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MISSOURI PUBLIC SERVICE COMMISSION

CASE NO. ER-2006-0314

SURREBUTTAL TESTIMONY

OF

ROBERT J. CAMFIELD

ON BEHALF OF

KANSAS CITY POWER & LIGHT COMPANY

Jefferson City, Missouri
October 2006

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Q. Are you the same Robert J. Camfield who has provided direct testimony on behalf of Kansas City Power and Light Company in the immediate proceeding?

A. Yes. My direct testimony provides a detailed assessment of the performance of Kansas City Power and Light (KCPL), from the perspective of retail consumers. Using a battery of objective performance metrics including productivity and overall price level, the assessment concludes and demonstrates that KCPL has, unequivocally, realized top level performance for its customers, with reference to that realized by the electric services industry as a whole and by two peer groups. The testimony recommends that the Missouri Public Service Commission ("MPSC" or "Commission") take full account of KCPL's exceptionally high performance in its determination of key issues of the immediate rate setting proceeding, including the allowed rate of return on common equity. My testimony goes on to recommend that the Commission consider the inclusion of a performance allowance of 50 – 100 basis points within the authorized rate of return on equity for KCPL in the immediate proceeding.

Q. What precipitates your Surrebuttal Testimony?

A. My Surrebuttal Testimony responds to the assertions, views, and general perspective of Ms. Deborah Ann Bernsen regarding KCPL's performance, as expressed within her Rebuttal Testimony in the instant proceeding. While I appreciate the concerns raised by Ms. Bernsen regarding performance, I am concerned that she may have reached an inappropriate position regarding KCPL's performance level, and the use of performance in the determination of rates for retail electricity services. Accordingly, I wish to clarify and elaborate on performance assessment, the value of KCPL's performance to retail consumers, the proper application of performance metrics in rate setting, and the consideration of the realized performance of KCPL by the MPSC in its deliberation of the outstanding issues before it in this proceeding.

Q. Please summarize the views expressed by Ms. Benson.

A. Ms. Benson's position regarding performance is that the Missouri Public Service Commission should not consider performance in its determination of the overall rate of return and rate level for KCPL in the immediate proceeding. Ms. Benson's position appears to be premised on two ideas. First, Ms. Benson cites procedural case history and decisions by the Missouri Public Service Commission regarding performance and concludes that the Commission, as a matter of policy, does not view performance as a basis to determine the authorized rate of return or overall rate level (pages 4–6). Ms. Benson provides a brief review of the decision by the MPSC regarding performance in support of this view and notes that in its deliberation of selected issues, the MPSC has adjusted the authorized rates of return on rate base—and thus the realized returns on common equity—in several rate proceedings including ER-82-39 and WR-82-50 involving Missouri Public Service Company; ER-83-42 involving Empire District Electric Company; and ER-83-49 involving Kansas City Power and Light. As described by Ms. Benson, "The Commission utilized both upward and downward adjustments to the rate of return…" As cited by Ms. Benson, these adjustments included modest upward adjustments of 40 basis points to the authorized rates of return on common equity in ER-83-42 (Empire) and ER-83-49 (KCPL). In these two proceedings, as cited by Ms. Benson, the Commission's decision favoring higher authorized returns on equity were based on performance including customer relations and management efficiency, respectively. In her Rebuttal Testimony (page 5), Ms. Benson goes on to describe Missouri proceedings where the Commission has declined to adopt adjustments to the authorized rates of return because of difficulty in the determination of the measurement of performance—"…can rarely be supported by sufficient evidence to warrant a decision." and "…the evidence in this case provides no real guide…" in Case No. TC-89-14 involving Southwestern Bell Telephone Company.

Second, Ms. Benson's argues that the measurement of a utility's effectiveness and efficiency is difficult and that the overall performance cannot be readily discerned (page 3). To this latter point, Ms. Benson raises issues regarding the linkage of performance and authorized rates of return, and reaches the conclusion that such issues need to be addressed beforehand (page 7), though acknowledges the principle that I set forth originally (page 8 of Benson Rebuttal). Finally, Ms. Benson's testimony discusses the responsibility of regulated utilities to obtain what I interpret to be an acceptable level of performance (page 7), regardless of the incentive properties confronting them.

