SPECIAL ISSUE

Special Electricity Issue

983

Pages 1-11

Electric Utility Capacity Expansion: Its Implications for Customers and Stockholders

by Stephen C. Peck (Electric Power Research Institute, Palo Alto, CA, USA)

Introduction

Utility company planners have for many years used the present value of revenue requirements (PVRR) as an important indicator of the outcome of their decisions. Since customers pay the utility's revenue requirements, the PVRR is an important measure from the point of view of utility customers. Yet, great dissatisfaction has recently been expressed with decisions that minimize the PVRR. An investment which minimizes PVRR is often also an investment which can land a company in serious financial trouble and reduce the wealth of the utility's stockholders. The majority of models, however, still focus on the PVRR and deal rather cursorily with the stockholders' interests. Presented in this paper is a simple model of the capacity expansion decision from the viewpoints of both the customers and the stockholders of a utility. It will be shown that to extend utility models to deal with stockholder interests, it is necessary to add: (1) a model of the relationship between utility customer outcomes and the rate of return on stockholder equity; and (2) a model of the relationship between the rate of return on stockholder equity and the value of utility company shares.

Pages 13-31

A Technology Choice for Model Electricity Generation

by Ralph L. Keeney (Systems Sciences Department, University of Southern California, Los Angeles, CA, USA)

Introduction

A major problem facing the utility industry is the choice between technologies for future electricity generating facilities. In each situation, a utility must select its best option and justify its decision to regulatory and judicial agencies, as well as to the public. This paper presents a model to assist the utility facing these tasks. Specifically, we hope to improve the utility industry's ability to make complex technology choice decisions in a consistent manner that can be logically defended before reviewers. Although only "build options" are compared, we do not assume that the utility has decided to build a facility. After reviewing the technology options, the best may then be compared with the option not to build. To achieve our purpose, the technology choice model is not limited to technological issues, but includes non-technical factors, such as regulatory delay, socioeconomic impacts, difficulties in the financial markets, and public attitudes. These factors are included by comparing power plants and the associated regulatory and decision processes leading to their existence and operation. The model is designed to be helpful after sites for each technology option and the capacity (i.e., megawatts) of the proposed facility are specified. Several sites using each technology can be compared, but it is easier first to conduct a siting study to identify a prime site for each technology.

Pages 33-53

Household Welfare Loss Due To Electricity Supply Disruptions

by Aran P. Sanghvi (ICF Incorporated, Washington, DC, USA)

Introduction

The economic consequences of an electricity supply interruption short-term outage costs and can be broadly classified into two categories - long-term adaptive response costs. The short-term outage cost is an ex post cost which measures the cost of a particular interruption to a household, given an essentially fixed electricity and energy-using capital stock. Specifically, each household has a preferred time-of-day pattern of electricity consumption. The household arrives at this preferred pattern based upon its appliance stock portfolio, daily rhythm of activity, prices by time-of-day (if such variation exists), ability to pay for electricity, and a host of other factors. The most important of these factors are the values the household attaches to the level of nutrition, comfort, labor savings, entertainment, security, and other utility-generating attributes associated with a particular level and pattern of electricity consumption.

Pages 55-74

The Cost Of Residential Electric Power Outages

by Robert W. Gilmer (Chief Economist Staff, Tennessee Valley Authority, Knoxville, TN, USA) and Richard S. Mack (Department of Economics, Central Washington University, Ellensburg, WA, USA)

Introduction

A critical input to planning by electric utilities is the cost to their customers of power outages. Figure 1, for example, shows the choice of the level of reserve generation as a comparison between outage costs and generation costs. Outage costs are assumed to decline as the margin grows, that is, as greater reliability is built into the system with spare generating capacity. The optimal reserve occurs at point A where the cost of additional generators begins to outweigh the cost of service interruptions. Furthermore, many decisions affecting the potential availability of existing capacity (such as the size of fuel inventories or maintenance schedules for generators) are tied to customer outage costs which are the penalty for failure to have capacity available. This paper assesses the cost of electrical outages to households, using customers of the Tennessee Valley Authority as an example. Unlike the industrial or commercial sectors where a loss of electric service disrupts a flow of goods and services, the residential sector has no measure of its output that is routinely valued by the market. This necessitates indirect methods to measure losses due to power outages - and perhaps explains the relative neglect of this sector in past studies.

Pages 75-91

An Integrated Approach to Electricity Demand Forecasting

by Harlan D. Platt (College of Business Administration, Northeastern University, Boston, MA, USA)

Introduction

Economists have not arrived at a consensus on the proper role of hourly load curve data in utility planning models. The electricity demand section of the planning model can either contain separate but related peak demand, energy and load shape components or an integrated load curve forecasting component. When projections come from the load curve format, peak demand is found as the maximum value of the load curve, and energy consumption as the integral of the load curve; the load shape assumes a unique value each day. With separate equations forecasting peak, energy and load shapes, it may not always be possible to ascertain whether the overall forecast is internally consistent. This drawback to separate equations seems to give load curve modeling a distinct advantage. Moreover, in the generation planning (Baughman and Joskow, 1974) and production planning (MVN, 1982) components of the utility planning model, the primary demand inputs are forecasts of the system's load duration curve and chronological load curve, respectively. These two important planning functions determine the system's future capacity needs and the optimal configuration of plants to use in meeting system requirements.

