INTEGRATING CONSERVATION SUPPLY INTO AUSTIN'S LOAD FORECAST

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ABSTRACT

In 1982 the City of Austin chose to displace one conventional baseload fired power plant with a 553 MW mix of alternative generation, conservation, load management and innovative rates and regulations. In the four years that have elapsed since Austin adopted this ambitious goal, the programs have evolved and matured to the point where they can be integrated into the electric utilities load forecasting and generation planning process. This paper addresses the theory and practical issues of integrating conservation supply into load forecast and power supply planning based on the experience of Austin Conservation Power Plant programs.

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INTRODUCTION

In 1982 the Austin City Council adopted their municipal electric utility's goal of implementing a 553 MW conservation and alternative generation plan to substitute for a planned baseload coal fired power plant. The Conservation Power Plant is a distributed and dynamic example of cost-effective demand side management. The programs in the plan cover not only demand side management but also the potential of alternative generation, innovative rates, and regulations such as energy efficient building codes. The major focus of this paper is the assessment of these demand side programs for load forecasting.

Primarily, Austin's programs are designed to promote the adoption of end-use efficiencies by combinations of incentives, education and market adjustments. While the theoretical concepts of demand side management have gained acceptance by public and private utilities and the agencies that regulate them, the approaches used to achieve the projected conservation potential require changes in technologies and marketing and require a continuous focus on reliability. This is especially so if the potential conservation supply is, as in Austin's case, incorporated into the utility's load forecast and generation plan. The Austin Electric Utility and the City's Resource Management Department have worked together to develop a variety of systems approaches to monitor the impacts of the programs. The key issues are validity of the assumptions used in both the program assessment and the integration of the programs into the utility's load forecast.

PRACTICAL ISSUES OF INCORPORATING CONSERVATION SUPPLY INTO AUSTIN'S LOAD FORECAST

The integration of conservation supply into the load forecast requires that the potential of conservation and efficiency programs to reduce consumption be of a sufficient magnitude to be a factor in power resource planning and operations. For the utility, the programs must succeed to the extent that the effects are predictable, measurable, and reliable over time. For programs to be readily adopted by customers, we assume that they will reduce customer cost immediately, are cost-effective, and have a reasonable payback period for the customer's investment. Predictability refers only to those measures and technologies adopted and installed by customers or the utility that can be measured using engineering estimates. Those reductions in energy use that are based upon changes in human behavior or reductions in convenience are not considered in estimating the effects of Austin's conservation load forecast because they are voluntary and are likely to be unpredictable in both time and duration. However, even the use of accepted engineering calculations to predict the reduction of consumption due to improvements in thermal efficiency or appliance efficiency may lead to overestimation of conservation impacts. (1.)

STRATEGIES USED IN ESTIMATING AND EVALUATING PROGRAM EFFECTS

The assessment of the Conservation Power Plant Program occurs during four periods in the program planning and implementation process. There is considerable integration among all three stages of evaluation, especially through the use of established tools and existing data bases. The four critical periods of evaluation are:

1) Program selection and program mix phase

2) Program pilot or test phase

3) Annual assessments for load forecasting

4) Mature program evaluation.

The tools used in these assessments include surveys, customer data bases, computerized analysis models, and actual metering data.

A. Data Bases and Surveys

Program specific data can be used to analyze many issues beyond those related directly to the analysis and evaluation of that program's performance. For example, data gathered during the residential energy audits on recommended measures will be used in designing new rebate programs. Customer and vendor surveys are also useful in developing marketing techniques for new and existing programs. The data bases derived from actual program implementation are the most valuable resource. The collection, compilation, and review of survey materials, data bases, and their design are critical to both process and impact assessments of the Conservation Power Plant programs.

B. Computerized Planning and Forecasting Models

The Electric Utility and Resource Management Departments use several computer models in economic assessment, load forecasting, and generation planning. The departments share the existing tools and are in the process of acquiring additional programs. Forecasting tools and computerized economic and energy use models are useful in all evaluation periods. The potential use and quality of results from these tools are based entirely on the quality of available data; accordingly, Resource Management and the Electric Utility continue to refine data base inputs used by these computer programs.

C. Building Energy Use Analysis Programs

Several detailed computer programs are used to predict residential and commercial building energy use.

