WHAT ARE THE NET IMPACTS OF RESIDENTIAL REBATE PROGRAMS?

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ABSTRACT

Utilities planning to undertake an appliance rebate program typically evaluate the program's cost-effectiveness after accounting for an anticipated level of free-riders -- customers who would have bought the efficient appliance without a rebate. This paper reviews ten utility rebate program evaluations to determine whether national experience is convergent on the proportion of free-riders that assail rebate programs. Although each program evaluation differs in its survey methodology, analytical method and geographical region served, the studies point to a net impact of 25% to 33% (that is, 67% to 75% of participants are free-riders).

The paper briefly reviews the methodological strengths and weaknesses of several of the program evaluations, focusing on five studies conducted by California utilities. Through the methodological review, the paper provides program evaluators with a discussion of eight potential analytical pitfalls that should be addressed in order that the resulting net program impact estimates be defensible.

Finally, the paper concludes with suggestions for further research in rebate program evaluation. These are the need for a systematic investigation of the impact of altemative program designs, and evaluations based on measured appliance sales data.

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It is not news that a species of people known as "free-riders" participate in utility-sponsored appliance efficiency incentive programs, nor is it news that their participation reduces the cost effectiveness of these programs. A program's cost effectiveness is driven by the program's net impact -- the number of purchases of efficient appliances that were stimulated by the incentive and would not have occurred in the absence of the program. What may be news to utilities or governmental agencies conducting or planning incentive programs is the net impact that they can expect to obtain, given the experience of those who have gone before them.

This paper reviews ten studies that were conducted on appliance incentive programs since 1983 and seeks to address several issues. To what degree is there consistency among the study findings on program net impacts? Are the evaluation methodologies used in each study to estimate net impacts equally robust? What range of techniques have been used to estimate net impacts and are they conclusive in their findings, or are further evaluations needed?

The paper is based on research conducted by XENERGY for the California Energy Commission (CEC) and draws heavily upon the findings presented in the study's final report. The CEC directed the study to focus on the California experience: five of the ten program evaluations reviewed in this paper were conducted by California utilities. A caveat to the study is that it was not designed to include all incentive program evaluations nor to select "representative" studies, whatever that might be.

The California evaluations in this study are those that were made available to us by Pacific Gas and Electric and Southern California Edison staff, and the non-California evaluations are drawn from those made available to us by contacts with various utilities and through published articles. Following the directions of the CEC, the California program evaluations were assessed in a thorough, detailed manner. The findings of the non-California evaluations were summarized without a critical assessment of the techniques employed.

The remainder of the paper is organized into five sections: methodology; assessment of California program evaluations; discussion of non-California program evaluations; comparison of net-to-gross ratio estimates; and a discussion of "do rebates matter?".

METHODOLOGY

We conducted an in-depth evaluation of five California program evaluations -- the reports prepared by the utilities that present their findings on net program impacts. Because the net impact is the indication of those purchases that would not have occurred in the absence of an incentive program, it can only be estimated, and not measured in a scientific sense. Thus, a starting point in comparing net impact estimates obtained from different programs is to evaluate how these estimates were derived. In this study, we critically review each California program evaluation according to a number of issues, including how the net impact was calculated, the type of data used, the questionnaire design, data biases, estimation errors, and the time frame in which the analysis was conducted. Based upon this review, we

assess whether the reported estimates are likely to be biased and, if so, the likely direction and magnitude of the bias.

There are a number of complex issues that affect the estimation of program impacts. This study investigates eight.

- Estimating "net impacts" -- What are the techniques used to determine the conservation actions that would not have occurred in the absence of the program?
- Participation bias -- Do current program participants differ from potential future participants?
- Price elasticity -- Is there a "snapback" effect where customers consume more in response to conservation savings?
- Measuring operating efficiencies -- Do efficiencies actually obtained once the appliance is installed and in use differ from estimated or rated efficiencies?
- Persistence -- How long do DSM program impacts last?
- Inertia -- How much time elapses subsequent to participation before customers undertake actions that result in load shape changes?
- Data collection issues -- Is sample bias or response bias present in the data available for program evaluation? Are survey data or sales data used? Are survey questions phrased unambiguously?
- Data analysis issues -- Might the econometric specification lead to biased estimates of the effect of participation? Are survey responses interpreted correctly?

