Final Report

The Low-income Public Purpose Test (LIPPT)

Updated for Version 2.0

May 25, 2001

Prepared for

RRM Working Group
Cost Effectiveness Committee

Prepared by
TecMarket Works
165 West Netherwood Road, Suite A, 2nd Floor
Oregon, WI 53575
Voice: (608) 835-8855
Fax: (608) 835-9490
Mail@TecMarket.net

Skumatz Economic Research, Inc.
and
Megdal and Associates

Table of Contents

Executive Summary

Overview of the Purpose of the Test

The California Low Income Public Purpose Test (LIPPT) is designed to assess the cost effectiveness of California's low-income energy efficiency programs from a public benefits perspective. The LIPPT is a new tool designed to inform public review of the overall cost effectiveness of low-income energy efficiency (LIEE) programs from a much wider perspective than previous tests. Previous tests have taken a limited or more narrowly defined approach for examining a LIEE program's cost effectiveness, focusing on the costs and energy benefits associated with a program from a specific point of reference. For example, the "Utility Test" focuses on the program costs and the benefits to the utility, the stockholders, and the ratepayers, while the "Participant Test" focuses on the program costs and the benefits to the participants. The Total Resource Cost (TRC) Test and the Public Purpose Test (PPT) are intended to assess the overall benefits and costs to all parts of society.

The LIPPT is intended to be a variation from the Public Purpose Test. It differs from the PPT in its inclusion of as many as possible of the major non-energy benefits of the LIEE program, which the PPT is also intended to do. However, the LIPPT varies from current practice in calculating PPT or TRC tests. Current calculations of the PPT used for the utilities' energy efficiency programs include very limited non-energy benefits because of difficulties of measurement and controversies among parties in the program proceedings.

The LIPPT has a different focus and is designed to provide a different set of cost effectiveness information. Users of previous tests will see a significant difference between these tests and the LIPPT, in that the LIPPT is designed to include a broader range of non-energy benefits obtained across a broad segment of the "public," a category including the utility, the shareholders, the ratepayers, program participants, and society at large. The purpose of the LIPPT is to count the appropriate energy and non-energy benefits that are derived from a LIEE program, without double counting these benefits. Specifically, the test is to include costs associated with program design, management, implementation, evaluation, oversight and other cost categories that are directly or indirectly associated with the program. The Benefits built into the test include the energy-associated benefits from the utility's avoided cost perspective as well as non-energy benefits that are produced as a result of the program for the utility, the participant and for society in general.

Because the purpose of the test is to examine the cost effectiveness of the LIEE programs from a public benefits perspective, the non-energy portion of the test includes a wide range of impact categories, and is not restricted to examining benefits that may only be associated with one section of the "public," such as the participant, or the utility conducting the program. This definition is consistent with a consensus reached by the Cost Effectiveness Subcommittee during the January project kick-off meeting, in which the Subcommittee decided that for purposes of this test, "public" refers to the public at large, including the combination of the utility, the participant, the non-participant, and other parts of the society that may benefit by the program. As a result, users of the

LIPPT will notice that the test has components common to the utility, societal, and participant tests. However, the LIPPT test should not be confused with, or viewed as a revision to these tests. It is a new, stand-alone test that incorporates some of the categories of variables that are also incorporated into other tests. However, the LIPPT test also includes non-energy benefits that are not included in the standard tests. While the LIPPT provides non-energy benefit results classified as utility, societal and participant benefits, these outputs should not be confused with, or considered comparable to the specific cost effectiveness tests that focus only on these perspectives. The LIPPT takes a more inclusive approach when compared to other tests and examines a wider range of benefits across three perspectives. The LIPPT is a tool that is designed to inform policy decision makers who have a public purpose responsibility as well as compare the benefits of utility programs.

The general equation for the California LIPPT cost effectiveness test is:

Cost Effectiveness = (Energy Benefits + Non-energy Benefits) / Cost(s),

Where:

- **Energy Benefit** is the net present value of all program related energy benefits
- **Non-energy Benefit** is the net present value of all program related non-energy benefits
- **Cost** is the net present value of all program related costs

The non-energy benefits included in the LIPPT can substantially change the cost benefit ratio for a given LIEE program. In conducting tests using program costs and energy savings data for an imaginary LIEE program, the cost benefit rations grew from .7 to 1.5 when the program associated non-energy benefits were included. That is, the non-energy benefits acted to more than double the cost benefit ratio, demonstrating that the non-energy benefits can be equal to or greater than the energy benefits associated with the imaginary program.

What the LIPPT does *not* do is just as important as what the test *is* designed to do. The LIPPT is not designed to examine the cost effectiveness of programs from a load or demand reduction perspective or to analyze the comparative costs associated with power generation or power acquisition. The energy savings included in the LIPPT are consumption saving rather than demand reduction values. As a result, the LIPPT it is not designed to make resource acquisition or allocation decisions or to support decisions associated with reducing energy demand.

