1

Overview of DEER NTFR Update Process for 2006-2007 Programs

1.1 Introduction

Net-to-gross ratio values in the Database for Energy Efficiency Resources (DEER) have not been updated for California investor-owned (IOU) utility energy efficiency programs since 2001. These values were based primarily on evaluations and programs implemented in the 1990s and have grown increasingly out of date. In late 2007, the CPUC requested that the Energy Division DEER Team develop new net-of-free-rider (NTFR) ratios based on more recent research results to increase confidence in their application of NTG ratios to estimate net energy saving for current and future programs. To meet this objective, a comprehensive literature review was recently conducted in order to develop more up-to-date values for DEER. The literature review results were then compared to the most recent configuration of measure and delivery methods for the 2006-2007 programs to develop a recommended NTG value to use for each program and sub element for the purpose of updating the ex ante estimates of expected net savings from these programs.

Key deliverables from this effort include the following:

- Summary spreadsheet of results of NTG literature review,
- Summary spreadsheet of Energy Division DEER Team's recommended NTFR values for 2006-07, and
- A summary report (this document) that provides, by program area, the rationale and documentation for the recommended NTG values.

1.2 Approach

The Energy Division DEER Team reviewed and summarized recently completed evaluations (primarily those for California Statewide and Local programs offered in PY2002-2005) for NTFR values by technology, measure, and delivery method. In a few cases, other pertinent data sources were also reviewed. This analysis was initially used as the basis for recommended updates to ex ante NTFR values to be used for 2009-2011 program planning. These recommended values were released on May 2 with the documentation for the values

following on May 30, 2008. Subsequently the Energy Division DEER Team was asked to update these values for use in updating NTFR values used for 2006-2007 programs.

Itron reviewed a total of 60 program evaluation studies from the period 2002-2008, representing 15 separate program categories. For each study, the following information was summarized:

- The methods used to estimate NTFR values
- Program-specific information such as target markets, delivery strategies and eligible measures
- Estimates of free ridership, and if available, participant and nonparticipant spillover at the end use and/or measure level

An overall confidence level was assigned based on the survey design, question wording, methods used, sample size and degree of convergence of results.

Data gathered during the research included the name of the study, target market, number of measures, sample size, precision level, and ranges for participant and nonparticipant spillover. In some cases, information was also collected on the market share, rebate level, and incremental cost.

1.3 Guide to Results of the NTG Review

Approximately two-thirds of the evaluations contained some analysis of free ridership and/or participant spillover or both.

The studies reviewed are summarized in the accompanying spreadsheet (DEER NTG Lit Review Summary 071008.xls).

The recommended NTFR values by target market, delivery method and measure based on this literature review and related Energy Division DEER Team analysis are reported in a second spreadsheet, (Updated DEER NTGR Values for 2006-2007 - 062008.xls)

The recommended values for the 2006-07 programs are based on an earlier review and recommendations for the 2009-2011 programs and some adjustment to these numbers because of the better information that is available for the 2006-07 programs that have already been implemented. These recommendations are *preliminary* and may be adjusted based on new market and evaluation information.

The recommendations spreadsheet also contains a comprehensive listing of delivery strategies, both those being used in current programs and new strategies likely to be used in the future. There are three main types of delivery strategies:

1 Those that provide energy efficiency information to customers through detailed audits, feasibility studies, and training,

2 Those that provide rebates or other financial assistance to improve the measure economics and/or reduce the payback period, and

3 Those that install more efficient measures or designs on a turnkey basis at no or little cost to the customer, typically in market segments with historically low participation rates.

Each of these delivery methods is likely to yield different estimates of free ridership depending on the target audience, the size of the rebate relative to the incremental measure cost, the intensity of non-incentive tactics (e.g., information, audits, etc.) and other market factors unrelated to program design such as current market share. Thus, it is important to match NTFR estimates for each energy efficiency measure to the target market and delivery method used in 2006-2007 programs. This will help in assessing the appropriateness of NTFR values estimated for past programs serving as ex ante basis for future programs and to what extent adjustments may be necessary.

Documentation of the review process and the rationales for NTG recommendations is provided by program area in Sections 2-16 of this document. In this section, the Energy Division DEER Team provides its recommendations for to develop NTG values for measures or delivery strategies without any recommended NTG values as part of this update.

1.4 Recommended Default Values for Program measures or Delivery Approaches without a Current NTG Value

The Energy Division DEER Team recommends the use of a 0.80 NTG default value for the 2006-2007 measures that are not updated in this round of DEER NTG updates since that was the default NTG value based on the CPUC Policy Manual. For any delivery strategy that is in the DEER 06-07 Measures Update NTG table, those NTG values should be used.

1.5 Summary of Important Changes Made in Recommendations Between 2009-2011 DEER NTFRs and 2006-2007 DEER NTFRs

A few changes and additions have been made to the July 10 NTFR recommendations for 2006-2007 programs compared to the values previously posted by the Energy Division of the

CPUC for 2009-2011 programs. The two major changes are summarized in Table 1-1. The rationale for each of these changes is provided after the table.

Table 1-1: Summary of Key Changes for the 2006-2007 Update of Ex Ante Net-to-Gross Parameters

Measure and Program Information		Net-to-Gross Ratio Information			
Measure Name(s)	**Program Delivery**	**NTG Values Used Typically by Utilities in Previous 2002-05 Filings**	**NTG Values Based on 2004-05 Program Evaluations**	**NTGR Values Recommended for 2006-07 Update**	**NTGR Values Recommended for 2009-11 Planning**
Local Government Partnerships	All design strategies	80%	75% to 85%	NTG value should be sales weighted average of recommended NTG for measures and end uses implemented by the local government program	Higher of weighted average of NTGRs from each targeted measure/delivery strategy weighted by the share of energy savings for the entire program or a default NTGR of 0.70
Standard Performance Contract and other customized programs for large nonresidential customers	Custom incentive electric measures	70%	54%	54%	64%
	Custom incentive gas measures	70%	54%	54%	64%

Rationales

Proposed NTFR values for local government partnerships operated in 2006 and 2007 (utility and local government)

In the 2009-2011 update, the Energy Division DEER Team was directed to provide the following wording in developing an NTFR for these programs:

> *"The NTG for these programs should be the higher of the weighted average of NTGs from each targeted measure/delivery strategy weighted by the share of energy savings for the entire program and a floor default NTG of 0.70."*

The rationale provided to establish a floor was that most local government programs would never have started without utility initiation of these programs and that the Commission wanted to encourage the growth in the size and anticipated savings from the local government programs in the planning process.

The Energy Division DEER Team does not believe these rationales are pertinent for the development of ex ante NTG ratios for the 2006-2007 update because these values are to apply to programs that have already been implemented as opposed to new portfolio filings. Use of a floor NTG value of 0.70 will not encourage any additional funding or implementation of future local government partnerships because these are values for programs that have already been delivered. In addition, there is a strong equity argument to be made that all program administrators should be treated equally and follow the same rules when estimating net energy savings from their programs.

Thus, the Energy Division DEER Team is recommending the removal of the floor NTG value of .70 and applying the same NTG treatment – based on measure type and delivery strategy - for all administrators of programs in 2006-2007.

Recommended NTG values for Standard Performance Contracting Programs

The Energy Division DEER Team recommends the use of the 0.54 NTG value for the 2006-2007 SPC program. This is the identical value we initially recommended in the 2009-2011 process but were later directed to use a higher value for policy and analytical reasons. (The original rationale for inclusion of a 0.10 adder was for possible self-report bias, which had been estimated in a 2001 study by XENERGY and Ridge and Associates and was subsequently included, along with a 0.05 spillover adder, in the CPUC's approved SPC ex ante NTG value of 0.70 in 2001).

We recommend the use of the 0.54 NTG value for several reasons:

a) A NTGR value of 0.54 was the result reported in the most recent evaluation of these programs in 2004-2005 and is supported by similar NTG findings in evaluations conducted for the 1998 through 2003 programs.

b) The Commission's direction to increase the NTGR value from 0.54 to 0.64 during the 2009-2011 planning process was based on the Commission's desire to encourage utilities to continue to emphasize incentive programs to large industrial customers. Given that the 2006-2007 programs have already happened, this rationale for a 0.10 adder is no longer germane to the issue of the correct value to use in estimating shareholder earnings.

c) The principal original rationale for increasing this NTGR value for the SPC program was that a 2001 study estimated a potential self report bias of 10%, based on analysis of studies conducted in the 1990s that included multiple NTG

measurement methods. Although that study found some evidence of a possible downward bias in self-report NTG method, it was not conclusive. The Energy Division DEER Team believes there is considerable uncertainty in this estimate and that its application to only one program area would be inconsistent. In addition, the possible use of DEER values in calculating MPS and PEB for risk-reward requires a higher standard of rigor than was associated with the program planning environment of 2001 during which the adjustment was initially adopted. The CPUC may want to consider updated and expanded research to assess the potential for systematic bias across all NTG methods.

For each of these reasons, the Energy Division DEER Team believes the Commission should use the 0.54 NTG value for the standard performance and related custom incentive programs targeted at large nonresidential customers.

2

Evaluation Methods Used to Estimate the Net Load Impacts from CFL Programs in California and Recommended NTFR Values

2.1 Overview and Summary

This section reviews a range of recent program evaluations that were used to estimate NTFR (net-of-free-rider ratios) and the corresponding net energy savings from energy efficiency programs that promote the sale and installation of compact fluorescent bulbs (CFLs) in the residential and small commercial markets. The results from these studies and an additional analysis of CFL sales data were used to estimate the appropriate NTFR's for future CFL programs anticipated to be operated in the program period 2009-2011 and are updated here for use in updating estimates of the expected net energy savings from 2006-2007 CFL programs.

This paper uses the results of that initial estimation process for program years 2009-2011 for the limited purpose of determining the appropriate net-of-free-rider ratios for program administrators use in updating the ex ante estimates of the same NTG ratio for CFL programs operated during the program years 2006-2007. In most cases all of the studies reviewed and analysis produced for the 2009-2011 update are equally useful for the purposes of updating the ex ante values used in the most current utility earnings claim filing for the 2006-2007 program year. For that reason, much of the analysis that follows is the same as the original analysis; if there is a reason to make a change to update the more recent program estimates we highlight these changes in blue to aid the readers who may have reviewed the earlier documentation and analysis.

Based on the team's review of the most recent CFL evaluation studies in California and six studies of CFL programs in other states, we recommend a decrease in the net to gross ratio for the upstream CFL rebate program from 0.74 for calendar years 2004-2005 to 0.60 for the years 2006-2007. This recommendation is also a reduction from the current NTG default value of 80% used by some utilities for their upstream CFL program filings for the 2006-2007 CFL programs. The recommended NTG value is based on a triangulation of NTFR estimates for upstream CFL programs from three types of evaluation methods, self-reports from upstream distributors and manufacturers, comparisons of CFL sales per household in

California and other states and, the observed trends in CFL prices in California and the nation between 2004 and 2007.

Itron recommends using a higher NTFR value of 0.85 for CFL programs that target hard to reach populations using direct installation contractors because these programs target populations who are not as likely to seek out and purchase the bulbs promoted by the upstream CFL programs. This result is consistent with the one or two evaluations that actually estimated net to gross ratios for direct install programs.

Itron stresses that its finding of a relatively high fraction of free riders in the upstream CFL programs is not the result of poor program design but instead probably reflects the long-term success of the upstream program that has convinced many customers to seek out CFLs on their own due to higher awareness and lower CFL prices. The 40% fraction of program participants in the upstream program who are estimated to be "free riders" is due in large part to the cumulative success of previous programs in increasing the sale of CFL both in California and most sales in states without active programs which has increased the fraction of customers who are likely to purchase CFLs without any programs assistance. Several sources indicate that national CFL sales increased dramatically by 200% to 350% between 2006 and 2007, (although we note that there is considerable uncertainty in these sales estimates). The reader is encouraged to examine the significant growth in CFL sales per household data across different states in Subsection 2.8.

The recommended NTFR value of 0.60 for the 2006-2007 program filing falls within the range of NTFR' calculated using evaluations of net savings based on self report's and the net to gross ratios produced by an analysis of CFL sales data from 2003 to 2007. The observed ranges of NTFR values estimated using different methods and definitions of net to gross ratios are highlighted in Table 2-1. The recommended 0.60 NTFR value is very close to the value estimated for the 2004-2005 program of 0.62 and in the middle of the range of NTFR results estimated using the sales comparison method for 2007 sales (row 3) highlighted in blue. The sales comparison of CFL sales per household with and without programs is the method that has the highest likelihood of providing the closest estimate of the true net NTFR value. This is because the sales comparison method does not rely on the skill of interviewers and other analysts to remove the bias from self-reported estimates of free ridership from surveys of the manufacturers and distributors participating in the program.

Table 2-1: Review of NTFR and NTG Results under Alternative Measurement Approaches

Measurement Method	NTFR/NTG Results Low Estimate	NTFR/NTG Results High Estimate	NTFR Results Reported Value or Recommended Value
Self Report for 2004/2005 Program-Retailers/& Manufacturers-NTFR	51%	75%	62% = Reported value 74%= Rec. value
Comparison of CFL sales from 2004 and 2005 at the state level-NTFR	29%	77%	53% =(Avg)
Comparison of CFL sales at state level - 2007 data using narrow net definition-NTFR	20%	72%	60%= Recommended. value
Comparison of 2007 CFL sales data using expansive net definition – NTG-	42%	94%	68%=(Avg)

The body of the paper provides a detailed review of the data sources used in these analyses and the reasoning behind the NTFR ranges reported in the table above. In addition, a review of all the previous CFL evaluations, both in and outside of California can be found in Section 2.2. Finally, the methods and evaluations used to develop recommended NTFR ratios for non-specialty CFL bulb with wattages in excess of 30 Watts and other delivery mechanisms can be found in Subsection 2.3.1.

2.2 Introduction

This paper reviews the available literature on estimates of net energy savings resulting from CFL programs run in California and other states. During our review it became important to differentiate between evaluation methods that focus on estimating net impacts using a narrow or conservative definition of net savings, which focused on estimating the level of free riders only, compared to broader definitions of net program savings (net to gross or NTG) that include both cumulative impacts of past programs on market sales and spillover impacts from current programs. To make this difference clear, we refer to the narrow definition of net savings impact throughout this paper with the letters NTFR and the broader definition of net savings using the letters NTG.[1]

[1] Estimates of free ridership are used to develop a net of free riders ratio (NTFR) in this report using the equation, NTFR= 1 - FR). We use NTFR throughout the report because it is simpler to convert estimates of gross program impacts into net impacts using the NTFR rather than multiplying gross impacts by (1-free riders).

The goal of this paper is develop updated NTFR (net-of-free-riders) estimates based on the narrow definition of net savings currently used in California for the upstream CFL rebate programs run in 2006 and 2007 by California's investor-owned utilities. The principal use of these new values will be for use in improving the accuracy of ex ante estimates of the net impacts associated with these programs.

Currently, evaluations of CFL programs in states outside of California generally do not attempt to estimate the level of free riders because of at least two reasons:

1) CFL programs in other states were designed to generate market effects or to transform markets so the measurement of broad market effects is often considered more important than estimating the level of free ridership
2) There are significant measurement challenges in separating free ridership effects from other types of market effects generated by CFL programs. This is because upstream programs, by definition, are designed to have price and stocking effects that can easily leak or spill over to nonparticipating jurisdictions. This makes the task of isolating or estimating the baseline or naturally occurring level of CFL sales much more difficult.

We have explicitly tried to develop NTGR estimates using a variety of estimation methods based on the principle contained in the current measurement protocols that triangulation of a variety of methods is likely to yield more accurate results than relying on one method or another.

However, we must acknowledge from the outset that it is extremely difficult to accurately separate the impacts of utility and other (e.g., EPA) programmatic activity over the last ten years from other private initiatives by manufacturers and large retailers to increase the sales of CFLs for environmental or business reasons. This statement is true for four basic reasons.

- ***Chicken and egg causality.*** Private sector, utility and government actors have been working together for years to promote increased sales of CFLs, making it difficult to tell which actor was or is influencing whom at any point in time.
- ***Media/global warming effects.*** The strong emphasis in the public media on reducing each household's carbon footprint by taking symbolic or simple energy efficiency actions such as purchasing CFLs to support the environment makes it difficult to separate mass media and related normative behavioral effects from program rebate impacts on the customer motivation to buy CFLs. This media/normative effect may be compounded by the actions of private retailers attempting to leverage this heightened "green" consumer awareness to increase their current CFL sales in non-program states. At a minimum, these private campaigns run in non-program states and often not in states with CFL programs confound evaluator attempts to isolate or measure the baseline or naturally occurring level sales of CFL bulbs per household.

- ***Recall error.*** Customer motivation to purchase a package of light bulbs on any given day is difficult to discover or accurately estimate even if they are interviewed moments after the purchase. Measuring customer motivation by asking them questions about why they made a specific purchase three to six months after the purchase is very difficult in practice and subject to large uncertainties unrelated to the program effects.
- ***Competitive effects/gaming of responses.*** It is exceedingly difficult to analyze or determine what level of influence, if any, upstream rebates may be having on actions taken by suppliers in a competitive market. Asking key executives at major retailers such as Home Depot's, Lowe's, or Costco to separate out the influence of rebate payments from their own corporate strategy to position their company as a Green retailer through aggressive marketing campaigns is problematic.

Given these uncertainties, it is reasonable to expect that evaluators will need to use a significant amount of judgment in triangulating the results of various types of evaluation and market research to analyze what the appropriate estimate, or range of estimates, of free riders should be for the current program cycle and for use on an ex ante basis for future programs.

2.3 Overview of Methods Used to Estimate the Net Savings Attributable to CFL Programs

The literature review revealed four basic methods of estimating the net and peak savings attributed to CFL rebate programs:

- Self-reports from customers: five studies reviewed
- Self-report from retailers/manufacturers: one study reviewed
- Discrete choice analysis based on product price choices made by customers and subsequent regression analysis: no studies found[2]
- Comparison of trends in total and program-reported and -induced sales data per household in states with and without programs to estimate the level of baseline sales expected in the absence of the program: five studies reviewed.
- Estimating a demand model to predict the relationship between changes in CFL price, different levels of customer awareness generated by the mass media, and incremental CFL sales in different regions of the country: no studies found but one study is underway in California.

[2] The evaluation team conducting the impact evaluation of the California IOU's 2006 to 2008 residential lighting programs plans to pursue the use of discrete choice analyses to better estimate net program effects. Details on their evaluation plan can be found at: http://www.energydataweb.com/cpuc/

Methods 1, 2, and 3 are primarily used by evaluators interested in estimating the fraction of program participants who can be identified as free riders and thus used to adjust gross savings downward. Methods 4 and 5 are primarily used to estimate the net effect of the programs which include both spillover and free rider impacts. A central challenge revealed in this review is that the use of upstream rebate strategies in California has made the programs somewhat invisible by design to many customers and thus the value of customer responses about what they might have done in the absence of a program is considered by some evaluators to be less relevant and reliable. The use of supplier interviews to replace customer perspectives on free ridership faces other challenges, for example, because suppliers may realize that giving the "right" answers can have an effect on both the continuation of the rebates themselves and their company's position in the competitive market.

Due to the potential for bias using self-report methods, we have further investigated the net to gross results from Methods 4 and tried to use currently available data to re-estimate free rider fractions in different states. Our goal is use additional sources of information to triangulate to establish the direction and possible range of free ridership impacts on California's future CFL program efforts (while expecting that results from California's 2006-2008 upstream CFL evaluations will increase the reliability of NTFR and NTG estimates).

In addition to uncertainties discussed above related to the choice of methods to estimate net effects, there are additional uncertainties related to the data sources used to estimate the gross sales of CFL bulbs. These uncertainties are discussed below and in greater depth in Subsection 2.8.

The DEER team used three primary sources for the CFL analysis.

- California Residential Market Share Tracking Study (RMST) managed by SCE and conducted by Itron. This study obtains point-of-sale (POS) data on all lighting equipment (ENERGY STAR qualified and non-ENERGY STAR qualified CFLs as well as incandescents, halogens, and linear fluorescents among others) sold through drug, hardware, and large food stores as well as some mass merchandisers. Data are obtained from AC Nielsen and Activant.
- EPA data collected by the CADMUS group. These data include ENERGY STAR qualified CFLs. CADMUS collects data from five major national retailers.
- 18Seconds.org. Data presented on this site is collected by AC Nielsen in conjunction with Yahoo! and Wal-Mart. These data overlap the RMST data in that they include many of the same sales channels.

The difficulty with all of these data sources is that they only look at a portion of the market and in some cases rely on voluntary data collection and retrieval from distributors and

retailers. Future efforts in California are already at work to combine the best parts of each database to provide a more accurate view of the overall trends in this important market.

Finally, it is critical to note we have been directed to estimate the marginal effect of California programs in the current or future years rather than measure the cumulative or average net effects of either California programs or all programs over a multi-year period. This difference is why most of the studies we reviewed estimate net to gross ratios in the range of 0.8 to 3 for CFL programs in states outside of California because they include the market effects generated by past and current programs rather than the marginal effect for a future program only. These studies, which measure the cumulative program impacts, report net to gross estimates (NTG) higher than the range of 0.5 to 0.9 for NTFR reported for most residential programs in California.

2.3.1 Discussion of Pros and Cons of Different Evaluation Methods to Estimate the Net Impacts of Upstream CFL Programs

Theoretically, the comparison of CFL sales data using treatment and control states or areas (Method 4) would provide the best estimate of net program effects and could be used to inform a free rider analysis. This is because this evaluation technique is not subject to the bias introduced by respondents (suppliers or customers) who may want to be politically correct or customers who truly cannot recall what motivated their decision to purchase CFLs months earlier.

However, since CFLs are part of a global market, it is likely there are a number of spillover effects from program to non-program states that may confound the sales comparison or free rider analysis even given an efficient sample design and relatively accurate sales data collection. It is also likely that program-induced CFL sales from California could affect the baseline level of sales in many bordering states. This is particularly true since the shipping and procurement decisions made by national home improvement store executives in a key state like California may affect the distribution, sales, and prices of CFLs in many states without programs. These potential spillover effects may confound the attempt to identify pure baseline sales rates of CFLs per household

The next choice for the most accurate NTFR analysis methods would probably be the use of discrete choice analysis. The strength of this method is that it can be used to identify free riders from a participant-only sample (using a stated preference approach) or it can be used to estimate net effects by interviewing participants and nonparticipants to estimate the probability of purchase decisions over the entire population of participants (usually known as the revealed preference approach). However given the range of CFL prices (and perhaps quality) observed in the very dynamic CFL market in different states, it is probably unreasonable to assume one can construct a set of known price and energy savings tradeoffs

to present to a sample of customers as part of a discrete choice analysis. In practice, discrete choice methods have not been used often to estimate net impacts from CFLs due to their complexity and expense.

The final choice to accurately assess the net impacts of upstream programs would be the use self reports from customers or suppliers (Methods 1 and 2). These methods have known problems related to the certainty of customer recall and the desire or program participants to please interviewers with the socially correct answer or, conversely, to present baseline behavior as rational. This is true whether respondents are customers or sales personnel. These bias problems are magnified for upstream rebate programs, which are in many cases invisible to the customer and thus make it difficult to report what they would have done in the absence of the program. In addition, self-reports are often approximate, not precise, data with respect to characterizing highly quantitative parameters like product sales.

Our review suggests that evaluators have made a valiant effort to minimize this potential bias of the self-report method by using a battery of questions and internal consistency validity checks to estimate the likely program influence. However, the bias may still exist due to competitive market effects and the challenges noted above. Thus using triangulation to compare these results with other methods is important.

The final method is to use comparative total sales CFL data at the state level to determine if trends in sales in different states are evolving in similar ways or have different trends. Unfortunately, there are numerous limitations to the data available for this approach that restricts its overall usefulness. In particular, the available data is not always comprehensive or reliable (i.e., limiting comparison of program areas from non-program areas).

In sum, each method reviewed above has some potential bias and reliability problems in addition to the larger societal influence concerns raised in the introduction. However, Itron's analysis shows that all of these different types of methods do provide some useful insights on the level of sales to be attributed to a program. Below we summarize the results from each evaluation method and then end with a comparison of CFL sales per household in different states to provide some additional benchmarking for our conclusions.

2.3.2 Review of Net of Free Rider Estimates Using the Self report Method

In this section, we review CFL evaluation studies and approaches that relied primarily on self-report methods. We begin with a brief summary of studies that used customer self-reports and then focus primarily on the retailer self report results from the CFL evaluation conducted by KEMA as part of Itron's 2004-2005 Statewide Single-Family Evaluation study.

Customer Self Report

Only one study that used the customer self-report method to estimate NTFR was found for CFL programs conducted during 2004 or 2005,[3] but this study evaluated a program administered by the Energy Trust of Oregon that used a significantly different delivery strategy than the upstream rebates associated with the bulk of the California IOU's residential CFL savings. Table 2-2 summarizes the results from much earlier evaluations that estimated net to gross ratios for California CFL programs over a wider period beginning in 1991 and culminating in 2003. The average NTGR value was 0.80 with a range of NTFRs from 0.65 to 0.90. Table 2-2 shows the studies and reported NTFR values.[4]

Table 2-2: Summary of NTFR Estimates from Customer Self-Report Based Studies for Residential CFL Programs

Study #	Utility	Study Name	Program Year	Delivery Method	NTFR Ratio	Evaluation Method	Evaluator
1	PG&E	Compact Fluorescent Lighting Study ID 14	1992	Rebate	0.75	Self-report	HBRS
2	SDG&E	CFL Giveaways ID 150	1991	Giveaway	0.65	Self-report	SDG&E
3	SCE and SDG&E	Residential Appliance Efficiency Incentives First Year Statewide Load Impacts Study	1994	Upstream rebates	0.90	Self-report of sales and comparison of sales/HH	Xenergy
4	SDG&E	Net Impact Evaluation of the 1993 Retail Sales Program	1993	customer rebates	0.87	Self-report	SDG&E
5	Oregon	Evaluation of the 2004 Oregon Home Energy Survey Program	2004	Direct install after audit	0.85	Self-report	Itron
		Residential Average			**0.80**		

An obvious problem with using the data in Table 2-2 is that most of it was collected during evaluation of the first generation of CFL programs and is likely irrelevant given current market conditions and the change in program strategy. Unfortunately, even the most recent study of the 2004 Oregon CFL program was based on a different program delivery strategy, direct install coupled with a home audit, which is not useful for the estimation of upstream CFLs. The only NTFR evaluation of an upstream rebate program was the evaluation of the 1994 Statewide CFL program in California, which found a net program ratio of 0.9 by comparing customer reports of sales in California to sales in out of state control areas.

