N80 24786

SPS MARKET ANALYSIS

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ABSTRACT

Advanced Energy Department of General Electric is performing a study for JPL on the Effects of System Factors on the Economics of and Demand for Small Solar Thermal Power Systems (SPS). Study goals are to estimate market penetration as a function of time, SPS performance factors, and market/economic considerations, and to formulate commercialization strategies. A market analysis task has included personal interviews by GE personnel and supplemental mail surveys to acquire statistical data and to identify and measure attitudes, reactions and intentions of prospective SPS users. Over 500 firms were contacted, including three ownership classes of electric utilities, industrial firms in the top SIC codes for energy consumption, and design engineering firms. A market demand model was developed which utilizes the data base developed by personal interviews and surveys, and projected energy price and consumption data to perform sensitivity analyses and estimate potential markets for SPS.

INTRODUCTION

This presentation reviews the on-going GE Advanced Energy Department study of Effects of System Factors on the Economics of and Demand for Small (1-10 MWe) Solar Thermal Power Systems (SPS). The study goals are to estimate market penetration rates for these systems as a function of time, SPS performance factors and market/economic considerations, and to develop cost effective strategies for accelerating the market penetration rate for promising near-term applications. Three major tasks comprising this study include: market analysis, market penetration sensitivity analysis, and commercialization strategy formulation. This review summarizes the market analysis tasks, with emphasis on results obtained from the personal interviews and mail survey conducted. The market demand model is also presented.

STUDY APPROACH

A nationwide study was conducted among three major classes of utility ownership, i.e., investor-owned utilities, rural electric cooperatives, and municipal systems, among the top eight energy consuming classifications of industrial firms, and among selected design engineering firms. Types of industrials contacted in the study included chemicals, paper, food, transportation equipment, textiles, stone, clay, glass, petroleum refining, and others. Firms in all fifty states were included in the study sample. The selection of industrial firms included an equal number of firms with and without in-plant generation equipment to help remove bias caused by this variable. Similarly, the electric utility firms contacted included both firms which generated all or part of their power requirements as well as non-generators which function as distributors and resellers of electric power.

Over 240 industrial, 200 utility and 70 design engineering firms were contacted. Although there were some firms which declined to participate in the study for a variety of reasons, the overall response rate has been high and is currently about 60%.

Personal interviews were conducted by project personnel and members of GE Industrial Sales and Electric Utility Sales Divisions. In addition to the market study information provided by the firms being interviewed, many of the GE field sales engineers provided their views and comments on the SPS and potential for applications of solar electric systems. Confidentiality of data provided was stressed with all respondents and was a key factor in their study participation, particularly in providing financial and investment criteria information.

In addition to personal interviews, a supplemental mail survey activity was conducted. A list of firms was carefully compiled to assure that it was as representative as possible and with minimum biases. All firms were contacted in advance to verify name, title, and address of the survey respondent. Each individual was sent a personal letter from the GE Program Manager soliciting participation in the sutdy, material describing the SPS and a comprehensive questionnaire. After a reasonable period of time, all who had not responded were contacted to verify receipt of the survey package. Duplicate mailings were sent to anyone who had not received the original mailing. Telephone interivews were conducted by professional interviewers in those cases in which the survey package had been received, and the respondent preferred such an interview rather than returning the completed questionnaire. To reduce bias resulting from a detailed technical evaluation of systems concepts by study participants, only a broad overview of the solar systems being considered by JPL was given. System configuration data and cost estimates were derived from data provided by JPL. Both the distributed collection central generation and distributed generation concepts were presented to encompass systems with and without process steam output. Sufficient detail was given to enable respondents to answer questions regarding the possibility that they would consider an SPS as a possible power plant option in the 1990 time frame. SPS land area requirements for three representative solar regions of the country were developed, as well as projected system and busbar energy costs for each region. SPS capacity factor of forty percent was used in the system descriptions.

INITIAL FINDINGS

Industrial Firm Responses

Primary reasons for in-plant generation were determined from responses of industrial firms which now generate all or some of their electric power requirements. Reasons stated in descending order of importance include; the fact that generation is a by-product of steam production, that is is less expensive than purchased power, that it provides a non-interruptible power source, or that the firm has an inexpensive fuel source.