While the LIPPT developed through this effort is a fully functional working model, and as such, is useful in program evaluation, it should not be considered a test that should remain as it now operates. The test should be considered as the first version of a low-income public purpose test, and additional modifications to the test need to be incorporated as more research is conducted to document the non-energy benefits

associated with California's LIEE programs. The current test (version one) is based on the best information available at the time of development. As more research is conducted to document the non-energy benefits associated with California's LIEE programs, the values and estimation procedures incorporated into version one should be revised to reflect the results of new and more rigorous research. To expedite this process the consultants have designed the LIPPT to be easily up-dated and revised as new research is conducted. In each of the non-energy benefits categories the consultants have identified current research results and the studies from which the results are taken. As new research results become available these studies can be replaced with up-dated or additional California-specific results and incorporated into a revised versions of the LIPPT. Likewise, the utility-specific cost data for estimated reductions in utility costs should also be up-dated from time to time. While we think that annual or bi-annual up-dates of the utility-specific non-energy benefits cost information is too often, an annual or bi-annual schedule to incorporate new non-energy benefits research results is not too often. The consultants recommend that the non-energy benefits calculation methods that are grounded in the literature reviews of current research be conducted annually or every two years. This recommendation is made so that the best calculation methods can be incorporated into the test shortly after the information become available. The utility-specific cost data may only need to be adjusted once every five years.

Regulatory Directive

The Reporting Requirements Manual (RRM) presents the format for reporting Low Income Energy Efficiency (LIEE) cost effectiveness based on tests that have been developed and approved by the California Public Utilities Commission (Commission) over the years. In 1999, interested parties discussed in workshops the possibility of modifying these tests, including the use of a "modified participant test" and narrative describing the limited applicability of the economic tests to low-income programs. Because consensus on such modifications could not be reached at that time, the Assigned Commissioner directed the RRM Working Group to further consider this issue.

The Assigned Commissioner Ruling dated April 28, 2000, directed the RRM Working Group to revise and standardize the RRM for reporting on LIEE programs. In Decision (D.) 00-09-036 dated September 7, 2000, the Commission stated its expectations that the RRM would develop specific modifications to the cost effectiveness tests for low income programs. The RRM Working Group was able to provide background and lay the foundation for future consideration of cost effectiveness for LIEE programs, but was unable to develop technical modifications to the test during phase 1. The RRM Working Group completed the first phase of this task and filed its Phase 1 RRM Report on October 2, 2000. The RRM Working Group formed a subcommittee of members with technical expertise to develop a cost effectiveness test for LIEE programs in a second phase.

In D. 01-03-028, Ordering Paragraph 15, the RRM Working Group was directed to:

…present recommendations on the following issues related to low-income assistance programs in a second phase report:

> (a) Technical modifications to cost-effectiveness testing and reporting, as appropriate. Methodological issues to be considered include the selection of appropriate discount rates, inflation rates and benefit and cost streams to use in cost-effectiveness analysis. Recommendations shall also address whether (and if so, how) to incorporate comfort, health and safety effects into the cost-effectiveness testing methodology. Avoided costs shall be based on the methodology and assumptions most recently adopted by the Commission.

In addition to the direction provided by Ordering Paragraph 15, the RRM Working Group reviewed the Standardization Team Phase 1 Report, adopted by the Commission in D. 00-09-036, which recommended that "a formal structured test be implemented [for the measure selection process] that incorporates both cost-effectiveness and judgmental indicators of hardship." As a result of the defined need for a test to assist with measure selection, the Working Group formulated the intent to be able to provide a test which could be applied at the individual measure level which included a measure of the non-energy benefits.

This report describes the California Low Income Public Purpose Test (LIPPT) and the use of the test to assess the value of LIEE programs and of individual measures installed by the program.

Project Background

In December of 2000 PG&E, on behalf of the RRM Working Group's Cost Effectiveness Subcommittee, contracted with TecMarket Works to design a new test to measure the cost effectiveness of California's low-income energy efficiency programs and measures funded by the public benefits charge on energy utility bills. TecMarket Works teamed with Skumatz Economic Research Associates and Megdal and Associates to complete develop the test.

In accordance with instructions from the Cost Effectiveness Subcommittee, the test was to be a multi-perspective, single integrated test that would calculate a cost benefit ratio of LIEE programs and measures, including the non-energy benefits, if appropriate benefit values could be derived. During the project kick-off meeting in December 2000 the contractor was directed by the RRM's Cost Effectiveness Subcommittee to include in the test program costs consistent with the cost reporting methods and forms presented in the California Bill Savings Report, filed February 1, 2001 and revised March 5, 2001.[1] In addition, the contractor was instructed to include a wide range of non-energy benefits that could be attributed to the LIEE programs, including health and safety and hardship benefits. Finally, the contractor was told that the Standardization Team was looking for a

[1] Joint Utility Low Income Energy Efficiency Program Costs and Bill Savings Standardization Report. Equipoise Consulting, (February 1, 2001, revised March 5, 2001).

method of evaluating individual program measures and that the RRM Working Group would like the model to be able to provide that assistance if possible.