Taken together, Ms. Benson reaches the conclusion that the Commission should not utilize or take account of KCPL's exceptional performance in its deliberation of the issues before it in the immediate proceeding.

Q. What is your response to Ms. Benson's Rebuttal Testimony?

A. I appreciate the issues raised by Ms. Benson but respectfully disagree with her interpretation and "read" of the Commission's Orders as cited and the direct applicability to the immediate proceeding; her qualitative yet general analysis of performance and performance measurement; the implied incentive properties of regulatory governance; and the overall conclusions and policy advice expressed within her Rebuttal Testimony. The following testimony provides in-depth discussion of these points of disagreement, which I respond to individually.

Q. You imply that perhaps Ms. Benson has not correctly interpreted the Commission's decisions regarding performance, and application of such decisions within the immediate proceeding. Please elaborate.

A. The Rebuttal Testimony of Ms. Benson cites pages 70–72 of the Commission's Order in Case No. TC-89-14 where the Commission states (in paraphrase) that only rarely can the ROE adjustment be supported by evidence and the case provided no real guide about how to value a certain management decision. I generally concur with the Commission's view (and that of Ms. Benson) that it is challenging and difficult to link a specific management decision to the value that such decision provides to retail consumers and markets. For these reasons, it is appropriate to define, beforehand, criteria for the consideration of a performance allowance, as my testimony does. Specifically, my testimony states:

> "…that the Commission apply a rational principle and criterion in determining the appropriate level of a performance allowance inclusion within the rate of return. In brief, the Commission should ensure that the net benefits…are sufficient to cover the allowance…" (Camfield Direct Testimony, page 27).

As the Commission states and as Ms. Benson appreciates, the linkage between specific actions and individual management decisions, which take place continually in the course of operating a complex and highly integrated organization of resources of entities like KCPL, and specific gains in value is not easily observable. Furthermore, performance should be defined broadly and aimed at tangible benefits to the retail markets served. For this reason, it is necessary and appropriate for the Commission to assess the impacts of corporate performance using pre-defined metrics that are measurable and objective. I suggest that the metrics that I have applied in the immediate proceeding, which give rise to tangible and measurable benefits to retail consumers and markets, satisfy the Commission's concerns, as expressed in its decisions and orders referenced by Ms. Benson, and the general principle that I cite in my Direct Testimony (reference above). To this end, my testimony goes on to identify key dimensions of benefits, including "Alignment of Long-term Performance with the Interests of Consumers" (Camfield Direct Testimony, page 27). These criteria, as I mention, are focused on retail markets and the benefits realized by electricity consumers. By these standards, which are definitive and measurable criteria, KCPL's high levels of total factor productivity and cost metrics translate directly into tangible and measurable benefits, stated in money terms, to KCPL's customers and the region as a whole. These benefits are contemporary insofar as they are observable in the price, cost, and productivity history of KCPL vis-à-vis the comparison groups of utilities. These benefits are also forward looking, as the obtained levels of high productivity and low costs give rise to flows of benefits to retail consumers over future years. Later on, I quantify the value of these net benefits for the consideration of the Commission and Ms. Benson.

In summary, I concur with the Commission and Ms. Benson that, for the Commission to seriously consider utility performance as a basis for determination of the retail price level, performance must be observable and directly linked to the value creation that such performance provides to retail consumers. For this reason, as mentioned above, I apply and utilize observable performance metrics including productivity and key cost diagnostics as the primary measures for the consideration of the Commission and Commission Staff. These performance metrics are measurable, definitive, and the net impacts of them translate directly into value to retail consumers that is measurable in money terms.

Q. What is the value and worth of KCPL's superior market performance to retail consumers?

A. As we demonstrate within my Direct Testimony, KCPL's overall performance resides at the very high end of the experience of the electric utility industry (Schedule RJC-3).