These programs fill a variety of needs for conservation program assessment and evaluation including:

1. Determining cost/benefits of specific retrofit recommendations

2. Predicting kilowatt and kilowatt-hour savings of energy saving products and designs

3. Determining "baseline" buildings for residential and commercial sectors.

D. Metered Program Savings

Several strategies are being developed to meter conservation and load management programs in an attempt to obtain empirical evidence of actual demand savings. The strategies are determined by the individual conservation program's goals, objectives. Ideally they include control groups and pre-and post-program analyses. The results from metering are suitable for evaluating programs already in place as well as estimating the impacts of potential future programs. The major objectives for the metering efforts are:

1. To measure the amount and time of demand (kilowatt) savings from conservation programs for the whole building and/or specific end-uses.

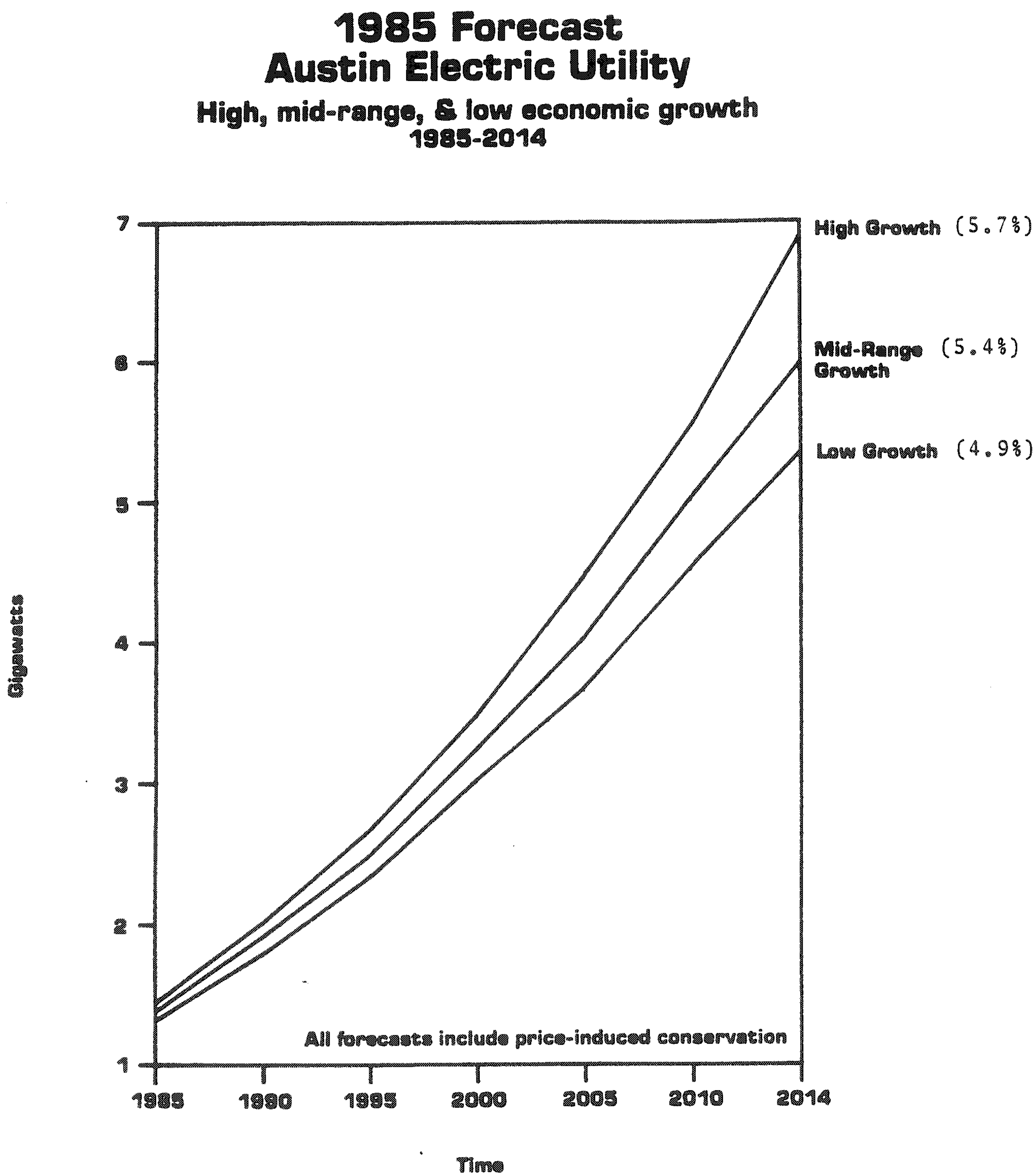
2. To determine from the metered data which end-uses are being reduced or shifted off-peak.

