32 could provide proper price signals if its pricing structure follows actual  
2 modern day energy production costs, where the cost components in E-32 include much  
3 higher energy prices on peak (summer weekday afternoons) and correspondingly lower  
4 prices off peak and winter. Further the demand charges should be phased out.

5

6 Q. YOU MENTIONED THAT PRICING SHOULD FOLLOW ACTUAL “MODERN  
7 DAY” GENERATION COSTS. HAS UTILITY GENERATION ECONOMICS  
8 CHANGED IN THE LAST 5 YEARS?

9 A. Before I answer this let me give a little background on traditional Company pricing  
10 philosophy. Pricing has been split between capital and operating costs.  
11 First, capital investment (generating, transmission, and distribution plant) has  
12 traditionally been recovered in demand charges, in units such as \$7 per kW/Month.  
13 Second, operating costs (fuel, labor, maintenance, losses, etc.) are in turn traditionally  
14 recovered in energy charges, in units such as 7¢ per kWh.

15

16 This philosophy has resulted over the last 40 years in large central generation investments  
17 whose goal was to lower fuel costs but raised demand charges. Coal and nuclear plants  
18 are examples of this investment shift away from high fuel (kWh) costs. The results are  
19 rates with low (base load) fuel costs – say 1 to 2¢/kWh. With corresponding capital costs  
20 that are about equal to – say 2¢/kWh (about \$7/kW/mo)

21

22 In the last five years however, more generating capacity has come on line than previously  
23 existed in Arizona. Not only has this new capacity exceeded the capacity of all the  
24 previous plants, but the new plants are fundamentally different from their predecessors.  
25 The new plants are Combined Cycle (Jet engines with waste boilers) that, in comparison  
26 to earlier central station plants, are relatively low capital cost, but have much higher fuel  
27 costs. – say 5¢/kwh. ( Gas at \$6/ million BTU, heat rate of 7,000 BTU/kWh + losses.  
28 For a total of 5¢ energy and 2¢/kWh demand equivalent).

29

1 We must recognize that this change to Combined Cycle plants has occurred across the  
2 world, but I not sure we fully understood what the impact would be on natural gas prices  
3 – now roughly 3 times the cost when these plants were announced.  
4

5 Q. HOW DOES THE CHANGE IN UTILITY ECONOMICS RELATE TO THE  
6 PROPOSED E-32 RATE?

7 A. The shift towards generation assets of lower relative capital cost should equate to a  
8 shift away from demand as the vehicle for recovering the investment. The proposed E-32  
9 is a move in the exact opposite direction from this concept and comes at a time when  
10 APS' and all other new generating plants (with VERY limited exception) have installed  
11 facilities whose cost recovery should be based on operating costs, not capital costs.  
12 Worded another way, the proposed E-32 does not properly reflect the cost recovery  
13 realities of the new generation market.  
14

15 Q. HOW WILL THE PROPOSED DEMAND-BASED CHARGES IN E-32 IMPACT  
16 THE USE OF DG BY GSCUSTOMERS?

17 A. DG technologies have come a long way in terms of reliability. It should be noted  
18 here that approximately 90% of utility customer outages are caused by utility distribution  
19 failures. Even though many DG technologies can rival the capacity factor (not to mention  
20 the thermal efficiency) of central station utility plants, there must come a time when all  
21 DG plants come 'off-line', if for no other reason than to perform scheduled maintenance.  
22 In addition, even the highest capacity factor plant design can and will suffer unplanned  
23 outages – just like any regulated utility plant.  
24

25 A customer's decision to invest in DG, and the economic performance of that asset once  
26 installed, is highly dependent on reasonable prices for electricity from the utility when the  
27 DG plant is out of service. Under the proposed E-32R rate, the cost of "standby"  
28 electricity (kW or demand related charges) will increase dramatically due to the  
29 significant increase in demand charges in the new proposed E-32 rates. This will have  
30 the effect of decreasing the economic attractiveness of solar and any other DG  
31 application. These technologies require just and reasonable standby electricity pricing in

1 order to hit a rate of return threshold necessary for implementation. As an example, a  
2 100kw E-32 customer with 60% load factor will see an almost 300% increase in demand  
3 charges from \$5.27/kW now to \$15.89 in the proposed rates. These changes are so  
4 dramatic that they could remove DG as a viable alternative to utility generation.

5  
6 Q. IS THERE SOME UPSIDE IN THE PROPOSED RATES FOR THOSE THAT ARE  
7 INTERESTED IN ACHIEVING ECONOMIC SAVINGS BY UTILIZING  
8 CONSERVATION?

9 A. Unfortunately, here too, revenue stability wins out over conservation. The small  
10 customer mentioned above will change from a savings of 7.5¢/kWh to a savings of only  
11 4.6¢/kWh with the proposed E-32. – A reduction of almost 40% in the economic benefits  
12 of conservation. Customers respond to clear price signals. The proposed E-32 will send  
13 price signals that discourage conservation.