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[3] Itron, Inc. *California Residential Efficiency Market Share Tracking: 2007 Lamp Report.* Prepared for Southern California Edison. May 2008 (forthcoming).

[4] More details on the sample size, precision levels, and potential sources of bias in these early studies can be found in CEC staff Meta analysis of Net to Gross Evaluations (see Winch 2007).

California Energy Commission. *Meta Review of Utility DSM Program Measurement and Evaluation Studies from 1985 to 1994.* Docket No. 93-ER94. August 25, 1994.

The approach from the Oregon study is discussed in more detail below given that it is the only recent evaluation using customer self reports. This evaluation of the 2003-2004 Oregon Home Energy Savers program in 2005 used a self-report method to estimate free riders, participant spillover and nonparticipant spillover. The program provided audits to customers supplemented by an offer from the onsite auditor to install up to 10 CFL lamps per home after the audit was complete. The auditor installed the CFLs on site.

To determine the NTFR rate, the study developed a battery of questions for use in a phone survey of 1,700 participants and 1,000 nonparticipants to determine the influence of the program. Three specific questions were asked related to the program's influence:

1) Before your audit was complete, did you have plans to install any CFLs?
2) If you did not have a home energy survey (audit), would you have installed any CFLs in the next two years?
3) How many CFLs would you have likely installed in the absence of an audit visit?

The answers to these questions were weighted based on probabilities that each response shows the respondent is a free rider. The study estimated a free rider rate of 15%, (NTFR=85%), participant spillover rate of 11% and nonparticipant spillover of 221%. The spillover estimates were based on participant and nonparticipant reports of adoptions over and above any CFLs installed by the program initially over a two-year period.

Given that the results from some of these studies are probably not representative of market conditions within five years and the fact that customers are often not aware when an upstream rebate program is in place, we conclude that customer self report-based NTFR results from these studies are not relevant for the current generation of upstream CFL programs.

Using Retailer, Distributor or Manufacturer Self Reports to Estimate NTG for Upstream Rebates (KEMA 2004-2005 California Upstream CFL Evaluation)

KEMA recently completed an evaluation of the IOUs' 2004-2005 upstream CFL program as part of the 2004-2005 Statewide Single-Family Rebate Program evaluation managed by Itron.[5] KEMA conducted a survey of retailers and manufacturers who participated in the 2004-2005 upstream lighting rebate program in California to determine what fraction of their CFLs are likely to have been sold in the absence of this program. Retailers and participating manufacturers were selected to be interviewed about the perceived effect of the program on their CFL sales and promotions because customers are only indirect participants in the

[5] KEMA, Inc./Itron, Inc. *2004/2005 Evaluation of Single Family Energy Efficiency Rebate Program.* Prepared for the California investor-owned utilities. September 2007.

program and are likely to be unaware of the fact that the bulbs they purchased were the result of a utility upstream rebate program.

The lighting component of the evaluation of the 2004-05 Single Family Energy Efficiency rebate program conducted interviews with over 20 participating retailers who represented roughly 70% of program sales and 65% of total CFL sales overall. The results of the net to gross analysis suggested that the program's influence over retailers' decisions to market and or reduce the cost of CFL bulbs varied strongly as a function of market sales channel, in part because some channels and store managers had a much longer history in selling the product. Estimated NTFR ratios ranged from 0.25 in big box stores to 0.59 in drug stores to 0.97 in discount stores. A sales weighted estimate of 0.62 for NTFR was derived using the sales from each channel.

This overall NTFR result of 0.62 is highly sensitive to the self-reported results from one or two key executives at the mass merchandizing stores who have a significant share of the CFL market. An independent review of these results suggested that results were fairly sensitive to responses from one mass merchandising retailer and one manufacturer given the low sample size (two respondents) and respondent's potential desire to show that their particular sales channel (Wal-Mart or Costco) were leading the industry independent of any program offerings in California. On the other hand, these respondents represented firms with CFL sales of over 73% of the mass merchandising channel.[6] We bound the high and the low end of the range around the 62% NTFR by examining the key factors that drive the overall NTFR for the program in this analysis.

Free ridership is likely to be lower if some of the suppliers interviewed had an interest in promoting their own firms initiatives in the CFL green space and either consciously or unconsciously downgraded the impact of the program on their decisions. For example if the answers provided by one or two key executives (out of a total sample of 55) in major mass merchandisers such as Costco or Wal-Mart overestimated free ridership by a factor of 2, the overall NTFR program changes from 62% to 69%. In fact, there is at least some evidence to suggest that the sales executives in this segment may have an interest in describing the surge in sales for their chain as the results of a private initiative to become green or responsible retailers as opposed to working with government/utility programs. If we consider the response of these two individuals as an outlier and remove it from the overall weighting of channel free ridership, estimates of the overall NTFR for the program increases from 62% to 75%.

On the other hand, free ridership for this program is likely to be higher overall if the overall program share of the sales channels with high reported rates of free ridership continues to

[6] Ibid.

increase. Given the recent surge in reported CFL sales for Wal-Mart and the large home improvement segment the overall program share of mass merchandisers could be increasing (the 2007 national CFL sales surge is discussed further later in this paper). To test this sensitivity, we assumed the program CFL shares (the share of total program bulbs sold by this channel) of mass merchandisers and home improvement stores in the overall CFL sales market increased from 34% in 2005 to 55 % of program sales in 2007. This scenario increase in program share for the mass merchandise and home improvement stores leads to a decrease in the sales weighted or expected NTFR from 62% to 51%.

Table 2-3 summarizes the results of this sensitivity analysis.

Table 2-3: Sensitivity Analysis of Self-Report Findings by Channel and Their Impact on Overall NTFR Estimate

Base or Sensitivity Case	Method	Resulting NTFR
Base KEMA Estimate	Weight NTFR results by program sales weight	0.62
Sensitivity – Potential respondent bias	Change NTFR for Mass Merchandise channel from .25 to .50	0.69
Sensitivity – Potential outlier bias	Eliminate responses from Mass Merchandise channel and re-weight channel responses	0.75
Sensitivity – Potential change in sales channels or free ridership estimate is too low for discount or grocery channels	Increase Mass Merchandise and Home Improvement program sales weights by 60% to mimic surge in sales for these channels in 2007	0.51

The range of expected NTFR values from the self-report analysis range from 51% to 75%, depending on the validity of supplier response and future program market share by channel.

NTFR Results by Sales Channel

Table 2-4 summarizes the results for the six channels in the KEMA analysis and compares them to a similar analysis of net program effects in Wisconsin.[7] These "net" impact ratio estimates are not directly comparable because the Wisconsin study estimates net program effects including spillover from past programs (NTG) while the California study estimates NTFR effects, which remove free riders at the margin for current programs only. However, comparison of the California and Wisconsin results does confirm a pattern of relatively lower net effects in the sales channels with larger overall volumes such as big box retailers (Wal-

[7] Winch, Rick and Tom Talerico, Glacier Consulting. *Public Benefits Evaluation*: *Comprehensive CFL Market Effects Study—Final Report.* Prepared for the State of Wisconsin Department of Administration Division of Energy. July 30, 2007.

Mart and Costco) and home improvement stores, and relatively higher net program effects for smaller sales channels such as grocery and drug stores.

Table 2-4: Net Impact Ratios (NTFR and NTG) Reported by CFL Sales Channel: Findings from California and Wisconsin Evaluations

	Mass Merch/Home Improvement	Grocery	Hardware	Drug	Discount	Sales Weighted Average
California (1)	29.5%	84.0%	48.0%	59.0%	97.0%	62.0%
Wisconsin (2)	61.0%	118.0%	98.0%	NA	NA	81.0%

(1) California definition of net program savings is limited to removing effects of free riders only and does not include estimation of spillover effects. The NTFR results for mass merchandise and home improvement channels in the California study were combined to ensure comparability with the Wisconsin study.[8]

(2) Wisconsin reports a generally higher net impact because they use a net definition, which includes the impacts of participant and nonparticipant spillover in addition to free riders.[9]

Summary of Self Report Method Review

Review of the studies above indicates that there is considerable uncertainty around estimates of NTFR or NTG ratio for CFL upstream programs derived from customer and supplier self-reports. This is particularly true for upstream programs that are less visible to downstream consumers. The uncertainty in values for specific sales channels, combined with the wide range of observed channel-specific values, from 0.25 to 0.95, and very recent dynamic changes in the CFL market (see discussion in following sections), suggest it is important to review other market-based evaluation methods to triangulate an overall NTGR estimate.

2.4 Exploration of Alternative Methods to Estimate or Bound the Net Savings and or Net of Free Rider Ratios from CFL Programs

In this section, we review the broad trends in the CFL market related to pricing and sales volumes before discussing how this data can be used to estimate NTFR and or NTG ratios for California or other states.

2.4.1 Trends in CFL Pricing

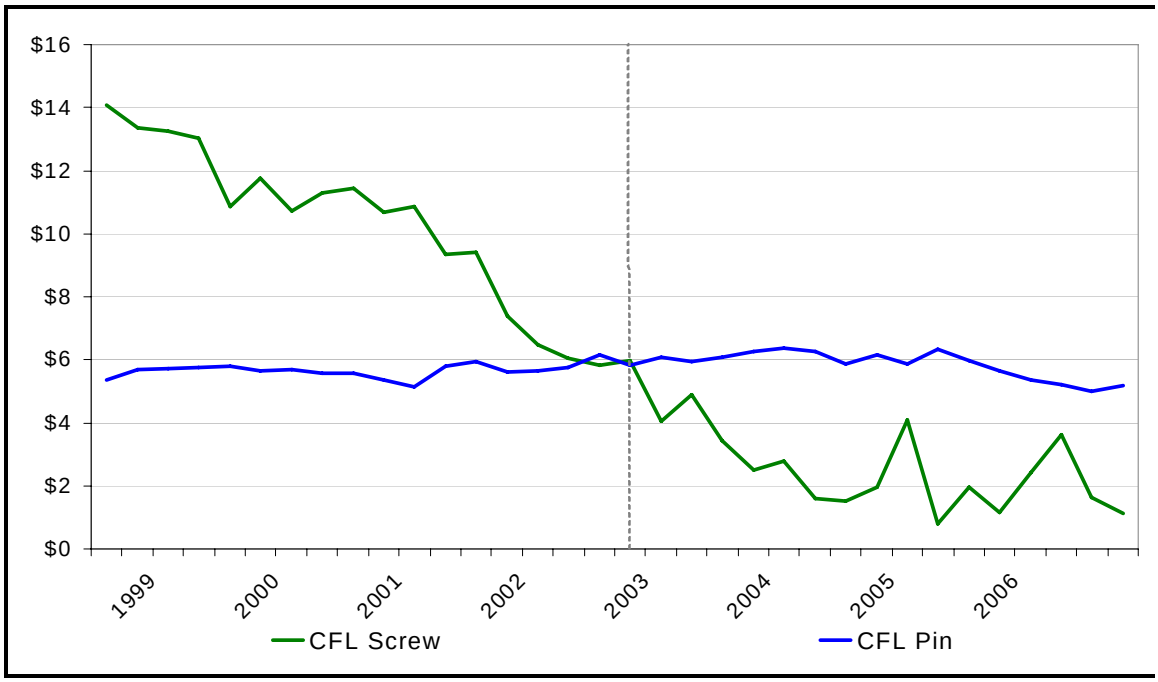
Trends in CFL retail prices over the last decade are reviewed in Figure 2-1 to provide some perspective on the factors that may be driving the changes in CFL sales at the national and or regional level. This figure shows observed retail prices for non-specialty CFLs over the last ten years in California have dropped by a factor of 5 (for bulbs captured in the RMST study, which are a significant but minority portion of all CFLs sold). Future analyses should focus

8 KEMA/Itron 2007, op cit.

9 Winch 2007, op cit.

on comparing the trends in California prices to national trends in CFL pricing, in part to determine if the California upstream rebates are having a localized price impact or if the overall drop in prices is spilling over to other states.

Figure 2-1: Medium Screw-Based CFL Prices and Pin-Based CFL Prices – California Weighted Average Prices Inclusive of Upstream Program Effects



* After 2003, the data no longer include home improvement stores.

Source: Itron work in progress, 2006 California lamp report.[10] Most of this data will be available in 2007 lamp report due out in late April 2008.

Key observations from this figure include:

- The rate of non-specialty CFL price decreases was relatively constant from the start of the first California CFL program in 1998 until 2005. At this point prices appear to begin to stabilize and even spike upward during two periods when the California upstream rebates were temporarily unavailable.
- The stabilization in unit prices observed in 2005 and 2006 appears to have been broken by a new wave of price drops described in the latest DEER incremental cost report and observable in the RMST data base. This price drop may be related to international trading conditions or simply the advent of a new multi-pack retailing strategy, which has driven unit prices down to $2.50 per pack or less, without the upstream rebates, and roughly $0.50 with the rebates.
- The pricing trends observed above probably have strong causal relationship to the trends in CFL sales observed in Table 2-5 and Table 2-6.

[10] Itron 2008 (forthcoming 2006 lamp report), op cit.

- Some of these price drops may be related to changes in the overall quality and likely lifespan of these bulbs. Future research should look carefully at the question of how or if quality levels can be tracked and correlated with prices.

2.4.2 Relevance of CFL Price Trends to Free Rider or Net Program Estimates

At first blush, the CFL price trend can be used to support a convincing story that the CFL energy efficiency programs begun in the mid 1990s have been successful in transforming these markets by reducing retail prices with upstream rebates. Recall that the original justification for changing from customer rebates to upstream rebates was to stimulate or increase the rate of CFL price declines in this market. The observed tenfold decrease in unit prices (from $20/bulb in 1987 to $2/bulb in 2006) and the corresponding ten-fold increase in CFL sales in California over the last twenty years is a remarkable achievement in any market and is likely to be related, at least in part, to the introduction of upstream rebates in the early 1990's and their reintroduction in the late 1990s and 2000s. It is also possible, however, that the observed price declines were the result of production economies planned by manufacturers based on their own analysis of demand as a function of price and anticipation of increasing product attractiveness in response to increasing environmental concerns. The relative importance of technological progress in manufacturing techniques compared to the effect of upstream rebates in contributing to CFL price declines are not known with certainty but should be investigated.

However, the key question we seek to answer when thinking about the appropriate NTFR to use for future programs is whether California CFL upstream rebate programs in 2009 and beyond are likely to continue to have an effect on the margin, either in terms of inducing more or "new" market participants to buy more CFL bulbs or continuing to stimulate or at least assist the downward trend in the price of CFLs. To estimate marginal program effects, we need to develop a better method to estimate baseline or naturally occurring CFL sales per household in California or gather this data from states "uncontaminated" by the CFL programs in California.

At least two approaches can be used to estimate the baseline or naturally occurring sales per household in California.

- Use of observed or estimated baseline CFL sales per household from other states without CFL programs to produce a revised estimate of NTFR for California.
- Development of a demand model that estimates changes in overall CFL sales in California as a function of observed prices, upstream rebates, and proxies for the program's information effect.

Itron is in the process of investigating the feasibility of using Method 2, estimating a demand model using RMST sales and pricing data. However, this is a longer term project that can

not be quickly developed and used here. The next section explores the strengths and weaknesses of the first approach above, i.e., use of existing data sources and quick analysis methods to bind the range of likely NTFR ratios for past and current CFL programs.

2.4.3 Estimates of Trends in CFL Sales at the State and National Level

Table 2-5 provides Itron's current estimate of the trends in CFL sales per household for states with programs, states without CFL programs and the nation as whole.[11] The total sales estimates in this table were developed using two major primary sources: RMST data from the California tracking system[12] and data from the EPA ENERGY STAR Partnership program.[13] The residential market share tracking data from AC Nielsen was the source for sales in the food, drug, and small hardware and discount channels. Data from EPA ENERGY STARS Partner program was used to cover the remaining sales from the mass merchandise channels (Wal-Mart and Costco) and do it yourself channels (Home Depot and Lowe's).

Table 2-5: Estimated Sales of Medium-Based CFLs in United States 2003-2007*

State/Region	2003	2004	2005	2006	2007
California	4,589	8,037	9,124	13,492	49,180
Percentage Change Year-to-Year	--	75%	14%	48%	264%
Non-California Sales	27,354	48,048	51,913	82,508	242,970
Percentage Change Year-to-Year	--	76%	8%	59%	194%
U.S. Sales	31,943	56,086	61,037	96,000	292,150
California Share of U.S. Market	14.4%	14.3%	14.9%	14.1%	16.8%

* Data are approximate and subject to significant uncertainty.

Source: Itron estimates of 2007 total CFL sales at the national level are based on integrating data from EPA and RMST. For more details on the composition of each estimate, see Subsection 2.8. The California estimates shown for 2003-2006 were developed using RMST and IOU-rebated CFLs. The national estimates for 2003-2006 are taken from the NEMA shipments data and then rationed down to estimate sales through retail channels.

The U.S. total sales estimate of 290 million CFLs was cross-checked against estimates of CFL shipments from the U.S. department of Commerce and on the channel level with estimates from private retailers and 18 seconds.org. The Department of Commerce reports total shipments of over 400 million CFLs in 2007 but it is not clear if some portion of these

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11 Readers should note there is considerable uncertainty in the estimates of nationwide and state level CFL sales due to different data sources, extrapolation errors and the unknown size of the Wal-Mart effect. A discussion of the strengths and weakness of these sources can be found in Subsection 2.7.

12 Itron 2008 (forthcoming 2006 lamp report), op cit.

13 Harris, Jeff. *Proposed Revision to Baseline Methodology (for Clothes Washers and* CFLs*).* Ten-page memo prepared for the Cost Effectiveness and Average MW Savings Committee, Northwest Energy Efficiency Alliance. Oregon and Washington CFL sales data for 2003-2005. November 6, 2006

CFLs is subsequently reshipped to Mexico or Canada. The non-California sales are simply Itron's estimate of U.S. sales minus Itron's best estimate of California CFL sales for each year. We note that it is still possible that direct sales from distributors to utilities or via the Internet to customers are not captured by either of these sources.

There are several important trends illustrated in this table that are likely to have an impact on future evaluators' ability to estimate the fraction of CFL program participants who are free riders.

- Reported CFL sales have been increasing at roughly the same rates in California and non-California markets for this five-year period. The California share of the total U.S. market has remained remarkably constant even give the tripling in California sales between 2006 and 2007.
- Data from both California and national sources indicate a record increase in CFL sales between 2006 and 2007 at the state and national levels. This spike was likely fueled by some combination of CFL price drops over the previous five years, significant increases in the number of states offering CFL programs beginning in 2002,[14] increases in CFL availability, and, possibly, other changes in consumer preferences favoring CFLs. We estimate the number of states with active CFL programs went from ten in 2002 to twenty in 2006.
- The surge in CFL sales in 2007 appears to be similarly distributed between California and the remaining 49 states regardless of the existence of programs. This is illustrated by the similar annual growth rates in sales between California and non-California states and only a slight difference in our estimate of CFL sales per household in states with and without programs. In later analyses, we will compare these same growth rates to states with and without active CFL programs.

Uncertainty in the Accuracy of National and State Sales Data

There is an ongoing discussion about the relative accuracy of CFL sales data collected and published at the state and national level due to different organizations reporting sales from different sales channels over time. In this section, we identify the potential sources of bias or error and then provide some examples of why obtaining accurate sales data at the state level may be important, particularly given the rapid increase in sales in 2007.

We discovered five potential sources of error in this review:

- Use of CFL shipments vs. point of sale data,
- Underreporting of sales of non-energy star CFL bulbs,

[14] Future analyses should assess whether there was a significant price drop for CFLs between 2005 and 2006 that might have contributed to the surge in 2007 CFL sales.

- Interpolation of market share into sales data for regions without point of sale data to confirm it,
- Different definitions and judgments about the relative importance of CFL sales from different channels, and
- Different definitions of program-associated or -induced sales.

Discussion of the magnitude and direction of these errors at the state and national level are presented in detail in Subsection 2.7. For now the important point to note is that EPA and Itron have developed independent estimates of national CFL sales for 2007 at roughly 290 million bulbs.[15,16]

Table 2-6 provides a similar overview of trends in CFL sales per household with non-California sales serving, temporarily, as a worst-case proxy for non-program sales. To construct this table, CFL sales estimates were taken directly from Table 2-5 and divided by the U.S. census estimates of households for all 50 states for 2003 through 2007. The final row simply shows the relative rate of growth between California sales per household and non-California sales per household by dividing results from row 1 by row 2.

Table 2-6: Estimated Sales of Medium Screw-Based CFLs per Household

State/Region	2003	2004	2005	2006	2007
California Sales/Household	0.36	0.63	0.70	1.02	3.68
Non-California Sales/Household	0.25	0.44	0.47	0.73	2.12
U.S. Sales/Household	0.26	0.46	0.49	0.76	2.28
California Rate/Non-California Rate/Household	0.44	0.43	0.51	0.40	0.74

Table 2-6 demonstrates that the sales rate per household in the entire country has been slowly increasing until 2006 and then, if current estimates hold, exploded upward by a factor of 3 in California and the remaining states in 2007. The rate of sales increases per household may have accelerated somewhat faster in California relative to the rest of the country in 2007 as illustrated by the increase in the ratio of California sales/household vs. non-California sales/household shown in the bottom row. This suggests that either the upstream programs in California have had a more significant effect on total CFL sales in California compared to sales in other states in 2007 or some other California specific differences related to demographic or media exposure should be used to explain the higher CFL sales growth in California compared to other states. It is also possible that the relative difference estimated is in error due to the uncertainties in the underlying sales data or household estimates.

15 KEMA/Itron 2007, op cit.

16 Itron 2008 (forthcoming 2006 lamp report), op cit.

Examination of Sales Trend Data at the State Level

Available evidence suggests the rate of CFL sales growth was fairly steady from 2003 to 2006 and then took off in 2007. This hypothesis was corroborated by the review of program tracking and overall sales tracking systems used in Wisconsin, New York, and California. However, the specific growth rate and distribution of these new CFL sales across states is still uncertain.

Table 2-7: Estimates of State-Level CFL Sales per HH in 2007 using EPA Preliminary Data for First Half of 2007

State	Region	2007 Annual CFL Sales*	2007 Households	2007 CFL/HH
Florida	South	18,431,213	8,806,387	2.09
Kentucky	South	4,598,847	1,910,941	2.41
Tennessee	South	6,608,909	2,725,208	2.43
Arizona	South	3,805,626	1,298,399	2.93
Massachusetts **	Northeast	3,329,714	2,726,861	1.22
All NE States	Northeast	38,118,328	23,551,359	1.62
California (EPA)	West	24,386,915	13,354,886	1.83
CA (RMST+EPA)	All	49,179,804	13,354,886	3.68
U.S. Average	All	290,336,964	128,103,561	2.22

* State-level CFL sales estimated from first six months of EPA sales data in 2007, assuming 20% growth in last months consistent with national trends. The large difference in EPA state sales estimates compared to CFL sales reported by evaluators in California and Massachusetts is related to the fact that EPA does not include sales from food, drug, and discount store chains.

** Massachusetts evaluators estimate total CFL sales of 10-12 million in 2006 vs. 3.3 million estimated by EPA for 2007.

Table 2-7 shows estimates of total sales per household for the U.S., California, several regions, and selected states in the South in 2007. This estimate is based on the use of EPA sales data for the first six months of 2007 without any adjustments for known omissions of sales data from food and drug stores. It is surprising that the estimated CFL sales per household for many of the Southern states which have no known CFL programs is so high relative to other states which have run established CFL programs for at least five years. Part of the explanation could be attributed to the high retail market share of Wal-Mart in some of these states.

Wal-Mart self-reported CFL sales of 137 million for 2007 at its stores, or 60.5 % of our estimate of national sales. If the self-reported Wal-Mart sales data are correct, overall sales for some states in the South with no appreciable program activity have achieved higher annual CFL sales per household in 2007 than some of the Northeast states that have been running CFL programs for years.

This sudden increase in CFL sales per household at the Southern states could be explained by differences in the saturation of CFL bulbs in existing household between states with programs and states without. Under this theory, the higher saturation of CFLs in existing homes in the Northeast compared to the saturation observed in the South may lead to decreased or more moderate demand in Northeastern states and a higher level of latent demand for CFLs in the Southern states once awareness, availability, and price barriers have been reduced by private marketing campaigns. Itron is in the process of comparing saturation levels across state and checking to seeing if these differences are inversely correlated or at least related to annual sales trends.

This table provides some evidence that the extrapolation of EPA sales data from the first two quarters of 2007 is not consistent with CFL sales data being collected at the state level for 2007. Comparison of rows 7 and 8 in Table 2-9 illustrates this difference for California. Itron estimates California CFL sales at 3.68 CFL per household, while extrapolation of the EPA sales data alone yields an estimate of 1.68 CFLs per household. A similar effect can be observed for Northeastern states.