3. To determine which customer classes, building types, and appliances offer the best targets for demand reduction.

The first phase of program assessment takes place during program selection. This process is not described in depth in this paper, however, the reader may refer to Volume I of Austin's Conservation Power Plant Plan. The process is briefly described in the flow chart presented as Figure 2.

During this phase, the preliminary assessments of program penetration rates, engineering estimates of kilowatt and kilowatt hour savings and budgeted program cost are made. In addition, the program is analyzed for cost-effectiveness using a version of the California Standard Practice Cost Benefit Model. Once a program has passed these preliminary tests, it is budgeted and included in the development of the load forecast.

FIGURE 2


1985 Forecast
Austin Electric Utility
High, mid-range, & low economic growth
1985-2014
High Growth (5.7%)
Mid-Range Growth (5.4%)
Low Growth (4.9%)
All forecasts include price-induced conservation
Gigawatts
7
6
5
4
3
2
1
1985
1990
1995
2000
2005
2010
2014
Time

The second through the fourth phases of program assessments depend on the integration of all the types of program monitoring and evaluation tools. These include: surveys and market analyses, customer data bases, computerized planning and forecasting models, building energy use analysis programs, the integration of metered program savings and internal process evaluations and auditing.

CONFOUNDING ISSUES IN PROGRAM ASSESSMENT

The dynamic nature of program participation, varied customer characteristics, and the nature of program savings highlights the difficulty of gathering definitive estimates of the impacts of the conservation and load management programs. Yet, this is critical if we are to rely on the inclusion of conservation savings into the utility's load forecast. All mature (two years of program operation) conservation programs are thoroughly evaluated for processes and impacts, including weather corrected analysis of billing data. Austin's programs are only just now beginning to collect metered end-use data on program effects. These empirical data will greatly enhance our ability to rely on programs for actual energy use reduction. Nevertheless, any evaluation strategy, no matter how comprehensive, is subject to inherent limitations. Some of the confounding factors that cloud our efforts to predict and evaluate program impacts include:

1. Drawing conclusions from program results may overlook non-program factors that contribute to the results. For example, comparisons of program participants with non-participants may be obscured by the fact that most participants are a self-selected group. Conservation and load management program participants tend to have higher income and education levels, own their own buildings, be responsible for paying their own utility bills, and have greater awareness of energy issues and economics then non-participants. These differences would yield different consumption patterns even without the effects of the program.

2. Savings may not be attributable only to the programs. Other key factors which may be affecting usage patterns include weather conditions, increases or decreases in utility rates, conservation measures taken outside the programs, and changes in residential or commercial building use over a period of time. Some of these factors are measurable in evaluations of weather corrected billing data. However, for new programs they are difficult if not impossible to estimate.

3. Determining pre-program characteristics and practices suffers the flaws inherent in self-reporting; the respondents often do not remember after-the-fact practices, and they are inclined to report what they think the questioner wants to hear.

4. Energy efficiency technology is extremely dynamic and the programs are designed to be flexible enough to adopt new technologies as they come on the market. An example of this is the incorporation of high efficiency florescent bulbs into a lighting program in mid-year. As a result, the savings estimates and penetration rate change dramatically.

5. It is difficult to perform pre- and post-program comparisons on individual participants of programs addressing new buildings, a major thrust of Austin's conservation programs. During the construction process, energy use analyses could be conducted using original building design versus energy efficient design. This process is expensive and cost-prohibitive.

Notwithstanding these limitations, the assessment and evaluation tools described are used to conduct several levels of program assessment and evaluation. On-going program operations are monitored to provide periodic analysis of individual program pace, cost and penetration, and these factors are often used as management tools to improve program delivery. The aggregate program results are considered valid enough to use in the utility's load forecast and generation plans.

INTEGRATING CONSERVATION INTO THE LOAD FORECAST

While the Austin Electric Utility's 1982 Generation plan included an estimate of the effects of conservation, alternative generation and building code changes, the actual predicted effects of conservation and load management programs were not included until the 1985 Load Forecast. The 1985 Load Forecast also incorporated the use of residential end-use and econometric energy models to project long term sales to energy customers. The forecast itself is presented as a range derived from varying assumptions of economic growth and the impact of the programs.