The actual form of the test was the subject of much discussion by the Subcommittee. The Subcommittee discussed the pros and cons of developing 1) a single, multi-perspective, integrated test that would calculate the cost benefit ratio of LIEE programs, or 2) a series of non-energy benefit adders to use with existing cost-effectiveness tests. The Subcommittee decided to develop a single, integrated test with non-energy benefit variables that can be turned on or off. The resulting test can stand on its own, but with the added flexibility of allowing the user to run the non-energy benefits as adders to existing utility cost benefit tests already in use.

The Subcommittee also considered and discussed developing a test based on the value of the energy savings from the LIEE programs as experienced by the customer rather than the avoided cost to the utility because this is a more accurate reflection of the public's program benefits. This issue also came up in the public workshop. Early versions of the test were valued based on bill savings to the customer. However, the Subcommittee was concerned that a test based on bill savings that included benefits valued from utility and societal perspectives as well as the participant perspective would not provide a meaningful end result, and the contractor was instructed to include the value of the avoided energy savings from the LIEE programs as experienced by the utility, rather than the bill savings to the participant.

In January of 2001 the contractors reviewed the literature and prepared technical memorandums that included presentations of the costs and benefits to be included in the test and received comments from the Subcommittee on modifications and gave instructions to proceed to prepare a draft model and to include a method of measure assessment if possible. A survey of California LIEE participants was conducted in February 2001 to assess the value LIEE participants ascribe to the increased comfort or reduced hardship associated with program participation.

In March of 2001 the contractor presented a working model to the RRM Working Group and at a public input workshop in San Francisco. During these meetings the non-energy benefits included in the test were discussed. Even though not all members of the RRM Working Group initially thought that developing one test to incorporate all non-energy benefits was the best methodology for assessing program cost benefits, and raised questions regarding the purpose of such a test and the benefits that should be included, the contractor was instructed to finalize the test for both the program level and measure level calculations and deliver a project report presenting the technical operations of the test, a working Excel model, and an operations manual providing instructions for using the test. The California Low-Income Public Purpose Test (LIPPT) is the result of this effort.

The LIPPT should be considered a work in progress. Although the parameters of the new test are complete and presented in detail in the project report, it should be remembered that this is a new cost effectiveness test that has never been performed before. The Subcommittee fully expects to discover areas that require more discussion and fine-

tuning as the utilities attempt to run the test for the first time for inclusion in the 2001 Annual Earnings Assessment Proceeding (AEAP).

Benefits Included in the Test

The process of determining which benefits to include and exclude in the test was an iterative process involving multiple presentations and discussion with the Cost Effectiveness Subcommittee. In this process, the consultants examined the current literature documenting and/or evaluating a wide range of program benefits associated with low-income programs. This effort involved the review of over 125 publications and was conducted in January and February 2001. The consultants then identified a list of benefits that could reasonably be considered to result from California's low-income programs. These benefits were then presented and discussed with the Cost Effectiveness Subcommittee though a process of multiple reviews and discussions over several on-site meetings and conference calls, and through a public input workshop. Following these efforts, the consultants developed an operational draft test and presented the test to the Subcommittee for review and discussion. During March of 2001 the Subcommittee met and reviewed each of the benefit categories included in the draft test and identified which benefits to include in the final test and which to exclude. There was much discussion by the Subcommittee and at the public workshop about which benefits to include in the test. The final test presented here includes benefits with sufficient California-specific data, or relevant proxies. The team tried to err on the side of conservatism, and justifications for inclusion or exclusion are included in Section 4. The consultants then revised the test to include the benefits the Subcommittee agreed should be included. The amount of discussion generated over the benefits confirmed the recommendations from the consultants to build the test so that individual benefit values can be turned "on" or "off" as needed by each user. This allows each utility to use the test in a way that best meets the reporting needs of the reporting utility, and, at the same time, provides a uniform framework for comparing programs across territories. The following table presents the list of benefits that were considered for the LIPPT and indicates which benefits the consultants were instructed to include in the test. The Committee agreed that all utilities would use the same benefits so that cross-utility results would be comparable, except in certain circumstances.