Representatives from the Northeast states believe the EPA sales totals do not include a significant number of rebated bulbs sold in their states through utility programs. In 2007, there was a factor of two differences in CFL sales per household estimates for Massachusetts. State sources estimate 6.2 million CFL bulbs were sold in Massachusetts[17,18] compared to the EPA sales estimate of 3.3 million provided in this table.

It is also possible that the recent economic slowdown over the last six months has had a differential effect on sales growth between northern and southern states and as such, the Wal-Mart effect on sales in southern states may be exaggerated by the extrapolation approach used here. Nevertheless, the pattern of suddenly high sales per household in the South suggests there may be some reporting errors, in part because not all EPA partner sales data is not independently verified.

Summary of Total CFL Sales Review

There is considerable uncertainty in all of the existing estimates of national, regional, and state CFL sales data. The availability of the new state-level, EPA-estimates for 2007 adds important detail to their previous aggregate estimates but still excludes critically important channels, particularly for programs like those in California. At a minimum, the uncertainties

[17] Massachusetts program-supported sales. Provided to Nexus Market Research by the sponsors of the Massachusetts ENERGY STAR Lighting Program. NMR did the market-level sales estimates for the Massachusetts sponsors. Provided by Lynn Hoefgen, Nexus Market Research.

[18] Ibid.

in these data sources suggest that future evaluations should spend considerable effort investigating and understanding such data. In the end, an expanded and well-funded collaborative national effort is likely needed to improve estimates of CFLs sales at all levels (e.g., state, region, country, world).

Table 2-8 provides the reported levels of program-associated CFL sales for California, Wisconsin, and New York.[19,20,21,22] The accuracy of these trends in program-associated sales data is relatively high for California but not well understood for most states with the exception of Wisconsin.[23] There may also be differences in the definition of program-associated sales between states. Our review of the Wisconsin study suggest they count CFL sales from participating stores as program-associated sales even if the customer did not claim a rebate or if the CFL sale was made during periods when the financial rebates were not available. California counts only bulbs shipped by manufacturers, who have claimed an upstream rebate.

Table 2-8: Estimated Program-Associated CFLs per Household

	2004	2005	2006	2007
California rebated CFL sales/HH	0.52	0.60	0.99	3.06
Wisconsin sales/HH participating stores with tracked rebates	0.15	0.22	0.45	NA
New York program-induced sales/HH	NA	0.50	0.65	NA
Massachusetts program sales/HH	0.88	1.21	0.94	1.03

Estimates of program-associated CFL sales at the state level are useful because they can be used to estimate the sales rate per household in program states and as a basis for comparison with sales per HH rates in states without programs. This topic is discussed below.

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19 State of Main Public Utilities Commission. *Process/Impact Evaluation Efficiency Maine Residential Lighting Program, Request for Proposals.* Maine program-supported sales. NMR estimated market-level sales for the Massachusetts sponsors. September 2006.

20 Itron 2006, op cit.

21 Itron, Inc. *California Residential Efficiency Market Share Tracking: 2005 Lamp Report.* Prepared for Southern California Edison. May 2006.

22 New Hampshire Public Utilities Commission. *2005 Year End Report: Core New Hampshire Program Highlights, Summary.* NHPUC Docket No. DE 03-169. New Hampshire program-supported sales. NMR estimated market-level sales for the Massachusetts sponsors. 2005.

23 Itron, Inc. *2003-2004 Home Energy Savings Program Residential Impact Evaluation.* Prepared for the Energy Trust of Oregon. 2006.

2.4.4 Estimates of CFL Baseline Sales per Household for California and Selected States

Some evaluators have tried to estimate the net impacts of their programs using the results from market share studies from other control state areas (Xenergy in 1994, Wisconsin in 2006, New York in 2006 and some recent evaluations in Massachusetts).[24] Some of these studies attempt to derive baseline CFL sales indirectly by gathering data on CFL market share as a fraction of the total medium screw based market and then leveraging this relationship to use total lamp sales data to back out CFL sales. The study from Wisconsin used a unique approach that focused on gathering CFL sales data at matched pairs of different retail chains and controlling for differences between participating and nonparticipating stores in both states.[25]

In that study the level of baseline or naturally occurring sales was estimated both for the participating stores population (using matches with similar Michigan stores) and for the nonparticipating stores. The results range from an estimate of 0.83 CFL/HH if only the participating stores are included to estimate free riders (and thus the baseline sales/HH) compared to 1.63 CFL/HH if the baseline CFL sales from the nonparticipating stores are also included. Selection of the participating stores level is the best fit for the narrow NTFR definition because we are concerned with the free riders as a fraction of the reported program participants and not as a fraction of the total market.

Estimates of baseline or naturally occurring sales per household for both participating store and nonparticipating store populations can be used to estimate both the narrow net (NTFR) ratios that account for free riders only and the more expansive definition of net program effects (NTG) that include the impacts of market effects on free ridership and market spillover effects over time for upstream programs in California.

Table 2-9 presents estimates of the trend in baseline sales per household in California and compares this to recent estimates of baseline sales in Wisconsin, Michigan, and New York. The estimates of baseline sales for California attempt to bound the high and low end of the range by considering a range of estimation approaches. In the first California row the KEMA 2004-2005 evaluation estimate of free ridership (38%) is multiplied by program sales in 2004 to yield the baseline or underlying natural sales rate. To estimate the baseline CFL sales rate for 2005 through 2007 in the low case we assume that the relationship between baseline sales per household and program-associated sales per household estimated for the 2004-05 programs will increase at the same rate as CFL sales for the 2006 to 2007 period. This is the low estimate of baseline sales shown in Table 2-9, row 1.

24 Itron reviewed evaluations from Wisconsin, New York, and California that used this method. See sources at end of the paper.

25 Winch 2007, op cit.

Table 2-9: Estimates of Baseline CFL Sales per HH for California and Selected States

Baseline CFL Sales by State	2004	2005	2006	2007
California baseline sales/HH low estimate	0.20	0.23	0.38	1.16
California baseline sales/HH high estimate	0.37	0.40	0.62	1.87
Wisconsin baseline low estimate for participating stores only – no spillover or nonparticipating stores	NA	NA	0.83	NA
Wisconsin baseline high estimate – expansive net for entire population	NA	NA	1.66	NA
Michigan	NA	NA	0.95	NA
New York baseline sales/HH		0.70	NA	NA

The high estimate of baseline CFL sales/HH for California (row 2) was derived using the average CFL sales rate per household estimated for the remaining 49 states without attempting to remove the effects of CFL programs in the 15 states, which currently run programs. This represents the upper bound of what baseline sales per household during this period because it assumes the existence of CFL programs in the 15 program states has no effect on the baseline sales rates for states without CFL programs. Removing CFL sales from the states with programs would lower the overall CFL sales and thus the baseline or average sales for the remaining households in states without CFL programs. Later we present an expected value case based on our best attempts to remove the sales from the states with CFL programs from 2004 onwards.

We also present an independent estimate of baseline sales per HH in New York based on analysis from Quantec and a similar independent estimate of baseline sales per household in the participant population from the Wisconsin study.[26] The New York estimate is based on market share data from EPA and estimates of sales from adjacent states without programs.[27]

2.4.5 Synthesis of Net to Gross and Net of Free Rider Estimation Methods

In this section, we develop estimates of likely NTFR ratios for 2004-2005 upstream programs and then for programs that may be offered in the 2009-2011 filing period. Estimating the fraction of program participants that would have bought CFLs in the absence of a program requires knowledge of the total CFL sales, program-associated sales and free ridership or the

[26] Ibid.

[27] Quantec LLC and Summit Blue. *New York Energy $Martsm Products Program Market Characterization, Market Assessment And Causality Evaluation.* Prepared for New York State Energy Research and Development Authority. June 2007.

naturally occurring level of CFL sales in the absence of programs. If comprehensive and reliable data were available, the baseline or naturally occurring level of CFL sales would be easy to estimate in states without CFL programs and more complicated for states with programs, as discussed below. This of course assumes there is no leakage of program effects across state boundaries. Different equations are presented to estimate net savings using the narrow net and expansive net definitions.

For states without CFL programs, net effects can be estimated as:

1) $Baseline\ sales\ /\ HH = total\ sales\ /\ HH$ (because program-associated sales are 0)
2) $Free\ rider\ ratio\ (FR) = (baseline\ sales\ /\ HH)/(program\text{-}associated\ sales\ /\ HH) =$
3) $NTRF = 1 - FR$

For states with CFL programs, the following definitions are considered:

4) NTG (expansive net)
$$= \frac{(total\ CFL\ sales/HH\ -\ baseline\ sales/HH)}{program\text{-}associated\ sales\ per\ household}$$

5) NTFR (narrow net) = 1-FR

where (FR) = $\dfrac{baseline\ sales/HH}{program\text{-}associated\ sales/HH}$

Table 2-10 uses these equations to bound estimates of free rider (narrow net) and market and spillover effects, (expansive net to gross) for the California upstream CFL programs fielded in 2004 and 2005. The baseline CFL sales rates per household are taken directly from Table 2-9 in the first two rows. The third row uses a revised estimate of sales from the 49 states in the non-California baseline CFL rate after removing estimated sales from the ten states with active CFL programs in 2004. (Details of this adjustment are presented in Subsection 2.8.)

Table 2-10: Range of Net Effect Estimates for the 2004 California Upstream CFL Program Using Different Baseline Sales Rates

Scenario	Baseline or Naturally Occurring CFL Sales/Household	Method for Estimating Baseline Sales	NTG Ratio using Expansive Net Definition (includes market effects and free riders)[a]	NTFR Ratio using Narrow Net Definition (only free riders)[b]
Base case NTFR=62%	0.20	Program CFL sales/HH×FR rate	69.7%	62.0%
High case-baseline=all 49 non-California states	0.43	Base=average non-California CFL sales/all non-California HH	38.5%	17.3%
Low case-CFL/HH for 40 states w/o CFL programs	0.12	Base=CFL sales in states without programs/HH in same states	98.1%	76.9%

a Expansive Net=(total sales/HH-base sales/HH)/program associated sales.
b Narrow Net=base sales/HH/program associated sales/HH.
c Non-California states with CFL programs in 2004 included Oregon, Washington, Massachusetts, New York, New Jersey, Rhode Island, Vermont, Wisconsin, and Connecticut.

Table 2-10 shows how sensitive the estimate of net program effects is to different assumptions about baseline or naturally occurring sales of CFLs in 2004. Changes in the estimate of baseline sales per household from 0.43 to 0.12 result in a change in the estimated NTFR ratios from 17% to 77%. The estimate of a baseline sales level 0.12 CFL sales per household is the most defensible because it attempts to correct for all known CFL program sales from the non-California CFL sales total. The 17% NTFR is considered too low because the baseline estimate of 0.43/HH does not remove the CFL sales from states with known CFL programs in 2004 from the 40 other non-program states.

This estimate of 0.12 CFL sales per household is also supported based on some independent analysis of AC Nielsen data on CFL sales per capita in non-active areas of the country in 2005 performed by the Northwest Energy Efficiency Alliance.[28] These data suggest the non-active sales or baseline CFL sales rate per household in 2004 was 0.035 bulbs/capita on a national level or 0.08 bulbs/HH using the 2.3 persons/HH average reported by the census for Oregon for 2004. Interestingly, this source reported the non-active sales rate per capita actually fell from 0.035 CFL/capita to 0.015 CFL/capita in the Pacific North west for 2005.

The range of NTFR and NTG estimates presented in Table 2-10 represent the second leg of the triangulation method that supports an upward adjustment in NTFR for the 2004-2005 upstream rebate program from 62% to 74%. The first was the sensitivity analysis of the NTFR estimated using supplier self reports discussed in Section 1. The final leg of the triangulation approach, estimating the impact of the upstream program on pricing and

[28] Harris 2006, op cit.

ultimately net CFL purchases is underway but will not be available for this round of the DEER update.

2.4.6 Estimating Net Program effects for Program Year 2007 and Beyond

Table 2-11 bounds the estimates of expansive (equation 4) and narrow (equation 5) net ratios to apply to gross savings for program year 2007. The results in Table 2-11 are estimated using the aforementioned narrow and expansive net formulas and the range of baseline CFL sales per household observed in non-program states without CFL programs (from 1.0 to 2.8) shown in this table. For consistency, we show that the formula used based on current California conditions come up with the same NTFR estimate of 62% at baseline sales per household rate of 1.14 CFLS/HH. Not surprisingly, as the level of baseline sales of CFL /HH rises from 1 to 2.8, the NTFR ratio falls from 89% to 29%. All of these calculations are based on Itron's current estimate of 3.7 CFL total sales and 3.08 program reported sales per household in California 2007; however, this estimate is also preliminary.

Table 2-11: Range of NTFR and NTG Estimates for the California CFL Program in 2007 as a Function of Estimated Baseline CLF Sales per Household

Baseline or Naturally Occurring CFL Sales/Household	Baseline based on State or Method	NTG Ratio using Expansive Net (includes market effects and free riders)[a]	NTFR Ratio using Narrow Net (only free riders)[b]
0.85	Non California state CFL sales-CFL sales from states with CFL programs	93.7%	71.9%
1.00	Vermont	88.7%	66.9%
1.15	California base=.38 (FR) × program reported sales	83.9%	62.0%
1.50	Michigan	72.2%	50.3%
2.20	Arizona	49.0%	27.2%
2.41	Kentucky	42.1%	20.2%

Definitions of NTG and NTFR
a Expansive Net=(total sales/HH-baseline sales/HH)/program sales
b Narrow Net=baseline sales/HH/program sales/HH

Table 2-11 suggests that the likely net to gross ratio for California program in 2007 ranges from 42% to 94% (Column 3) based on the range of observed CFL sales reported for individual states, an estimate of the CFL sales per household in states without program and the California baseline assuming KEMA's estimate of free ridership at 38% for the 2004-2005 programs can be used to estimate the baseline CFL California sales in 2007. Details of the state-by-state CFL sales levels and adjustments to the non-California CLF sales totals are provided in Subsection 2.8.

Use of the more conservative or narrow definition of net suggest a range of expected NTFR for future programs that ranges from 27% to 72% (last column of this table). Our recommended NTFR value for future upstream CFL programs of 60% is at the lower end of the range based on the expansive definition of net savings and the higher end of the NTFR range shown in column 4 based on the narrow definition of net program impacts (free riders only).

The range observed for both definitions of net impacts support the hypothesis that the likely trend in NTFR for upstream CFL programs is downward, if the 2007 national CFL sales surge is borne out. In both cases the increase in market share for mass merchandise and home improvement retailers and higher sales in programs without programs will likely lead to lower estimates of NTFR for California programs using the current measurement methods approved by the CPUC (again, if the 2007 national sales surge is borne out).

2.5 Synthesis of Results from Different Measurement Approaches

Table 2-12 shows the range of results for NTFR and NTG ratios for California's CFL programs based on different evaluation methods. This review provides ample evidence that there is considerable uncertainty in the likely net impacts of future programs regardless of the choice of an expansive definition of net impacts used in the rest of the country or the narrow net definition used in California.

Table 2-12: Review of NTFR Results Under Alternative Measurement Approaches

Measurement Method	NTFR results Low estimate	NTFR results High estimate	NTFR results Reported Value or Recommended Value
Self-Report for 2004/2005 Program-Retailers and Manufacturers	51%	75%	62% = Reported value 74%= Rec. value
Comparison of CFL sales at state level- 2004-2005 (Table 2-10)	29%	77%	53% =(Avg)
Comparison of CFL sales at state level - 2007 using narrow net (Table 2-11)	20%	72%	60%= Rec. value
Comparison of CFL sales using expansive net definition –NTG-2007 (Table 2-10)	42%	94%	68%=(Avg)

Our review of the self report methods used for 2004-2005 programs suggest the actual NTFR estimate will range from 51% to 75% for the overall program. A key question for the future is whether the trend toward increases in CFL market share for mass merchandisers like Wal-Mart is likely to cause the overall NTFR to drop given the high level of free ridership reported for mass merchandising channel in 2004-2005 programs.

Our review of different methods to compare the rate of CFL sales between states with and without programs yields a range of NTFR from 29% to 77% for the 2004 program year and a slightly larger range of 20% to 72% for the 2007 program year. Both methods suggest the NTFR is likely to continue to decline given available trends in market share and product pricing.

Given the NTFR results from both evaluation methods, we suggest it is prudent to select an NTFR value which is at the lower end of the self report method range and in the middle to higher end of the range produced using CFL sales with and without programs. We selected an overall NTFR of 60% based on this criterion of triangulation for both the current 2006-2008 programs and for future 2009-2011 programs.

Finally, it is important to stress that the 60% NTFR value recommended here for use in estimating the net of free rider impacts of 2006-2007 CFL programs, for non-specialty bulbs, is an interim value subject to the many sources of uncertainty discussed in this review. The NTFR recommendations made here should be seen as an indicator of likely future direction of NTFR estimates and is not intended to be definitive. A key objective of this review is to stimulate new thoughts about likely future program goals and better methods to measure them.

The significant decrease in CFL product prices and significant increases in out of state CFL sales will make it very difficult to estimate any ongoing marginal impacts from future upstream rebate programs in California. It will be very important to examine if current CFL program goals and theory need to be changed in light of these new market realities. For example, should the goal of new CFL programs in 2009-2011 be to continue to contribute to the reduction of mainstream CFL prices (e.g., below $2/bulb) or has this goal been achieved? If the price reduction goal has been achieved and the new price is considered sustainable, are there new program designs and approaches that should be explored to increase installations and savings from CFLs in California. Similarly, the sustainability of availability of CFLs in high NTFR channels, such as food and drug stores, should be assessed to determine the importance of channel distribution relative to other factors like price. Further research is also needed to assess the extent to which consumers will shift purchases from one chain to another in response to price and availability changes.

Another key question is whether removing upstream rebates in California or elsewhere is likely to have an impact on nationwide pricing. This is because the original program goals of increasing customer awareness of CFLs, reducing their prices, and increasing their availability in major channels have largely been achieved. It is not yet clear whether these effects are sustainable were the program intervention to be removed or significantly modified. It will be important to discuss whether the new programs will have different objectives or maintain the same price reduction goals. We also recognize that non-specialty CFL program goals and strategies are likely to be closely related to other policy drivers such as the shareholder incentive mechanism, its relationship to the CPUC energy savings goals, and the desired role of CFLs in contributing to goal attainment.

2.5.1 Final Recommendations

Table 2-13 presents our recommended NTFR values for the different types of CFL bulbs and different delivery methods for use in the May 2008 DEER update. While the vast majority of time in this review was devoted to developing values for medium screw based CFL bulb with wattages less than 30 watts, we have also recommended default values for specialty bulbs in this table. There are several different types of specialty bulbs that are just starting to appear on market shelves and have not experienced the price declines seen in the mainstream CFL market. We recommend the use of an NTFR of 0.85 for these types of bulbs. Specialty bulbs include dimmable bulbs, spotlights, and high wattage applications. Note that these values only apply if the bulbs are installed in their intended applications, e.g., a dimmable bulb that is purchased in lieu of a non-specialty CFL and applied in a non-dimmable application would not be appropriate for the 0.85 NTFR. Rather, a dimmable CFL that replaces a dimmable incandescent would be the intended application of the higher NTFR value.

Table 2-13: Recommended NTFR values by CFL type and Program Delivery Mechanism

Measure and Program Information				Net-of-Free-Ridership (NTFR) Information		
Measure Name(s)	Efficiency or Capacity Descriptor	Target Market(s)	Program Delivery Method/ Channel	NTG Values Used by Utilities in Previous Filings	NTFR Values Based on 2004-05 Studies	Recommended NTFR Values for 2009-11
Lighting						
CFL-screw in	<= 30 Watt	All residential	Upstream prescriptive rebate - All channels	80%	74%	60% **
CFL-screw in	<= 30 Watt	Hard to reach	Direct Install	80%	85%	85%
CFL-screw in	> 30 watt *	All residential	Downstream prescriptive rebate	80%	75%	75% **
CFL-screw in	> 30 watt *	All residential	Upstream prescriptive rebate	80%	85%	85% **

Notes
*excluding dimmable and reflector bulbs
** These values will need to be adjusted once details of program delivery methods are available

This review of net impact analyses over the last decade suggest that the usefulness of the self report method for estimating net effects may decline as CFL sales became more of a mainstream purchase and there is a growing need to estimate net effects using market data on sales by product and prices. Crucial questions related to the marginal effects of CFL programs hinge on an understanding of market dynamics that cannot be derived solely from in state interviews with suppliers. We recommend the following steps be taken to improve future estimates of NTFR for CFL programs.

- Improve the accuracy of current CFL sales tracking mechanisms at the state and national level to provide a much better understanding of how the California market interacts with other state and national markets and alternative methods of estimating net program impacts.
- Investigate the degree of competition for the same types of customer between key CFL sales channels. For example, does Wal-Mart try to compete for CFL market shares with loyal grocery store by offering larger discounts or does their research show that most customers will come to Wal-Mart eventually regardless of any purchases at the local market? If local grocery stores are no longer offered upstream rebates, will they continue to stock the CFL product or choose to no longer compete for CFLs given the lower cost distribution channels enjoyed by the mass merchandising sales channels?
- Improve estimation of CFL installation rates over time. Very little information is available to assess whether the drop in CFL prices, both with and without upstream rebates, leads to an increase in CFL storage rates (decrease in installation), or change in the rate of installation over time from date of purchase. The analysis here implicitly assumes that CFL sales are CFL installations. There may be significant effects on NTFR and NTG if installation rates are inversely correlated to sales rates.
- Build a demand model that can predict incremental CFL sales volumes and level of free rider-ship as a function of CFL price, availability, program effects, and other causal factors (e.g., customer characteristics).
- Investigate the sustainability of current CFL pricing with and without rebates by working with manufacturer representatives to discover the production cost or price at the factory gate for CFLs in China and other major manufacturing centers and to what extent this price is available to a variety of distribution chains in the United States.
- Continue to focus on differentiating market effects by sales channel.

2.5.2 Closing Observations

An expansion in evaluation methods may be needed in the CFL market because the objectives of CFL programs are likely to change:

It is becoming more and more difficult to separate program from competitive price effects because CFL sales occur in a national market with plenty of spillover impacts that have no regard for state boundaries. For example, Michigan may have captured benefits of neighboring state Wisconsin's program. This suggests that effective NTFR analysis must really take place at the national level and explicitly analyze the role of price changes in inducing CFL sales at the margin.

Changes in CFL program design should proceed cautiously.

We anticipate any proposed downward adjustment to the overall NTFR estimate for the 2009-2011 programs may stimulate some utilities to consider redesigning the upstream rebate program to favor some market channels over others and thus perhaps increase the actual NTFR of the program. The data we reviewed suggest that price competition is now sufficiently robust across CFL sales channels that the selective use of rebates for certain channels may not have the intended result of increasing the overall NTFR but we cannot be sure without more study of how prices are being set in this market.

The primary criterion that should be used to evaluate any proposed changes in CFL program design should be to first "do no harm" to the positive changes already observed in the market. This means being careful to ensure that program design changes intended to maximize marginal energy savings do not inadvertently slow or reverse the downward trend in CFL unit prices and sharply upward trend in sales. This downward trend in CFL prices has probably increased net dollar savings to customers from cheaper bulbs far more than the energy savings achieved over the last decade. Experimental designs and good old fashioned consultations with the trade allies are two possible strategies that can be used to minimize the chances of this adverse outcome**.**

2.6 Discussion of the strengths and weaknesses of different sources used to construct state and national CFL sales data

Five main sources of CFL data were used to construct estimates of statewide and national CFL sales.

- EPA Energy Star Tracking system[29]
- California RMST Lighting Tracking Study[30]

[29] EPA Office of Air and Radiation, Climate Protection Partnerships Division. *ENERGY STAR Qualifying CFLs: Sales Data from Major National and Regional Retailers for the First Quarter of 2007.* Prepared by the CADMUS Group. 2007.

[30] Itron 2008 (forthcoming 2006 lamp report), op cit.

- Wisconsin Comprehensive CFL Market Effects Evaluation (Prepared for Focus on Energy in Wisconsin, July 2007)[31]
- Estimate of New York Total and Program Induced CFL sales from Quantec[32] - based on market share data from EPA Energy star partners and other sources.
- Estimates of Program and Market sales for Massachusetts, Maine, New Hampshire and Connecticut (provided by Lynn Hoefgen, Nexus Market Research.[33,34,35,36]

We also compare our estimate of national CFL sales vs. the Department of Commerce national import data for CFLs at the end of this section.

The strengths and weakness of each system are discussed below.

2.6.1 Energy Star CFL Tracking System Maintained by the Cadmus Group

Strengths

- Collects point-of-sales information in every state from a consistent set of national distributors and retailer and publishes every six months.
- Good working arrangements allow EPA staff to work closely with selected retailers to access their data and look into potential anomalies in reporting systems.

Weaknesses

- Sales totals do not include sales from hardware (non-large home improvement stores), food and drug chains, regional chains, internet channels, or small Mom and Pop retail stores.
- The data collection system does not attempt to collect data for CFLs that do not qualify for the ENERGY STAR Label.
- The voluntary nature of the data submittal process from EPA's channel partners makes it difficult for CADMUS to set up quality control or verification processes to guard against double counting or misreporting of CFL sales.

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31 Winch 2007, op cit.

32 Quantec/Summit Blue 2007, op cit.

33 Presentation by Jeff Pratt. *Connecticut ECMB Residential Program Update-Sector Snapshot*. Connecticut program-supported sales. NMR estimated market-level sales for the Connecticut sponsors. Provided by Lynn Hoefgen. May 9, 2006.