Three levels of economic and demographic growth were projected:

1. High-Higher than recent economic and demographic growth; 5.7% compounded annual growth,

2. Mid-Range-Continuation of recent growth trends; 5.4% compounded annual growth, and

3. Low-Lower than recent economic and demographic growth; 4.9% compounded annual growth.

(See Figure 2)

Each of these forecasts included assumed effects of price induced conservation, or the attempts by customers to conserve energy as a response to increasing prices of electricity.

The three levels of econometric and demographic growth for Austin were derived from historic data from the utility including fuel prices, income, weather and numbers of customers as well as historic peak demand. These projections were fed into the end-use models and validated using actual electricity use from 1980 to 1984.

The impacts of the conservation programs were modeled by developing a range of high, medium and low penetration rates for the combined programs. The effects of the varying ranges of conservation impacts were applied to each of the three levels of economic growth, resulting in a twelve line forecast (Figure 3) with compounded annual growth rates ranging from 4.9% to 5.7% per year.

Developing the high, medium, and low ranges of the conservation forecast was largely based on assumptions as we had only two years of program participation to work with. Many of the programs included were barely out of their pilot phases, some of them were only on paper. The mid-range projection represented our best bet based on existing and planned program assessments developed for the Conservation Power Plant Plan. A worst case, or low projection, assumed that only 75% of the estimated mid-range forecast would occur due to lower participation. For the high range we estimated a 25% increase in the number of participants for each program. (Figure 4)

RECONCILING THE FORECAST WITH THE REALITY

The actual demand usage for the Austin's Electric Utility for the period forecast in 1985 was 1320 MW. This exceeded the utility staffs projection by 20MW . The actual amount of conservation supply generated during this period fell very near our mid-range projection. Figures 4 and 5 show the projected high economic growth forecast incorporating the mid-range conservation forecast. The term actual is applied rather loosely in this case, as it is not based on metered program data. Rather the savings are based on statistically derived estimates from weather corrected billing data of previous program participants.

