ECONOMICALLY STRANDED INVESTMENT
IN A
COMPETITIVE ELECTRIC UTILITY INDUSTRY

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ABSTRACT

"Stranded investment" is an economic, not an engineering/physical concept. It is likely that the stranded investment caused by retail wheeling will be much greater than determined simply by looking at the mW of load which leave a utility's system for the greener pastures of retail wheeling. The capacity which is made redundant by retail wheeling is the type of capacity that corresponds to the type of load which left the system.

This paper provides a primer on the concept of economically stranded investment that might arise as a result of "retail wheeling" in the electric industry. The paper posits that attention focused on stranded *capacity* ignores the full range of economic consequences of retail wheeling and understates the extent to which retail wheeling will result in stranded *investment*.

THE GUIDANCE OF THE "USED AND USEFUL" STANDARD

The primary regulatory guidance for assessing whether and to what extent an electric system has stranded investment comes from application of the "used and useful" standard. Under this doctrine, first articulated in the U.S. Supreme Court case *Smyth v. Ames*,[1] investment in capacity not "used and useful" in providing jurisdictional service is not to be passed through in jurisdictional rates.

There are two key aspects to the used and useful standard when applying it to stranded investment resulting from retail wheeling:[2]

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[1] 169 U.S. 466, 544 (1898); *see also*, ***Denver Union Stockyard v. United States***, 304 U.S. 470, 475 (1938).

[2] *See generally*, R.Colton (1985). "Excess Capacity: A Case Study in Ratemaking Theory and Application." 20 ***Tulsa Law Journal*** 402, *reprinted*, VIII ***Public Utilities Anthology*** 739.

I."Used and useful" is a *two*-part test. The term "used" imposes a different constraint than the term "useful." and

II.The term "used and useful" applies *not* to mW of capacity, but rather to dollars of investment.

The significance of each of these observations becomes apparent below.

The Two Parts of "Used and Useful"

The "used and useful" standard imposes a two-part test to be applied to investment in capacity proposed to be included in jurisdictional rates. Moreover, the word "and" makes clear that the tests are additive. They must *both* be met.

<u>The "used" test</u>: For investment in capacity to be includible in rates to consumers, the capacity in question must be "used." In this sense, the term "used" means the capacity must be fully operational and actually providing service to jurisdictional ratepayers in an engineering sense. The application of this part of the "used and useful" test has most often arisen in discussions with regard to when a plant ceases to accrue AFUDC and instead begins to generate actual cash returns for investors.[3] When applied to a multi-billion dollar plant, the "in-service"date for purposes of actual operation can be significant.[4]

Application of the "used" test has also frequently been applied to exclude construction work in progress (CWIP) from a utility's rate base. By definition, investments in CWIP are not in operation and providing service to ratepayers. Under the used test, therefore, CWIP is not to be included in current rates, nor is it allowed to generate a return to be included in current rates.

Finally, it is the "used" part of the "used and useful" test which often prevents investment in *canceled* plant from being included in rates. By definition, canceled plant never becomes operational and does not meet the "in actual operation and providing service" criteria.[5]

<u>The "useful" test</u>: In contrast to the "used" test, which looks at plant operation from an engineering

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[3] AFUDC is a regulatory term of art. It denotes the process of capitalizing the rate of return on funds used during construction, which capitalized return then becomes part of the total "investment" in the construction project. As a capitalized return, there is no cash involved with it.

[4] This is one of the reasons that there was such controversy over the in-service date of the Seabrook nuclear plant, for example. Under state law, Seabrook owners could not start charging ratepayers for the cost of the plant until it was actually in operation.

[5] It is for these reasons that a utility is unlikely to retire a plant that has been stranded due to the loss of customers to retail wheeling. If retired, the plant is no longer "used" and thus cannot be included in rates.

perspective, the "useful" test looks at the *economics* of the investment in plant proposed to be included in rates. To be "useful," the investment in plant must either be "necessary" to provide service or "beneficial" in the provision of service.