Table 1 Benefits categories considered for LIPPT

Benefit Category and description	Included or excluded in LIPPT
Utility benefits	
Reduced Carrying Cost on Arrearages (7A) valued in terms of the cost to the utility	Included
Lower Bad Debt Written Off (7B) valued at utility costs	Included
Fewer shutoffs (7C) valued at utility costs	Included
Fewer reconnects (7D) valued at utility costs	Included
Fewer notices (7E) valued at utility costs	Included
Fewer customer calls (7F) valued at utility costs	Included
Lower collection costs (7G) valued at utility costs	Not included because separate data were not available
Reduction in gas emergency calls (7H) valued at utility costs	Included
Insurance savings	Not included to avoid double counting and because data weren't available
Transmission and/or Distribution savings (7J)	Excluded because the energy savings computations used in the LIPPT test incorporate these benefits
Reduced Subsidy (7K) valued at utility and ratepayer savings	Included
Societal benefits	
Economic Impacts (8A) measured in state- or public benefits terms	Not included because supporting data were unreliable
Emissions / environmental Impacts (8B) measured in public benefits terms	Excluded because the avoided cost used in the energy savings computations for the LIPPT test include this benefit.
Health and Safety Benefits (8C) valued at amortized installation cost	Included, but zero value because no H&S measures are included in the LIEE program.
Water and Wastewater savings (8D) valued at avoided societal costs	Included conceptually, but zero value because of short life.
Participant benefits	
Program incentives	Included, if applicable
Participant Water and wastewater bill savings (9A)	Included
Participant value from fewer shutoffs (9B)	Included
Participant value from fewer calls to the utility valued as time savings (9C)	Included
Fewer reconnects (9D) valued in saved time and costs for participants	Included
Property value benefits from program-provided home repairs (9E)	Included
Fewer fire losses to participants and society (9F)	Included

Fewer health-related expenses from health and safety improvements (9G)	Included, but zero value because no health and safety measures are included in the default LIEE programs.
Participant savings from fewer moves (9H)	Included
Fewer lost sick days from work (9I)	Included
Reduced transactions costs (9J)	Excluded because underlying data weak
Improved comfort, noise, and similar benefits to participants (9K)	Included
Reduced other hardship benefits – control over bill and energy use (9K)	Included

Determining Benefit Values

The determinations of benefit values were made using several different techniques as appropriate for each benefit. In the development of the test, the Subcommittee discussed how to value energy benefits: at retail costs to the participant or at avoided costs to the utilities. The Subcommittee decided that the energy benefits or energy savings should be counted at the avoided costs to the utility rather than the value of the savings to the participant because this is the value that is most reflective of the societal value for conserved energy. The non-energy benefits would be valued in one of three ways.

In the first method the utilities were each asked to provide data on costs associated with billing, arrearage, debt, connects, disconnects and costs associated with customer interactions. For the utility benefits associated with LIEE programs the calculated value of the benefit used in the test are derived from these utility-specific cost data. The benefits included in this report are average, state-wide benefits derived from all four utility's data. Upon use of the LIPPT model, utility-specific data will be used. The level of non-energy utility-associated impact for a LIEE program is estimated using program evaluations and estimations focusing on specific benefits and the expected occurrence of the benefit in a LIEE program. These impact estimations were then projected for California LIEE programs by using the best estimated results from the evaluation studies reviewed in the first two month of the project. These estimated incidences of the benefit are multiplied by the cost of the benefits as calculated using the utility-specific cost data.

The second method was used to calculate non-energy benefits when actual cost or savings values were not available from the utilities. For these benefits the consultants used estimates of benefit values as reported in the literature for low-income or residential programs. In many cases the search found a wide range of benefit estimations in the literature and the consultants were tasked to identify a study or estimation method that could conservatively be equated to California's low income program benefits. The calculation methods and the source of the benefit estimations are included in the program report and in the working model of the test.

The third method for valuing benefits primarily applied to participant benefits that could not be quantified through the literature or through utility cost data. These benefits include

comfort, hardship and similar benefits associated with participation. For estimating these benefit values the consultants conducted a survey of California low-income program participants and asked them to give a monitory value that they would be willing to pay for the increased comfort or the reduced hardship associated with program participation. These benefits and benefit values are detailed later in this project report and in the Excel model and range from a low of a negative $12.62 per participant for the added hassles associated with participation to a high of $31.67 per year per household for their increased comfort as a result of the installed measures.

The values associated with specific NEBs using these methods are reflected in the following tables and provide an estimation of the expected benefits associated with an imaginary LIEE program implemented in California. Actual values will be different for each program.