34 NHPUC Docket No. DE 03-169, op cit.

35 Maine PUC 2006, op cit.

36 Massachusetts ENERGY STAR, op cit.

Figure 2-2: Example of EPA Data Set Used

ENERGY STAR Qualifying CFL Sales Data from Six Major National and Regional U.S. Retailers by State[1]

First quarter, 2007

State	ENERGY STAR CFL Sales[2] (total # of bulbs sold by reporting U.S. retailers)
AK	127,695
AL	883,001
AR	644,501
AZ	1,051,755
CA	4,491,067
CO	771,857
CT	727,842
DC	6,481
DE	207,948
FL	3,151,999
GA	1,334,006
HI	271,092
IA	490,832
ID	247,008
IL	2,176,297
IN	1,079,436
KS	532,349
KY	824,559
LA	747,520
MA	591,894
MD	802,302
ME	245,036
MI	1,143,983
MN	672,629
MO	1,183,941
MS	524,612
MT	197,142
NC	1,681,589
ND	89,574
NE	259,810

State	Sales[2] (total # of bulbs sold by reporting U.S.
NH	297,578
NJ	946,396
NM	308,308
NV	546,434
NY	1,783,555
OH	1,698,535
OK	787,623
OR	543,585
PA	1,708,423
PR	145,346
RI	95,421
SC	793,931
SD	138,403
TN	1,205,509
TX	4,510,584
UT	427,161
VA	1,530,079
VI	4,607
VT	56,459
WA	1,138,821
WI	687,026
WV	313,150
WY	81,047
Total	46,907,738

Notes:

1. *Major retailers do not include retailers from food and drug chains. Retail sales data includes data from Puerto Rico, U.S. Virgin Islands, and Washington DC.*

Source: EPA Office of Air and Radiation, Climate Protection Partnerships Division. *ENERGY STAR Qualifying CFLs: Sales Data from Major National and Regional Retailers for the First Quarter of 2007*. U.S. Environmental Protection Agency.. 2007. Prepared by the Cadmus Group.

In the report, we state that 2007 CFL state level sales data reported by EPA "appears to be evenly distributed across the states" because we are not yet confident in the accuracy of these data for states with active CFL programs. This is because many of these states have promoted CFL sales in channels not included in the EPA data tracking system, such as grocery stores. In addition, it is still not clear if the sales estimates for some of these states have been derived from a sample or census of sales of all EPA energy star lighting products or for medium-based screw lamps only. Finally, there are uncertainties related to the fact that EPA's data does not include CFL bulbs purchased through internet sales channels or direct wholesale purchases of CFLs by utilities or other corporations involved in CFL giveaways.

Additional uncertainty is present in the state level projections of CFL sales data for 2007 using the EPA data for the first two quarters of 2007 as the foundation of the overall sales estimate. As noted in this table, overall sales levels for 2007 were estimated by Itron using a uniform extrapolation factor of 2.4 to convert the EPA state-by-state estimates from the first six months of 2007 sales data to a 12-month basis. Use of this extrapolation technique for California resulted in a total sales estimate of 24 million bulbs for 2007, which is 50% lower than the 49 million CFL estimate reported from in-state California sources. This may be because of the larger share of rebated bulbs from sales channels in California that are excluded from the EPA database. Whether this reporting or extrapolation bias exists for other states with large CFL rebate programs is not yet known but it appears a similar bias exists for Massachusetts and Connecticut based on a comparison of their published total sales vs. the estimated derived from the EPA source.

2.6.2 RMST Lighting Tracking Study – conducted for the California IOUs, managed by SCE and conducted by Itron

Strengths

- Use of a consistent set of data based on point of sale information at both the state and national levels allows for high quality time series analysis.
- Use of a well respected data collection firms, AC Nielsen and Activant, brings high level of confidence to data collected.
- Includes UPC level data including wattage, bulb type and shape, and price.
- Same channels collected both inside and outside of California.

Weaknesses

- The data analyzed in the tracking system do not include sales through other channels, such as club warehouse stores, the Internet, small independent stores, and direct sales from the manufacturer to the consumer. This has become a bigger problem over time as customers spend more time purchasing goods at a lower cost

through Sam's Club and Costco and well as small food store and discount store channels.

- Difficult to ascertain differences in sales tracking techniques for smaller channels vs. those techniques used in large home improvement and mass merchandise outlets.

Figure 2-3: Example of Data Reports

Table 1: Annual Medium Screw-Based Lamp Sales (in thousands)

	CFLs							
Region	1998*	1999	2000	2001	2002	2003	2004	2005
U.S.	1,928	5,063	6,796	22,078	27,079	31,943	29,299	35,144
CA	259	713	1,161	5,744	4,463	4,589	5,135	6,028
SCE	64	169	328	1,679	1,214	1,324	1,454	1,800
SDG&E	26	70	157	506	356	420	545	708
PG&E	112	318	416	2,540	2,141	2,009	2,207	2,511
Other	57	155	261	1,019	752	549	639	724
	Incandescent Lamps							
Region	1998*	1999	2000	2001	2002	2003	2004	2005
U.S.	633,672	1,322,715	1,355,233	1,301,845	1,278,327	1,234,269	1,183,569	1,096,000
CA	54,014	112,636	114,717	92,916	95,430	91,548	87,765	79,240
SCE	16,634	34,174	35,460	29,712	30,551	30,375	28,776	26,304
SDG&E	4,309	9,042	9,059	7,357	7,390	7,237	6,920	6,329
PG&E	22,670	47,861	47,881	37,562	38,477	35,386	34,132	30,457
Other	10,402	21,560	22,316	18,285	19,012	12,930	12,169	10,550

*Third and forth quarters only.

Source: 2005 California Lamp Report, Itron 2006

2.6.3 CFL Sales Data from Wisconsin and Michigan

Source: Rick Winch and Tom Talerico, Glacier Consulting, Comprehensive Focus on Energy Public Benefits Evaluation: *Comprehensive CFL Market Effects Study—Final Report (*July 30, 2007)

Strengths

- This team collects CFL sales data directly from stores and had the ability to monitor relationship between shelf placement and area devoted to CFL sales and actual sales by SKU number. Shelf space data are gathered by mystery shoppers.

- Innovative methodology compares sales from similar stores in same chain but in different states to identify baseline or naturally occurring sales rates per household and the incremental net effect of programs on the sales per store in similar chains in the treatment and control states.

Weaknesses

- Estimation method requires inferring CFL sales per store in cases where store manager refused to cooperate and provide data based on relationship between shelf space used for CFLs and monthly sales.
- Definition of net program effect includes the net difference in sales from Wisconsin stores vs. Michigan stores without analyzing the effects that other factors might have had on this difference in sales. This report does compare demographic factors between states and concludes the states are similar. Other factors that may have led to this difference in CFL sales per store include different levels of media stories related to CFLs, differences in sales taxes, electricity rate structures, disposable income/household, promotional events held by private chain initiatives in one state and not the other differences in trade, and differences in state or local government/ support of CLF sales. The point is that assuming the CFL program is responsible for 100% of the observed market effect is likely to be an overestimate, how much of an overestimate is unknown.
- No guarantee that data collection system will pick up all CFL sales from small stores or discount stores, relies on cooperation on in store managers

Figure 2-4: Example Data Set Used from this Source

Table 4-1. 2006 Wisconsin CFL Sales and Baseline Sales

		CFL Sales				
	# of Stores	(a) Rewards Paid	(b) Not Rewarded	(c) Total a + b	(d) Baseline	NTG Ratio (c-d)/a
Participants						
Hardware	294	552,619	29,761	582,380	43,200	**0.98**
Home Improvement	133	556,834	1,845,196	2,402,030	2,060,372	**0.61**
Grocery & Other	45	42,225	18,468	60,693	10,727	**1.18**
Drug & Mass	0	0	0	0	0	
Sub-Total	**472**	**1,151,678**	**1,893,425**	**3,045,103**	**2,114,299**	**0.81**
Nonparticipants						
Hardware	106	540	6,328	6,868	6,782	
Home Improvement	228	225	91,677	91,902	90,746	
Grocery	1,099	143	13,578	13,721	13,548	
Drug	564	25	10,650	10,675	10,541	
Mass Merchants	703	1,288	74,288	75,576	74,626	
Other	36	1,872	0	1,872	1,848	
Wal-Mart	89	18,000	1,385,975	1,403,975	1,386,326	
Sub-Total	**2,825**	**22,093**	**1,582,495**	**1,604,588**	**1,584,417**	
Grand-Total	**3,297**	**1,173,771**	**3,475,920**	**4,649,691**	**3,698,716**	**0.81**

2.6.4 Estimate of New York and Other State CFL Sales from Quantec Based on Data from EPA ENERGY STAR Partners and Other Sources

Table 2-14: Step 2A—Calculate Total Number of CFLs Sold in Non-Program Areas in 2005

State/Region	Total Number All CFLs Sold in 2005	Number of Households in 2005	Average Number of CFLs Sold per Household
US, total	90,435,840	111,090,617	0.81
New York (**Energy $mart**[SM] region only)	9,452,644	6,134,292	1.54
California	15,511,815	12,097,894	1.28
Connecticut	4,233,417	1,323,838	3.20
LIPA (NY)	2,537,177	980,139	2.60
Maine	487,490	542,158	0.90
Massachusetts	6,336,949	2,448,032	2.60
New Hampshire	536,730	497,054	1.08
New Jersey	6,612,077	3,141,956	2.10
Northwest (ID, MT, OR, WA)	6,800,000	4,776,217	1.42
Rhode Island	1,051,198	406,089	2.60
Vermont	349,900	248,825	1.41
Wisconsin	2,230,659	2,219,571	1.00
Total, program areas	56,140,056	34,816,065	1.61
Total, non-program areas (baseline)	34,295,784	76,274,552	0.45

Source: Quantec analysis for NYSERDA in Jan 2006.[37]

2.6.5 Estimates of Program and Market sales for Massachusetts, Connecticut, Maine, and New Hampshire

Table 2-15 presents estimates of program and market sales.

[37] Quantec/Summit Blue 2007, op cit.

Table 2-15: Estimates of Program and Market sales for Massachusetts, Connecticut, Maine, and New Hampshire

State	Program CFL sales 2004	Program CFL Sales 2005	Program Sales Source	Market Level CFL Sales Estimate for 2005
Connecticut	Not Available	2,000,000	from CT ECMB RES UPDATE_Pratt_050906-DRAFT	2,391,795 to 3,882,522
Maine	Not Available	500,000	from Maine RFP	597,949 to 970,630
New Hampshire	Not Available	223,140	from core NH program highlights	266,853 to 433,173
Massachusetts	2,362,652	3,264,347	from program files	6,336,949

Source: Lynn Hoefgen, Nexus Market Research, 4/17/2008

Strengths-

- All store types, and participants as well as nonparticipants, are represented.
- Estimates of non-program CFLs at participating stores are calibrated by known sales of program CFLs at each store
- Estimates based on retailer on-site surveys—with product counts and retailer estimates of turnover time, as well as seasonal variation—are roughly comparable to estimates derived from consumer surveys—which in turn are validated by on-site visits to the homes of those who say they have bought CFLs.

Weaknesses-

- Sample, not census, of stores
- Relies on cooperation of store managers—if a store manager refuses, that store is replaced with another store of the same type

2.6.6 Comparison of US Import Data vs. US CFL Sales Estimate included in this study

Table 2-16 shows the differences in import compared to national sales data. Review of the time series trends suggests that U.S. sales are roughly 60 to 70% of CFL imports over time over time. There may be several explanations for the differences between import and sales levels First, a significant but constant fraction of CFLs may be trans-shipped back out to Mexico or Canada after arriving in the U.S. Second, there may be a time lag between imports and sales. Third, there may be a large share of CFL overall sales not being counted by the current retail sales collection process because the CFLs are moving through wholesale channels to the ultimate user.

Table 2-16: Comparison of U.S. CFL Imports vs. U.S. Sales

Years	U.S. Sales Using EPA and RMST sources	U.S. Shipments using Department of Commerce data
2004	56,085,600	93,475,116
2005	61,037,400	101,772,949
2006	96,000,000	184,686,594
2007	292,149,519	397,128,692

Source of imports = U.S. Department of Commerce
Source of Sales: EPA and RMST data from CADMUS and Itron

2.7 Discussion of Uncertainty in National and State CFL Sales Estimates

It is important to note that there is considerable uncertainty attached to the estimates of statewide and national sales totals presented in this paper. This is because of the need to use multiple sources from different sales channels to construct the national and state estimates because there is not one comprehensive source. At last count there were three competing sources providing national CFL sales and or shipment data. In addition to these factors, there is additional considerable uncertainty in the national and per state CFL sales estimates because of the following.

- The existence of multiple data collection sources who often choose not to reveal how they estimated CFL sales for proprietary or business reasons
- The use of fixed rules of thumb to allocate sales of CFLs between small commercial customer and residential households
- The use of a rule of thumb (ranging from .15 to .25) to adjust energy star sales to derive non qualifying and total CFL market sales
- Potential double counting between individual store sources and consortiums such as 18 seconds.org

In addition the actual level of CFL sales for the third or fourth quarter of 2007 is based on a forecast for California that CFL sales increased by 20% over the last six months of 2007. It may turn out that the recent economic slowdown or recessions either slowed down sales or had differential effects between states or regions.

2.8 Derivation of Baseline CFL Sales per Household in Program and Non-CFL Program States

The table below shows the data used to estimate the baseline sales from states with and without programs in the years before 2007.

- Start with estimates of CFL sales in California and Nationwide
- Derive CFL sales estimates for the lower 49 states for 2004-2007
- Independently gather information on the estimated total CFL sales for the 10 states known to operate CFL programs in for 2004, 2005 and 2006. Trend to 2007 based on rate of growth in non-California sales.[38,39,40,41,42,43,44,45,46]
- Subtract these CFL sales totals for the nine (ten including California) programs with CFL programs from the lower 49 states total to get the total CFLs sold in 40 states without programs.
- Derive a "states without CFL sales per household" by dividing non-state CFL sales (step 4) by US census estimates of HH per state for 2004-2007.

The data to complete steps 1, 2, 4 and 5 in the spreadsheet shown below, Data for Step 3 is in separate table of CFL sales for states with programs, farther down on the next page.

Table 2-17: Derivation of Baseline CFL Sales for States without Programs

Appendix D- Derivation of Baseline CFL sales for states without programs

Steps	State/Region	2003	2004	2005	2006
Step 1	California total sales (from combinationof EPA &RMST)	4,589	8,035	9,124	13,492
Step 2	Non California Sales (other than CA 49)	27,354	48,051	51,913	82,508
Step 1	US CFL SALES-=(combine RMST +EPA sources)	31,943	56,086	61,037	96,000
Step 4	Non CA CFL sales less sales from program states	Not available	14,213	13,462	24,975
	CA CFL Sales/ HH		0.63	0.70	1.02
	Non California Sales/HH		0.44	0.47	0.73
	US Sales / HH		0.46	0.49	0.76
Step 5	Non ca state cfls less cfl sales from program states		0.16	0.17	0.27
	% year to year change in US cfl salestotals		75.6%	8.8%	57.3%
	% year to year change CA			12.0%	45.9%
	% year to year change non CA states			6.4%	56.7%

38 Winch 2007, op cit.

39 Itron 2008 (forthcoming 2006 lamp report), op cit.

40 Quantec/Summit Blue 2007, op cit.

41 EPA 2007, op cit.

42 Harris 2006, op cit.

43 Pratt 2006, op cit.

44 NHPUC Docket No. DE 03-169, op cit.

45 Maine PUC 2006, op cit.

46 Massachusetts ENERGY STAR, op cit.

Table 2-18: CFL Sales Estimates for States with Active CFL programs

Analysis Steps	Estimated CFL sales in States with programs	2003	2004	2005	2006
Step 3	Massachusetts	NA	5,576,515	6,336,949	9,251,946
Step 3	Rhode Island	NA	925,054	1,051,198	1,534,749
Step 3	Connecticut	NA	3,725,407	4,233,417	6,180,789
Step 3	Oregon	NA	1,547,394	1,758,403	2,567,268
Step 3	Washington	NA	3,420,595	3,887,040	5,675,078
Step 3	Vermont	NA	307,912	349,900	510,854
Step 3	Wisconsin	NA	1,962,980	2,230,659	4,650,000
Step 3	New Jersey	NA	5,818,628	6,612,077	9,653,632
Step 3	New York	NA	10,552,802	11,991,821	17,508,059
Step 3	subtotal states with programs	NA	33,837,288	38,451,463	57,532,374
Step 3	CFL sales/HH for states with CFL programs		1.51	1.70	2.53
Step 2	Non ca sales less CFLsales from 9 CFL program states	NA	14,213,312	13,461,794	24,975,154
Sources	Massachusetts, Conneticut Reference 10&13				
Sources	Rhode Island and New York Reference 7				
Sources	Oregon and Washington from Jeff harris memo reference 9				
Sources	Wisconsin from reference 3 for 2006				
Sources	Vermont from Reference 7				
Sources	NY and NJ 2005 +2006 from quantec reference 7				
Sources	2004 state sales based on 12 % increase observed in CA and US2004 sales=2005 sales*.88				

2.9 Discussion of Potential Program Price Effects

We can test the original CFL program theory related to the effect of upstream rebates by estimate how much of the observed price drops over the last five years was due to upstream rebates. It appears that the introduction of upstream rebates from the utility CFL programs beginning in early 2005 has had a dramatic effect on overall sales levels of CFLs. Recall that the program theory for upstream rebates hypothesized that at $1.80 rebate at the manufacturer level would lead to a 150% to 200% larger drop in the retail price, This is because the distributor and retailer markup are included in the final retail price. Another noticeable market effect has been the home improvement chains attempt to move CFL bulbs in bulk with multi-bulb packaging and large floor displays. Given the RMST estimate of the price of a 23-watt CFL in 2003 of 6.00 (2003 DEER says price was $ 10.56/bulb), a $1.80 rebate should translate to a $3.60 to $4.5 drop in retail price or a price of $1.50 to $2.50 per bulb in 2007. In fact, preliminary data from the 2007 lamp report confirm that prices have reached this level and in some cases dropped farther. This chart suggest that the upstream rebate has been inducing the desired price drops

This figure does not include the emergence of multi pack bulb marketing strategy. Multi bulb packaging has drive prices down to as low as 50 cents per bulb with an average reported at $1.00 per bulb. In contrast, the average observed price for single bulbs in 2006 was $5.55. Clearly it is critical to understand whether the multi packaging strategy will be sustained if rebate amounts per bulb continue to drop or are discontinued.

Another potential effect of the program is to promote the sales of lower quality and lower price CFL bulbs as retailers move aggressively to bring the lowest price product to high volume home improvement and discount chains. Thus the drop in price may not be such a good thing if CFL bulbs at the lower price range start to fail at high rates. Itron will release a

2007 report in mid April that will attempt to analyze whether the rebates have resulted in higher market share for lower quality bulbs.

Given these observed market effects, it is important to make sure that changes in program design do not reverse the decreasing price trend and lead to higher overall CFL prices. Some analysts are worried that discontinuing rebates might lead to California prices floating back up to the national level. This is not likely given that other states have experienced these lower prices.

The key question is what will happen to the retail price of CFLs if the upstate rebate programs are reduced or removed. This will depend on at least two factors.

- The extent to which the manufacturing cost, not just retail price, of CFLs has dropped in last ten years. If costs have dropped proportionately to retail prices, lower prices have a higher likelihood of being sustained.
- The competitiveness of the retail CFL market across states- If markets are competitive, dropping rebates in one state or channel will not necessarily result in price increases in other states or channels.

One way to analyze this problem is to look at the trend in prices in states that are not running CFL rebate programs and compare them to CFL prices in program states with CFL programs. These results would be valid if we assume that the pricing impacts of state CFL programs do not spillover or effect prices in prices in non program states. This is probably not true in the Northeast due to higher population density and extensive "trading" between the states.

As mentioned earlier at least part of the observed price drop was due to a change in packaging strategies from single or double packs to four packs or six packs at much lower per bulb costs. Future research should focus on analyzing if this price drop was observed uniformly across the sales channels or whether there were larger price drops in specific channels such as the big box stores. Certainly, the price drop confirms the self-reports of retailers that the program had a big effect on the CFL market and customer's willingness to purchase CFLs.

The bottom line is that it will be important to develop a demand model to estimate impacts of price changes in sales levels and ultimately free rider ship. Without this data, California will be forced to rely on self-interested CFL retailers and suppliers who may or may not provide useful data.

3

Net-of-Free-Ridership Program Area: Residential HVAC

3.1 Data Sources

This paper documents the data sources and analysis used to produce recommended net-of-free-rider (NTFR) values for the different delivery methods and measures offered by the energy efficiency programs from 2002 through 2005 that promoted the installation and use of measures designed to reduce HVAC use in residential dwellings. Five evaluations of HVAC programs were reviewed. Three of the five evaluation reports[1] estimated the gross and net impacts of utility HVAC programs using surveys while the other two studies used deemed net to gross values of 80%. In addition, market data from the Statewide Residential Lighting and Appliances saturation survey was obtained. Table 3-1 below presents an overview of the studies reviewed with a net to gross analysis and associated program information.

[1] The citations for the evaluation studies used in this review are presented in Appendix A

Table 3-1: Studies Reviewed

Study Information	**Name of Study**	2004-2005 Statewide Residential Retrofit Single-Family Energy Efficiency Rebate Evaluation	EM&V STUDY OF THE ENERGY ANALYSIS TECHNOLOGIES RESIDENTIAL DUCT SERVICES 2004-2005 NON-UTILITY PROGRAM IMPLEMENTATIONS-1311-04	Evaluation of High Efficiency HVAC Interest Rate Buy down program (Program Study ID--141-02
	Authors	Itron	Sisson Associates	Summit Blue
	Program Years	2004-05	2004-2005	2002-2003
	Sample Size	Between 253 and 651 customers, depending on the measure	80 customers	132 customers and 99 contractors
	Precision Level	Not reported	Not reported	Not reported
Program and Measure Information	**Sector**	Residential	Residential	Residential
	Program Type/Segment	Prescriptive incentives	Prescriptive incentives	Interest rate buydown
	End Use (s)	HVAC	HVAC ,lighting	HVAC
	Measure (s) included in Evaluation	Central AC, Ceiling Insulation, Programmable thermostats and efficient windows	Basic and advanced HVAC diagnostic, Duct Sealing, and free CFLs	Efficient Central HVAC systems and HVAC diagnostics
	Market Event	Natural replacement and retrofit	Retrofit/maintenance	Replacement
	Delivery approach	Cash incentives to customer	Free CFLS handed out as part of program service	Interest rate buydown to customer-worth $1,700 on average
NTGR Components	**Free Ridership**	Self report and Discrete choice	Yes	Yes
	Participant Spillover	Self report	Self report	Yes
	Nonparticipant Spillover	Self report	No	Yes
	Other adjustment			

These studies include NTFR estimates for the six key measures promoted by programs that have a direct effect on residential HVAC energy use. The first five measures listed were selected because the reported energy savings from these measures comprised over 75% of the recorded non-HVAC savings. The measures are listed below:

- Central air conditioners and heat pumps,
- Gas furnaces,
- Windows,
- Insulation (ceiling and wall),
- Programmable thermostats, and
- HVAC diagnostics and duct sealing.

In addition to NTFR point estimates, we also developed information on other factors likely to influence free ridership going forward. For example, we developed data showing the most recent trends in the market share of central air conditioners, room air conditioners, and programmable thermostats. We also calculated the share of the rebate offered by each program versus the incremental costs of each measure for central air conditioners, insulation, high efficiency windows, and programmable thermostats.

In the Single Family Rebate program evaluation, we found NTFR estimates based on Discrete Choice and Self Report methods for central air conditioners and programmable thermostats measures and NTFR estimates using the Self Report method for the windows and insulation measures. We also included estimates of free ridership for interest rate buy-downs (Evaluation of HVAC Interest Rate Buy Down Program) and a 2004-05 duct services program administered by a third party. These studies estimated NTFR values of 0.9 and 0.63 for duct sealing and duct repair based on customer self reports supported by some contractor interviews.

3.2 Data Analysis

In this section of the analysis, we reviewed survey content and question wording to triangulate customer answers relative to what they would have done in the absence of the program. The survey instruments used in the Single Family Rebate program evaluation were more extensive than the "simplified" type of surveys reviewed in other studies. The more detailed and longer list of questions was used because of the need to support the detailed discrete choice analysis in this report and to gather data to meet other research objectives. Despite the longer list, over 500 interviews were completed with customers who purchased the measures listed above.

The Single Family Rebate program evaluation study also included estimates of participant and non-participant spillover based on the discrete choice analysis for the four measures discussed above. We chose not to use the nonparticipant spillover analysis because the sample size of non-participants who invested in other efficiency measures was usually below 20 respondents and therefore, not considered reliable.

3.3 Recommendations

Table 3-2 presents the recommended NTFR estimates for the efficiency measures promoted by the 2002 through 2005 programs. We recommend the use of NTFR values found in the evaluation of the 2004-2005 Single Family Rebate program for most of the HVAC measures covered in this report because of the larger sample size, the responses collected from nonparticipants, and the triangulation approach used to collect free ridership information in this study. We recommend use of the NTFR values found in the Summit Blue and Sisson Associates studies for HVAC diagnostic and duct repair measures because they were the only evaluations that provided net impact analysis for these measures and delivery methods.