FIGURE 3

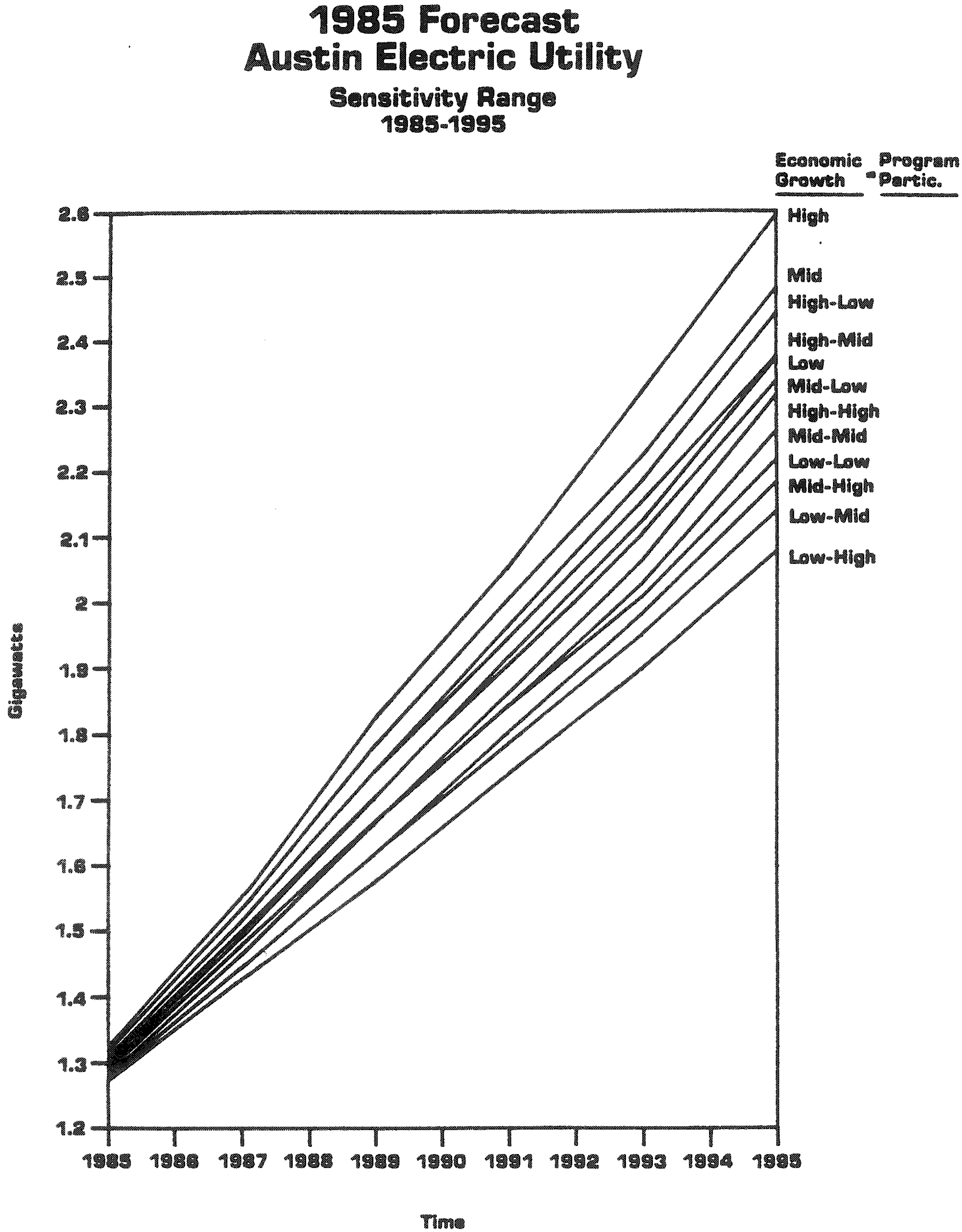

1985 Forecast
Austin Electric Utility
Sensitivity Range
1985-1995
Economic Growth
Program Partic.
High
Mid
High-Low
High-Mid
Low
Mid-Low
High-High
Mid-Mid
Low-Low
Mid-High
Low-Mid
Low-High
Gigawatts
2.6
2.5
2.4
2.3
2.2
2.1
2
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
Time