Many of the above terms are familiar to all of us who work in the areas of program design and evaluation. Some elaboration, however, is required of the issues subsumed under estimating net impact, data collection and data analysis.

Estimating Net Impacts

All of the techniques used by the California utilities employed survey data. Four of the non-California studies used survey data, although one analysis (for NYSEG) also used sales data. Only one study of the ten reviewed was based solely on sales data. At issue is the relative reliability of the two data sources for evaluating program effectiveness. Measurements from survey data are only as accurate as people are when they describe their motivations and behavior. Measurements from sales data are only as accurate as the representativeness of the control group.

Four techniques were used among the nine studies using survey data. These are: regression analysis of participant and non-participant actions; inquiries regarding customers' past decisions; inquiries regarding customers' future plans; and conjoint questioning (do you prefer A or B?).

Regression techniques are powerful tools for controlling customer characteristics that vary between participants and their proxies (the non-participants). In the abstract, they are the preferred tools

for estimating net impacts. In practice, however regression equations can be inaccurately specified, resulting in inaccurate estimates.

The validity of survey inquiries regarding customers' past decisions rests in the assumption that people know what characteristics of an item were the deciding factors in their decision to purchase that item and that they report this accurately. Even if one accepts this assumption, there can be problems in the implementation of this technique. Ambiguous questions or too few questions to fully probe customer decision-making mark the downfall of this approach.

Inquiries regarding customers' future plans is, we believe, the weakest approach among the studies reviewed. Customers do not necessarily do what they say they are going to do. The studies using this technique recognize this fact and apply an arbitrary deflation factor to develop what the researchers hope are more realistic estimates of future actions.

Conjoint analysis is an established, reputable technique for estimating what appliances a customer will buy when faced with different options in the market place. However, the results are sensitive to the specification of the appliance characteristics. For example, if the price differential between different options is large compared to the differentials among other elements specified, it may appear that customers' choices are driven by the price and are relatively unaffected by other options. Such an appearance would be an artifact of the study's design.

Data Collection Issues

Data collection issues include sample bias, response bias, self-reported data bias and questionnaire design. Sample bias occurs when the customers being evaluated are not representative of the entire eligible population. Sample bias commonly occurs when the sample has been drawn from participants. Response bias occurs when systematic error is introduced by the failure of customers to respond to certain questions in a survey.

Self-reported data may provide an inaccurate description of what customers would have done in the absence of a program. In an effort to please the surveyor, customers may overstate the importance of rebates in their purchase decision, or conversely, customers may understate the importance of rebate in an effort to convince themselves that their choice was not influenced by factors other than their own preferences. ("Cognitive dissonance" is the term used to describe such psychological phenomena.)

The final issue under data collection is that of questionnaire design. Many of the studies reviewed rely upon the responses to one or two questions to measure the effectiveness of a rebate program. It is critical that these key questions be phrased unambiguously. Furthermore, survey instruments are strengthened when they have redundancy -- that is, several questions eliciting similar information but from different angles -- in areas central to the analysis.

Data Analysis Issues

Econometric techniques can lead to biased estimates of net impacts if the equations are poorly specified. Regressions can suffer from such problems as multicolinearity, an incomplete specification, and an important independent variable (such as program participation) being correlated with the error term.

ASSESSMENT OF CALIFORNIA PROGRAM EVALUATIONS

Table I describes the five California incentive program evaluations that we examined in this study. For each program evaluation, the table briefly describes the program (the end use it targeted and the incentive offered), its impact (gross impact -- i.e., total number units for which a rebate was issued -- and net impact), and the technique used to estimate the net impact.

Table I. Description of California rebate program evaluations.