Table 2 Example of utility non-energy benefits

Utility-Related Benefits: Benefits Valued At Utility Costs And Savings

		Annualized Benefits per Participant	Horizon for Benefit (in years)
7A	Reduced Carrying Cost on Arrearages (interest)	$3.76	10
7B	Lower Bad Debt Written Off	$0.48	10
7C	Fewer Shutoffs	$0.05	10
7D	Fewer Reconnects	$0.02	10
7E	Fewer Notices	$1.49	10
7F	Fewer Customer Calls	$1.58	10
7G	Lower Collection Costs	$0.00	10
7H	Red'n in emergency gas service calls	$0.07	10
7I	Utility Health & Safety - Insurance savings only	$0.00	10
7J	Transmission and/or distribution savings (distribution only)	$0.00	10
7K	Utility Rate Subsidy Avoided (CARE) payments	$2.77	10
	Subtotal	$10.22	

Scaling Benefit Values for Programs with Few Measures or Less Energy Savings

The NEBs are based on a combination of primary data from the utilities, program design assumptions, and secondary data on program impacts gleaned from the literature. The program impacts, or "changes in incidence" incorporated into the NEB module developed by the RRM and the evaluation consultants were based on typical low income weatherization programs found in the literature that are similar to those used in California. However, computations based solely on standard weatherization programs do not provide accurate estimations of the NEB for programs that have fewer measures or services and thus have less energy savings, when compared to a typical weatherization Program. As a result, the team needed to incorporate into the model a method for adjusting the NEBs for LIEE programs that are not as aggressive as typical weatherization programs. To provide this capability, adjustment mechanisms are incorporated into the NEB module that allow the NEBs to be scaled back if a LIEE program provides energy savings that are significantly less than a typical weatherization program.

This is accomplished with a switch at the bottom of worksheet "5B NEB Assumptions." When the lower most check-box on this worksheet is switched on, the model is adjusted for programs with fewer measures and lower energy savings. This should only be used when annual per participant energy savings are less than the dollar amount presented in the cell just below the adjustment factor check-box. This is called the 'Per household energy savings threshold adjustment factor,' and the default value is $175 of annual gas and electric energy savings per participant. When programs save this amount or more, the scaling factor has no effect. However, when program energy savings are less than this level, the value of NEB savings can be scaled down by the 'Calculated pivot ratio.' The pivot ratio is displayed to the right of the check-box, and is calculated by taking the actual annual gas and electric program savings in dollars and dividing it by the threshold adjustment factor (Default $175). Please see Appendix E for more details.

Table 3 Example of societal non-energy benefits

Societal / Public Benefits: Benefits Beyond Utility And Participants

	NEB Category	Annualized Benefits per Participant	Horizon for Benefit (in years)
8A	Economic impact (direct and indirect employment)	$0.00	1
8B	Emissions / Environmental	$0.00	10
8C	Health and Safety Equipment (CO and Other H&S)	$0.00	7
8D	Water and wastewater (avoided)	$0.00	3
	Subtotal	$0.00	

Table 4 Example of participant non-energy benefits

Participant Benefits: Benefits Accruing To And Valued At Participant Values And Costs

		Annualized Benefits per Participant	Horizon for Benefit (in years)
	Program rebate (directly from assumptions above)	$0.00	1
9A	Water/sewer savings	$5.65	3
9B	Fewer shutoffs	$0.17	3
9C	Fewer Calls to the utility	$0.18	10
9D	Fewer reconnects	$0.08	10
9E	Property value benefits	$17.80	10
9F	Fewer fires	$2.44	10
9G	Indoor Air quality (CO-related)	$0.00	7
9H	Moving costs / mobility	$1.30	10
9I	Fewer Illnesses and lost days from work/school	$3.78	10
9J	Reduced transactions costs (limited measures)	$0.00	0
9K	Net Household Benefits from Comfort, Noise, net of negatives	$6.44	10
9K	Net Household Benefits from Additional Hardship Benefits	$2.57	10
	Subtotal	$40.41	

Table 5 Summary example of net present value for non-energy benefits

Summary Of All Non-Energy Benefits	Annualized Benefits per Participant	Net Present Value of Benefits
Utility-Related NEBs: Benefits Valued at Utility-avoided Costs, Savings, or Values	$10.22	$368,460
Societal/Public NEBs: Benefits beyond those accruing to Utility or Participants	$0.00	$0
Participant NEBs: Benefits to Participants, Valued at Participant Costs and Values	$40.41	$1,456,291
Sum of Non-Energy Benefits (NEBs) Valued from All Perspectives	$50.63	$1,824,751

The following sections of this report present the detailed operations of the LIPPT.

The general equation for the California LIPPT cost effectiveness test is:

Cost Effectiveness = (Energy Benefits + Non-energy Benefits) / Cost(s),

Where:

- **Energy Benefit** is the net present value of all program related energy benefits
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The actual form of the test was the subject of much discussion by the Subcommittee. The Subcommittee discussed the pros and cons of developing 1) a single, multi-perspective, integrated test that would calculate the cost benefit ratio of LIEE programs, or 2) a series of non-energy benefit adders to use with existing cost-effectiveness tests. The Subcommittee decided to develop a single, integrated test with non-energy benefit variables that can be turned on or off. The resulting test can stand on its own, but with the added flexibility of allowing the user to run the non-energy benefits as adders to existing utility cost benefit tests already in use.