Productivity refers to the quantity of inputs used in the process of producing and delivering retail electricity services, with reference to the quantity of services delivered. Productivity growth refers to the rate of change in the quantity of inputs with reference to the rate of change in output. If outputs increase faster than inputs, productivity is rising. The productivity estimates account for changes in internal processes of the service provider, as a result of changes in input prices, which are external to management decisions.

I estimate that KCPL's relative performance advantage translates into net value gains to retail consumers of \$116.9 – \$144.6 million, when compared to productivity for utilities within the contiguous region and for the industry as a whole, respectively. For generation service, the value obtained for retail electricity consumers by KCPL's superior performance is equal to $111.6 – $132.8 million, also shown relative to the region and the industry, while the net gains in distribution and customers services are equal to $11.6 – 13.9 million, and $2.3 – $3.4 million, respectively. For transmission, KCPL appears to demonstrate lower productivity than the region or the industry as a whole. However, I recommend that the Commission consider the overall picture and, because transmission costs are very small with reference to other services, the overall result is very positive for KCPL and its customers. In fact, KCPL's transmission cost experience is unusual, and needs to be reviewed further.

The methodology used to determine net gains in value is a straightforward analysis procedure, and draws upon the study of KCPL performance with reference to the overall industry, and the two peer groups. Essentially, net gains to consumers are calculated as the change in total costs for KCPL that would have resulted, had KCPL realized productivity growth equal to the comparison groups. The net gain is then equal to the difference in total costs resulting from the productivity advantage of KCPL with reference to the comparison groups. In summary, net gain is essentially the monetary value realized by consumers through lower prices, a direct result of KCPL's high level of productivity growth. KCPL's productivity gains translate into lower prices; lower prices, in turn, create improved incremental value for consumers. The gains are sizable.

It is perhaps useful to mention that the industry-wide productivity analysis, referred to as total factory productivity, is firmly rooted in economic analysis. Over the years, our methods have been adopted by professional economists worldwide and are currently applied by the Bureau of Labor Statistics of the U.S. Government. For the consideration of the Commission and interested parties, I attach a discussion of methodology (*Technical Discussion Paper*) which provides a review of the technical analysis used to determine productivity for the industry, peer groups, and for KCPL.

Q. How does the value gains from KCPL's high performance compare to the revenue implications of the performance allowance that you recommend?

A. The incremental revenues attending the suggested performance allowance, \$5.6 – \$11.1 million, is small with reference to the value gains to retail electricity consumers that result from KCPL's performance. In other words, the value gains to consumers from KCPL's productivity advantage far outweigh the modest revenue impacts of the allowance that I recommend for consideration by the Commission.

Q. Is a performance allowance consistent with the principles that underlie just and reasonable rates?

A. Absolutely. The principles of just and reasonable rates reach back to the often referenced "Bluefield Waterworks" decision ("Bluefield") by the U.S. Supreme Court (*Bluefield Water Works & Improvement Company vs. Public Service Commission of West Virginia*, 262 U.S.,1923). While earlier judicial decisions deal with the notion of fair rate of return for utilities—such as *Chicago, Milwaukee & St. Paul Railway Company vs. Minnesota Railroad & Warehouse Commission*, 134 U.S., 1890—the Bluefield decision as fortified by the Hope Natural Gas decision *(Federal Power Commission vs. Nope Natural Gas Company*, 320 U.S., 1944) set the commonly recognized standard for fair rate of return and just and reasonable rates. In short, these legal guidelines and principles state that the rate of return must be non-confiscatory of the capital, and utilities are entitled to returns equivalent to that realized on investments of comparable risks. Moreover, regulatory agencies including the Missouri Public Service Commission have for many years recognized that the principle of just and reasonable rates and fair rate of return can, properly, recognize efficiency. Indeed, Charles Phillips in the opening paragraph of the chapter on Rate of Return of his classic work entitled *The Regulation of Public Utilities* writes "regulation may use the rate of return as an incentive by awarding returns that are higher than the minimum to those utilities with relatively greater efficiency." Phillips goes on to mention that in the U.S. Supreme Court's decision in *Smyth vs. Ames*, 169 U.S., 1898, describes the list of factors that should be considered in the determination of the fair rate of return, include the effectiveness of the utility and its management. The Court also mentions, says Phillips, that the "commissions were to consider all relevant factors and to exercise an enlightened judgment." Phillips goes on to state "The cost of capital standard, as discussed above, has one serous limitation: it makes no specific allowance for efficiency. Furthermore, Supreme Court "…Justice Brandeis argued that an efficient utility might properly be allowed more than a rate of return barely above the level of confiscation" (Phillips, page 381). Finally, the Florida commission has defined the difficulty in not recognizing differences in effectiveness and efficiency across utilities. In summary, we can say that it would appear that the Missouri Public Service Commission, as it has within its decisions regarding previous rate case proceedings, is on solid ground to consider and account for the effectiveness of utilities in setting rate levels and determining authorized rates of return.