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FIGURE 4

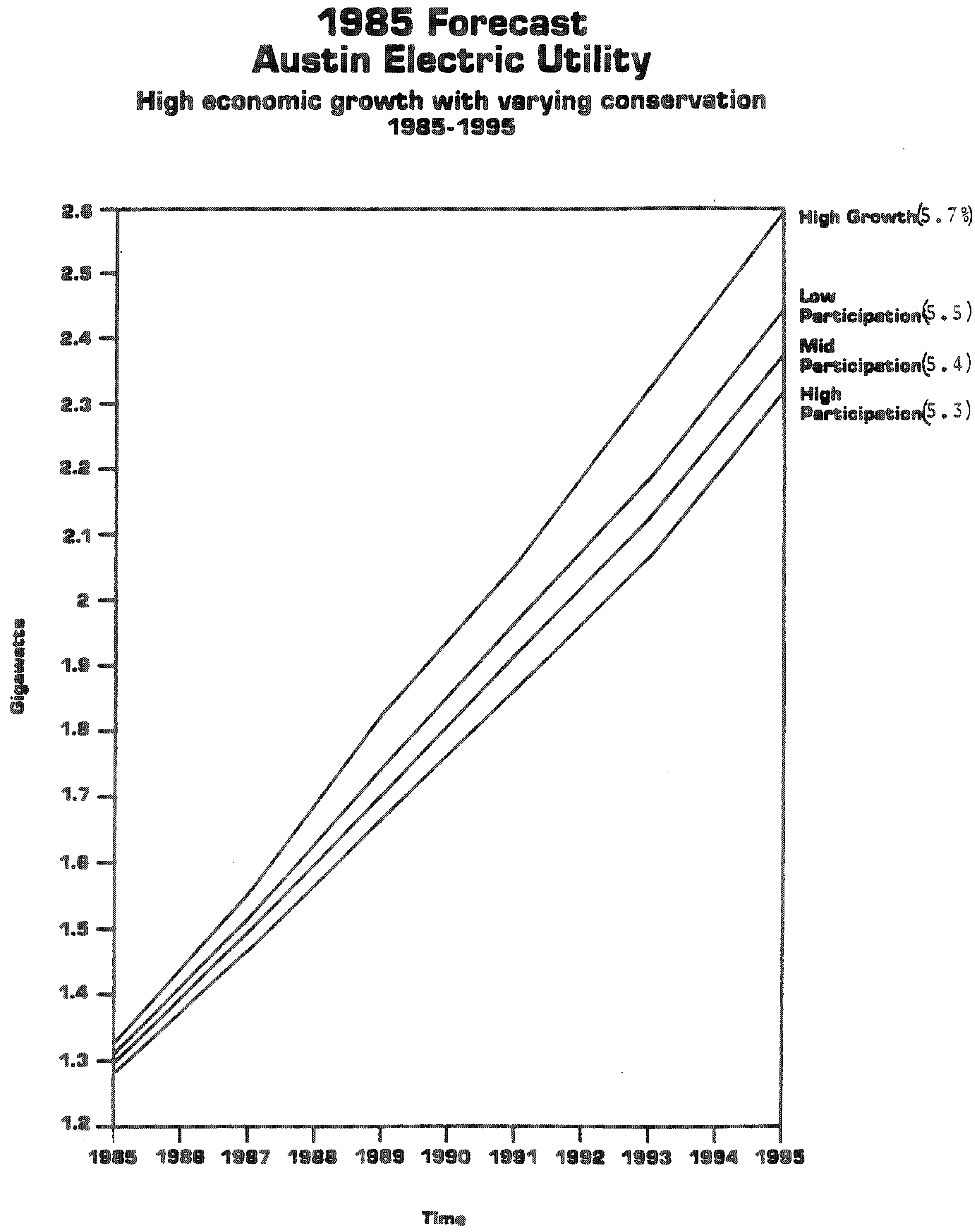

FIGURE 5

RANGE OF PROJECTED CONSERVATION AND LOAD MANAGEMENT SAVINGS (MW)

	PRICE-INDUCED CONSERVATION INCLUDED IN:			CITY PROGRAM SAVINGS BASED ON:		
YEAR	High Economic Forecast	Mid-Range Economic Forecast	Low Economic Participation	High Participation	Mid-Range Participation	Low Participation
1985	5	5	5	31	18	6
1986	12	12	11	56	38	21
1987	18	18	17	85	61	37
1988	19	18	18	115	85	54
1989	20	19	18	148	110	72
1990	21	20	19	173	129	85
1991	22	21	20	195	147	98
1992	23	22	21	217	165	112
1993	24	23	22	239	182	125
1994	26	24	23	262	200	138
1995	27	25	24	284	218	152
1996	28	27	25	309	238	167
1997	30	28	26	334	258	182
1998	31	29	27	359	278	197
1999	32	30	28	384	298	212
2000	34	32	29	409	318	227
2001	35	33	30	434	338	242
2002	37	35	31	459	358	257
2003	38	37	32	484	378	272
2004	40	38	33	509	398	287
2005	42	38	34	534	418	302
2006	44	40	35	559	438	317
2007	46	42	36	584	458	332
2008	48	44	37	609	478	347
2009	50	46	38	634	498	362
2010	52	49	39	659	518	377
2011	54	51	40	684	538	392
2012	56	53	41	709	558	407
2013	58	55	42	734	578	422
2014	60	57	43	759	598	437

Notes: (a) 25 MW of conservation savings have been achieved through 1984.
(b) The City of Austin Electric Utility is currently committed to 121.3 MW of generation from alternative fuel sources, provided from:
(1) Valley View Biomass - 2 Units, 49 MW each (1986 + 1987) (3) Refuse Plant, 20 MW (1988).

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Figure 7 below provides a comparison of the predicted savings with results from actual program participants.

FIGURE 7

PROGRAM	PREDICTED MID-RANGE MW	ACTUAL MW	% DIFFERENCE +, (-)
Residential Audit/Loan	3.51 MW	3.87 MW	10%
Appliance Rebates	12.39 MW	14.14 MW	14%
New Home Rating	.49 MW	.28 MW	(43%)
Commercial Lighting	1.17 MW	.77 MW	(34%)
Municipal Program	.58 MW	.04 MW	(93%)

As Figure 7 clearly shows, we were able to forecast penetration rates and savings for the mature programs - the Residential Audit/Loan program and the Appliance Efficiency program - within 10-15%. However, our abilities to forecast for the pilot or newly instituted programs ranged from poor to abysmal. This only points up the need for extreme conservatism in predicting the adoption and savings in new programs.

CONCLUDING REMARKS

Predicting and measuring the impacts of conservation and load management programs are difficult problems for a variety of reasons including varying ranges of customer response and behavior, the range of weather effects, and rapid changes in technology. An additional key issue is the need to sort out natural market induced and price elasticity effects from program induced conservation supply.

The methods to analyze the impacts of the programs need to be incorporated early in the program plan. If possible, baseline assumptions of conservation or efficiency investments by consumers need to be established before program implementation. There is a considerable range in methodology and costs of various levels of monitoring and evaluation. However, as the savings of the programs continue over time and their impacts are included in the forecast, the care and attention paid to reliable program evaluation becomes critical.

REFERENCES

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3) Forecast of System Energy and Peak Demand - City of Austin Electric Utility - 1985.