Table 3-2: Recommended NTFR Values

Measure Name(s)	Target Market	Delivery Method	NTG Values Used in Previous Utility Filings	Recommended NTFR for 2004-2005	Recommended NTFR for 2006-2007 Programs	Methods Used to Estimate Free Ridership	Data Sources
Central AC>14 SEER	Residential Customers	Prescriptive Downstream Rebate	80%	67%	67%	Self Report/Discrete Choice	Itron (2007) Source 1
Central AC>15 SEER	Residential Customers	Prescriptive Downstream Rebate	80%	80%	80%	Self Report/ Discrete Choice and Market data	Itron (2007) Source 1
Central AC >14 SEER	Res Customer/ Contractors	Loan with Interest Rate Buy Down	80%	63%	63%	Self Report	Summit Blue (Source 2)
Heat Pump - ES	Residential Customers	Prescriptive Downstream Rebate	80%	55%	55%	Self Report	Itron (2007) Source 1
Gas Furnace - =>90 % AFUE	Residential Customers	Prescriptive Downstream Rebate	80%	60%	60%	Self Report	Itron (2007) Source 1
Insulation - Ceiling and Wall	Residential Customers	Prescriptive Downstream Rebate	80%	70%	70%	Self Report	Itron (2007) Source 1
Programmable Thermostats	Residential Customers	Prescriptive Downstream Rebate	80%	49%	49%	Self Report/ Discrete Choice	Itron (2007) Source 1
HVAC Diagnostic	Res Customers/ Contractors	Free with Central Air Purchase	80%	78%	78%	Self Report	Source 2&3
HVAC Duct Seal	Res Customers/ Contractors	Free with Central Air Purchase	80%	78%	78%	Self Report	Source 2&3
Windows - SHGC<=.4	Residential Customers	Prescriptive Downstream Rebate	80%	55%	55%	Self Report	Source 1

SHGC=solar heat gain coefficient

1. Itron/Kema, 2004-2005 Statewide Residential Retrofit Single-Family Energy Efficiency Rebate Evaluation (September, 2007)
2. Summit Blue, Evaluation of High Efficiency HVAC Interest Rate Buy Down Program (August, 2005)
3. Sisson and Associates, EM&V Study of THE Energy Analysis Technologies Residential Duct Services 2004-2005 Non-Utility Program Implementations (August 2006)

The NTFR values are presented in the table above as a function of efficiency levels, target markets, and delivery methods because each of these factors has an impact of the final value. Changes in any of these factors in future programs may make it necessary to adjust these values to reflect the new program characteristics. In particular the proposed shift to a midstream delivery strategy for HVAC duct sealing and changes in the qualifying efficiency specifications for high efficiency windows probably warrant the use of the default NTFR of .70 rather than the values shown in this table for downstream or contractor delivery strategies. The sample size and estimated accuracy or precision around these estimates is included in the detailed literature review spreadsheets.

3.4 Participant and Nonparticipant Spillover estimates

For completeness, we report on the results of our review of participant spillover and non-participant spillover results in this section. Our review suggests that the quality of data collected and analysis performed to estimate spillover is lower than that used to estimate free ridership. For example, in two of the studies, participants or nonparticipants who claimed to be aware of the programs were asked if they had installed any additional measures as a result of the program. However, they were not asked any additional follow-up questions related to the timing of the purchase or the level of efficiency selected. In the Single Family Rebate program study, the degree of self reported influence was used as a screen to ensure spillover impacts were only reported for those customers who were highly influenced by the program. This provides the most conservative estimate of participant spillover impacts. Table 3-3 presents indicated values for participant spillover by measure. All of these measures were promoted using prescriptive rebates.

Table 3-3: Participant Spillover Estimates

Measure	Participant Spillover Estimates				
	Self Report Estimate	**Sample Highly Influenced by Program (N)**	**Discrete Choice Estimate**	**Sample Highly Influenced by Program (N)**	**Indicated Value for Participant spillover**
Central AC> 14 SEER	6.20%	13	31%	11	27%
Gas Furnace	1.50%	1	NA	NA	5%
Insulation	4.90%	7	55%	5	10%
Pool pump-2 speed	1.70%	1			5%
Programmable stat	1.60%	5	44%	22	10%
HVAC diagnostic	NA	NA			5%
HVAC duct seal	27.00%	95	NA	NA	20%
Windows-SHGC<=.4	1.50%	8	NA	NA	5%

In all cases, the indicated values were selected from the range of values found using the Self Report and Discrete Choice methods and rounded to the nearest five percent given our assessment of the uncertainties inherent in these values.

3.5 Other Data That May Influence Future NTFR Values

Changes in NTFR values for 2006-2008 programs may also be necessary because of changes in program delivery methods, changes in efficiency measure specifications, and trends in the underlying market share and incremental cost of more energy efficient technologies between 2004-05 and the program portfolios launched in 2006. We recommend consideration of the following factors when considering further NTFR adjustments for future program designs and measure combinations:

- Trends in market share of measure over last five years.
- Changes in program delivery method.
- Changes in rebate level and the underlying incremental cost of the measure over the last five years.
- Introduction of new measures that are direct substitutes for current measures.

For example, a program that promoted more efficient gas furnaces in new homes might compete with emerging hydronic heating systems (a direct substitute for furnaces) by dropping their prices and potentially changing the underlying NTFR.

The data we have been able to gather on the ratio of rebate level to incremental cost is summarized in Table 3-4. It is not yet clear if increases in the ratio of rebate to incremental cost are likely to be proposed for future programs and if so whether they are likely to have an effect on the NTFR. This determination of a likely effect on NTFR depends on whether the rebates are being used as a signal to customers or whether they are specifically attempting to achieve a reduction in the payback time for customers to a specific threshold. This will need to be considered on a case by case basis.

Table 3-4: Other Market and Cost Data

	Market and Cost Data to Use for NTFR Adjustment					
	Base Seer	**Efficient Seer**	**Market Share of Efficient Measure**	**$ Incremental Cost**	**Rebate per System or Unit**	**Rebate/Inc %**
Central AC Systems	10	13		290	200	69%
Central AC Systems	10	14		362	300	83%
Central AC Systems	13	14		93	Not known	
Central AC Systems	13	15		185	Not known	
Central AC Systems	13	15		277	Not known	
		for 13 ton units				
Heat Pump ES	10	13	Not yet known	223	Not known	

Source of incremental cost data: 2004-05 DEER
Source of rebates: utility program implementation filings

Our preliminary review suggests that there have been sufficient changes in the market share of more efficient appliances over the last five years to warrant consideration of some adjustments to the NTFR values recommended in the table above. In the interim, we recommend the use of the 2004/2005 values for the 2006-2007 programs which utilized the measure/delivery method combinations similar to the ones identified in these tables.

4

Net-of-Free-Ridership Program Area: Residential Appliances

4.1 Overview

This section documents the data sources and analysis used to develop recommended NTFR values for the residential appliances program category for 2006-2007. Programs in this category provide downstream rebates to residential customers that install ENERGY STAR-qualified measures from a prescribed set of equipment options. Equipment addressed in this program category includes energy efficient clothes washers, dishwashers, pool pumps, and water heaters. Primary data sources reviewed were an evaluation of the statewide PY2004-05 Single Family Rebate program[1] and a second evaluation of a third party program.[2]

4.2 Data Sources

To locate relevant data sources, we searched the CALMAC database for all of the EM&V studies of PY 2002-2005 residential prescriptive rebate programs that included estimation of net savings. Two studies were found. The first and most comprehensive study evaluated the impacts of the 2004-2005 Statewide Single Family Rebate program. The second study evaluated the gross impacts of the South Bay Energy Rewards third party program, which provided coupons for energy efficient gas furnaces, water heaters, clothes washers, and dishwashers, and promoted the direct installation of CFLs in multifamily dwellings. The Single Family Rebate Evaluation estimated the gross and net impacts of the following ENERGY STAR measures that are promoted by the program:

- Dishwasher,
- Clothes washer,
- Efficient gas and electric water heaters, and
- Two-speed pool pump motors.

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1 Itron Inc. *2004/2005 Statewide Residential Retrofit Single-Family Energy Efficiency Rebate Evaluation.* CPUC-ID#:1115-04. September 2007.

2 Quantec. *South Bay energyrewards™ Program Evaluation.* Prepared for Rita Norton. May 2004.

These measures were selected for evaluation in the Single Family Rebate study because their reported energy savings put them in the top eight non-lighting measures promoted by the program. They accounted for over 75% of the recorded non-HVAC and non-lighting savings for 2004-05. In addition to net-of-free-ridership (NTFR) information, we reviewed data on the most recent trends in the market share of these measures and compared the ratio of the rebate offered by each program against estimates of incremental costs for each of these appliances.

4.3 Data Analysis

Evaluation Methods Comparison. We found NTFR estimates in the Single Family Rebate study based on both the discrete choice and self-report methods for dishwashers and clothes washers. NTFR estimates for the two-speed pool pump and efficient water heating measures were developed based on the self-report method only. In general, the discrete choice method yielded slightly higher NTFR estimates than those developed using the self-report method.

Question Construction Review. The questions used to assess net program impacts addressed the relevant topics related to accelerated purchases and thus partial free riders, program effect on efficiency level selected and the number of efficiency products purchased. The relatively large sample size (>1,500 nonparticipants) and high completion rate for the self-report surveys yielded robust and statistically significant NTFR results.

We recommend the updated NTFR values for the DEER database be based on the Single Family Rebate evaluation. This is because of the large sample size, the dual approach used to estimate free ridership, and the availability of supplemental purchase decision data from nonparticipants, which could be used to corroborate the results. Furthermore, we recommend NTFRs be based on the discrete choice method when values are available, since NTFR estimates are derived from a model based on hypothesized purchasing behavior that includes nonparticipants, and are less prone to self-report bias.

4.4 Recommendations

4.4.1 Free Ridership

Table 4-1 presents the recommended NTFR estimates by measure for the residential prescriptive measures. NTFR estimates based on the discrete choice method were considered more credible than self-report results and are recommended for inclusion in the DEER database in cases where both estimates are available.

Table 4-1: Recommended NTFR Values

Measure and Program Information			Net-to-Gross Ratio Information			
Measure Name(s)	**Target Market(s)**	**Program Delivery Method/ Channel**	**NTG Values Used Typically by Utilities in Previous Filings**	**NTG Values Based on 2004-05 Program Studies**	**NTG Values Recommended for 2006-07 update**	**Sources**
Refrigerator/Freezer-450 kWh/yr;18 cubic feet (current standard)	All residential	Downstream prescriptive rebate	80%	57%	57%	2004-2005 Statewide Residential Retrofit Single-Family Energy Efficiency Rebate Evaluation
Refrigerator/Freezer- 15% Beyond current standard	All residential	Downstream prescriptive rebate	80%	75%	75%	Default judgment
Clothes washer >1.72 MEF	All residential	Downstream prescriptive rebate	80%	81%	81%	2004-2005 Statewide Residential Retrofit Single-Family Energy Efficiency Rebate Evaluation
Clothes washer- 15% above DOE standard	All residential	Downstream prescriptive rebate	80%	85%	85%	2004-2005 Statewide Residential Retrofit Single-Family Energy Efficiency Rebate Evaluation
Dishwasher > .58 EF and <.65 EF	All residential	Downstream prescriptive rebate	80%	41%	41%	2004-2005 Statewide Residential Retrofit Single-Family Energy Efficiency Rebate Evaluation
Dishwasher - 15% above current standard or E star	All residential	Downstream prescriptive rebate	80%	80%	80%	2004-2005 Statewide Residential Retrofit Single-Family Energy Efficiency Rebate Evaluation
Pool pump-2 Speed	Single Family	Downstream prescriptive rebate	80%	69%	69%	2004-2005 Statewide Residential Retrofit Single-Family Energy Efficiency Rebate Evaluation
Water Heater EF >.62	Single Family	Downstream prescriptive rebate	80%	58%	58%	2004-2005 Statewide Residential Retrofit Single-Family Energy Efficiency Rebate Evaluation

The NTFR values are presented in Table 4-1 as a function of efficiency levels, target markets, and delivery methods because each of these factors has an impact of the final value. We recommend using the default NTFR of .70 for appliance programs that have switched from the use of downstream rebates in 2004-05 to midstream rebates that are given to distributors or retailers in 2006-07 programs. Changes in any of these factors in future programs may make it necessary to adjust these values to reflect the new program characteristics. The sample size and estimated accuracy or precision around these estimates is included in the detailed literature review spreadsheets.

4.5 Participant Spillover Results

The results of our review of participant and nonparticipant spillover findings are presented in this section. Our review found that the quality of both the questions asked and the data used to estimate spillover for participants and nonparticipants was lacking. In the two studies reviewed, participants or nonparticipants who claimed to be award of the programs were asked if they had installed any additional measures as a result of the program, but were not asked about the timing of the purchase or the level of efficiency selected. In the final Single Family Rebate program evaluation, the degree of self- reported influence was used as a screen to ensure spillover impacts were only reported for those customers who were highly influenced by the program. It is not clear why the energy savings impacts from nonparticipants, who reported taking additional efficiency actions but were not aware of being influenced by the program, were excluded from this study. In many cases, nonparticipants may be completely unaware that a program has produced a particular market effect, such as a reduction in price or increase in advertising that actually influenced their purchase at the market level.

Table 4-2 presents indicated values for participant spillover by measure. All of these measures were promoted using prescriptive rebates. We have rounded up to 5% for most measures to account for the tendency for self-reports to under report measures they have installed as a result of the program's information and knowledge impacts.

Table 4-2: Recommended Participant Spillover values

Measure	Self Report	Discrete Choice	Recommended Value
Clothes Washer	2%	19%	5%
Dishwasher	1%	N/A	1%
Pool Pump	2%	N/A	2%
Room AC	0%	N/A	0%

4.6 Other Data That May Influence Future NTFR Values

NTFR values are expected to be sensitive over time to changes in program-qualifying efficiency levels, changes in program design (including incentive levels), changes in measure costs, and changes in out-of-program market share. Additional data that may provide insight into likely NTFRs in future program offerings is presented below. Information is presented for two areas:

- Trends in Market Share of Measure, and
- Rebate Level as a Share of Incremental Measure Cost.

4.6.1 Trends in Market Share of Measure

Table 4-3 shows the trend in the overall market share of efficient measures that met the ENERGY STAR qualifying level over the last six years. A rapid increase in market share increases the chances that the NTFR estimated for a specific measure might need to be reduced. We recommend that a downward adjustment in NTFRs be considered when the following conditions are met:

- The market share of the efficient appliance has exceeded 50% of the annual sales for that equipment category, and
- The rate of market share growth outside the program is greater than 10% per year.

Table 4-3: Market Share of ENERGY STAR/More Efficient Appliances over Time[3,4]

Measure	2000	2005	2006	NTFR Adjustment
Clothes Washer	20%	50%	60%	-5% for 2009 onward
Dishwasher	15%	65%	N/A	-5% for 2009
Two-Speed Pool Pump	<5%	10%	100% required in 2008	None-New standard precludes this measure after 1/12008
Gas Water Heater- Average Energy Factor Market Share >.64 EF	 57% 23.1%	 58% 26.8%	 N/A N/A	None
Electric Water Heaters Market Share >.92 EF	 6.3%	 12.6%	 N/A	None

4.6.2 Rebate and Incremental Cost Data

Table 4-4 presents information on another potential indicator of NTFR changes - the share of the incremental equipment cost being paid for by the program rebate.

Table 4-4: Estimated Ratios of Rebates to Incremental Measure Costs for ENERGY STAR Appliances

Measure	Rebate[5]	Incremental Cost[6]	Rebate as a % of Incremental Cost	Capacity
Clothes Washer >1.72 MEF	$50	$592	8.4%	medium-2.65cf
Dishwasher>.58EF	$30	$134	22.4%	215 wash cycle/yr
Two speed Pool Pump	$300	$264	113.6%	2 hp
Water heater EF >.63	$40	$175	22.9%	50 gallon tank

The relatively low rebate fraction of incremental cost may indicate that other factors, besides direct cost reduction, are responsible for program effects for some of these products. The pool pump measure is now required by the California Energy Commission's Appliance Standards and will probably not be eligible for utility incentives in the future.

3 RLW Analytics. *Statewide Residential Lighting and Appliances Study*. Year 2000 data from report published in June 2000; 2005 data from report published in August 2005.

4 Itron, Inc. *Residential Market Share Tracking Study: Appliances 2005*. Prepared for Southern California Edison. October 2006.

5 Itron 2007, op cit.

6 California Energy Commission/California Public Utilities Commission 2004-05 Data base for Energy Efficient Resources.

5

Net-of-Free-Ridership Program Area: Residential Multifamily

5.1 Data Sources

A literature review of all evaluations of PY2002-2005 California Multifamily energy efficiency programs was conducted. The DEER team retrieved all relevant studies from the CALMAC database, and selected those that included estimation of free ridership or net-to-gross ratios. We found three relevant evaluations published in 2006 that included estimates of free ridership: an evaluation of the California IOUs' 2004-2005 Multifamily Rebate Program (KEMA) and two evaluations of 2004-2005 third-party Multifamily programs (the Partnership for Energy Affordability in Multifamily Housing and the Designed for Comfort Program, both conducted by KEMA).

Prior to 2003, there were very few if any estimates of net savings for multifamily programs. This was because the Multifamily sector was included in California IOUs' umbrella of all residential energy efficiency programs and as a result there were not any independent estimates of NTFR. From the late 1990s through 2002, these programs were focused on market transformation and program evaluations did not include estimates of net-to-gross ratios or free ridership. The California IOUs' 2003 Multifamily program was evaluated by Wirtshafter and Associates, however, that study's main focus was process evaluation and did not include estimation of free ridership. As a result, we focus our review on net to gross estimates of 2004-2005 multifamily programs.

Table 5-1 and Table 5-2 provide an overview of the studies used to develop the recommended NTFR estimates.

Table 5-1: Studies Reviewed Energy Affordability MF program (part 1)

		Study #1	Study #1	Study #1	Study #1
Program and Measure Information	**Sector**	Residential	Residential	Residential	Residential
	Program Type/Segment	Multifamily	Multifamily	Multifamily	Multifamily
	End Use	Lighting	HVAC	Water heating/HVAC	Water heating/HVAC
	Market Event	Natural replacement	New purchase	Natural replacement	New purchase
	Delivery approach	Direct install to affordable housing properties	Direct install to affordable housing properties	Rebate for affordable housing properties	Rebate for affordable housing properties
	Measure(s)	Lighting	P-stats	High-efficiency boilers	Boiler controls
Study Information	**Name of Study**	Evaluation of the 2004-2005 Partnership for Energy Affordability in Multi-Family Housing Program	Evaluation of the 2004-2005 Partnership for Energy Affordability in Multi-Family Housing Program	Evaluation of the 2004-2005 Partnership for Energy Affordability in Multi-Family Housing Program	Evaluation of the 2004-2005 Partnership for Energy Affordability in Multi-Family Housing Program
	Authors	KEMA Inc.	KEMA Inc.	KEMA Inc.	KEMA Inc.
	Program Years	2004-2005	2004-2005	2004-2005	2004-2005
	Sample Size	23	23	23	23
	Precision Level	not calculated	not calculated	not calculated	not calculated
Free Ridership	**Methodology Used**	Participant self-report combined with interviews of program implementer	Participant self-report combined with interviews of program implementer	Participant self-report combined with interviews of program implementer	Participant self-report combined with interviews of program implementer
	Value or Range of Values - NTGR	80%	86%	85%	100%
	Comments/Observations				
Participant Spillover	**Methodology Used**	Participant self-report of EE actions combined with deemed savings values - spillover rate calculated as a % of program measure energy savings	Participant self-report of EE actions combined with deemed savings values - spillover rate calculated as a % of program measure energy savings	Participant self-report of EE actions combined with deemed savings values - spillover rate calculated as a % of program measure energy savings	Participant self-report of EE actions combined with deemed savings values - spillover rate calculated as a % of program measure energy savings
	Value or Range of Values	11%	11%	11%	11%
	Comments/Observations	Reasonable	Reasonable	Reasonable	Reasonable

Table 5-2: Studies Reviewed- Statewide Multi family program in 2004-05 (part 2)

		Study #2	Study #2	Study #2	Study #3
Program and Measure Information	**Sector**	Residential	Residential	Residential	Residential
	Program Type/Segment	Multifamily	Multifamily	Multifamily	Multifamily
	End Use	Lighting	HVAC	Water heating/HVAC	HVAC/water heating
	Market Event	New purchase	New purchase	New purchase	
	Delivery approach	Direct install to market-rate properties - mostly individually metered tenant units and common areas	Direct install to market-rate properties - mostly individually metered tenant units	Rebate for market-rate properties	Rebates to affordable multifamily housing properties based on meeting proposed 2005 Title 24 stds; exceeding 2001 Title 24 stds by 15%; or exceeding existing efficiency by 20%
	Measure(s)	CFLs	P-stats	Boiler controls	HVAC and DHW system improvements - insulation, windows, controls, HVAC and DHW equip replacement
Study Information	**Name of Study**	Evaluation of the 2004-2005 Statewide Multifamily Rebate Program	Evaluation of the 2004-2005 Statewide Multifamily Rebate Program	Evaluation of the 2004-2005 Statewide Multifamily Rebate Program	Evaluation of the 2004-2005 Designed for Comfort Program
	Authors	KEMA Inc.	KEMA Inc.	KEMA Inc.	KEMA Inc.
	Program Years	2004-2005	2004-2005	2004-2005	2004-2005
	Sample Size	47	45	20	18
	Precision Level	not calculated	not calculated	not calculated	not calculated
Free Ridership	**Methodology Used**	Participant self-report	Participant self-report	Participant self-report	Participant self-report
	Value or Range of Values - NTGR	76%	79%	81%	79% - 86%
	Comments/Observations				
Participant Spillover	**Methodology Used**	Not measured	Not measured	Not measured	Not measured
	Value or Range of Values				
	Comments/Observations				

5.2 Program Context

In 2004-2005, the Statewide Multifamily program achieved the vast majority of its savings through the installation of lighting measures (mostly CFLs) and programmable thermostats. These measures were typically installed by a dedicated pool of canvassing contractors with the measure and labor costs covered by the program. The program also attracts a smaller number of self-initiating property managers and owners, who apply for program rebates directly. These projects are typically more comprehensive and may include high-efficiency windows, appliances, HVAC, and water heating system retrofits. However, the volume of self-initiating property managers/owners is low. The program plans to increase its marketing to skilled contractors such as plumbers and HVAC contractors who can then mention the program to property managers/owners when they are considering equipment replacement. The program is also increasing its marketing directly to property managers/owners.

The affordable housing programs used a different model with affordable housing advocacy organizations identifying eligible properties and conducting audits and providing other education and technical assistance. These projects were more likely to be comprehensive, but the volume of projects was low.

5.3 Data Analysis

We reviewed the survey and sampling approach for each of the studies and concluded that the resulting estimates were reasonable. There was little to no overlap of the relevant evaluations that contained net-to-gross ratio estimates, so for all but one case we simply used each of the evaluation estimates. Note that we distinguished between multifamily target markets, since market-rate and affordable housing have different measure penetration rates and associated levels of program free ridership. In the one case where there was overlap between studies and multifamily target markets (i.e., for HVAC and water heating equipment replacement for multifamily affordable housing), the point estimate from the first study was within the range estimate of the second study, so we used the point estimate from the first study.

5.4 Recommendations

Table 5-3 presents our recommended NTFR values for each of the measures, delivery methods, and Multifamily target markets reviewed above. These estimates should be applicable for the 2006-2007 round of IOU programs if the delivery strategies and target market have not changed much from 2005, when the research was conducted for the prior evaluations. Note that the IOUs removed programmable thermostats from both the single-family and Multifamily programs in 2005, and they are reconsidering whether or not to offer

boiler control measures after the 2004-2005 evaluation studies estimated very low gross savings for these measures.

As CFLs become increasingly saturated in market-rate Multifamily properties, the programs will likely shift their focus by broadening the lighting measure mix, placing greater emphasis on other non-lighting electric measures, and emphasizing property manager-initiated projects, which are typically more comprehensive than contractor-initiated projects. So these NTFR estimates at the program level should be examined closely to be sure they are still applicable as the IOUs shift their measure mix over time. The affordable housing estimates of NTFR should hold up longer since that market has so many barriers to investments in energy efficiency equipment, CFLs included, that there has been very little program penetration of measures to date.

Table 5-3: Recommended NTFR Values

Measure Description	Target Market	Delivery Strategy	NTG Values Used Typically by Utilities in Previous Filings	NTG Values Based on 2004-05 Program Studies	NTGR Values Recommended for 2006-07 update
CFLs & hardwired fixtures	Multi-family market-rate housing- retrofit applications	Direct Install	80%	76%	76%
Boiler controls	Multi-family market-rate housing	Downstream Prescriptive Rebate	80%	81%	81%
Programmable thermostats	Multi-family market-rate housing	Direct Install	80%	79%	79%
CFLs & hardwired fixtures	Multifamily - affordable housing	Downstream Prescriptive Rebate and Direct Install	80%	80%	80%
Boiler controls	Multifamily - affordable housing	Downstream Prescriptive Rebate	80%	100%	100%
Programmable thermostats	Multifamily - affordable housing	Direct Install	80%	86%	86%
HVAC/Water heating equipment replacement	Multifamily - affordable housing	Downstream Prescriptive Rebate	80%	85%	85%

5.5 Participant and Nonparticipant Spillover

Our review also included capturing any information on participant and nonparticipant spillover that may have been included in the studies. One of the studies reviewed (Partnership for Energy Affordability evaluation) developed estimates of participant spillover. Values were based on a combination of participant self-reported energy efficiency actions combined with deemed energy savings estimates. The spillover rate was calculated as a percentage of program measure energy savings. Using this approach, spillover was estimated to be 11% of annual program savings.

6

Net-of-Free-Ridership Program Area: Residential New Construction

6.1 Data Sources

A literature review was conducted on all 2002-2005 evaluation studies for information on free ridership and participant and nonparticipant spillover. The CALMAC database was queried for evaluation studies with estimates and methods for assessing net savings of residential new construction programs. The two evaluation reports listed in Table 6-1 were reviewed. The primary efficiency measures assessed in the reports include lighting, envelope, HVAC, water heating, and appliances.