Study Name	End Use	Incentive	Gross Impact	Net Impact	Technique Used to Assess Net Impact
SCE Conservation Financing Program	Space Conditioning	$19(weatherstrip-) ping) ranging to $915 (heat pump)	44,595 ECMs*	20,735 ECMs*	Regression analysis of participant and nonparticipant actions
SCE Refrigerator Rebate Program	Refrigeration	$50, $75 depending on efficiency of units	27,936 refrigs.	9,311 refrigs.	Inquiries regarding customers' past decisions
PG&E Refrig. Rebate Study	Refrigeration	$0, $50, $100	36,700 refrigs.	9,400 refrigs	Conjoint questioning: Do you prefer A or B?
PG&E 2nd Refrigerator Study	Refrigeration	$35 for giving 2nd refrigerator to PG&E or charity	23.2% of mkt	17.2% of mkt	Inquiries regarding customers' future plans
PG&E Coupon Program Study	Space Conditioning; Lighting; Water Heating	Rebates ranged from $1 (for filters) to $10 (for shades)	filters: 40% of mkt shades: 18% of mkt blankets: 21% of mkt	12% of mkt 9% of mkt 15% of mkt	Inquiries regarding customers' future plans

*ECMs = Energy Conservation Measures

In order to compare the differing net impact estimates obtained for each program, we assessed the estimation methods used by the utilities. The criteria we used are those given in the preceding section. Table II summarizes our findings.

Table II. Assessment of California Rebate Program Studies.

Sources of Bias / Direction of Bias: / Study Name	Participation Bias overestimates net ratio	Price Elasticity overestimates net ratio	Installed Efficiency overestimates net ratio	Persistence overestimates net ratio	Inertia underestimates net ratio	Sample Bias indeterminate impact	Response Bias indeterminate impact
SCE Conservation Financing Program	Y (Y) (N)	Y (N)	Y (N)	Y (N)	Y (Y) (N)	Y (Y)	Y (Y)
SCE Refrigerator Rebate Program	Y (Y) (N)	Y (N)	Y (N)	N N/A	Y (Y) (N)	Y (Y)	Y (Y)
PG&E Refrigerator Rebate Study	N N/A	Y (N)	Y (N)	N N/A	N N/A	Y (Y) (N)	Y (Y) (N)
PG&E 2nd Refrigerator Program	Y (Y) (N)	Y (N)	N/A N/A	N N/A	N N/A	Y (Y) (N)	Y (Y) (N)
PG&E Coupon Program: filters	N N/A	Y (N)	N/A N/A	Y (N)	N N/A	Y (Y) (N)	Y (Y) (N)
blankets	Y (Y) (N)	Y (N)	N/A N/A	N N/A	N N/A	Y (Y) (N)	Y (Y) (N)
shades	Y (Y) (N)	Y (N)	N/A N/A	Y (N)	N N/A	Y (Y) (N)	Y (Y) (N)
PG&E Gas Dryer Study	N N/A	Y (N)	N N/A	N N/A	N N/A	Y (N)	Y (N)
PG&E Gas Dryer Rebate Program	Y (Y) (N)	Y (N)	N N/A	N N/A	N N/A	Y (N)	Y (N)

Is it a problem area? [Y] yes [N] no N/A: not applicable to program

Is it satisfactorily addressed? (Y) yes (N) no N/A: not applicable

greater importance to study*

medium importance to study

lesser importance to study

* Shading indicates importance of the particular bias in relation to the other biases affecting the study

The top row of Table II lists the technical issues employed as evaluation criteria. At the top of the left-hand column, the term "direction of bias" describes the expected bias in the net-to-gross ratios that would result from the problem. For example, participation bias is expected to result in the overestimation of net-to-gross ratio because the forecast would be extrapolated from an observed initial surge in program participation. The directions of sample and response biases are labeled indeterminate because the consequence of the bias will be particular to each study.

Table II is designed to be read row-by-row. Each cell has two markers: a square on the left-hand side and an oval on the right-hand side. The square indicates whether the technical issue is pertinent to the relevant study. An "N" inside the box indicates that the issue does not pose a problem to the study's net-to-gross estimates. A "Y" indicates that a problem exists. The term N/A means that the technical issue is not applicable to the study.