The best example of necessary capacity investment is the investment in plant to prevent a capacity shortfall. If a utility faces a peak demand of 1000 mW, in other words, but has only 800 mW of capacity, investment in 200 mW of additional plant would be "necessary."[6] In order to meet current demand, the utility is required to invest in additional plant.

In the alternative, investment in plant may be considered "useful" if it, though not "necessary" *per se*, is *beneficial* in the provision of service. It is this application of the "useful" test, of course, that gave rise to the heated debates over "excess capacity" in the 1980s.[7]

Investment in plant that is not necessary can be beneficial nonetheless if it provides economic benefits to ratepayers. Thus, for example, in the 1980s, a utility who had 1000 mW of capacity to meet 1000 mW of demand might nonetheless argue that an additional 200 mW of capacity was "useful" if it provided economic benefits by allowing the company to back-out very expensive oil-fired capacity.[8] In addition, utilities argued that investment in capacity substantially in excess of their peak demand was beneficial in that it provided reserve margins economically justified by their addition of operational reliability. Reserve margins of 40 and 50 percent or more were held to be "useful" in that they were "beneficial" as a reliability reserve even if not strictly "necessary."[9]

In sum, investment in capacity must be used *and* useful to be included in rates. These tests are conjunctive; they must *both* be met. To be used, a plant must be fully operational. To be "useful," the investment in plant must be either "necessary" or "beneficial."

Dollars of Investment are "Used and Useful," <u>not</u> mW of Capacity

A common misapplication of the "used and useful" test is the application of the concept to mW of capacity rather than to dollars of investment. A utility's rate base, however, is made up of dollars, not

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[6] We will set aside for the moment discussions about alternatives such as purchased power or increased use of demand side management measures.

[7] *See generally*, R.Colton. (1984). "Prudence, Planning and Principled Ratemaking." 35 ***Hastings Law Journal*** 721; R.Colton. (1983). "Excess Capacity: Who Gets the Charge from the Power Plant?" 33 ***Hastings Law Journal*** 1133.

[8] We will set aside for the moment the "usefulness" of the oil-fired capacity rendered obsolete by such a back-out tactic.

[9] It is doubtful anyone would *plan* to have a reserve margin of 40 or 50 percent. And, indeed, holding that such reserve margins were "useful" was more likely a failure of regulatory will to place the obligation to pay for non-useful capacity on investors where it belonged.

of mW.[10] The genesis of the distinction between plant and equipment can be traced to the United States Supreme Court decision in *Missouri ex rel. Southwestern Bell Telephone Co. v. Public Service Commission*.[11] In a dissenting opinion, Justice Brandeis observed the capital that made up the rate base: "the thing devoted by the investor to the public use is not specific property, tangible and intangible, but capital embarked in the enterprise."[12]

The "used and useful" standard is the mechanism to determine the dollars eligible to be included in the rate base on which the utility is permitted to earn a rate of return. To show that mW of capacity and mW of demand are identical, in other words, does not answer the question of whether the *investment* in the particular capacity is "useful." If demand could be met through less expensive capacity, for example, then the investment in the more expensive capacity is neither "necessary" nor "beneficial."[13] It is to a further explanation of this concept of "useful" to which we now turn. And it is this observation which underlies the concept of economically stranded investment resulting from retail wheeling.

THE NECESSARY RATEMAKING CONCEPTS TO UNDERSTAND.

To understand how investment in capacity might be found not to be "useful" on economic grounds, one needs to understand four different ratemaking and regulatory concepts:

oLeast-cost service obligations;

oFixed and variable costs;

oAnnual load curves (demand and energy); and

oBase load and peaking capacity.

While closely interrelated, these four concepts are nonetheless independent.

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[10] *See*, R.Colton, "Excess Capacity: A Case Study in Ratemaking Theory and Application," 20 ***Tulsa Law Journal*** 402, n.122 (1985) (citing, K.Howe and E.Rasmussen, ***Public Utility Economics and Finance*** 91 (1981) [original cost standard has an emphasis on the principal invested in the public utility rather than an emphasis on physical equipment]; P.Garfield and W.Lovejoy, ***Public Utility Economics*** 60 (1964) ["the property element in the rate base is the sum of the amounts actually spent for initial construction, acquisition, and additions and betterments less depreciation."])