The Residential New Construction High Efficiency Appliance and Lighting Program served the customers of San Diego Gas and Electric in 2003. The program provided rebates to builders and homeowners to encourage the installation of ENERGY STAR Appliances in new homes.

The Statewide ENERGY STAR New Homes Program provides financial incentives, education, and marketing support to builders for homes that exceed the building energy efficiency standards (Title 24) by 15% or more.

Table 6-1: Overview of Studies Used

		Study #1	Study #2
Program and Measure Information	**Sector**	Residential	Residential
	Program Type/Segment	New Construction	New Construction
	End Use	Appliance and Lighting	HVAC, envelope, lighting and water heating
	Market Event	New Construction	New Construction
	Delivery approach	Prescriptive rebate	Custom rebate, based on performance vs. code
	Measure(s)	Dishwashers, clothes washers, lighting	Performance program, however measures installed by high percentage of builders include HVAC, high performance windows, tight ducts and tight envelope
	Estimated Market Share (%)	Dishwashers 44%, lighting 11%, clothes washers 15%	ES estimated 5-10% of market
Study Information	**Name of Study**	Residential New Construction High Efficiency Appliance and Lighting Program	Evaluation, Measurement and Verification of the 2004 and 2005 CA Statewide Energy Star New Homes Program
	Authors	Quantec, LLC	RLW Analytics, Inc.
	Program Years	2003	2004 and 2005
	Sample Size	16 participating builders	55 Single Family builders (33 parts, 21 nonparts) and 28 MultiFamily (20 parts, 8 nonparts)
	Precision Level	N/A	
Free Ridership	**Methodology Used**	Deemed values used	Self Report with corraborating factors. P/NP builder surveys.
	Value or Range of Values	Deemed NTGRs of 0.80 used	Single Family - 46 to 58% ree ridership, MultiFamily - 47% free ridership
	Comments/Observations	Authors assess little free ridership to the program	Almost half of the savings can not be attributed to the program
Participant Spillover	**Methodology Used**	Participant survey	Self Report
	Value or Range of Values	up to 50% of direct program impacts (but short-lived)	32% - 54%
	Comments/Observations		

6.2 Data Analysis

The Residential New Construction High Efficiency Appliance and Lighting Program did not assess Net-of- Free Ridership (NTFR), however the evaluators believed that there was little free ridership. A deemed value of 0.8 was used.

For the Statewide ENERGY STAR New Homes Program evaluation, several variations of the core NTG question were asked to ascertain the savings that can be attributable to the program. Not accounting for influencing factors, the responses indicated a free ridership estimate of between 50% and 68%. To enhance this information, corroborating questions were asked as well, and used for better calibration. The responses from several additional questions provided more robust results. The free ridership estimates range from 46% to 58% (average 52%) showing that about half of the savings can be attributable to the program.

Determining NTFR for the ENERGY STAR Program can be challenging as the program is not a single measure but a combination of design practices and measures.

The report provides statewide net-to-gross ratios, inclusive of estimated market effects. For coastal regions the study estimate is 0.75. For inland regions, the study estimated a Net-to-gross ratio inclusive of market effects of 1.27. This implies estimated market effects exceed estimated free-ridership for inland areas.

6.3 Recommendations

Table 6-2 presents the recommended NTFR value for the Residential New Construction program category. The only measure category for which a value is recommended is the whole building category. This recommendation is based on a review of the 2002-2005 programs listed above. As noted above, it is not possible to assign NTFR values for individual measures as measure-level analysis was not conducted in the reports reviewed. We note that these NTFR estimates are likely to be very sensitive to changes in a number of factors including program design strategies and incentive levels, energy efficiency market share trends, and program-qualifying levels of efficiency (e.g., higher level of savings beyond Title 24 may increase expected NTFRs).

Table 6-2: Recommended NTFR Values

Measure and Program Information			Net-of-Free-Ridership (NTFR) Information			
Measure Name(s)	**Target Market(s)**	**Program Delivery Method/ Channel**	**NTG Values Used by Utilities in Previous Filings**	**NTFR Values Based on 2004-05 Studies**	**Recommended NTFR Values for 2006-07**	**Data Source(s)**
Whole building	Single Family	Custom rebate, based on performance vs. code	80%	48%	48%	Evaluation, Measurement and Verification of the 2004 and 2005 CA Statewide ENERGY STAR New Homes Program

The evaluation of free rider ship conducted in this study used a self report method for both Single Family and multi-family dwellings. The method is described on pages 42 (for Single Family) and page 57 (for multifamily dwellings) with the results recommended by the DEER Team shown on pages 71 through 73. These net results are sometimes confused with the broader definitions of net to gross reported later in the report by RLW. The RLW study did provide an analysis of the broad definition of net impacts of the program using a difference

of differences approach using billing analysis. This analysis is not useful in estimating narrow definition of free ridership because it combines the free rider effect at issue in this analysis with a separate gross savings issue related to the question of the extent that utility programs should get credit for inducing new buildings to comply with the code, either for participants or for nonparticipants. This effect, which in the study's methodology can lead to estimates of NTG that exceed 1.0, is not consistent with the definition of NTFR used for this DEER update as previously discussed. The compliance effect that is included in the net analysis in the RLW study should be dealt with in estimates of gross savings and code compliance baseline analysis for this program.

6.4 Participant and Nonparticipant Spillover

Spillover was assessed using the Self Report method in both of the studies review. The Residential New Construction High Efficiency Appliance and Lighting Program found strong evidence of spillover with builders installing ENERGY STAR equipment in regions outside of the program. More significant is that ENERGY STAR was specified after the conclusion of the program. Spillover was determined to be up to 50% of the program impacts. Spillover for the ENERGY STAR New Homes Program was also estimated to be very high at 32% to 54%.

7

Net-of-Free-Ridership Program Area: Residential Appliance Recycling

7.1 Data Sources

To assess net-of-free ridership (NTFR) values for Residential Appliance Recycling Programs (RARP) operated in 2006-2007, evaluation studies from program years 2002 and 2004-05 were reviewed for information on free ridership. The only studies addressing this program category were evaluations of California's Statewide Residential Appliance Recycling Program. The PY2002 study was conducted by KEMA, and the PY2004-05 study was conducted by ADM/Athens Consulting/Innovologie.

7.2 Methodology for Calculating Free Ridership

KEMA methodology. In KEMA's evaluation of the 2002 RARP, the approach used for the net-to-gross analysis had two main components: attribution factors and part-use factors. The attribution factor adjusts for the percentage of participants that would have disposed of the unit anyway, and gives partial credit to the program for destroying a unit that would otherwise have been transferred to another user.[1] The part-use factor adjusts for the fraction of the time that participants would have used the unit if they had kept it.[2] There are four categories for what could have happened to a unit had it not been recycled: (1) the unit is kept by the household but not used; (2) the unit is kept by the household and still used; (3) the unit is discarded by the household through a method in which the unit would be destroyed; and (4) the unit is discarded by the household through a method in which the unit would be transferred and kept in use. For each category, there is an attribution factor that determines how much of the energy savings associated with a recycled appliance unit should be credited to RARP. This approach, in which the NTG ratio is developed from all four factors, will be referred to as the "KEMA methodology."

ADM methodology. The PY2004-2005 evaluation study by ADM used the same basic framework to estimate free-ridership but approached it more narrowly. Attribution factors

[1] KEMA-XENERGY, Inc. Final Report: *Measurement and Evaluation Study of 2002 Statewide Residential.* Appliance Recycling Program, Prepared for Southern California Edison, February 2004.

[2] Ibid.

were developed based only on: (1) units that would have been kept by a household but not used; and (2) units that would have been discarded by a household through a method in which the refrigerator would have been destroyed. Units that are transferred and kept in use are not accounted for. Units which are kept and used are accounted for through an adjustment to gross savings. Resulting NTG ratios are 0.614 for refrigerators and 0.706 for freezers.

KEMA methodology replicated in 2004-2005 study. This study also developed NTG values based on the KEMA methodology, for comparative purposes. The ADM study improved upon the earlier method by making an adjustment to units in the discarded-transferred category to account for the impact of replacing an older used unit with a newer used unit. Based on this adjustment, the resulting NTG ratios are 0.522 for refrigerators and 0.500 for freezers.

7.3 Recommended NTFR Values

In developing recommended NTFR values for this program category, there were two options:

(1) Use NTG values from the 2004-2005 study, based on the ADM methodology, and make adjustments to gross savings to account for part-use, and for the impact on savings from units that are transferred and kept in use; or

(2) Use NTG values from the 2004-2005 study, based on the KEMA methodology (but adjusted for the improved efficiency for the unit that was discarded and kept in use). No adjustments to gross savings are needed under this option.

The DEER Team has learned that the methodology being used to update DEER gross savings values for refrigerator-freezers will make adjustments to gross savings estimates to capture the effect of discarded-transferred units. Therefore, the DEER Team/ED agree that NTFR values of 0.614 for refrigerators and 0.702 for freezers, based on in the PY2004-05 EV&M study should be used for the 2006-2007 programs.

8

Net-of-Free-Ridership Program Area: Residential Audits

8.1 Data Sources

A literature review was conducted on all 2002-2007 evaluation studies for information on free ridership and participant and nonparticipant spillover. The CALMAC database was reviewed for evaluation studies with assessments of net savings of residential audit programs. Four evaluations were identified and reviewed. These studies assessed the effectiveness of audits with different program delivery mechanisms ranging from onsite audits to audits delivered online. Only one study by Opinion Dynamics contained a detailed analysis of net to gross impacts for the influence of the audit alone. This study of the Statewide Home Energy Survey Program had the most ambitious scope and methods used to estimate both gross and net program impacts. Table 8-1 below presents an overview of the studies reviewed and used to develop the recommended values.

Table 8-1: Overview of Evaluation Studies Reviewed

		Study #1	Study #2	Study #3	Study #4
Study Information	**Name of Study**	Evaluation Measurement and Verification Report for the Time-of-Sale Home Inspection	Final Report for the Measurement and Evaluation Study of SCE PY2002 local in home audit	RCS Audits- National Grid	Statewide Home Energy Efficiency Program (HEES)
	Authors	Robert Mowris & Associates	KVD Research Consulting	National Grid	Opinion Dynamics Corp
	Program Years	2003	2002	2004	2004-05
	Sample Size	N/A	N/A	N/A	3,884 participants, 1110 nonparticipants
	Precision Level				1,200 participants, 400 nonparticipants for load impact analysis
Free Ridership	**Methodology Used**	Deemed value	Deemed value	Deemed value	Participant self report of taking action anyway weighted by certainty of taking action before program, timing of action and efficiency level responses
	Value or Range of Values	28%	28%	0%	1% to 3%
	Comments/Observations	CPUC-approved value from policy rules	CPUC approved value from policy rules	Deemed value	Billing Analysis of participant and ponparticipant usage produced unstable load impacts, recommend use of participant pre-post model to estimate gross and net impacts
Participant Spillover	**Methodology Used**	None	None	None	None
	Value or Range of Values				
	Comments/Observations				
Nonparticipant Spillover	**Methodology Used**	None	None	None	None
	Value or Range of Values				
	Comments/Observations				
Other	**Other Adjustment**				
	Limitations of Study				Authors note free ridership rates are low based on contradictory responses from those who report they would have installed without measure and then state they had no plans to install measure within year or at higher efff levels

8.2 Data Analysis

Each study was reviewed to determine the definition of net impacts, as well as if the studies assessed the combined impacts of audits plus available rebate programs or the audit alone. The Opinion Dynamics study was primarily charged with investigating different methods of to estimate gross savings from the program using the billing history of participants and nonparticipants. The study defined net impacts for the audit programs as the expected load impacts from the program participants less the savings from the proportion of customers who report they would have installed the recommended measures without receiving an audit. To determine the actual NTFR the study used a battery of five questions aimed at discovering the effect of the audit on the likelihood of the purchase, the timing of the purchase, and the efficiency level of the measure installed.

The final results from the Opinion Dynamics study identify free ridership rates ranging from 1.5% to 3%, (depending on the delivery method) which translate to a net of free ridership ratio (NFTR) from 97% to 98.5%. The authors state these free rider-ship results seem quite

low but in line with their expectations that a pure information program will likely have low levels of free ridership (Study 4, page 145). These results were based on a set of questions seeking customer opinions on the likelihood they would have installed the same efficiency measure without the audit. Respondent answers which suggested that the audit would have even a small effect on the customer purchase decision were counted as 100% program influenced.

It is also important to look at the potential for double counting the net energy impacts generated by audits versus the impacts achieved through other programs via a referral from the audit itself. The ODC analysis suggest this effect will be quite small because of their finding that only 5.5% of the audit participants participated in a program as a result of or at the same time as the audit. However the most frequent recommendations made across all audits (71% of the time) was to purchases and install a compact fluorescent lamp. Since participation in the CFL programs (by purchasing a CFL lamp from a store that is participating in an upstream rebate program) is not tracked by individual household, it is possible that this could lead to some double counting of energy savings. The effects are not expected to be significant since only 13% of audit recommendations are implemented by customers within the next year.

We believe that the final results from this study may have an upward bias, since customers seeking to validate the program, and their own intelligent purchase decision, would be expected to answer that the audits had a significant impact on their final decision. This leads us to believe that the estimate of 97% to 98.5% NTFR is probably too high. We therefore recommend a NTFR value of 80% for all forms of audits delivered on site, via mail, or via phone. The 80% estimate is more consistent with the actual level of free ridership experience over time and in the middle part of the range between 97% and 72% described earlier.

8.3 Recommendations

Table 8-2 presents the recommended NTFR estimates for residential audit programs for use in the 2008 DEER update. In the absence of more evaluation data, we chose to recommend a value on the conservative end of the range of most recent NTFR values from the ODC study (97% to 98.5%) and previous evaluations of residential audit programs (72%) and recommend an NTFR of 80% for onsite, phone, and mail in audits.

No NTFR estimates are provided for time of sale home inspection delivery. The DEER default process should be used to estimate NTFR values for measures using this delivery method. The actual free ridership rate in the future could change if the penetration of home energy use displays are used to increase customer awareness and interest in the energy use of different appliances and linked to on line audit tools.

We anticipate that these values may be updated based on potential changes to audit program design and technological developments in the in home display field.

Table 8-2: Recommended NTFR Values

Measure and Program Information			NTG Information			
Measure Name(s)	**Target Market(s)**	**Program Delivery Method/Channel**	**NTG Values Used Typically by Utilities in Previous Filings**	**NTG Values Based on 2004-05 Program Studies**	**NTGR Values Recommended for 2006-07 Update**	**Data Sources**
Audit	Single Family	On-site Audit, Phone, or Mail in Survey to get Audit	72%	80%	80%	Evaluation of the 2004-05 Statewide Home Energy Efficiency Program
Audit	Single Family	On-line Audit	72%	80%	80%	N/A

9

Net-of-Free-Ridership Program Area: Residential Direct Install

9.1 Data Sources

A literature review was conducted on available 2002-2005 evaluation studies for information on free ridership and participant and nonparticipant spillover. The CALMAC database was combed for evaluation studies with estimates and methods for assessing net savings of residential direct install programs. The three evaluation reports listed in Table 9-1 were reviewed. The primary efficiency measures assessed in the reports include building envelope, lighting, HVAC, and water heating measures.

Table 9-1: Overview of Studies Used

Study Information	**Name of Study**	EM&V of City of Berkeley - CA Youth Energy Services	EM&V of the H&L Energy Savers Performance 2004-2005 Non-Utility Implementation	EM&V Report for the Comprehensive Hard-to-Reach Mobile Home Energy Savings Programs
	Authors	Summit Blue Consulting	Sisson and Associates	Robert Mowris and Associates
	Program Years	2003	2004 - 2005	2003
	Sample Size	20	82	N/A
	Precision Level	N/A	N/A	N/A
End Use	**End Use(s)**	lighting, HVAC, water heating	envelope, lighting, HVAC	lighting, HVAC, water heating, envelope
	Measure Names	CFLs, water saving devices, water heater temp reduction, pipe insulation, clothesline installation and programmable thermostats	ceiling and wall insulation, duct sealing, CFLs	hard-wired lighting, CFLs, duct testing/sealing, AC tune-ups, programmable thermostats, pipe insulation, water heater blankets, low flow showerheads, aerators, infiltration measures
NTGR Components	**Free Ridership**	Yes	Yes	No
	Participant Spillover	Self report	Self report	No
	Nonparticipant Spillover	No	No	No

The City of Berkeley Program is a direct install program for the low to moderate income market. The H&L Energy Savers Program provides no-cost audits and rebates for homes being purchased, renovated, or refinanced. The Hard-to-Reach Mobile Home Program consists of education and direct installation of energy efficiency features for mobile home customers.

9.2 Data Analysis

The three studies were limited in their methods and findings. The City of Berkeley evaluation study assessed the viability of an assumed Net-of-Free-Riders (NTFR) Ratio of 0.80. The evaluation estimated the level of free ridership at 0.26 and additional spillover impacts at 0.06 for an overall Net to Gross Ratio of 0.78.[1] This method was determined by

[1] NTG = (1-0.26) * (1+0.06) = 0.78

the report authors to yield a valid estimate of free ridership. For this analysis, the NTFR value for the Berkeley study is 74% because of the current policy direction not to consider spillover effects in the overall estimate of program net effects for DEER. However, the findings of this study were not rigorous enough to recommend this value for DEER. The H&L Energy Savers and the Hard to Reach Mobile Home Programs assumed a Net to Gross Ratio of 89% for all measures.

Only two of the evaluation reports reviewed addressed free ridership and both used the self report method. The two measure-specific and time-frame questions for the H&L Energy Savers Program were treated as a proportional variable. Measure specific Net to Gross was set at 100% if the time-frame for adoption without the program would have been one year or more. Moderately high free ridership ratios were found for core measures (ceiling insulation, wall insulation and whole house fan). There was low free ridership found for aerators, low flow showerheads, duct sealing, and non-program measures.

The City of Berkeley Program estimated free ridership for both lighting and non-lighting measures. Two questions were asked of 20 program participants. Free ridership was determined to be 32% for CFLs and 23% for the other efficiency measures for an overall free ridership value of 26%.

9.3 Recommendations

The studies reviewed provided only limited information on free ridership. From the information that was available, little variation was found in NTG values. Direct install programs have historically had high NTFR values, particularly in hard to reach sectors where the saturation of targeted efficiency measures is low to moderate as compared to the overall population. We therefore recommend a default NTFR value of 0.85 for measures targeted to Hard-to-Reach populations which incorporate direct installation delivery methods until more robust ex post evaluation results are available for this program area.

Table 9-2: Recommended NTFR Values

Measure and Program Information			Net-of-Free-Ridership (NTFR) Information			
Measure Name(s)	**Target Market(s)**	**Program Delivery Method/ Channel**	**NTG Values Used by Utilities in Previous Filings**	**NTFR Values Based on 2004-05 Studies**	**Recommended NTFR Values for 2006-07**	**Data Source(s)**
CFL-screw in	Hard to reach	Direct Install	80%	85%	85%	2004-2005 Statewide Residential Retrofit Single-Family Energy Efficiency Rebate Evaluation
Low flow showerheads	Hard to reach	Direct Install	80%	85%	85%	2004-2005 City of Berkeley - CA Youth Energy Services Program Evaluation, EM&V of the H&L Energy Savers Performance 2004-2005 Non-Utility Implementation, and EM&V Report for the Comprehensive Hard-to-Reach Mobile Home Energy Savings Programs
Pipe insulation	Hard to reach	Direct Install	80%	85%	85%	2004-2005 City of Berkeley - CA Youth Energy Services Program Evaluation, EM&V of the H&L Energy Savers Performance 2004-2005 Non-Utility Implementation, and EM&V Report for the Comprehensive Hard-to-Reach Mobile Home Energy Savings Programs
Programmable thermostats	Hard to reach	Direct Install	80%	85%	85%	2004-2005 City of Berkeley - CA Youth Energy Services Program Evaluation, EM&V of the H&L Energy Savers Performance 2004-2005 Non-Utility Implementation, and EM&V Report for the Comprehensive Hard-to-Reach Mobile Home Energy Savings Programs

9.4 Participant and Nonparticipant Spillover

Nonparticipant spillover was not addressed in the three residential direct install studies evaluated.

For the H&L Energy Savers Program, participant spillover was noted in 24 of the 82 sampled applications (29% of sample); however the methodology to determine this is suspect. The most frequent spillover measure was building envelope (knee wall insulation, door weather-stripping, added ceiling insulation, and windows).

The City of Berkeley Program had a limited self-report sample (20 respondents) with a fairly high spillover rating of 8% for CFLs and 6% for other measures. The Hard-to-Reach Mobile Home Program did not assess spillover.

10

Net-of-Free-Ridership Program Area: Nonresidential Prescriptive Rebates

10.1 Data Sources

This paper documents the data sources and analysis used to produce recommended net-of-free-rider (NTFR) values for the Nonresidential Prescriptive Rebates program category. Programs in this category provide downstream rebates to businesses that install energy efficient lighting, HVAC, refrigeration and motor systems from a prescribed set of equipment options. Primary data sources include evaluations of the Statewide PY2004-05 Express Efficiency Program and the Nonresidential Audit Program,[1,2] and the evaluations of four other small commercial programs sponsored by Third Party administrators and SCE.[3,4,5,6]

To locate relevant data sources, we searched the CALMAC database for all of the EM&V studies of PY 2002-2005 small and medium business prescriptive rebate programs that included estimation of net savings. Itron found four previous evaluations that had been completed for various types of prescriptive rebates in this sector. In addition, Itron reviewed results from two draft evaluation projects that were, as yet, unpublished - those for the 2004-2005 Statewide Nonresidential Audit (NRA) and Express Efficiency programs. Based on these considerations, six evaluation reports were reviewed. Three of the six evaluations reviewed conducted their own NTFR analysis, while the other three used deemed net-to-gross ratios. Evaluations of the 2004-05 Express Efficiency program and the 2004-05 SCE Small Business Energy Connection program estimated NTFRs and net program impacts using self report and billing analyses. The NRA evaluation included an analysis of net-to-

1 Itron, Inc. *2004/2005 Statewide Express Efficiency Program Evaluation.* Prepared for Pacific Gas & Electric. Draft report. April 2008.

2 Itron, Inc. *2004-2005 Statewide Nonresidential Audit Program Evaluation.* Prepared for Pacific Gas & Electric. Draft report. April 2008.

3 EcoNorthwest. *Evaluation of the SCE 2004-05 Small Business Energy Connnection Program*. April 2007

4 Quantec, LLC. *EM&V Report: ENERGY STAR® CFL Program for Small Hardware and Grocery Retailers.* Prepared for Ecos Consulting. 2002

5 RLW Analytics, *Nonresidential Financial Incentives Program Evaluation.* Prepared for the California Public Utilities Commission. 2003.

6 Mowris, Robert, and Associates. *Local Small Commercial Energy Efficiency & Market Transformation Program.* Prepared for Southern California Edison. 2002.

gross ratios for three significant measures: CFLs, T-8 fixtures, and split and packaged HVAC systems.

The Express Efficiency evaluation[7] estimated NTFRs at the end-use level and for specific measures within each end use based on self-reports and will soon provide results based on a discrete choice analysis. The NRA evaluation estimated gross and net impacts at the measure and end-use level as a result of the audit alone, the Express Efficiency program rebate alone, and the combined effect of both programs. These results were based on both the self-report and discrete choice methods. The draft discrete choice results presented in the draft NRA report were developed by the same analysis team developing the Express Efficiency discrete choice analysis. Although draft results have been developed, final analyses are still in progress. The Small Business Energy Connection study estimated free ridership using the self-report method and performed a billing analysis to estimate net overall program impacts, including the impacts of both free riders and nonparticipant spillover.[8]

The results from the Small Business Energy Connection program are not directly comparable to the first two evaluations of rebate programs because this program used an audit-direct install delivery approach that provided the majority of the energy efficiency measures recommended at no cost to customers. We include the results from this evaluation here because this is the only study we have been able to find that includes a net to gross analysis for measures installed in the small commercial sector only as opposed to the statewide rebate programs that provide rebates to large, medium and small nonresidential customers.

The Express Efficiency evaluation contained NTFR estimates for the following commercial end uses:

- Indoor lighting,
- HVAC,
- Refrigeration,
- Motors, and
- Water heating.

Estimates of the NTFR for the measures representing the majority of Express Efficiency program energy savings for each end use were provided. These measures included CFLs, T-8 and T-5 fixtures with electronic ballasts, programmable thermostats, split and packaged HVAC systems, strip door curtains, more efficient evaporative motors, door gaskets, motors in general and more energy efficient water heaters.

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7 Itron Express Efficiency 2008, op cit.

8 EcoNorthwest 2007, op cit.

10.2 Data Analysis

We used the following procedure to review NTFR results from each study. First, we summarized the net-to-gross (NTG) or NTFR ratios reported in each study, and documented the associated methods used to develop these estimates. We also captured any participant and nonparticipant spillover estimates that were made. In some cases, we contacted the author of the study to clarify what data was presented or the sample size used. Then we reviewed the survey questions or analysis used to derive the result and the sample size and response rate for each key question. Based on this review process, we developed recommended NTFR values by measure and end use category (if measure information was not available).

Lighting Measures

Table 10-1 compares the NTFR values for common lighting measures within the three evaluation studies reviewed. In the work-in-progress Express Efficiency evaluation, we found self-report based NTFR estimates for nine specific measures. The draft NRA/Express discrete choice analysis provides NTFR estimates for two common lighting measures, while the Small Business Energy Connection evaluation published data for three measures. The comparisons show somewhat different NTFR estimates for three lighting measures: CFLs, T8 fixtures, and LED exit signs.