The oval indicates whether the issue has been satisfactorily addressed. An "N"inside the oval means that it has not been addressed, while a "Y" indicates it has been addressed. The term N/A means that the issue is not applicable or that is not a problem area (i.e., the box corresponding to the oval contains an N/A or an "N").

The shading in the squares and ovals represents the significance of the problem. In the table, three levels of significance are indicated: most significant (dark shading); secondary importance (medium shading); and least significance (no shading). The key at the bottom of the table summarizes the labeling convention.

Not presented in the table is our critique of each study in terms of the data collection and data analysis issues raised above. These issues were not easy to summarize for tabular presentation. Table I lists the techniques used by each study to estimate net impacts, and the relative strengths and weaknesses of each technique is described in the preceding section. Table II does present two components of data collection -- sample bias and response bias -- but the issues of self-reported data and questionnaire design are not easily summarized, nor are the issues under data analysis included.

Lack of space prevents us from presenting our critique of each study; the following paragraphs attempt to summarize the most important findings. The issues most seriously affecting net impact estimates are those that we were not able to summarize in Table II because they are unique to each study.

For the SCE conservation financing program, a regression technique was used to estimate program impacts. The estimated equation has a very low R-squared statistic (0.17) -- indicating an inaccurate or incomplete specification of the equation -- and appears to suffer form multicolinearity. A strength of the method is that SCE obtained data on conservation actions from both participants and non-participants. The regression equation attempts to control non-program-related differences between the two groups and estimates a net-to-gross impact ratio of 0.67. A simple comparison of the mean number of actions taken by the two groups provides an upper bound for the net-to-gross ratio of 0.73.

The second study reviewed evaluated SCE's refrigerator rebate program. The analysis of the survey data is done correctly, in our judgement. The data are weighted to correct for sample and response biases. The responses to three key questions were used to determine whether a given customer was truly influenced by the program or was a free rider. This approach is the standard one used for estimating net impacts from survey data. The results, however, are highly sensitive to the clarity of the question phrasing; and the results reflect customers' perceptions rather than actions. In this study, ambiguity in phrasing of a key question has resulted in an underestimate of the program's net impact.

The question that determined whether or not a respondent had "prior knowledge of the incentive" was phrased ambiguously. Its intent is to exclude from the count of net participants those customers who learned of the rebate after they made their decision to purchase the efficient unit. The question is phrased "Were you aware of the availability of a cash rebate from the Edison Company prior to making your purchase decision?" As it is phrased, the question could be interpreted as asking whether the customer was aware of the rebate before his or her decision to purchase a refrigerator, rather than the decision to purchase an efficient refrigerator. Customers who did not know of the rebate before they entered the store might respond to the question as phrased with "No." Yet these customers may, in fact, have learned of the rebate before their decision to purchase an efficient model. Thus, the ambiguity in the phrasing of this key question results in some customers being incorrectly classified as free riders. The net-to-gross ratio of the program, therefore, is underestimated.

The PG&E refrigerator rebate study surveyed a sample of residential customers who had either just purchased a refrigerator or were planning to buy one. The questionnaire was designed for conjoint analysis. As discussed in the previous section, the results obtained from a conjoint analysis are sensitive to the specification of the level of attributes presented to the respondent. The purchase prices specified are $525, $875 and $1,175. These cost levels may be too far apart to be useful in comparing similarly sized units. Given the large difference between the specified attribute levels and the relatively small

differences in operating cost attribute levels ($5, $8, and $10/month), energy efficiency will play a small role in the selection of an appliance. This was borne out by the survey. The rebate levels of $0, $50, $100 are insufficient to cover the difference in initial cost, which would be $300 at a minimum, using the attribute levels included in the study. Thus, the influence of rebates and the net-to-gross ratio derived from this study may be underestimated because the attribute levels for initial cost are set too far apart.

A second drawback to the attribute levels specified is that the operating savings for higher efficiency models are not sufficient to make a higher-priced unit cost-effective for the customer, even if a rebate is offered. Thus, the attribute levels specified in the model do not reflect a program design that would be judged as viable by the regulatory agencies. As the study is designed, the shortest economic payback that a customer preferring the rebates faces is 3.3 years and the longest is 25 years.