14  
15 Q. DO YOU BELIEVE THAT UTILITY CONSERVATION & DEMAND SIDE  
16 MANAGEMENT (DSM) PROGRAMS ARE NECESSARY?

17 A. Absolutely, but DSM is not an efficient response as a permanent replacement for  
18 understandable price signals to customers. And as long as we have a current rate or a  
19 proposed rate design that relies on the declining block structure and demand charges that  
20 are generally misunderstood, DSM will not take hold and produce the intended results

21  
22 Q. DO YOU THINK THAT RATES DESIGNED FOR CLARITY, SIMPLICITY, AND  
23 UNDERSTANDABILITY CAN ULTIMATELY DISPLACE OR LIMIT THE NEED  
24 FOR THESE PROGRAMS.

25 A. Yes, by implementing rates that deliver clear and correct price signals, we can achieve  
26 more uniform loads that will result in benefits for all customers. In addition, clear pricing  
27 signals that reflect actual market costs - when applied through understandable rates - will  
28 allow customers to alter their usage in a variety of means and thereby limit or eliminate  
29 the need for additional public goods charges.

1 Q. DO YOU BELIEVE RATE DESIGN IS AN ART AND NOT A SCIENCE?

2 A. Yes, I do and I believe that rates can and should be designed to also benefit the  
3 customer.

4

5 Q. ARE THERE ACTIONS THAT THIS COMMISSION CAN TAKE TO ANSWER  
6 THE RATE DESIGN ISSUES THAT YOU HAVE RAISED IN THIS TESTIMONY.

7 A. Yes, and I will attempt to provide a list of actions that this Commission can take to  
8 solve these “Revenue Stability” vs. “Clear Price Signals”. These actions include the  
9 following:

10 1. Provide an E-32 rate design that is at least neutral for DG.

11 2. Provide an incentive to design an E-32 rate that provides significant seasonal  
12 TOD energy (kWh) price signals.

13 3. This new proposed E-32 should be designed with clarity, simplicity, And with  
14 the appropriate TOD (energy) pricing signals. – without confusing demand charges.

15

16 Q. THERE HAVE BEEN WORKSHOPS IN THE PAST 3 YEARS TO AGREE ON  
17 NEW, FAIR INTERCONNECTIONS FOR SMALL COGENERATION AND  
18 RENEWAL RESOURCES- WERE YOU PLEASED WITH THESE WORKSHOPS?

19 A. No, this turned into an endurance effort in which the Arizona utilities clearly outlasted  
20 all other stakeholders. The current ratemaking process of continuing workshops and rate  
21 proceeding where utilities “rate base” their staff and consultant time (legal and  
22 engineering) – and customers who want to be part of the process use their own funds as  
23 well as risk higher rates as a result of being involved in the process due to paying the  
24 utility’s costs of the process. I would suggest a hearing on this subject to compare  
25 interconnection rules from other states. We can create a record and settle on the fairest  
26 cost-based standard.

27

28 Q. DOES THIS COMPLETE YOUR COMMENTS?

29 A. Yes.

APPENDIX A  
STATEMENT OF QUALIFICATIONS  
WILLIAM J. MURPHY, P.E.

Mr. Murphy received a B.S. in Mechanical Engineering from the University of Arizona in 1958, graduating in the top 25% of his class. He has also attended Regis University in Denver, Arizona State University, Phoenix College and other institutions of learning, consistently keeping his education current.

Currently William Murphy is a principle in Murphy Consulting. He has been studying utility pricing since he was first exposed to commercial electric pricing during his first employment after graduation at Hirt Combustion Engineers in Southern California. There he was requested to develop an understanding the pricing of electricity from Southern California Edison. During Mr. Murphy's 16 year employment at Arizona Public Service, he served as the Manager of Power Contracts after serving for many years dealing with commercial and industrial customers who were attempting to lower their utility costs. He also served on many committees while with APS including the Tantalization Committee, the Peak Load Forecast Committee, and the Cogeneration Committee.

From 1979 to 1992, Mr. Murphy owned and operated Murphy Engineering, where he provided expert advice to commercial and industrial customers who were trying to lower their electric costs. He consulted with Saguaro Petroleum,, San Carlos Housing, Summerton School District, Scottsdale School District, St. Joseph Hospital, Sullivan and Durand, Symington Development, Southwest Management Association and others..

Mr. Murphy spent 11 years working for the City of Phoenix where he was Deputy Director of the Public Works Department. The City has over 3,000 electric meters and buys over 500, 000,000 kWh\ yr. While there he led a team that created and implemented a system whereby the operators and occupants of the many City facilities could view their daily energy use over the internet. Further, they could compare their energy use the prior day, week, year etc. Though the system cost over \$600,000, the resulting savings paid off the investment in the first year of existence.

He is a registered Professional Engineer in Arizona  
The Association of Energy Engineers (AEE) has certified him as:  
Certified Energy Manager  
Certified Cogeneration Professional