[2] Joint Utility Low Income Energy Efficiency Program Costs and Bill Savings Standardization Report. Equipoise Consulting, (February 1, 2001, revised March 5, 2001).

The Subcommittee also considered and discussed developing a test based on the value of the energy savings from the LIEE programs as experienced by the customer rather than the avoided cost to the utility because this is a more accurate reflection of the public's program benefits. This issue also came up in the public workshop. Early versions of the test were valued based on bill savings to the customer. However, the Subcommittee was concerned that a test based on bill savings that included benefits valued from utility and societal perspectives as well as the participant perspective would not provide a meaningful end result, and the contractor was instructed to include the value of the avoided energy savings from the LIEE programs as experienced by the utility, rather than the bill savings to the participant.

In January of 2001 the contractors reviewed the literature and prepared technical memorandums that included presentations of the costs and benefits to be included in the test and received comments from the Subcommittee on modifications and gave instructions to proceed to prepare a draft model and to include a method of measure assessment if possible. A survey of California LIEE participants was conducted in February 2001 to assess the value LIEE participants ascribe to the increased comfort or reduced hardship associated with program participation.

In March of 2001 the contractor presented a working model to the RRM Working Group and at a public input workshop in San Francisco. During these meetings the non-energy benefits included in the test were discussed. Even though not all members of the RRM Working Group initially thought that developing one test to incorporate all non-energy benefits was the best methodology for assessing program cost benefits, and raised questions regarding the purpose of such a test and the benefits that should be included, the contractor was instructed to finalize the test for both the program level and measure level calculations and deliver a project report presenting the technical operations of the test, a working Excel model, and an operations manual providing instructions for using the test. The California Low-Income Public Purpose Test (LIPPT) is the result of this effort.

The LIPPT should be considered a work in progress. Although the parameters of the new test are complete and presented in detail in the project report, it should be remembered that this is a new cost effectiveness test that has never been performed before. The Subcommittee fully expects to discover areas that require more discussion and fine-tuning as the utilities attempt to run the test for the first time for inclusion in the 2001 Annual Earnings Assessment Proceeding (AEAP).

Benefits Included in the Test

The process of determining which benefits to include and exclude in the test was an iterative process involving multiple presentations and discussion with the Cost Effectiveness Subcommittee. In this process, the consultants examined the current literature documenting and/or evaluating a wide range of program benefits associated with low-income programs. This effort involved the review of over 125 publications and was conducted in January and February 2001. The consultants then identified a list of

benefits that could reasonably be considered to result from California's low-income programs. These benefits were then presented and discussed with the Cost Effectiveness Subcommittee though a process of multiple reviews and discussions over several on-site meetings and conference calls, and through a public input workshop. Following these efforts, the consultants developed an operational draft test and presented the test to the Subcommittee for review and discussion. During March of 2001 the Subcommittee met and reviewed each of the benefit categories included in the draft test and identified which benefits to include in the final test and which to exclude. There was much discussion by the Subcommittee and at the public workshop about which benefits to include in the test. The final test presented here includes benefits with sufficient California-specific data, or relevant proxies. The team tried to err on the side of conservatism, and justifications for inclusion or exclusion are included in Section 4. The consultants then revised the test to include the benefits the Subcommittee agreed should be included. The amount of discussion generated over the benefits confirmed the recommendations from the consultants to build the test so that individual benefit values can be turned "on" or "off" as needed by each user. This allows each utility to use the test in a way that best meets the reporting needs of the reporting utility, and, at the same time, provides a uniform framework for comparing programs across territories. The following table presents the list of benefits that were considered for the LIPPT and indicates which benefits the consultants were instructed to include in the test. The Committee agreed that all utilities would use the same benefits so that cross-utility results would be comparable, except in certain circumstances.

Table 6 Benefits categories considered for LIPPT

Benefit Category and description	Included or excluded in LIPPT
Utility benefits	
Reduced Carrying Cost on Arrearages (7A) valued in terms of the cost to the utility	Included
Lower Bad Debt Written Off (7B) valued at utility costs	Included
Fewer shutoffs (7C) valued at utility costs	Included
Fewer reconnects (7D) valued at utility costs	Included
Fewer notices (7E) valued at utility costs	Included
Fewer customer calls (7F) valued at utility costs	Included
Lower collection costs (7G) valued at utility costs	Not included because separate data were not available
Reduction in gas emergency calls (7H) valued at utility costs	Included
Insurance savings	Not included to avoid double counting and because data weren't available
Transmission and/or Distribution savings (7J)	Excluded because the energy savings computations used in the LIPPT test incorporate these benefits
Reduced Subsidy (7K) valued at utility and ratepayer savings	Included
Societal benefits	
Economic Impacts (8A) measured in state- or public benefits terms	Not included because supporting data were unreliable
Emissions / environmental Impacts (8B) measured in public benefits terms	Excluded because the avoided cost used in the energy savings computations for the LIPPT test include this benefit.
Health and Safety Benefits (8C) valued at amortized installation cost	Included, but zero value because no H&S measures are included in the LIEE program.
Water and Wastewater savings (8D) valued at avoided societal costs	Included conceptually, but zero value because of short life.
Participant benefits	
Program incentives	Included, if applicable
Participant Water and wastewater bill savings (9A)	Included
Participant value from fewer shutoffs (9B)	Included
Participant value from fewer calls to the utility valued as time savings (9C)	Included
Fewer reconnects (9D) valued in saved time and costs for participants	Included
Property value benefits from program-provided home repairs (9E)	Included
Fewer fire losses to participants and society (9F)	Included