Information on plans for dealing with future energy requirements was also solicited, and provided data on plans for conversion to other fuel types, adding or replacing existing in-plant generation equipment, or purchasing of greater proportions of electrical needs.

Among the factors which would have the most influence in consideration of purchase of a SPS in the 1990 time frame, the list included; meeting the company's financial criteria for capital investments, lower operating costs than conventional systems, tax credits, delivered energy costs (¢/kWh), and ability to fossil fire the SPS to achieve higher capacity factor. The least influential factors included; appearance or aesthetics of the systems, modularity and relocatability, loan guarantees, and the exchange of excess power with local utilities.

Fifty-six percent of the industrial firms contacted stated that they would consider the SPS as an option in the 1990-time frame. Of these positive responses, 59% felt that the SPS would most likely be considered as an addition to their present generating equipment, 27% as a replacement for the generation equipment now on-line, and 21% as a system to repower existing power plants. Due to multiple answers by some firms, these total over 100%. Major SPS benefits perceived included fuel availability, energy price protection, clean non-polluting system, and availability of steam or process heat. Major drawbacks were cited as land cost and availability, busbar energy cost, system capital cost, and low capacity factor.

The mean after tax rate of return on investment (ROI) required was 19 percent. The average price of industrial land suitable for installation of the SPS was $20,600 per acre. Land prices varied from a few hundred dollars to over $100,000 per acre.

Electric Utility Responses

An overall positive response rate of fifty-five percent was expressed by utility firms with regard to whether they would consider an SPS as a power plant option in the 1990-time frame. Among those responding in the affirmative, 76% perceived the SPS as an addition to present generating capacity, 14% as a system for repowering existing power plants, and 16% as a replacement for generating equipment now on-line.

The most influential factors considered by utilities in the purchase of an SPS were meeting the firms' capital investment requirements, busbar cost of electricity, lower operating costs than conventional systems, initial system price ($ per kilowatt) and demonstrations of SPS in the local area. The least influential were availability of process steam, usability to power existing plants, and tax credits. Major benefits perceived included transmission savings, price protection, fuel availability, and clean non-polluting system. Major drawbacks to SPS perceived by utilities were low capacity factor, land cost and availability, system capital costs, and non-proven technology.

The average fixed charge rate for utility firms was approximately twenty percent, while the required ROI was about twelve percent. The price of suitable land for SPS utility installations averaged $8,700 per acre.