An additional criticism of the conjoint approach for estimating impact of rebate programs is that it does not account for the information component of rebate program design. Respondents were not subject to advertisements and materials describing the benefits of energy efficiency. For example, a unit initially costing $300 more, but eligible for a $100 rebate and saving $50 per year in operating cost, would have a 2.3 year payback. The net-to-gross ratio may be underestimated since information, which generally complements the economic incentives, is absent. Other programs, such as the Bonneville Power Administration's Blue Clue, have shown that information is critical in influencing the sale of efficient appliances.

The remaining studies examined the PG&E Second Refrigerator Study and the PG&E Coupon Program Study. These studies rely on customers' reported plans for future purchases. Customers were asked their plans to dispose of their second refrigerator or to buy items such as shades and water heater blankets. Then customers were asked if their plans would change were they to receive a specified monetary incentive for the action. The net impacts were estimated based upon a comparison of the responses. We believe that this technique is the least reliable of any of the techniques employed. The researchers themselves recognize that people do not do what they say they will do. To adjust for this phenomenon, the researchers apply a deflation factor to the proportion of customers expressing purchase the item. We do not feel that this deflation factor is able to strengthen the validity of the method.

In the section below, we briefly describe the non-California programs that we reviewed for this project. The succeeding section presents the net-to-gross impact ratios found by each of the studies reviewed.

NON-CALIFORNIA REBATE EVALUATIONS

The scope of work for the project described in this paper was to develop a detailed critique of rebate program evaluations conducted by California utilities. While we did not assess any non-California studies in-depth, a presentation of these studies' net-to-gross estimates provides a context for the California findings. Accordingly, this section includes the net-to-gross estimates derived by five other utilities for their rebate programs. These utilities are: Central Maine Power (CMP), New England Electric System (NEES), Northeast Utilities (NU), New York State Electric and Gas (NYSEG), and Wisconsin Power and Light (WP&L). Table III summarizes the five rebate programs and each method used for estimating net impacts. Refrigeration is the predominant end use, and is addressed by a variety of rebate designs. Three of the five utilities used customers' responses to survey questions to calculate the net impacts. One utility, NU, used sales data from control and treatment groups to gauge net impacts. The control and treatment groups were in geographically distinct regions. The fifth utility, NYSEG, used both survey and sales data. Its net impact calculation combined survey data with the results from a sales data methodology similar to NU's program evaluation.

Table III. Description of national rebate program evaluations.

Study Name	End Use	Incentive	Gross Impact	Net Impact	Technique Used to Assess Net Impact
CMP Appliance Rebate Program	Refrigeration Water Heating	$25 refrigs. $20-$30 WHs depending on size	7,463 refrigs. 1,837 WHs	1,653 refrigs. 539 WHs	Inquiries regarding customers' past decisions
Mass.Elec. Co. Refrigerator Rebate Program (NEES)	Refrigeration	$100	1,000 refrigs.	227 refrigs.	Inquiries regarding customers' past decisions
NU Refrigerator Rebate Pilot Program	Refrigeration	$85, $110, $135 varies randomly	1,050 refrigs.	116 refrigs.	Sales data from regions with and without program
NYSEG Appliance Rebate Program	Refrigeration	$0, $35, $50 according to region	Not calculated	32% of mkt/$35 35% of mkt/$50 0% of mkt/$0	Sales data; inquiries regarding customers' past decisions
WP&L Refrigerator Rebate Program	Refrigeration	$30, $50, $100 depending on efficiency and region	1,950 refrigs.	546 refrigs.	Inquiries regarding customers' past decisions

We also reviewed an evaluation of Northern States Power Company's Appliance Rebate Program. This evaluation used both sales data and data from two surveys. The study is interesting, and one we recommend to the reader because of its multiple data sources, however, we do not include its findings here. This exclusion is due to the fact that NSP makes no attempt to reconcile the net impact estimates calculated from the three data sources. For example, sales data for refrigerators indicated a net-to-gross impact of 0.91; responses to the survey accompanying the rebate application indicated a ratio of 0.14; and responses to a follow-up survey indicated 0.07. Without a critique of NSP's evaluation, which was beyond the scope of this study, we are unable to suggest whether NSP's program was critically important, as evidenced by the 0.91 figure, or virtually ineffective, as indicated by 0.07, in promoting the sale of efficient appliances. Thus, we omit this study from our discussion.