[11] 262 U.S. 276 (1923).

[12] *Id.*, at 290.

[13] This is one of the failures of the reserve margin test. It does not account for the *types* of capacity a utility maintains.

Least Cost Service

Many people view the concept of "least cost service" simply as a Demand Side Management (DSM) term. It is not. The obligation of a utility to provide least-cost service not only pre-dates DSM planning, but pervades a utility's entire realm of operations.[14]

From a *legal* perspective, the obligation to provide least-cost service can be traced to the dictates of *Hope*[15] and *Bluefield*[16] that a utility operate with all reasonable efficiencies. Inefficient and uneconomic operations were not to be subsidized through ratepayer dollars. Accordingly, a host of issues illustrate the ongoing application of the least-cost service obligation:

oDoes a utility self-insure or does it purchase an insurance policy?

oDoes a utility pay bank fees or does it maintain compensating bank balances?

oDoes a utility seek out debt capital or equity capital, and if debt, should it be long-term or short-term?

In each instance here, the answer depends, to a large degree, on which choice will result in least-cost service to ratepayers.

Indeed, a more current application of the least-cost analysis is to the ratemaking treatment of low-income inability-to-pay problems. An increasing number of regulators are finding that it is less expensive to provide affordable rates to low-income households with which to begin than it is to charge a fully-embedded rate and seek to collect those dollars through extensive credit and collection efforts.[17]

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[14] The duty to provide least-cost service is always pursued within the constraint of maintaining adequate service.

[15] ***Federal Power Commission v. Hope Natural Gas Co.***, 320 U.S. 591 (1944).

[16] ***Bluefield Waterworks & Improvement Co. v. Pub. Serv. Comm'n of W. Virginia***, 262 U.S. 679 (1923).

[17] *See generally*, R.Colton (1994). ***Models of Low-Income Rates***, Fisher, Sheehan & Colton, Public Finance and General Economics: Belmont, MA; R.Colton (1994). ***Identifying Savings Arising From Low-Income Programs*** Fisher, Sheehan & Colton, Public Finance and General Economics: Belmont, MA; R.Colton (1994). ***Low-Income Programs And Their Impact on Reducing Utility Working Capital Allowances***, Fisher, Sheehan & Colton, Public Finance and General Economics: Belmont, MA.

Fixed and Variable Costs

The application of the least-cost service concept to capacity planning requires an understanding of both fixed and variable costs. Total production costs included in utility rates include two components: (1) fixed costs; and (2) variable costs. For a utility to meet its least-cost service obligation, it must minimize the *sum* of these two components.

The fixed costs of production consist primarily of the total costs of the power plant divided by the kWh produced by that plant. Thus, a 1000 kW plant that cost $100,000 and produces 1.0 million kWh contributes 10 cents per kWh of fixed costs to rates (100,000 / 1,000,000 = .10). If the plant produces 2.0 million kWh of energy, the fixed cost component of rates is only five cents. If the plant produces only 500,000 kWh, the fixed cost is 20 cents. The *aggregate* capacity costs of a power plant are fixed. The aggregate capacity cost divided by the total kWh produced equals the fixed cost component of rates.

In contrast to fixed costs are the variable costs of production. These are the costs the incurrence of which depends on the amount of energy produced. While there are some variable operation and maintenance costs,[18] the proto-typical variable cost involves fuel expenses. As more energy is produced, more coal (or oil or natural gas) is consumed and more costs are incurred. Total fuel costs vary up or down as total production varies up or down.[19]

The least-cost service obligation requires a utility to minimize the sum of fixed plus variable costs for ratemaking purposes. Hence, if Plant A has costs of five cents fixed and 2.5 cents variable, and Plant B has costs of two cents fixed and seven cents variable, the least-cost service obligation requires the utility to utilize Plant A (7.5 cents vs. 9.0 cents). Moreover, as discussed in more detail below, it is the investment in Plant A which is thus both necessary and beneficial for purposes of applying the "used and useful" test.