Fewer health-related expenses from health and safety improvements (9G)	Included, but zero value because no health and safety measures are included in the default LIEE programs.
Participant savings from fewer moves (9H)	Included
Fewer lost sick days from work (9I)	Included
Reduced transactions costs (9J)	Excluded because underlying data weak
Improved comfort, noise, and similar benefits to participants (9K)	Included
Reduced other hardship benefits – control over bill and energy use (9K)	Included

Determining Benefit Values

The determinations of benefit values were made using several different techniques as appropriate for each benefit. In the development of the test, the Subcommittee discussed how to value energy benefits: at retail costs to the participant or at avoided costs to the utilities. The Subcommittee decided that the energy benefits or energy savings should be counted at the avoided costs to the utility rather than the value of the savings to the participant because this is the value that is most reflective of the societal value for conserved energy. The non-energy benefits would be valued in one of three ways.

In the first method the utilities were each asked to provide data on costs associated with billing, arrearage, debt, connects, disconnects and costs associated with customer interactions. For the utility benefits associated with LIEE programs the calculated value of the benefit used in the test are derived from these utility-specific cost data. The benefits included in this report are average, state-wide benefits derived from all four utility's data. Upon use of the LIPPT model, utility-specific data will be used. The level of non-energy utility-associated impact for a LIEE program is estimated using program evaluations and estimations focusing on specific benefits and the expected occurrence of the benefit in a LIEE program. These impact estimations were then projected for California LIEE programs by using the best estimated results from the evaluation studies reviewed in the first two month of the project. These estimated incidences of the benefit are multiplied by the cost of the benefits as calculated using the utility-specific cost data.

The second method was used to calculate non-energy benefits when actual cost or savings values were not available from the utilities. For these benefits the consultants used estimates of benefit values as reported in the literature for low-income or residential programs. In many cases the search found a wide range of benefit estimations in the literature and the consultants were tasked to identify a study or estimation method that could conservatively be equated to California's low income program benefits. The calculation methods and the source of the benefit estimations are included in the program report and in the working model of the test.

The third method for valuing benefits primarily applied to participant benefits that could not be quantified through the literature or through utility cost data. These benefits include

comfort, hardship and similar benefits associated with participation. For estimating these benefit values the consultants conducted a survey of California low-income program participants and asked them to give a monitory value that they would be willing to pay for the increased comfort or the reduced hardship associated with program participation. These benefits and benefit values are detailed later in this project report and in the Excel model and range from a low of a negative $12.62 per participant for the added hassles associated with participation to a high of $31.67 per year per household for their increased comfort as a result of the installed measures.

The values associated with specific NEBs using these methods are reflected in the following tables and provide an estimation of the expected benefits associated with an imaginary LIEE program implemented in California. Actual values will be different for each program.

Table 7 Example of utility non-energy benefits

Utility-Related Benefits: Benefits Valued At Utility Costs And Savings

		Annualized Benefits per Participant	Horizon for Benefit (in years)
7A	Reduced Carrying Cost on Arrearages (interest)	$3.76	10
7B	Lower Bad Debt Written Off	$0.48	10
7C	Fewer Shutoffs	$0.05	10
7D	Fewer Reconnects	$0.02	10
7E	Fewer Notices	$1.49	10
7F	Fewer Customer Calls	$1.58	10
7G	Lower Collection Costs	$0.00	10
7H	Red'n in emergency gas service calls	$0.07	10
7I	Utility Health & Safety - Insurance savings only	$0.00	10
7J	Transmission and/or distribution savings (distribution only)	$0.00	10
7K	Utility Rate Subsidy Avoided (CARE) payments	$2.77	10
	Subtotal	$10.22	

Scaling Benefit Values for Programs with Few Measures or Less Energy Savings

The NEBs are based on a combination of primary data from the utilities, program design assumptions, and secondary data on program impacts gleaned from the literature. The program impacts, or "changes in incidence" incorporated into the NEB module developed by the RRM and the evaluation consultants were based on typical low income weatherization programs found in the literature that are similar to those used in California. However, computations based solely on standard weatherization programs do not provide accurate estimations of the NEB for programs that have fewer measures or services and thus have less energy savings, when compared to a typical weatherization Program. As a result, the team needed to incorporate into the model a method for adjusting the NEBs for LIEE programs that are not as aggressive as typical weatherization programs. To provide this capability, adjustment mechanisms are incorporated into the NEB module that allow the NEBs to be scaled back if a LIEE program provides energy savings that are significantly less than a typical weatherization program.