COMPARISON OF NET-TO-GROSS RATIO ESTIMATES

Table IV compares the net-to-gross ratios from both California and other utilities by end use. Most of the programs reviewed in this study provide rebates for energy efficient refrigerators. Eight ratios are presented in the table for these appliances, with a ninth ratio included for PG&E's second refrigerator

program. (NYSEG's program offered two rebates -- $35 and $50 -- and the program evaluation determined two net-to-gross ratios.)

Table IV. Comparison of utility net-to-gross ratios.

End Use	Net-to-Gross Ratio	Study Name
Refrigeration	.11	NU Refrigerator Rebate Pilot Program
	.20	PG&E Refrigerator Rebate Study
	.22	CMP Appliance Rebate Program
	.23	NEES Refrigerator Rebate Program
	.28	WP&L Refrigerator Rebate Program
	.32/.35	NYSEG App. Rebate Program
($35/$50)		
	.34	SCE Refrigerator Rebate Program
	.75	PG&E 2nd Refrigerator Study
Lost Cost Measures & Space Conditioning		
Furnace & AC Filters	.30	PG&E Coupon Program Study
Window Shades	.50	PG&E Coupon Program Study
Weatherization, Heat Pumps & Evap. Coolers	.67	SCE Conservation Financing Program
Water Heater Blankets	.71	PG&E Coupon Program
Water Heaters	.29	CMP Appliance Rebate Program

The ratios for the energy efficient refrigerator rebate programs range from 0.11 to 0.35. The mean and median of the range are each 0.26, and there is no mode.

Comprising the high end of the range are the NYSEG and SCE estimates. As discussed above, the SCE ratio may, in fact, be an understatement of the program's net impact. The evaluation used survey data and a key question was phrased ambiguously. The NYSEG estimates are a hybrid of survey and sales data.

At the low end of the range is 0.11, the ratio that NU calculated from sales data. NYSEG reported a value similar to NU's that it estimated from its sales data alone for the $35 rebate. This ratio was 0.10. For the $50 rebate, NYSEG's sales data indicated a net-to-gross ratio of 0.19. While the lower value is comparable to the NU estimate and the higher value is comparable to the CMP and NEES estimates, these values are not given in Table IV because NYSEG's evaluation did not report the numbers as "stand alone" estimates. The values are calculated by NYSEG at one step in the methodology yielding the 0.32/0.35 numbers presented in the table.

The ratios calculated from survey data alone range from 0.20 to 0.34 (where 0.34 is the SCE number and is likely to be underestimated) and are framed by the low NU and high NYSEG estimates.

Because sales data have only been employed by a few of the studies, it is impossible to say whether sales and survey data result in comparable net-to-gross estimates. As we discuss in the last section of this paper -- Do Rebates Matter? -- survey data can be contaminated by the respondents' psychological inclination. Estimates based on sales data, on the other hand, are easily flawed by a control group that is not representative of the treatment group. We are unable to resolve this issue from the national research conducted to date and, as a consequence, have little conviction that current studies have produced an "accurate" net-to-gross ratio estimate.

For the low cost conservation measures, four net-to-gross ratios are presented, though the specific measures described are diverse. The estimates range from 0.30 to 0.71. The low end of the range reports findings for furnace and air conditioner filters. Filters are an extremely low-cost item. It is unlikely that a rebate influences customers' behavior. Therefore, we do not believe this program's net-to-gross ratio is useful for assessing the general effectiveness of incentives.

The three remaining estimates range from 0.50 to 0.71. The SCE value of 0.67 may be overstated due to specification error and multicolinearity in the regression equation used to estimate the value. The midpoint between the two remaining values of 0.50 and 0.71 is 0.60. We have reservations about recommending this value as an impact estimate because it is based on few observations.