Load Curves and the Difference Between Demand and Energy

Not all electric usage imposes the same burdens on a utility's system. Electric usage has two components to it: (1) demand; and (2) energy. "Demand" is the measurement of electric usage at any given instantaneous moment. Electric demand is measured in terms of watts. Thus, one speaks of kW or mW of demand. Measuring demand is akin to measuring the speed of a car. It measures the *rate* at which electricity is being used.[20]

In contrast, "energy" has a time component to it. Energy is usage over a period of time and is expressed in terms of kWh or mWh. Hence, 10 mW of demand persisting for one hour will result in 10 mWh of energy. The same 10 mW of demand persisting for one-half hour will result in five

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[18] Just as there are some fixed O&M costs.

[19] We will set aside nuclear fuel expense for these purposes. Nuclear fuel tends to be a capital cost, not a variable cost.

[20] A speedometer measures the rate at which a car is travelling at any given instantaneous moment in time.

mWh of energy.[21]

The combination of demand and energy requirements placed upon a utility's system can be pictured in a "load curve." The load curve demonstrates both the kW of demand at each moment in time and, as a result, the kWh of energy consumed over the course of the period portrayed. The demand curve is the *line* of the load curve while the energy is the *area* below the curve.

Peak demands and base load demands are revealed by a "load curve." A peak demand occurs when there is a relatively short-lived increase in demand which subsequently drops to previous lower levels. A typical annual load curve for a summer peaking utility is pictured below.

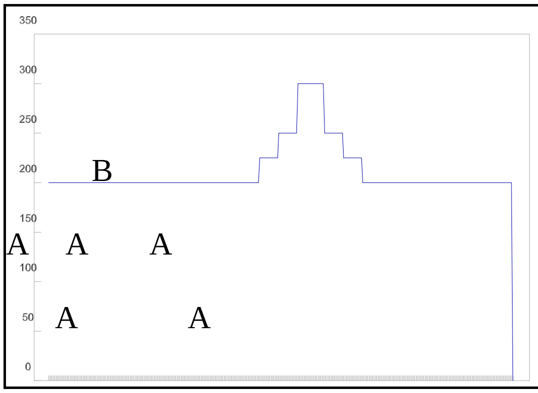

Figure 1: Typical load curve for summer peaking utility.

In this load curve, the usage generally represented by Area A is considered "base load." It is a constant, relatively unchanging, demand on the system over the period represented by the graph. In contrast, the usage generally represented by Area B is considered "peak load." It is a sharp increase in demand that persists for a relatively short period of time.

Because of its short duration, a peak demand has too few kWh of energy to cost-justify the operation of a base load plant as a means to meet the energy needs during such a period. As explained in more detail below, the high capital costs of base load capacity are only affordable if spread over a sufficiently large number of kWh to make the *per* kWh cost affordable.

It is to an explanation of different types of capacity to which we thus now turn.

Base Load Plant vs. Peaking Plant

Combining the concepts of the least-cost service obligation, peak and base load demand, and the fixed/variable cost distinction, has particular significance within the framework of base load and peaking facilities. Base load plants tend to have high capital costs with relatively low variable costs. In contrast, peaking facilities tend to have low capital costs with higher fuel costs.

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[21] The odometer of your car measures consumption. Traveling 60 miles per hour for two hours will result in the "consumption" of 120 miles.

The high capital costs of base load facilities are made affordable on a per unit of energy basis because of the large number of kWh over which those capital costs are spread. Given the magnitude of base load production, in other words, the cost *per kWh* is lower and can lead to least cost service.[22]

In this regard, therefore, not all mW of demand are equal. A 10 mW peak demand, in other words, can cost-justify a different type of plant than a 10 mW base load demand. The question involves to what extent does the type of demand *match* the type of capacity available to meet that demand. A peak demand of 10 mW, in other words, provides insufficient mWh of energy to cost-justify 10 mW of base load capacity.