Pages 93-102

Power Factors and the Efficient Pricing and Production of Reactive Power

by Sanford V. Berg (Public Utility Research Center, University of Florida, Gainesville, FL, USA) with the assistance of Jim Adams and Bob Niekum (Departments of Nuclear Engineering and Electrical Engineering, University of Florida)

Our understanding of the efficient pricing of electricity has improved in recent years as utilities and regulators examine the implications of price signals for customers. One neglected area is the so-called power factor adjustment for large industrial customers found in most electricity price schedules. This paper identifies the relevant cost-of-service issues, describes how electric utilities tend to charge customers for costs incurred in dealing with the power factor problem, and suggests the need for changes in present pricing practices. One reason so little attention has been given to reactive power is the inherent difficulty in understanding the concept. A technical discussion of the phenomenon of reactive power involves references to resistive and inductive loads, capacitors and inductors, and kilovolt amperes. The confused economist turns to other, more pressing problems.

Pages 103-126

An Analysis of Commercial and industrial Customer Response to Time-of-Use Rates

by Joseph G. Hirschberg and Dennis J. Aigner (Department of Economics, University of Southern California, Los Angeles, CA, USA)

Introduction

Recently there has been much interest in time-of-use (TOU) pricing structures for electric utilities. Time-of-use pricing provides a mechanism for reflecting more closely the costs of supplying electricity, which vary over the course of a single day as well as over days of the week and by season of the year. Although such pricing structures have long been used in Europe, they did not receive much attention in the United States prior to 1974. Only recently have the effects of TOU pricing on large industrial and commercial customers been assessed. Even so, the bulk of these are comparative studies (e.g., SCE Revenue Requirements Dept., 1980) that do not attempt to estimate specific price effects. In the work by Chung and Aigner, however, kWh price elasticities were estimated for 64 customers in 13 four-digit SIC code groups in Pacific Gas & Electric Company's A-23 rate class, which consists of approximately 133 customers with billing demands in excess of 4000 kW. In this paper we apply an improved version of the Chung-Aigner econometric framework to individual firm data for the Southern California Edison Company's (SCE) TOU-8 rate class.

Pages 127-140

The Economics of Electricity Demand Charges

by J. Stephen Henderson (National Regulatory Research Institute, The Ohio State University, Columbus, OH, USA)

Introduction

Virtually all industrial customers of privately owned electric companies and most commercial customers are billed both for electric energy (in kilowatt-hours) and for their own maximum demand (in kilowatts). The price for the maximum demand is called the demand charge by the electric industry while the kWh price is the energy charge. A demand charge provides an incentive for customers to smooth out their time pattern of consumption and improve their own load factor by reducing their maximum demand. This behavior, in turn, may have a favorable effect on the utility if the system-wide peak demand is reduced. This paper has two purposes. The more important one is to present estimates of the effects that demand charges have on the demand for electricity and to understand in turn how system peak demand is affected. A secondary purpose is to discuss the social welfare implications of this type of pricing. Despite the relatively rich U.S. experience with demand charges, only a few studies have included them. Spann and Beauvais (1977) use demand charges to estimate peak demand from monthly time-series data for one utility. The econometric studies of Mount, Chapman, and Tyrell (1973), Baxter and Rees (1968), and others reviewed by Taylor (1975) have not included demand charges. Marchand (1974) and Dreze (1964) considered the welfare maximizing price for demand variance that is closely related to the concept of demand charge.

Pages 141-151

Distributed Lags and the Demand for Electricity

by Ronald J. Sutherland (Los Alamos National Laboratory, Los Alamos, NM, USA)

Introduction

Empirical evidence is presented in this paper on the distributed lag effect of the price of electricity, gross national product (GNP), and the price of a substitute fuel (natural gas) on the quantity of electricity demanded. Distributed lag coefficients, estimated by the Almon procedure, are used to infer long-run price, income, and cross-price elasticities. The long-run demand for electricity in the residential and commercial sectors is estimated to be price elastic, with elasticities slightly greater than two. Demand in the long-run appears to be income inelastic, but elastic with respect to the price of gas. Most of the electric demand studies in the literature employ a partial adjustment model that results in a final-form equation that includes a lagged dependent variable. The well-known statistical consequences of this specification include biased and potentially inconsistent regression coefficients. A further implication of this specification is that each independent variable has a geometrically declining lag structure with an identical rate of adjustment. To overcome these limitations, a more flexible statistical procedure, the Ahnon technique, or polynomial distributed lag, is used here to estimate the length and shape of lag structure in an electric demand function.

Pages 153-162

Asymmetry in the Residential Demand for Electricity

by Trevor Young (Department of Agricultural Economics, University of Manchester, England) Thomas H. Stevens, and Cleve Willis (Department of Agricultural and Resource Economics, University of Massachusetts, Amherst, MA, USA)

Introduction

Much attention has been focused on the measurement of the price elasticity of electricity demand, as this information is necessary for forecasting energy consumption, for investment planning, and for national energy policy. Although there is an otherwise impressive body of econometric literature on residential demand for electricity, there does not appear to have been a systematic investigation of the possibility of asymmetry of consumer response to changes in price or other market conditions. The notion that the demand function for a product may be asymmetric is attributed to Marshall (1927). According to Marshall, asymmetry could be traced to habit formation, namely, "habits which have once grown up around the use of a commodity while its price is low are not quickly abandoned when its price rises again." Scitovsky (1976, 1978) recently re-examined asymmetry in demand analysis and argued that "asymmetry is pretty nearly universal." A consumer may become attached to any aspect of a higher standard of living once he has experienced it. Graphically, the demand curve becomes kinked, so that the response to a price rise is less elastic than a price fall over the relevant range. Taylor (1975) and Halvorsen (1975) have recognized that habit formation may be a feature of the demand for residential electricity.