Q. Has the general topic of the performance within the context of utility regulation been taken into account by regulatory economists? Please elaborate.

A. Regulatory governance has been a topic of keen interest for regulatory law and economics for some time. In fact, alternative regulatory governance structures including alternative forms of regulation were a popular topic during the late-1970s to the early-1980s. The essential concern was that, in the case of cost-based regulation, utilities may not realize high performance levels and thus minimum cost levels and maximum value to retail consumers may not obtain.

While Ms. Benson may assert that utilities have a responsibility to minimize costs—an idea with which I generally concur—most regulatory economists and observers would suggest that substantial differences in performance exist after accounting for other factors—in particular, differences and similarities in input costs. Furthermore, we would generally suggest that it is also the responsibility of the regulatory agency to put in place the appropriate regulatory mechanisms that encourages the desired performance. The performance allowance, as I recommend in the immediate case, is a regulatory mechanism that obtains the desired result. As I suggest above, the cost of the allowance—which can be viewed as a sharing mechanism—is a fraction of the net benefits realized for retail consumers by KCPL's high performance levels.

The performance allowance communicates a valuable signal to service providers, in additional to providing the other benefits that I mention—i.e., management and accommodation of risks, endorsement of KCPL's resource plan, and the alignment of performance with the interests of consumers. In essence, the performance allowance is incentive compatible. Moreover, evidence suggests that the recognition of performance works where performance metrics are defined in a manner that aligns the interests of retail consumers with increased returns to capital. For this reason, I encourage the Commission to give consideration to the principle that I have defined on page 27 of my Direct Testimony, and as stated above and referenced by Ms. Benson in her Rebuttal Testimony. That principle allows the Commission a substantial level of discretion about how to share the net gains, in the form of the specific amount of the allowance that is allowed.

Q. Is it necessary that the performance allowance be incorporated only within the authorized rate of return on equity, or are other avenues for recognition of performance available to the Commission?

A. While incorporation of the performance allowance within the rate of return is consistent with just and reasonable rates and is certainly the strongest signal—particularly in view of KCPL's capital needs to fund its resource plan—KCPL's performance can and should be considered by the Commission as it deliberates all outstanding issues regarding the immediate case.

Q. Does this conclude your Surrebuttal Testimony?

A. It does.

TECHNICAL DISCUSSION PAPER

TOTAL FACTOR PRODUCTIVITY
of the
U.S. ELECTRIC UTILITY INDUSTRY

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This discussion reviews the methods used to construct total factor productivity (TFP) performance measures for Kansas City Power and Light and other investor-owned electric utilities. A comprehensive TFP measure, which evaluates all utility operations together, is developed for generation, transmission, distribution, and customer service categories of integrated services.[1] The estimation of TFP performance metrics requires the development of measures of output and inputs used in the process of providing electric services. Inputs include labor, materials and services, capital, and fuel.

Output Measures

The following measures were used to measure output. First, the comprehensive (company wide) measure of TFP for integrated services uses total MWH sales covering the various retail customer classes and sales in wholesale markets. The output measure used is a Fisher ideal quantity index of MWH sales to residential customers, commercial customers, industrial customers, and MWH sales for resale. The weights used for these measures are based on revenues realized from the sales to each customer class.[2]

For generation operations, the output measure used is net generation. For transmission operations, the study uses annual peak MW and total miles of transmission lines as the measure of output. We average the annual growth rates for these two output measures, and then compute an output index by obtaining an annual average growth rate. For distribution operations, the output measure is peak MW and the number of customers, using the same averaging procedure as employed to compute transmission output. The output measure for customer service is the number of customers.