Table 10-1: Reported NTFR by Study for Lighting Measures

Measure	Express Efficiency Program NTFR	Nonresidential Audit Program NTFR	Small Business Energy Connection Program NTFR
CFLs	82%- 95%[9]	82%	79%
T-8	76%-92%	76%	91%
LED signs	not available	not available	81%

The NTFR values for CFLs in all three studies are relatively close and are probably within the bounds of estimation error. The sample size of participating and nonparticipating customers interviewed in each study was considered sufficient to yield statistically significant results at the program, end use, and measure level.[10]

[9] Range shows the impact of including the results of the program influence question on the overall NTFR for each measure. Recall this evaluation used a self-report method.

[10] Sample sizes in the respective studies were 1,800 participants for Express Efficiency, 600 participant interviews in the EcoNorthwest study, and over 1,500 nonparticipants and 1,200 participants in the draft NRA/Express Efficiency discrete choice analysis.

Question Construction. The range of NTFR results displayed for the lighting measures in the self-report portion of the Express Efficiency NTFR analysis is based on the use of two different weighting formulas to estimate free ridership. The higher NTFR result uses a weighting scheme that includes respondents' answer to the question: "On a scale of 1 to 10 how influential was the program in the purchase of this measure?" The evaluators in this study recommended the exclusion of this question from the overall NTFR weighting because respondents tend to exaggerate the influence of the program, perhaps to help re-assure themselves they had made the correct investment decision based on the program recommendation. The lower NTFR in the range uses a 33% weighting for the results of questions related to the program's influence on efficiency levels chosen, timing of the purchase, and the number of measures purchased and excludes the answers to the general question about overall program influence.

At this time, we recommend the use of draft NTFR values derived using the discrete choice analysis because this method gathers data from both participants and nonparticipants on their purchasing decisions and is generally more reliable than the self-report method. We recommend the use of the draft self-report estimates from the Express Efficiency study when discrete choice analysis results are not available for that measure. The NTFR results of this analysis are likely to be more relevant for the general segment and delivery mechanism of non-residential prescriptive rebates than the values reported for the Small Business Energy Connection program because of the robust sample size, the interviews with large and medium customers and the rebate program delivery method.

However, it may be that the NTFR values reported from the Small Business Energy Connection study are more representative of free ridership for the small business class rather than the entire nonresidential sector served by the Express Efficiency program. This is because the small business program was limited to customers under 20 kW, while the Express Efficiency program was open to all nonresidential customers. The small commercial direct install segment/delivery mechanism is also addressed in our NTFR discussion for the nonresidential direct installation program area.

NTFR Results for Non-Lighting Measures

The Express Efficiency program evaluation also provided NTFR estimates for HVAC, refrigeration, motor and water heating measures, and/or systems that were not available from any other study. We recommend the use of the self-report NTFR values from the Express Efficiency evaluation for all non-lighting measures except in the special case of split/package HVAC systems where discrete choice-based estimates are available for the NRA evaluation.

In this case, we recommend the use of an NTFR of 0.58 rather than the self-report values that ranged from 0.39 to 0.65 from the statewide Express Efficiency evaluation.[11]

10.3 Recommendations

Table 10-2 presents the recommended NTFR estimates by measure. NTFR estimates based on the discrete choice method were generally considered more credible than self-report results and are recommended for inclusion in the DEER database in cases where both estimates are available. The derivation of the .60 NTFR value for upstream rebates CFL programs is discussed in the residential CFL program documentation (Section 2). The NTFR for downstream prescriptive rebates for CFLs is reduced somewhat relative to the 2004-2005 estimate due to uncertainty associated with the dramatic increase in non-program CFL sales nationally in 2007 (see residential CFL program area for discussion).

In most cases, the recommended NTFR values are lower than the NTG ratio of 0.96 used by some utilities for many nonresidential prescriptive programs and measures. The measures with lower NTFR values in this table, in particular programmable thermostats and strip door curtains, should be considered candidates for changes in rebate levels and refinement to program design to increase NTFR, along with careful reassessment of cost effectiveness and portfolio contribution.

[11] Itron Express Efficiency 2008, op cit., Table 5-16, all Express participants.

Table 10-2: Recommended NTFR Values

Measure and Program Information				Net To Gross Values		
Measure Name(s)	**Additional Specification Detail**	**Target Market(s)**	**Program Delivery Method/ Channel**	**NTG Values Used by Utilities in Previous Filings**	**NTFR Values Based on 2004-05 Studies**	**Recom-mended NTFR Values for 2006-07**
CFL Screw In	<=30 Watt	Nonresidential buildings	Upstream Rebates	80%	74%	60%
CFL Screw In	<=30 Watts	Nonresidential buildings	Downstream Prescriptive	96%	81%	81%
CFL Screw In	>30 Watt or specialty bulbs	Nonresidential buildings	Downstream Prescriptive	90%	81%	81%
T-8 or T-5 CFL Lamps	4-ft. and 8-ft. lamps	Nonresidential buildings	Downstream Prescriptive	96%	76%	76%
Occupancy Sensors	Large area lighting controls	Nonresidential buildings	Downstream Prescriptive	96%	84%	84%
Other Lighting	Delamping, LED exit signs, and other high efficiency lighting sources	Nonresidential buildings	Upstream Rebates	96%	83%	83%%
Other HVAC	Variable speed drives, package systems, HVAC controls, programmable thermostats	Nonresidential buildings	Downstream Prescriptive	96%	50%	50%
Split Package AC Systems		Nonresidential buildings	Upstream Prescriptive rebates	96%	58%	default
Strip Door Curtains			Downstream Prescriptive	96%	46%	46%
Door Gaskets		Nonresidential buildings	Downstream Prescriptive	96%	80%	76%
Efficient Evaporative Motors		Nonresidential buildings	Downstream Prescriptive	96%	75%	default
Motors		Nonresidential buildings	Downstream Prescriptive	96%	52%	52%
Water Heating Systems		Nonresidential buildings	Downstream Prescriptive	96%	36%	36

* Note that the CFL NTFR estimates are not intended for use with direct installation programs, these values are discussed as a separate program areas in a separate documentation paper..

10.4 Participant and Nonparticipant Spillover Estimates

The Express Efficiency evaluation will also include estimates of participant spillover and nonparticipant spillover effects for the measures identified in Table 10-2. The measures in this table contribute the majority of direct and probably indirect energy savings from this program, but the specific results will not be available until the final express efficiency evaluation is published in the summer of 2008.

11

Net-of-Free-Ridership Program Area: Nonresidential Audits

Data Sources

Programs in this category provide free energy management services and information to nonresidential customers using a survey of customers' energy using equipment, which results in a report providing recommendations for energy conservation practices and energy efficiency equipment or measure upgrades. The report typically includes information on rebate programs and specific rebates available for recommended measures.

To locate relevant data sources, the CALMAC database was searched for EM&V studies of PY 2002-2005 nonresidential audit program evaluations that estimate net savings. There are many impact studies of programs that combine audit services with rebates or direct install services, but few impact evaluations of stand-alone audit programs. The available impact studies identified for this analysis include the PY 2002, PY 2003, and draft PY 2004/2005 Nonresidential Audit (NRA) evaluations and the draft evaluation of PG&E's 2004/2005 Local Program, which was conducted in conjunction with the 2004/2005 NRA.[1] The analysis conducted for these studies and the survey data collected were reviewed, considered, and in some cases, re-analyzed in support of the recommendations made in this report.

Among the available impact assessments, only the draft 2004/2005 NRA and Local Program evaluations present formal NTG assessments of audit activities. Both self-report and discrete choice methods were used. Self-report methods were deemed more reliable and selected for the final study results and for the values recommended in this report.[2]

Table 11-1 summarizes the various M&V studies reviewed for information on free ridership.

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[1] Also considered and reviewed was an EM&V study of the ASW Engineering and RLW Analytics Small Business Energy Alliance (SBEA) Energy Savings 2004/2005 Non-Utility Programs. However, this program combines audit, rebate, and direct install program components; thus the NTG estimate is not relevant to audit-only services.

[2] The discrete choice method was implemented as part of a cross-program study that integrated survey and tracking system data from participants in the NRA, Express Efficiency, and SPC programs, and customers with both audit and incentive program participation. The discrete choice method result was unreliable as an estimator of audit net impacts due to a high degree of multicolinearity with rebate program awareness. At a more basic level, the modelers were unable to successfully model the influence of the NRA program on incentive program awareness, mostly due to limitations inherent to survey data. For example, few people were able to report the specific point in time and source of their Express Efficiency awareness.

Table 11-1: Summary of Relevant Data Sources

		Study #1	Study #2	Study #4	Study #5
Study Information	**Name of Study**	PY 2002 Statewide Nonresidential Audit Evaluation	PY 2003 Statewide Nonresidential Audit Evaluation	PY 2004/2005 Statewide Nonresidential Audit Evaluation	PY 2004/2005 PG&E Local Program Evaluation
	Authors	Quantum Consulting, Ridge & Assoc., and Equipoise	Quantum Consulting	Itron	Itron
	Program Years	PY2002	PY2003	PY2004/2005	PY2004/2005
	Sample Size	500	84 Med/Large and 259 Very Small/Small	815 small/very small and 190 medium/large participant surveys	40 Participant surveys
	Precision Level	With simplifying assumptions, plus or minus 9 to 11 percent for 90 CI. See "precision Calc" tab for details	For Very Small/Small with simplifying assumptions, plus and minus about 11 percent (90% CI). Medium/Large is plus/minus 14 to 15 percent	precision around FR: md/lg onsite is +/- 16%; S/VS onsite +/-12%; S/VS remote +/- 8%	precision around FR; +/-11%
Free Ridership	**Methodology Used**	Self-Report			
	Value or Range of Values	88% net for kWh total program, see tab "PY2002 NTG Results Table" for other segment results	70.6% net for Very Small/Small and 78.2% net for Medium/Large, both estimates for annual kWh, see "PY2003 NTG Results Table" tab for other segment results	FREE RIDERSHIP VALUES: Md/lg onsite: .54 S/VS onsite: 0.52 S/VS remote: 0.71	FREE-RIDERSHIP = 0.89
	Comments/Observations	Results based on zeroing out impacts for measures where customer reported audit influence to be less than or equal to 4 on a scale from one to 10. Results are shown by end-use, audit-type and fuel (kWh, kW, Therms).		Self-Report Technique consistent with Express Efficiency Technique for 2004/2005 Evaluation	
Participant Spillover	**Methodology Used**	None	None		
	Value or Range of Values	N/A	N/A		
	Comments/Observations	None, Not a defined concept for Audits as evaluated here. Sometimes gross impacts are limited to measures recommended in audit reports. For this Evaluation, we consider all measures implemented by customers to potentially be part of gross program impacts.	None, Not a defined concept for Audits as evaluated here. Sometimes gross impacts are limited to measures recommended in audit reports. For this Evaluation, we consider all measures implemented by customers to potentially be part of gross program impacts.	Same comment as PY2002 and PY2003 to the left	Same comment as PY2002 and PY2003 to the left
Nonparticipant Spillover	**Methodology Used**	N/A	N/A	None - not investigated	None - not investigated
	Value or Range of Values	N/A	N/A	N/A	N/A
	Comments/Observations	No attempt to measure nonparticipant spillover has been seriously considered for the Statewide NRA evaluations. This could potentially be an area of study - as nonparticipants may have greater access to information given greater prevalence of audit services.			
Other	**Other Adjustment**	None	None	None	None
	Limitations of Study	The "influence-adjusted" results make use of only one of many survey questions that relate to ntg issues. A complete listing of questions that could potentially be used to adjust impacts are shown in tab "PY2002 NTG questions".		Robust SR technique, no obvious drawback except the reliance on self-reported values, and inherent difficulties in measuring free ridership for information programs.	Robust SR technique, but small sample size, program has focus on medium and large customers.

Data Analysis

This section describes the analytical process that lead to the recommended values. The first step was to review the impact and net to gross methods and results for each available Evaluation report. The second step was to consider alternative evaluation approaches that could be implemented with available data collected for these studies. These alternatives are then explored and presented. Finally, the advantages and drawbacks of available indicators are assessed and values are chosen.

There was no formal net-to-gross analysis for the PY 2002 and PY 2003 NRA evaluations. However, these evaluations include an "influence-adjusted" impact report that relies on a simple algorithm to exclude impacts from measures installed by customers clearly not influenced by the audit program. More specifically, this algorithm relies on the survey question "How influential was the Audit program on your decision to install <measure> on a scale from 1 to 10, where 1 is not influential and all and 10 is very influential?" Customers reporting an "influence score" of 4 or less are assumed to be free riders.

The selected influence score cut-off of 4 used in the 2002 and 2003 evaluation studies is relatively lenient. To better understand these data and to improve the quality of the analysis, survey data for the 2002, 2003 and 2004/2005 evaluations were combined and analyzed using this method and applying a range of cutoff values. The results for free-ridership cutoff values of 4, 7 and 8 are presented in the Table 11-2. In the course of performing this analysis, it became apparent that 2004/2005 free-ridership levels are notably higher than 2002 and 2003 levels. To illustrate this, the analysis is performed by program year segment; once for the combined 2002 and 2003 data and separately for the 2004/2005 data.

Table 11-2: Self-Report Based Free-Ridership Rates using Various Influence Cutoffs, by Program Year, Customer Size, and Delivery Method

Evaluation Study Data Source	Max Self-Reported Audit Influence Score Indicating FR (1 to 10 scale)	Free-Ridership Rates and Sample Sizes		
		On-Site Audits		Remote Audits
		Very Small/Small	Medium/Large	
PY 2002, 2003 and 2004/2005	4	49%	45%	53%
	7	55%	59%	74%
	8	62%	59%	84%
	Sample Size	200	121	293
PY 2002, 2003	4	21%	33%	55%
	7	26%	48%	73%
	8	35%	48%	81%
	Sample Size	52	50	128
PY 2004/2005	4	66%	67%	52%
	7	72%	78%	74%
	8	77%	79%	87%
	Sample Size	148	71	165

Table 11-2 indicates an upward trend in free ridership. The PY 2004/2005 NRA Evaluation Report also indicates that a much greater portion of the program related activity is occurring through incentive program offerings for the 2004/2005 program participants than among the 2002 or 2003 program participants. The free-ridership rates among the measures installed outside rebate programs have correspondingly risen.

As noted above, the draft 2004/2005 NRA evaluation recommends its results from the more traditional self-report method. The implemented self-report method relies on several survey questions,[3] using them to create three sub-scores based on questions determining the following:

- Program influence on the decision to purchase,
- Efficiency of the equipment, and
- Timing of the purchase.

These sub-scores are multiplied to yield the final free ridership rate. This method is judged comprehensive and appropriately stringent. Thus, no re-analyzing of the data is performed. In addition, this evaluation utilizes a large sample (1,005), and relies on data collected more recently. The latter is important, since clearly there have been some recent trends causing free ridership rates to change. For these reasons, the draft PY2004/2005 evaluation is the source of the recommended NTFR values in this paper.

[3] The self-report method *does not* incorporate the self-reported "influence score" relied upon in previous years.

11.2 Recommendations

The new recommended DEER NTG values for the 2006-2007 savings update are summarized in Table 11-3 below, and are based directly on the draft 2004/2005 Nonresidential Audit Evaluation. The basis for the development of these recommended values, and the criteria that should be used in assessing their relevance include the following.

- Ex-ante impacts are defined as the universe of all non-rebated efficient lighting and cooling measures installed in the first two to three years following the audit.
- These estimates reflect the California NRA program portfolio of recommendations, which generally emphasizes lighting measures (~60%), and cooling measures (~30%).
- The NRA program is a relatively standardized audit program, with the medium/large on-site audits having the greatest degree of customization. Reviewers should note that this program is not representative of intensive on-site audits directed at larger customers, such as those involving customized engineering analysis and very detailed reports.
- The NRA program is highly focused on referrals to incentive programs and has been shown to produce greater per-unit net impacts through the rebate programs than it does through non-rebated measures.

Audit programs also often have highly uncertain ex-ante gross impacts. Thus, to the degree it is possible/useful to provide NTG ratios for audit programs, it is perhaps also useful to provide per-unit net impacts; thus are included below.

Table 11-3: Recommended Per-Unit Impacts and Net-of-Free Ridership Ratios for Audit Programs, by Customer Size, Delivery Mechanism, and End Use

Customer Size	Delivery Method	End Use	NTFR	Net kWh per Audit	Net kW per Audit
Very Small/Small	On-Site	Lighting	55%	373	0.1
		Cooling	33%	116	0.1
		Total	**48%**	**488**	**0.3**
	Remote	Lighting	56%	193	0.1
		Cooling	11%	62	0.1
		Total	**29%**	**254**	**0.1**
Medium/Large	On-Site	Lighting	49%	708	0.1
		Cooling	41%	403	0.3
		Total	**46%**	**1,111**	**0.4**

Table 11-4 provides recommended NTFR values based on the analysis noted above.

Table 11-4: Summary of Free-Ridership Recommendations

Program Information			Free-Ridership Information				
Measure Name(s)	**Target Market**	**Delivery Method**	**NTG Values Used by Utilities in Previous Filings**	**NTFR Values Based on 2004/2005 Studies**	**Recommended NTFR Values for 2009-20011**	**Methodology Used to Estimate Free Ridership**	**Data Source**
Audit – Lighting and Cooling Measures	Med/Large (>100 kW)	On-Site	17%	46%	46%	Self-Report Approach	2004-05 Statewide Nonresidential Audit Program Evaluation (draft)
Audit – Lighting and Cooling Measures	Very Small/Small (≤100 kW)	On-Site	17%	48%	48%		
Audit – Lighting and Cooling Measures	Very Small (<20 kW)	Remote (phone, mail, online, CD-ROM)	17%	29%	29%		

* These free-ridership values apply to all non-rebated efficient measures adopted over the first two to three years following the audit. These apply to an audit program that includes referrals to rebate programs.

There are several things to keep in mind when applying this data to other programs in this category. Audit programs are unique in their relationship to NTG ratio estimation. This uniqueness arises primarily from the absence of a clearly defined ex-ante impact. Depending on data availability and the particular objectives of a program planner or evaluator, ex-ante impact estimates may be defined as the savings potential identified in audit reports and recommendations, or as the universe of all efficient measures adopted over the first two to three years following the audit. Many other definitions are also possible. The definition used in the evaluation of the 2004/2005 NRA program is the portion of impacts arising from participant-installed, non-rebated efficient measures attributable to the NRA program. This definition is readily accessible with limited data, which was the primary driver for the selection of this definition for the 2004/2005 NRA evaluation.[4]

Thus, if a program planner is working with a definition of ex-ante impacts not consistent with those used in the PY2004/2005 NRA evaluation, the NTG ratios presented in this paper *do not apply*. The ratios presented here provide the percent of impacts resulting from non-rebated energy efficient actions taken by participants that are attributable to an audit program.

Among audit programs, there are several program characteristics that substantially change what is relevant NTG data.

[4] Due to this definition of ex-ante impacts, the resulting net impacts might be interpreted as inclusive of participant spillover, as there is no distinguishing between program and non-program measures.

- Audits delivered through the mail, phone, online, or by a distributed CD-ROM have a substantively different impact on customers than an audit provided on-site. Audits provided to smaller (less than 100 kW) customers have a different expected net impact than those provided to larger customers (more than 100 kW).
- The degree of customization of audit recommendations is also important to the program's net impacts, with more customization leading generally to more adoptions (though not necessarily to more *non-rebated* adoptions).
- Net impacts depend on the degree to which an audit program is aggressive in its role as a "feeder" program to other nonresidential program offerings. Generally, the degree to which the audit acts as a referral program or 'feeder' program correlates to higher free ridership for *non-rebated* measures. If an audit program recommends efficient measures and emphasizes program referrals, participants *influenced* by the program are likely to install measures *through the incentive programs*. This is illustrated by the findings that the Local Program, which had outstanding crossover of participants to the incentive programs, created more awareness of incentive programs, and had much higher free ridership for non-rebated measures. Ninety-five percent of the estimated net impacts arising from this audit program occurred through the installation of *rebated* measures.[5] The NRA program is also closely tied to referrals to rebate programs; the 04/05 NRA evaluation study found about three-fourths of the total net impact arose from *rebated* measures.[6]
- Another important program characteristic is the portfolio of recommendations. For the NTG ratios recommended in this report to be transferable to another audit program, there needs to be reasonable consistency across the portfolios of recommendations, at least at the end use level. End-use specific recommended ratios are presented to assist in transferring appropriate ratios.

Participant and Nonparticipant Spillover

Itron's review also included capturing any information on participant and nonparticipant spillover that may have been included in the studies. However, participant and nonparticipant spillover were not investigated in any of the studies that were reviewed.

[5] Cross-program attribution techniques based on self-report data were used to attribute net impacts from rebated measures across rebate and audit effects.

[6] It is also notable that the portion of energy efficient actions taken by audit participants through rebate programs may vary with incentive program offerings, budget, and marketing.

12

Net-of-Free-Ridership Program Area: Large Nonresidential – Custom

12.1 Data Sources

To assess net-of-free ridership (NTFR) values for large nonresidential custom programs, evaluation studies spanning program years 2000 through 2004-05 were reviewed for information on free ridership and participant and participant spillover. The most pertinent studies were evaluations of California's Statewide Standard Performance Contracting Program. Results of studies from program years 2000, 2001, 2002, 2003 and 2004-05 are presented. The 2002, 2003 and 2004-05 studies were conducted by Itron (formerly Quantum Consulting), while the 2000-2001 study was completed by XENERGY (now KEMA). In all cases, these evaluations measured the effects of free riders but did not attempt to quantify spillover impacts.

In addition, the review included a companion study, completed by KEMA/Rick Ridge.[1] This study provided the basis for the adjustments for self-report bias and participant spillover that are reflected in the 0.70 net to gross (NTG) value used by the utilities in previous filings.

The most relevant study reviewed is the 2004-05 SPC program evaluation. However, NTFR findings have been very stable since 2000 and therefore, our recommendation (based on 2004-05 results) is generally consistent with the range of NTFR values reported since 2000.

These studies rely on the self-report method, since other available methods and research designs are generally not feasible for large nonresidential customer programs focused on customized and highly site-specific measures, particularly in the industrial sector. It is important to note that the self-report method has been consistently applied in all of these studies, (i.e., with identical question wording and weighting/scoring of results).

Table 12-1 summarizes the various M&V studies reviewed for information on free ridership.

[1] Ridge, Rick. *Improving the Standard Performance Contracting Program: An Examination of Historical Evidence and Directions for the Future.* Prepared for KEMA, Inc. (formerly XENERGY). 2001.

Table 12-1: M&V Studies Reviewed for Free Ridership

		Study #1	Study #2	Study #3
Study Information	Name of Study	2000 and 2001 Nonresidential Large SPC Evaluation Study	2003 Statewide Nonresidential SPC Program Measurement and Evaluation Study	2004-2005 Statewide Nonresi-dential SPC Program Measurement and Evaluation Study (draft results)
	Authors	Xenergy, Inc.	Quantum Consulting/KEMA, Inc.	Itron, Inc./KEMA, Inc.
	Program Years	2000-2001	2002-2003	2004-2005
	Sample Size	39 participants	64 participants (25 for PY2003 + 39 for PY2002)	113 participants
	Precision Level	90/10	90/10	90/10
Free Ridership	Methodology Used	Self-report	Self-report	Self-report
	Value or Range of Values	2000: Weighted net-of-free-ridership of 0.41 2001: Weighted net-of-free-ridership of 0.65	2002-2003: Weighted net-of-free-ridership of 0.42	Weighted net-of-free-ridership of 0.54
	Comments/Observations	90% confidence interval	90% confidence interval – 0.42 to 0.55	90% confidence interval – 0.46 to 0.61
Participant Spillover	Methodology Used		Deemed adjustment	
	Value or Range of Values		0.05 adder (intended to be temporary while longer term measurement protocols are being developed and implemented)	
	Comments/Observations		The study also noted that for the 1999 SPC program, the estimated spillover-based adjustment to the NTGR was +0.23. For the 2000 SPC program, the estimated adjustment was +0.17. For the 2001 SPC program, the adjustment was +0.27. ***Note that the estimated NTGRs for these program years were not adjusted to take into account these spillover estimates.*** (Ridge 2001)	
Nonparticipant Spillover	Methodology Used	NA	NA	NA
	Value or Range of Values			
	Comments/Observations			
Other	Other Adjustment	Minimum upward adjustment of 0.10 to account for self-report bias (also intended to be temporary)	Minimum upward adjustment of 0.10 to account for self-report bias (also intended to be temporary)	
	Limitation of Study		Recommended adjustment is based on differences found in NTGRs based on the application of different free-ridership methodologies to the same population (self-report, discrete choice, etc.). The self-report NTGR is typically 0.10 or more lower than under other methods. (Ridge 2001)	

12.2 Data Analysis

Free Ridership. All four of the studies reviewed provided NTFR values for a single delivery strategy/end use with custom incentives. Table 12-2 shows the weighted NTFR values in these studies.

Table 12-2: Weighted NTFR Values

Program Year	NTFR Value
2000	0.41
2001	0.65
2002-2003	0.48
2004-2005*	0.54

* Draft values

The mean value across these four studies is 0.52. Drawing from even earlier study results, the NTFRs for the 1998 and 1999 SPC programs resulting from the use of the self-report method are both 0.53.

In addition, the stability of results based on the NTG methodology used in the PY2004-05 evaluation was examined in the 2001 KEMA report. The study applied different algorithms, transformations and weighting schemes to the results from the 1998 and 1999 evaluations. The study found there was only moderate sensitivity to these revisions. The study noted that "These NTGRs ranged from 0.44 to 0.53 with filed NTGR at 0.488. Such moderate stability provides some assurance that the questions used to calculate the reported NTGR did not produce extreme values and all the conceivable questions, transformations, and weighting schemes all point in more or less the same direction."