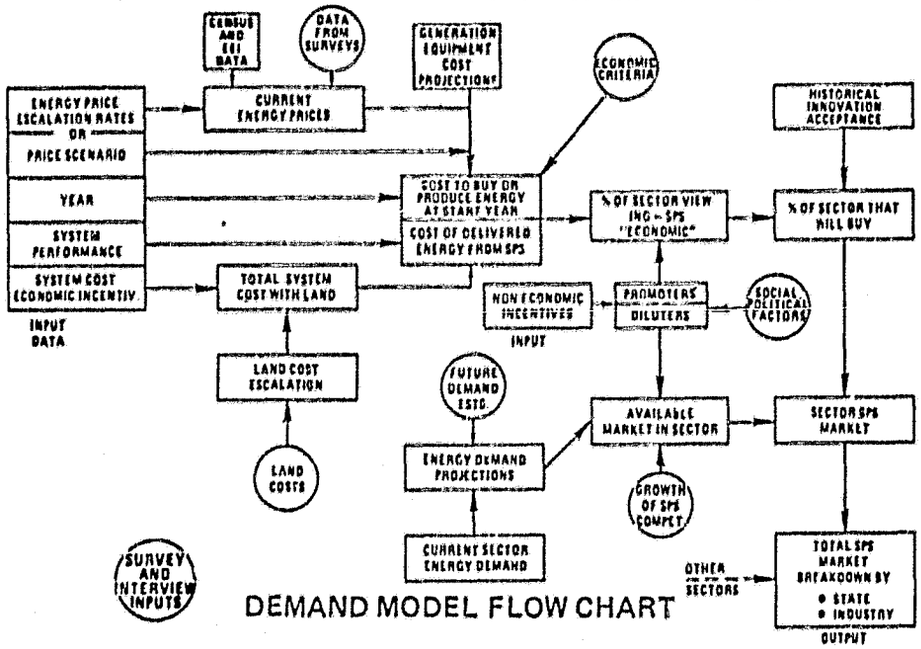
Design Engineering Responses

The seventy design engineering firms were contacted for qualitative data and to

obtain their views and reactions to the two system configurations presented. The SPS configuration option featuring central generation was preferred 2:1 by the design engineering firms responding. Most were concerned about solar energy variability and felt that supplemental fossil fuel firing for added capacity factor was important. The availability of process steam as an output was a desirable feature. In general, these firms were not as concerned about land cost and availability as industrial and electrical firms contacted, perhaps reflecting the fact that they may be somewhat insulated from the effects of land costs.

MARKET DEMAND MODEL

A schematic diagram of the SPS demand model is shown below.



DEMAND MODEL FLOW CHART

Principal user inputs to the model include: year for which SPS market estimate is desired, SPS cost estimate at that time, SPS performance - electrical and thermal output (including variation with insolation level), applicable economic incentives such as tax credits, either a future energy price scenario or, alternatively, price escalation rates which the model can apply to current price levels.

Model output is an estimate of SPS total industrial market at the year of interest and a breakdown by individual sectors - industries and states. Exercise of the model for a series of years and corresponding system costs will yield a market penetration scenario. Input parameters can be varied to test the sensitivity of each on the rate of penetration.

The data model input includes Edison Electric Institute data on energy prices and Survey of Manufacturers data on energy prices and energy consumption. Price and consumption data are augmented with data from the personal interviews and mail survey.

Principal interview and survey inputs to the model include (in approximate order of importance): economic criteria applicable to investment in equipment such as SPS, land availability and cost, non-economic influences (such as pollution problems, energy curtailment protection, etc.), strategies to meet future energy requirements, and desirable SPS system characteristics.

Actual treatment of these inputs in the model depends on the type and quality of interview responses. Items such as land costs and economic criteria are found to be statistically distributed so as to be representable by standard distribution curves in most sectors. Where this is not the case, tabular data is utilized.

Within a sector, given land cost distribution and the input system cost, a total cost distribution is first computed. Energy price for the sector at the reference year is obtained either from the input price scenario or from current prices and the input escalation rates. The economic criteria distribution is then employed to determine, based on energy price versus SPS performance and cost, what portion of the sector will view SPS as economic or cost effective.

Once economic viability is reached, SPS penetration rate will be assumed to follow historical patterns typified by the Fisher-Pry substitution model. The available market within a sector will be established from current sector energy requirements and future projections. Interviews and surveys have identified market diluters, such as land non-availability, that reduce the available SPS market size. Combining the available sector market with the above determined penetration rates yields the estimated SPS market at the particular point in time of interest. Combining all sectors yields total SPS market. Data on product technology substitutions experienced by the General Electric Company in various power generation equipment fields will be used in establishing a historical trend data base for the model. The SPS demand model is easily expandable to more sectors either to enlarge the scope of the market assessment or to "fine tune" the results.

CONCLUSIONS AND COMMENTS

The high response rate from industrial, utility and design engineering firms achieved during the market analysis task is a strong indication of a high level of interest in SPS. Data obtained from the personal interviews and mail survey activities is now on computer files. There are approximately 140 variables associated with each industrial questionnaire and 100 with each utility questionnaire completed. The data base contains information on present and future electrical requirements, electricity purchases and in-plant generation, process steam use, options for dealing with future energy requirements, land costs, investment criteria, and factors which would influence SPS purchase considerations by industrial and utility firms and other such information. The demand model and this data base provide a means for performing market penetration rate sensitivity analyses using actual industrial and electric utility data, and in helping to identify potential SPS demonstration sites and applications.. Formulation of commercialization strategies will benefit from and rely heavily on these market analysis results.