[1] Customer service includes the functional accounting categories of customer accounts, customer service and informational, and sales.

[2] A Fisher ideal index was chosen in this analysis instead of a Tornqvist index because some utilities do not provide all outputs or use all inputs. A Tornqvist index cannot handle zero quantities.

Fuel and Purchased Power Inputs

The comprehensive TFP measure and the generation TFP measure incorporate fuel inputs, and the comprehensive TFP measure also incorporates purchased power.[3] Four fuel inputs are separately recognized including coal, nuclear, natural gas, and oil. Fuel types are inputs into three of the four generation categories including fossil steam, nuclear power, and other power generation. The values of these fuel inputs are observed in the fuel expenses recorded in the electric operation and maintenance report contained in the FERC Form 1 reports.

The prices for these fuel inputs are as follows. A coal price index is assigned to steam generation fuel, a nuclear fuel price index is assigned to nuclear generation fuel, and a composite price index of gas and oil is assigned to other power generation fuel. The composite price index assigns a weight of .97 to the natural gas price index, and .03 to the oil price index. The quantities of fuel for these fuel inputs are obtained by dividing the expense values by the price indexes. A composite quantity index of fuel is derived from a Fisher ideal index of the fuel input quantities.

The value of purchased power is based on purchased power expenses, also as recorded in the FERC Form 1 reports. The price index for purchased power is based on revenue per MWH from sales for resale.

Labor Inputs

For the comprehensive TFP measure, the quantity of labor input is based on the number of employees. The value of labor input equals the total salaries and wages reported for each of the operation and maintenance expense categories, plus reported pension expenses. The price of labor input is obtained by dividing the labor value (expenses, or cost) by the quantity of labor.

To obtain labor input measures for the different operations, the study distributes total labor quantity and value. This is done by developing a distribution key based on the direct payroll, as reported for generation, transmission, distribution, and customer service. This distribution key effectively distributes administrative and general wages and salaries and payroll charged to clearing accounts in proportion to the direct wages and salaries for generation, transmission, distribution, and customer service.

Materials and Services Inputs

For the comprehensive TFP measure, the value of materials and services inputs, which appear in the non-fuel operations and maintenance expenses, is obtained by taking total O&M expenses, subtracting the value of labor, the value of fuel, and the value of purchased power. The price of materials and services input is set equal to the Gross Domestic Product Price Index, and the quantity of materials and services input is obtained by dividing the value of inputs by the price index.

[3] Purchased power must be included in the comprehensive TFP measure since the output measure is based on total sales. Since the generation TFP output measure is based on net generation instead of total sales, it would be inappropriate to include purchased power as an input.

To obtain the value of materials and services input for the different operations, we take the O&M expense booked to the operation, plus a share of administrative and general O&M expense, less the value of labor expense for the specific area and, in the case of generation, less the value of fuel and purchased power. The distribution of administrative and general O&M expense is based on the allocation key described in the section on labor input.

Capital Inputs

The value, price, and quantities of capital input are based on the methodology established by Christensen, Gollop, and Stevenson.[4] Seven capital asset classes are distinguished: steam production, nuclear production, hydro production, other production, transmission plant, distribution plant, and general plant. The first step is to compute quantities of the capital stock using the perpetual inventory method. The perpetual inventory equation assumes the form:

$$K_{it} = I_{it} + (1 - \delta_i) \cdot K_{i,t-1},$$

where K represents the quantity of capital stock, I the quantity of investment, δ the rate of replacement, i the asset class, and t the year. The perpetual inventory equation requires a benchmark (or starting) year and value. 1965 is selected as the benchmark year.