As can be seen, therefore, the type of demand that a utility experiences and the type of capacity that a utility has built in response to that demand, exerts the primary influence on the amount of total dollar investment that a utility has in plant. In our illustrative load curve above, for example, the utility will have made different levels of investment to meet the different levels of demand.

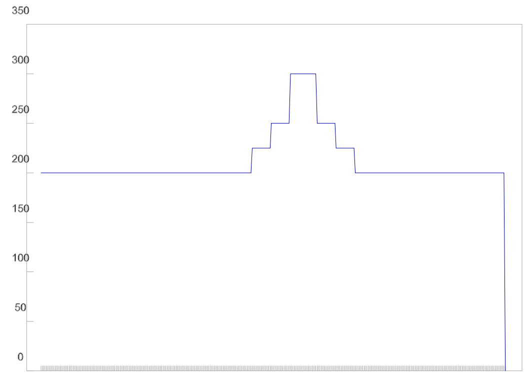

Figure 2: Match Between Capacity Type and Load Type

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[22] The discussion above, for example, shows the difference in cost *per kWh* given alternative assumptions of 1.0 million kWh production, 2.0 million kWh production, and 0.5 million kWh production.

B

A A
A A A

The usage in Area A, being base load, will be marked by large dollar capital investments in plant. Base load plants costing $2500 to $4000 per kW are not uncommon. In contrast, the usage in Area B, being peak load usage, will be marked by lower levels of dollar investment. Peak load plants costing $300 to $700 per kW are not uncommon.

In sum, a mW is not a mW. Or, to put it differently, not all mW are equal from an investment perspective. A mW of base load demand requires substantially greater investment than a mW of peak load demand.

THE IMPACT OF RETAIL WHEELING ON SYSTEM LOADS

The loss of large industrial loads to retail wheeling will likely involve the loss of large amounts of base load capacity to the local distribution utility. As a result, the loss of load to retail wheeling will not only affect the *amount* of capacity that a utility needs, but it will affect the *type* of capacity a utility needs as well.

An illustration of the loss of one or more large industrial customers to retail wheeling is set forth below. Let us assume in the "before retail wheeling" scenario that the utility's type of capacity was appropriately matched to the utility's type of demand as explained above. The utility's base load needs were met with base load plants, in other words, while its peak load needs were met with peak load plants. The utility then loses some industrial load to retail wheeling.

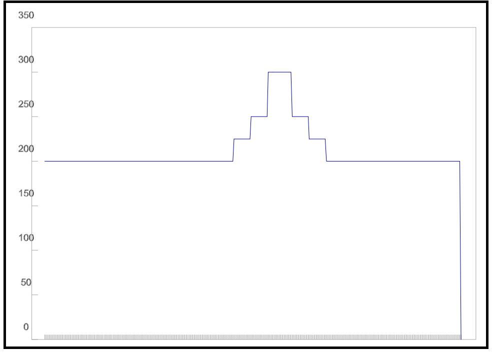

Figure 3 Pre-Retail Wheeling Load Curve

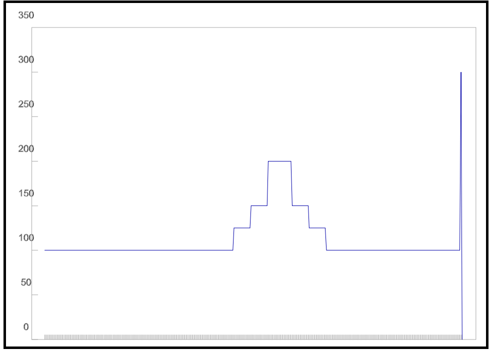

Figure 4 Post Retail Wheeling Load Curve

As can be seen in this scenario, the loss of the industrial customers in Figure 4 shifts the entire load curve downward by the mW of capacity represented by the industrial load that moved to a retail wheeling supply.