The NTFR value of 0.54 in the most recent evaluation is in line with the average value from the past four evaluation cycles, and the values for the 1998 and 1999 programs. Since it is also derived from the most recent evaluation study, it is also the most relevant to future applications. Therefore, the recommended NTFR value is 0.54.

The current value used by utilities in previous filings also includes upward adjustments of +0.10 for self-report bias and +0.05 for participant spillover. The rationale for these values is provided in the 2001 KEMA/Ridge study. For future programs, the CPUC/ED should consider whether to continue the upward adjustment for self-report bias.

12.3 Recommendations

Table 12-3 provides the recommended NTFR value based on the analysis noted above.

Table 12-3: Recommended NTFR Value

Program Information			Net-of-Free-Ridership Information					
Measure Name(s)	**Target Market**	**Delivery Method**	**NTG Values Used by Utilities in Previous Filings**	**NTFR Values Based on 2004/2005 Studies**	**Recommended NTFR Values for 2006-2007**	**Methodology Used to Estimate Free Ridership**	**Data Source**	
Custom	Large Nonresidential	Customized Incentive	Including adjustments for self-report bias and spillover: 70%	54%	54%	Self-Report Approach	2004-05 Standard Performance Contracting Program Evaluation (draft)	2002, 2003 Standard Performance Contracting Program Evaluations

12.4 Participant and Nonparticipant Spillover

Our review also included capturing any information on participant and nonparticipant spillover that may have been included in the studies. However, participant spillover was only addressed in the 2001 KEMA/Ridge study, and the recommended value (0.05) was based on a Meta analysis of other studies' results. None of the studies done subsequently has investigated participant spillover in any depth.

13

Net-of-Free-Ridership Program Area: Nonresidential New Construction

13.1 Data Sources

A literature review was conducted on available 2002-2007 evaluation studies for information on free ridership and participant and nonparticipant spillover for nonresidential new construction programs. The CALMAC database was reviewed for evaluation studies with estimates and methods for assessing net savings of non-residential new construction programs; the programs of interest for this information include the statewide evaluations of the Energy Design Resources and Savings by Design (SBD) programs. Of the four evaluation reports reviewed; three were evaluations of the Savings by Design Program conducted by RLW Analytics. Table 13-1 summarizes the various M&V studies reviewed for information on free ridership.

Table 13-1: Overview of Studies Reviewed

		Study #1	Study #2	Study #3	Study #4
Study Information	Name of Study	Energy Design Resources 2003 Evaluation	An Evaluation of the 2004-2005 Savings By Design Program	An Evaluation of the 2003 Savings By Design Program	An Evaluation of the 2002 Savings By Design Program
	Authors	Opinion Dynamics Corporation	RLW Analytics	RLW Analytics	RLW Analytics
	Program Years	2003	2004 - 2005	2003	2002
	Sample Size	N/A	180 statewide	74 participants, 36 nonparticipant	68 participants, 64 nonparticipant
	Precision Level	N/A	90% sampling precision	90% precision	90% confidence level
End Use	End Use(s)	All	All	All	All
	Measure Names	Program provides design tools	Shell, reduction in LPD, HVAC and motors, lighting controls, daylighting controls, water heating, refrigeration, industrial process improvements,	Shell, LPD reduction, daylighting controls, other lighting controls, HVAC and motors, refrigeration	Shell, reduction in LPD, Daylighting, Interior Lighting, HVAC, Motors, Refrigeration
NTGR Components	Free Ridership	No	Yes	Yes	Yes
	Participant Spillover	No	No	No	No
	Nonparticipant Spillover	No	No	Self report	Self report

The Savings by Design program, a statewide program offered by the IOUs, provided design assistance and financial incentives to improve the energy efficiency of commercial and industrial facilities. To qualify for the program, the building or facility design must meet or exceed Title 24 standards by 10%.

RLW Analytics has used the same methodology to conduct evaluations of the Savings by Design Program since 1999. For this study, evaluations were reviewed for the 2002, 2003, and 2004-2005 programs. RLW Analytics used a Self Report decision maker survey to calculate free ridership by measure category and end-use for all three studies.

The 2003 evaluation of Energy Design Resources (EDR) was also reviewed; however, EDR is an information program and the evaluation provided no assessment of free ridership, spillover or net-to-gross ratios. For this reason, the EDR report is not included in this analysis.

13.2 Data Analysis

Table 13-2 provides Net-to-Gross values reported from the 2002, 2003, and 2004-2005 Savings by Design Evaluations.

The Net-to-Gross Ratios for Combined Industrial improved significantly since 2002 – from 35% to a ratio of 64% for 2004/2005. Industrial measures were reported to have lower Net-to-Gross ratios because the decision to install the more efficient equipment was frequently made before contact with the SBD program. The Net-to-Gross ratio for Combined Commercial has remained steady at about 75% for all the studies reviewed.

Table 13-2: Net-to-Gross (NTG) Values for 2002-2005 Savings by Design

Measure Name(s)	2004/05 NTG Values	2003 NTG Values	2002 NTG Values	NTG Average
Shell	86.90%	94.30%	87.40%	89.53%
Lighting Power Density (LPD)	73.60%	73.40%	68.20%	71.73%
Daylighting controls	96.70%	39.40%	56.80%	64.30%
Other lighting controls	89.60%	74.80%	78.40%	80.93%
HVAC and motors	84.20%	82.70%	65.90%	77.60%
Refrigeration	N/A	96.60%	150%	123.30%
Domestic Hot Water	N/A	Not provided	Not provided	
Whole Building	70.20%	Not provided	Not provided	70.20%
Combined Commercial	75.40%	76.20%[1]	75.30%[2]	75.63%
Combined Industrial	63.60%	59.90%	35.20%	52.90%

13.3 Recommendations

Table 13-3 presents the recommended Net-of-Free-Rider (NTFR) estimates for the non-residential energy efficiency measures delivered in the 2002-2005 programs and reviewed above.

1 0.09% non-participant spillover – mostly LPD reduction.

2 5% non-participant spillover -70% of this is from refrigeration measures from a large grocery chain with significant contribution from LPD reduction.

Table 13-3: Recommended NTFR Values

Program Information			Free Ridership Information				
Measure Name(s)	**Target market**	**Delivery Method**	**NTG Values Used by Utilities in Previous Studies**	**NTFR Values Based on 2004/2005 Studies**	**Recommended NTFR Values for 2006-2007**	**Methodology Used to Estimate Free Ridership**	**Data Sources**
Shell	70% new construction, 30% major renovation	Performance incentive	82%	13%	87%	DOE2 Model adjusted with info from Self Report	An Evaluation of the 2004-2005 Savings By Design (SBD) Program
LPD	70% new construction, 30% major renovation	Performance incentive	82%	74%	74%	DOE2 Model adjusted with info from Self Report	An Evaluation of the 2004-2005 SBD Program
Daylighting controls	70% new construction, 30% major renovation	Performance incentive	82%	64%	64%	DOE2 Model adjusted with info from Self Report	An Evaluation of the 2004-2005 SBD Program
Other lighting controls	70% new construction, 30% major renovation	Performance incentive	82%	81%	81%	DOE2 Model adjusted with info from Self Report	An Evaluation of the 2004-2005 SBD Program
HVAC and motors	70% new construction, 30% major renovation	Performance incentive	82%	84%	84%	DOE2 Model adjusted with info from Self Report	An Evaluation of the 2004-2005 SBD Program
Refrigeration	70% new construction, 30% major renovation	Performance incentive	82%	82%	82%	DOE2 Model adjusted with info from Self Report	An Evaluation of the 2004-2005 SBD Program
Domestic Hot Water	70% new construction, 30% major renovation	Performance incentive	82%	82%	82%	DOE2 Model adjusted with info from Self Report	An Evaluation of the 2004-2005 SBD Program
Whole Building	70% new construction, 30% major renovation	Performance incentive	82%	70%	70%	DOE2 Model adjusted with info from Self Report	An Evaluation of the 2004-2005 SBD Program
Combined Commercial	70% new construction, 30% major renovation	Performance incentive	82%	75%	75%	DOE2 Model adjusted with info from Self Report	An Evaluation of the 2004-2005 SBD Program
Combined Industrial	70% new construction, 30% major renovation	Performance incentive	62%	64%	64%	DOE2 Model adjusted with info from Self Report	An Evaluation of the 2004-2005 SBD Program

The NTFR values reported in the 2004/2005 Savings by Design evaluations were recommended in cases where there was not significant change in the values over the years reviewed. These measures include the building shell, lighting power density reduction, HVAC and motors, domestic hot water, refrigeration, combined Industrial, and Combined Commercial. Where there were a wide range of NTFR values over the 2002-2005 period, the average NTFR value from all three studies for the measure is recommended for the 2007-07 programs. These measures include daylighting controls and other lighting controls.

13.4 Participant and Nonparticipant Spillover

Participant spillover was not assessed for the Savings by Design or Energy Design Resources Programs. Non-participant spillover was assessed for the 2002 and 2003 Savings by Design Program using the Self Report approach. For 2002, RLW estimated that spillover was 5% for commercial customers with no spillover for industrial customers. Over 70% of the spillover savings were estimated to come from refrigeration measures, principally from a large grocery chain with the other spillover contributions from lighting power density reduction. For 2003, commercial spillover was estimated to be less than 1% of total net program savings and was primarily from lighting power density reduction measures.

14

Net-of-Free-Ridership Program Area: Nonresidential Retrocommissioning

14.1 Summary

Data Sources

To assess net-of-free ridership (NTFR) values for Residential Appliance Recycling Programs, evaluation studies from program years 2004-05 were reviewed for relevant information on free ridership. The only studies addressing this program category were an evaluation of QuEST's 2004-05 Building Tune-Up Program by SBW Consulting, and an evaluation of the 2004-05 PECI San Diego Retrocommissioning Program by Itron. Both of these studies used the self-report method to estimate free ridership.

In the SBW study, participating customers were asked about the following:

- The likelihood that they would have performed some or all of the improvements on their own without the engineering analysis provided by the program,
- The likelihood that they would have performed some or all of these improvements on their own without the financial incentives provided by the program, and
- The timing of any improvements they would have likely performed in the program's absence.

Their responses to these questions were used to estimate free ridership levels. The resulting NTFR estimates were 0.87 for electric projects and 1.00 for natural gas projects. This result was based on analysis of 17 customer projects.

In Itron's study of the 2004-05 PECI San Diego Retrocommissioning Program, the estimate of free ridership was based on participating customers' answers to the following three questions:

1. Would you have initiated and paid for the retrocommissioning investigation if you had not participated in the program?

2. If the answer to #1 is no, would you have implemented any of the measures without the energy and cost savings calculations provided by the program? If so, what percentage and on what approximate timeline?
3. If the answer to #1 is yes, please explain what the impetus for pursuing RCx would have been and if it was budgeted or scheduled prior to learning about the RCx program. What percentage of the measures would you have implemented on your own and on what approximate timeline?

Based on responses from three customers, the resulting NTFR value for this program was 1.0

Recommended NTFR Values

Based on the results of these two studies, an NTFR value of 0.90 is recommended for this program category for program year 2006-2007. In developing this recommendation, greater weight was given to the results from the SBW evaluation of the QuEST Building Tune-Up program, because of the larger sample size.

15

Net-of-Free-Ridership Program Area: Agricultural

15.1 Data Sources

A literature review was conducted on all 2002-2007 evaluation studies for information on free ridership and participant and nonparticipant spillover. The CALMAC database was reviewed for evaluation studies with estimates and methods for assessing net savings of agricultural energy efficiency programs. The primary data source used was the recently completed Evaluation, Measurement, and Verification Report for the PY2004-05 California Multi-Measure Farm Program (CALMAC ID ENS0002.01). This evaluation was completed in March 2007 by kW Engineering. Dr. Phil Willems performed the net-of-free ridership (NTFR) analysis. This is the most relevant and current information source on which to base recommended NTFR values.

The 2004-05 evaluation also references a previous study, which provides the basis for the ex-ante NTFR value for the vacuum pump variable speed drive (VSD) measure of 0.75 (which is also the current DEER value). This measure was not addressed in this latest study, although it accounted for the majority of savings (roughly 60%) of the five measures implemented in 2004-05. This previous evaluation of the 2002-03 California Variable Speed Drive Farm Program was not available from CALMAC for this review.

A recently completed evaluation of the Wisconsin Focus on Energy Agriculture Program was also reviewed for relevance. However, the NTFR values in the Wisconsin study were only available at the program level and not at the end-use or measure level. In addition, the Wisconsin Agriculture Program offers a different measure mix than the corresponding California programs, calling into question the relevance of Wisconsin-based NTFR values as a basis for informing DEER. Based on this consideration, it was decided not to include the NTFR results from the Wisconsin Agricultural Program evaluation in the analysis.

Table 15-1 provides an overview of the studies used to develop the recommended NTFR values. As the table indicates, the primary study used to develop recommended values is the recently completed evaluation of the 2004-05 California Multi-Measure Farm Program.

Table 15-1: Overview of Studies Used to Develop Recommended NTFR Values

		Study #1	Study #2	Study #3
Program and Measure Information	Sector	Agricultural	Agricultural	Agricultural
	Program Type/Segment	Prescriptive Incentive	Prescriptive Incentive	Prescriptive Incentive
	End Use	Milk pumping	All others	Pumping
	Market Event	Replacement	Replacement	Add-on
	Measure(s)	Milk pump VSDs	All 50 measures	Vacuum pump VSDs
Study Information	Name of Study	Evaluation, Measurement, and Verification Report of 2004-2005 California Multi-Measure Farm Program	Evaluation, Measurement, and Verification Report of 2004-2005 California Multi-Measure Farm Program	2002-2003 California Variable Speed Drive Farm Program Evaluation
	Authors	kW Engineering/Phil Willems	kW Engineering/Phil Willems	
	Program Years	2004-2005	2004-2005	2002-2003
	Sample Size	50 participants out of 188 participants	50 participants out of 188 participants	
	Precision Level	90/10	90/10	
Free Ridership	Methodology Used	Self-report	Self-report	Self-report
	Value or Range of Values	34% FR, 0.66 NTGR	58% FR, 0.42 NTGR	25% FR, 0.75 NTGR
	Comments/Observations	Milk pump VSDs were the only measure for which an individual NTG value could be calculated (due to a sufficiently large number of installations, N=32)	Other than milk pump VSDs, there were relatively few installs of other measures. Therefore, the NTGR could only be calculated for all 50 measures.	Vacuum pump VSD NTGR from previous study (2002-2003 California Variable Speed Drive Program Evaluation).
Participant Spillover	Methodology Used	Not quantified	Not quantified	Not quantified
	Value or Range of Values			
	Comments/Observations			
Nonparticipant Spillover	Methodology Used	Not quantified	Not quantified	Not quantified
	Value or Range of Values			
	Comments/Observations			
Other	Other Adjustment	NA	NA	NA
	Limitation of Study			

15.2 Data Analysis

- Approach used:
  - Recommended DEER values for all but the vacuum pump VSD measure are simply taken directly from the 2004-05 evaluation, since this is essentially, the most pertinent and current data source.
  - The 2004-05 study did not address vacuum pump VSDs.
  - The number of participants who installed each measure was fewer than 10 for all but milk pump VSDs, making the results statistically invalid at the individual measure level. Therefore, a combined NTFR value was developed

for all measure categories addressed by the study except milk pump VSDs. The combined value is 0.42. This is the value recommended for all measures except vacuum pump VSDs, milk pump VSDs, and milk plate coolers.

- For milk pump VSDs, the study notes "32 participants installed the measure, and 34% of those said they would have installed the measure anyway, while 41% said they would have installed, but not as soon. Combining the percentage who said they would not have installed the measure and the percentage who would not have installed at this time, we calculate the NTG for this measure as .25 plus 0.41, or 0.66. More conservatively, if the percentage who would have installed the measure later is weighted at 50% to account for deferred free-ridership, the NTG for this measure would be 0.25 plus 0.20, or 0.45." Therefore, we recommend a NTFR value for milk pump VSDs of 0.45.
- Lastly, the study notes that it appears milk plate coolers have become standard practice, with 74% of participants (N=37) indicating they had installed them outside of any program. Although the study did not have sufficient sample points to calculate a measure level NTG value, this finding provides support for further reducing the NTFR value for this measure. The program influence (NTFR) will be assumed to be one minus the fraction of respondents that installed milk plate coolers outside of any program. The recommended NTFR value for milk plate coolers is therefore 0.26 (=1-0.74).

15.3 Recommendations

The table below provides recommended NTFR values for each of the measures noted above. Because the values based on 2004-05 are based on a single study, which had a limited budget to investigate free ridership, we feel there is considerable uncertainty in the resulting NTFR estimates. Therefore, we are recommending slightly increased NTFR levels of 50% for all measures except vacuum pump VSDs and plate coolers. These values are only for measures installed on dairy farms; all other agricultural applications are assigned the NTFR default value.

Table 15-2: Recommended NTFR Values for Agricultural Measures

Program Information			NTFR Information				
Measure Name(s)	**Target Market**	**Delivery Method**	**NTG Values Used by Utilities in Previous Filings**	**NTFR Values Based on 2004/2005 Studies**	**Recommended NTFR Values for 2006-2007**	**Methodology Used to Estimate NTFR**	**Data Source**
Milk Pump VSD	Dairy Farms	Prescriptive Rebate	75%	45%	50%	Self-Report	EM&V Report of 2004-2005 California Multi-Measure Farm Program
Scroll Compressor	Dairy Farms	Prescriptive Rebate	75%	52%	50%	Self-Report	EM&V Report of 2004-2005 California Multi-Measure Farm Program
Plate Cooler	Dairy Farms	Prescriptive Rebate	75%	26%	26%	Self-Report	EM&V Report of 2004-2005 California Multi-Measure Farm Program
Compressor Heat Recovery Unit	Dairy Farms	Prescriptive Rebate	75%	42%	50%	Self-Report	EM&V Report of 2004-2005 California Multi-Measure Farm Program
Vacuum Pump VSD	Dairy Farms	Prescriptive Rebate	75%	75%	75%	Self-Report	EM&V Report of 2004-2005 California Multi-Measure Farm Program
All Other	Dairy Farms	Prescriptive Rebate	75%	42%	50%	Self-Report	EM&V Report of 2004-2005 California Multi-Measure Farm Program

15.4 Participant and Nonparticipant Spillover

Itron's review also included capturing any information on participant and nonparticipant spillover that may have been included in the evaluation studies. However, the study reviewed did not have any data pertaining to participant or nonparticipant spillover.

16

Net-of-Free-Ridership Program Area: Nonresidential Direct Install

16.1 Data Sources

This section documents the approach used to develop the estimates of free-ridership for measures installed through nonresidential programs using a direct-install delivery method for the 2006-2007 program years. The Net-of-Free-Rider ratios (NTFR) recommended here will also be used to support the 2008 update of the Database of Energy Efficiency Resources (DEER).

To assess NTFR values for Nonresidential Direct Install programs, evaluation studies spanning program years 2002 through 2004-05 were reviewed for information on free ridership and participant and nonparticipant spillover. The most pertinent studies were evaluations of programs offered during the most recent funding cycle (2004-2005), and findings from these studies provided the basis for the NTFR values that are recommended. The initial query included a third evaluation report that dealt exclusively with reduced-flow spray nozzles for restaurants, but this study was not included in the assessment due to the narrow focus of the spray nozzle program.

This assessment relied on the results of two evaluation reports, for which details are provided in Table 16-1.

Table 16-1: Overview of Studies Used

		Study #1	Study #2
Program and Measure Information	**Sector**	Commercial	Commercial
	Program Type/Segment	Rebate, Direct Install.	Rebate, Direct Install.**
	End Use	Lighting	Multiple
	Market Event	Retrofit and new purchase.	Retrofit and replacement
	Delivery approach	Rebate, Direct Install.	Rebate, Direct Install.**
	Measure(s)	Measure - Installs / Savings T5/T8 - 88% / 66% CFL - 11% / 30% Exit sign - <1% / 2% Occupancy sensor - 1% / 2%	T-8 fluorescent lamps - Compact fluorescent lamps (CFLs) - Lighting controls - HVAC/economizer controls - Window film - Programmable thermostats - Customized electric measures - Customized gas measures.
	Estimated Market Share (%)	Not provided, but authors feel that the target market has been mostly saturated, suggesting a large market share.	N/A
Study Information	**Name of Study**	Evaluation of the SDG&E 2004-05 Small Business Energy Efficiency Program	E,M & V of the 2004-2005 Business Energy Services Team (BEST) Program of the San Diego Regional Energy Office (SDREO)
	Authors	ECONorthwest	Nexant
	Program Years	2004-2005	2004-2005
	Sample Size	150 for free ridership	Two phases to survey with 34 responses to free-ridership question in first and 57 in second.
	Precision Level	90/10	90/10 - "The telephone survey will target up to 68 completions in each 4th QTR of 2004 and 2005 (representing a 90% confidence level with a 10% level of precision, assuming a large population and a coefficient of variation of 0.5)."
Free Ridership	**Methodology Used**	Self-report	Self-report
	Value or Range of Values	0.06 free ridership for overall program; CFL - 0.1 free ridership, with alternative high and low of 0.15 and 0.07; T8/T5 - 0 .04, with alternative high and low of 0.06 and 0.02	0.17 free ridership
	Comments/Observations	Calculation of free ridership is based on single question, but there are additional questions that provide support for the results.	Based on responses to one question, but response pattern was changed from first survey.
Participant Spillover	**Methodology Used**	Self-Report	None
	Value or Range of Values	Not calculated, but study included questions to indicate influence of program on future purchases. "Suggests there may be some participant spillover impacts resulting from the program."	
	Comments/Observations		

16.2 Data Analysis

Given the limited number of sources available for direct install programs, the approach to developing the NTFR estimates was straightforward. The two reports listed in Table 16-1 were reviewed for estimates of free ridership, spillover, or any other information that would inform NTFR ratios.

In addition to NTFR, other information collected to help discern the robustness of the data included the NTFR methodology (e.g. Self Report or Discrete Choice), sample size, confidence and precision, and the specificity of the results (program- or measure-level and point estimates or ranges). Information useful to corroborate the reports' findings, such as the level of incentives was also identified.

Estimates of free ridership were assessed for their overall quality and applicability and compared to other estimates to determine reliable NTFR values. Other comparisons were obvious, such as larger sample sizes being better than small. In a few cases, we also examined the NTFR question wording and analyzed alternative weighting schemes to determine the sensitivity of NTFR values to these changes. After comparing the estimates and weighing the various pros and cons of each, a set of NTFR values were recommended.

16.3 Recommendations

Both studies reviewed relied on the participant Self Report method for estimating NTFR values. Each reported the same confidence and precision levels. However, each study had limitations. One of the studies had a smaller sample size and collected data in separate phases, with minor changes to the survey instrument occurring in the interim. These minor details lessened confidence in the NTFR estimates associated with this study. The other study provided more confidence, but covered only lighting measures. Therefore the recommendations are based on a combination of NTFR values from the two studies.

As shown in Table 16-2, a common NTFR value of 0.85 is recommended for all measures installed using the direct install method for 2006 and 2007 programs. This is partly because there was little variation in NTG values in the underlying studies. Those for most measure categories were similar to the 0.85 recommended values. There is longer-term historical evidence for higher NTG values for direct install programs. Values for T-8/T-5 lighting and CFLs were somewhat higher, however, because they are based on a single study tied to a specific program approach; the findings are not robust enough to apply to the entire class of Nonresidential Direct Install programs. Therefore, we recommend use of the default value of 0.85 for all Nonresidential Direct Install measures.

Table 16-2: Recommended NTFR Values

Measure and Program Information			Net-of-Free-Ridership (NTFR) Information			
Measure Name(s)	**Target Market(s)**	**Program Delivery Method/Channel**	**NTG Values Used by Utilities in Previous Filings**	**NTFR Values Based on 2004-05 Studies**	**Recommended NTFR Values for 2006-07**	**Data Source(s)**
CFLs	Small, hard-to-reach nonresidential customers	Direct install	80%	85%	85%	Evaluation of the SDG&E 2004-05 Small Business Energy Efficiency Program, Final Report
T8	Small, hard-to-reach nonresidential customers	Direct install	80%	85%	85%	Evaluation of the SDG&E 2004-05 Small Business Energy Efficiency Program, Final Report
Lighting controls	Small, hard-to-reach nonresidential customers	Direct install	80%	85%	85%	Evaluation of the SDG&E 2004-05 Small Business Energy Efficiency Program, Final Report
LED Exit Signs	Small, hard-to-reach nonresidential customers	Direct install	80%	85%	85%	Evaluation of the SDG&E 2004-05 Small Business Energy Efficiency Program, Final Report
HVAC/ economizer controls	Small, hard-to-reach nonresidential customers	Direct install	80%	85%	85%	Evaluation, Measurement & Verification of the 2004-2005 BEST Program of the SDREO
Window Film	Small, hard-to-reach nonresidential customers	Direct install	80%	85%	85%	Evaluation, Measurement & Verification of the 2004-2005 BEST Program of the SDREO
Customized electric measures	Small, hard-to-reach nonresidential customers	Direct install	80%	85%	85%	Evaluation, Measurement & Verification of the 2004-2005 BEST Program of the SDREO
Customized gas measures.	Small, hard-to-reach nonresidential customers	Direct install	80%	85%	85%	Evaluation, Measurement & Verification of the 2004-2005 BEST Program of the SDREO

16.4 Participant and Nonparticipant Spillover

Our review also included capturing any information on participant and nonparticipant spillover that may have been included in the studies. Neither of the studies calculated spillover; however the Evaluation of the SDG&E 2004/05 Small Business Energy Efficiency Program included a few survey questions probing on the influence of the program on future purchases. The responses to the questions suggest that there may be some spillover impact from the program.