To compute the quantity of investment in each year, the analyses begin by first determining the value of investment, measured in dollars, and the price of investment. The procedure then divides the investment value by the investment price index to obtain the quantity of investment. The value of investment is observed as the additions to plant in service for each asset class, as reported in the FERC Form 1 Report, Electric Plant in Service. The price indexes are based on various Handy-Whitman indexes. The following table shows the mapping of Handy-Whitman indexes to asset classes.

Steam Production Plant	Table E, Line 6 (Total Steam Production Plant)
Nuclear Production Plant	Table E, Line 17 (Total Nuclear Production Plant)
Hydro Production Plant	Table E, Line 22 (Total Hydraulic Production Plant)
Other Production Plant	Table E, Line 28 (Total Other Production Plant)
Transmission Plant	Table E, Line 33 (Total Transmission Plant)
Distribution Plant	Table E, Line 42 (Total Distribution Plant)
General Plant	Table B, Line 2 (Reinforced Concrete Building Construction)

[4] Laurits R. Christensen, Frank M. Gollop, and Rodney Stevenson, "Estimates of Capital Stocks and Capital Services Flows for Privately-Owned Electric Utilities in the U.S., 1950-1975," University of Wisconsin–Madison, May 1980.

The July price index values of Handy-Whitman are used to represent the capital price level for each year of the analysis. Each utility in the sample is mapped to a Handy-Whitman index region and assigned the set of indexes for that region. The Handy-Whitman indexes are all based to 100 in 1973. The analysis procedure rescales the price indexes to the relative price levels using the Christensen-Gollop-Stevenson scaling factors for 1966. These factors are shown in the following table.

Relative Scaling Factors for Investment Prices in 1966						
Region/Category	**1**	**2**	**3**	**4**	**5**	**6**
Steam ($/kW)	122.81	119.35	126.26	121.54	126.61	130.08
Nuclear ($/kW)	176.85	171.86	181.82	175.01	182.32	187.31
Hydro ($/kW)	221.06	214.83	227.27	218.77	227.90	234.14
Other Production ($/kW)	83.51	81.16	85.86	82.65	86.10	88.45
Transmission ($ per circuit miles)	90792.82	88233.07	93343.34	89850.24	93602.09	96161.85
Distribution ($/customer connection)	1670.25	1623.16	1717.17	1652.91	1721.93	1769.02
General Plant ($/ft.^{2})	1.0316	1.0025	1.0606	1.0209	1.0635	1.0926

The replacement rates are based on the 1.5 declining balance method. This means that the replacement rate $\delta_i = 1.5/T_i$, where T_i is the estimated service life of the asset. Following Christensen-Gollop-Stevenson, the study uses the following estimated service lives: steam production plant – 33 years, nuclear production plant – 33 years, hydro production plant – 56 years, other production plant – 24 years, transmission plant – 37 years, distribution plant – 37 years, and general plant – 25 years.[5]

The benchmark values for capital are based on the reported net book values of plant for 1965. The analysis procedure converts the net book values to quantities by using a deflation procedure that accounts for the different vintages of investment goods comprising book value. The net book value, B_i, is obtained by taking the balance at end of year, as reported in the electric plant in service report, and subtracting the end of year balance of accumulated depreciation, reported in the accumulated provision for depreciation of electric utility plant report. The net book value is then divided by a triangularized weighed average of scaled Handy-Whitman values:

[5] These nominal values for the life of capital should perhaps be reviewed and, if needed, adjusted.

$$K_{i,1965} = B_{i,1965} \Bigg/ \sum_{k=1}^{20} \left(\frac{k \cdot HW_{i,1945+i}}{\sum_{k=1}^{20} k} \right)$$

where HW represents the scaled Handy-Whitman index. The triangularized weighted average approach gives more weight to price index values in more recent years, reflecting the fact that the net book value has more investments of recent vintage.