Moreover, it is safe to assume that the lost industrial load will be relatively constant, base load, usage. Conventional wisdom posits that the primary contribution to peak comes from summer residential air conditioning. If industrial customers leave, they will take base load usage with them, thus leaving the peak demand.

In this scenario, the loss of large industrial customers to retail wheeling will have two impacts on the load curves of the monopoly utility serving the remaining, captive, customers. The first and most obvious impact is that the retail wheeling loss will shift the entire total mW of demand on the utility's system downward. This will result in a mismatch between the mW of total capacity and the mW of total demand which that capacity is designed to serve. Since the utility in our illustration had capacity which exactly matched its demand before retail wheeling, the loss of some number of mW of load will result in an "over built" system by that number of lost mW. Thus the term "stranded capacity."

This, however, is the *easy* part of the analysis. As was discussed in detail above, "stranded investment" is measured in terms of dollars, not in terms of mW. Accordingly, we need to set aside the mW of stranded capacity and look for the *dollars* that are either no longer *necessary* or no longer *beneficial*.

The investment in the mW of base load usage which is no longer on the system is the set of dollars that should be considered "stranded." Examine carefully, however, why the statement above is important. The conclusion does not refer to 10 mW of generic "capacity" that is no longer needed. Indeed, given the post-retail wheeling load curve, all peaking capacity will still be required. The dollars that are stranded, therefore, do not include the investment in the (relatively cheap) peaking facilities. Nor are they an *average* investment in plant (which would blend the less expensive peaking plants with the more expensive base load plants). *The capacity which is made redundant by retail wheeling is the type of capacity that corresponds to the type of load which left the system.*

To say that the peaking facilities are the last plants to run and thus the first plants to be "stranded" is a fallacious argument. That is an argument that concentrates on mW of capacity rather than dollars of investment. The real question to ask, within the least-cost framework outlined above, is what patterns of investment would lead to the least-cost provision of service given the load left in a retail wheeling environment.

To determine the level of stranded investment, therefore, the same equation as discussed at the beginning of this paper must be answered. What combination of fixed and variable costs, given the type of load that is left on the system, will result in least-cost service? In pursuing this analysis, one finds that, given the loss of base load, there is insufficient kWh of energy left in the remaining area of peak demand to reduce the capital cost of the base load facility to an affordable level. The cost of the base load plant available to serve the mW of demand in Area B must be divided by the kWh of energy to obtain a per kWh of fixed charge. The variable fuel cots of the base load plant must then be added. This result is then compared to the total per kWh charge that results if one alternatively assumed that Area B was served by the rate represented by the sum of fixed and variable costs associated with peaking facilities spread over the same energy.

It is a virtual certainty that in this scenario, the total cost of the peaking facilities will be less than the total cost of the base load facilities devoted to serving peak demands. It is the investment in base load capacity, therefore, which has been stranded.

SUMMARY AND CONCLUSIONS

In sum, the identification of "stranded capacity" resulting from a move to retail wheeling must look *not* at mW. To look at mW would inappropriately tend to lead one to an identification of the plants serving the marginal demand in the pre-retail wheeling scenario as the stranded investment.

Instead, the dollars of investment that no longer remain "useful" should be found to be "stranded." To be useful, the investment must be either necessary or beneficial. Hence, while the mW of base load capacity may be actually used to meet the mW of peak demand, the large capital investment in such facilities is not "necessary." A smaller capital investment in the much less expensive peaking facilities is all that is "necessary" to serve that particular demand. Moreover, unless the utility can show that there are sufficient kWh in the peak to bring per kWh fixed costs low enough so that the total costs using the base load plant are less than the total costs of the peak load plant, the higher capital investment in the base load capacity is not "beneficial" either.

"Stranded investment" is an economic, not an engineering/physical concept. It is likely that the stranded investment caused by retail wheeling will be much greater than determined simply by looking at the mW of load which leave a utility's system for the greener pastures of retail wheeling. The capacity which is made redundant by retail wheeling is the type of capacity that corresponds to the type of load which left the system.