The CMP estimate for water heaters is 0.29 and is the only one reported. The estimate is based on survey data and is comparable to the net-to-gross ratios for refrigerators.

DO REBATES MATTER?

Rebate program effectiveness has been expressed in this report in terms of its net-to-gross ratio. This ratio measures how many customers were induced by the program to purchase high efficiency units. The higher the net-to-gross ratio, the greater the number of participants who were truly influenced by the program. The lower the ratio, the larger the number of free-riders. Through an assessment of the net-to-gross ratio achieved by rebate programs, one should be able to reach a judgement as to whether or not rebates matter.

The data in Table IV indicate that rebate programs have a high level of free-riders. A utility can not reasonably expect, given the experience of others, to obtain more than a 33% net-to-gross impact. Less charitably, the mean impact of the studies we reviewed is 25%. That means that only one out of four sales for which a rebate was issued specifically resulted because of the rebate and would not have occurred in its absence. Utilities looking to develop best estimates of whether contemplated programs would be cost-effective might do well to use free-rider estimates in the range of two-thirds to three-quarters.

Our research has also led us to conclude that the utility industry does not have, to date, enough systematic experience by which to develop robust estimates of expected net-to-gross ratios. Two issues having a major impact on estimating program effectiveness have not been studied in a scientific or controlled manner. These issues are program design and the use of self-reported, as opposed to measured, data.

Regarding program design, not all program designs will be equally attractive to participants. Most obviously, a program providing rebates that are applicable to a larger portion of the existing market will have more free-riders than a program that gives rebates only for super-efficient appliances that currently capture a small market share. (It is uncertain, however, whether such programs will have a larger proportion of free riders.) Programs with higher incentives will be more successful in influencing

people's decision than will programs with relatively low incentives. The marketing of the rebate program, and the information component of the program (that is, the information made available to the customer on the benefits of an efficient appliance) also affects the persuasiveness of the program. Finally, the program administration -- such as the ease with which a customer can receive a rebate -- may affect the proportion of people who are influenced by the program.

The utility industry does not have enough experience to evaluate how these factors affect program effectiveness. The preceding passage identified five aspects of a program that might vary, and three of those dimensions are themselves composites of several aspects of program design. Even so, the list only partially identifies areas of differences among programs.[1] With so many aspects of program design being variable, in order to determine the effect of program design on a program's effectiveness, one either needs a very large number of observations or one needs to design programs systematically, so that a single element of the design can be evaluated at a time.

While a few utilities have designed experimental programs to test the impact of a given design change, such as a change in the level of rebate or the method of rebate delivery, definitive judgments have not been reached. Furthermore, the influence of many aspects of program design have not been explored at all.

The second major issue that blocks us from concluding whether or not rebate programs are effective is the disagreement among researchers regarding what constitutes proof of effectiveness. If customers report, when asked by the utility, that they were influenced by the rebate, can one believe that customers are accurately stating the facts?

Researchers are divided in their opinion of the accuracy of self-reported data. Responding to different psychological impulses, customers may either overstate or understate the importance of rebates in their purchase decisions. The validity of analyses using sales data, however, rests entirely upon whether or not the behavior of the control group accurately represents the behavior of the treatment group in the absence of the program. Sales data, therefore, do not necessarily present "the truth." Systematic experiments need to be undertaken to determine how impacts measured form sales data typically differ from those measured by survey data, when both techniques employ a sound methodology.

We conclude that the definitive estimate of the impact of appliance rebate programs can not be determined from utility experience to date. The effect of variations in program design have not been systematically explored, nor have sales data been used to conclusively support or reject the findings reached by survey data. Nonetheless, we have reviewed studies that use a variety of survey techniques, have varying strengths and weaknesses associated with the analytical techniques employed, and address diverse geographical areas. Given the diversity of studies, it is perhaps all the more indicative that appliance rebate programs have a large proportion of free-riders. An estimate of a 25% to 33% net impact is consistent with current utility experience.

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[1] See XENERGY, DSM Commercial Customer Acceptance, Volume 1: Program Planning Insights, EPRI RP2548-01, October 1987, for a discussion of how variations in commercial DSM programs affect customer acceptance of the programs.

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