Once capital stocks are computed for the seven asset classes, the approach is to then compute quantities, prices, and values of capital input. The quantity of capital input (which represents a flow of services during the year) is set to equal the quantity of the capital stock at the end of the previous year:

$$K_{it}^{S} = K_{i,t-1} \,.$$

The price of capital input is based on the Christensen-Jorgenson rental price equation:

$$p_{it}^{S} = \frac{(1 - u_t \cdot z_{it})}{(1 - u_t)} \cdot \left(r_t \cdot p_{i,t-1} + \delta_i \cdot p_{it} - (p_{it} - p_{i,t-1}) \right) + \tau_t \cdot p_{t-1}$$

where p^S is the implicit rental price, p is the investment price, u is the rate of taxation on corporate income, z is the present value of tax depreciation allowances, r is the after-tax rate of return, δ is the replacement rate used in the perpetual inventory equation (which also equals the rate of economic depreciation), and τ is the rate of property taxation. The study approach simplifies the rental price equation using a method analyzed by Harper, Berndt, and Wood,[6] which obtains the following conversion of the above equation to:

$$p_{it}^{S} = \frac{(1 - u_t \cdot z_{it})}{(1 - u_t)} \cdot (\bar{r}_t + \delta_i) \cdot p_{i,t-1} + \tau_t \cdot p_{t-1}$$

where $\bar{r}$ is the real rate of return on capital. We use a 4% real rate of return, which is in line with the range proposed by Harper, Berndt, and Wood. The values of z are based on the MACRS depreciation allowance schedule, while the value of u is set to the marginal federal tax rate of 35%. The property tax rate is computed by dividing reported taxes other than income taxes (found in the statement of income for the year report) by the value of the total capital stock at the end of the year. The value of the capital stock for each asset class is obtained by multiplying the capital stock quantity by the scaled Handy-Whitman index. The total value of capital stock is obtained by adding the values for the seven asset classes.

The value of capital input for each asset class is obtained by multiplying the price by the quantity. The quantity of capital input for the comprehensive TFP measure is

[6] Michael J. Harper, Ernst R. Berndt, and David O. Wood, "Rates of Return and Capital Aggregation Using Alternative Rental Prices," in Dale W. Jorgenson and Ralph Landau, eds., Technology and Capital Formation, (MIT Press, 1989), pp. 331-372.

based on a Fisher ideal quantity index of capital input for the seven asset classes. To obtain capital input measures for each operation, the study approach is to assign the capital inputs to the different operations. Steam production plant, nuclear production plant, hydro production plant, and other production plant are assigned to generation operations. Transmission plant is assigned to transmission operations, while distribution plant is assigned to distribution operation. General plant is distributed to the generation, transmission, distribution, and customer service operations according to the allocation factors described in the section above on labor inputs. Once the capital inputs are assigned to the different operations, they are aggregated using a Fisher ideal quantity index to obtain measures of total capital input.

Determining Total Input

The quantity of total input in the comprehensive TFP measure is computed as a Fisher ideal index of the fuel, purchased power, labor, materials, and capital input quantities. The value of total input is obtained by summing the values of fuel, purchased power, labor, materials, and capital input. The price of total input is obtained by dividing the value by the quantity. The total quantity input measures for the different operations are computed in a similar manner.

Constructing Data for the Electric Industry, and Data Issues

Data used in the immediate study covers those electric utilities that have generation, transmission, and distribution operations. The study begins with 122 utilities that submitted FERC Form 1 reports during the 1994-2004 period,[7] although reaching back many years the data base consists of well over 200 utilities. Many of these utilities divested themselves of a substantial share of their generation (or transmission) assets during that period, making it difficult to develop comparable capital input measures for those firms. Thus, a number of utilities are excluded from the immediate analysis. Data anomalies are also present for some utilities. While the study work was often able to resolve these anomalies by drawing upon other data sources and estimation methods,[8] some anomalies could not be resolved leading unfortunately to their exclusion from the immediate study. Finally, a few reporting entities had not reported results for 2004 at the time that the study was performed. The immediate study of U.S. electric utilities covers 55 service providers.

[7] Some of these firms merged during the study period. In those instances we consolidated their data.

[8] For example, a couple of firms reported MWh sales for 2004 that were clearly off by an order of magnitude. A close investigation showed that the data reported represented one quarter of sales reported in kWh instead of annual sale reported in MWh. We were able to make corrections for those firms.