This is accomplished with a switch at the bottom of worksheet "5B NEB Assumptions." When the lower most check-box on this worksheet is switched on, the model is adjusted for programs with fewer measures and lower energy savings. This should only be used when annual per participant energy savings are less than the dollar amount presented in the cell just below the adjustment factor check-box. This is called the 'Per household energy savings threshold adjustment factor,' and the default value is $175 of annual gas and electric energy savings per participant. When programs save this amount or more, the scaling factor has no effect. However, when program energy savings are less than this level, the value of NEB savings can be scaled down by the 'Calculated pivot ratio.' The pivot ratio is displayed to the right of the check-box, and is calculated by taking the actual annual gas and electric program savings in dollars and dividing it by the threshold adjustment factor (Default $175). Please see Appendix E for more details.

Table 8 Example of societal non-energy benefits

Societal / Public Benefits: Benefits Beyond Utility And Participants

	NEB Category	Annualized Benefits per Participant	Horizon for Benefit (in years)
8A	Economic impact (direct and indirect employment)	$0.00	1
8B	Emissions / Environmental	$0.00	10
8C	Health and Safety Equipment (CO and Other H&S)	$0.00	7
8D	Water and wastewater (avoided)	$0.00	3
	Subtotal	$0.00	

Table 9 Example of participant non-energy benefits

Participant Benefits: Benefits Accruing To And Valued At Participant Values And Costs

		Annualized Benefits per Participant	Horizon for Benefit (in years)
	Program rebate (directly from assumptions above)	$0.00	1
9A	Water/sewer savings	$5.65	3
9B	Fewer shutoffs	$0.17	3
9C	Fewer Calls to the utility	$0.18	10
9D	Fewer reconnects	$0.08	10
9E	Property value benefits	$17.80	10
9F	Fewer fires	$2.44	10
9G	Indoor Air quality (CO-related)	$0.00	7
9H	Moving costs / mobility	$1.30	10
9I	Fewer Illnesses and lost days from work/school	$3.78	10
9J	Reduced transactions costs (limited measures)	$0.00	0
9K	Net Household Benefits from Comfort, Noise, net of negatives	$6.44	10
9K	Net Household Benefits from Additional Hardship Benefits	$2.57	10
	Subtotal	$40.41	

Table 10 Summary example of net present value for non-energy benefits

Summary Of All Non-Energy Benefits	Annualized Benefits per Participant	Net Present Value of Benefits
Utility-Related NEBs: Benefits Valued at Utility-avoided Costs, Savings, or Values	$10.22	$368,460
Societal/Public NEBs: Benefits beyond those accruing to Utility or Participants	$0.00	$0
Participant NEBs: Benefits to Participants, Valued at Participant Costs and Values	$40.41	$1,456,291
Sum of Non-Energy Benefits (NEBs) Valued from All Perspectives	$50.63	$1,824,751

The following sections of this report present the detailed operations of the LIPPT.

Chapter 1: Introduction

In December of 2000 the California Reporting Requirements Manual (RRM) Working Group's Cost Effectiveness Subcommittee, hired contractors to design the California Low-income Public Purpose test. This test is to be an additional cost effectiveness test to complement the current arsenal of program reporting tools used to report low-income cost effectiveness. Unlike other tests, the LIPPT is designed to have a broad view of the costs and benefits associated with the delivery of low-income energy efficiency programs incorporating a more comprehensive list of program benefits than California's current cost effectiveness tests. In addition, the test is structured to be both user friendly and capable of being easily modified as new non-energy benefit research is completed. This test is also flexible, and allows users to "turn on and off" various cost and benefit values to allow the user to examine the program's cost effectiveness from different perspectives.

This report presents the overall general equations of the LIPPT and describes the components or variables included in the equations. In developing these equations, we have substantially complied with the request of the RRM Working Group's Cost Effectiveness Committee to use current program tracking and reporting methods, so that the LIPPT does not present a new administrative or management burden on the four utilities.

There are three cost benefit categories defined in this report and included in the LIPPT. These are:

- Program costs
- Energy benefits (energy savings)
- Non-energy benefits

Each of these three categories are presented and described in this report, and together make up the LIPPT. The equations for each category are more fully defined and illustrated in the following sections.

Chapter 2: Overview of the LIPPT and Cost Categories

The general equation for the LIPPT cost effectiveness test is presented below. This equation is followed by three sections, each focusing on one of the primary components of the cost effectiveness equation. The first section describes the program-associated costs. The second section describes the energy benefits, and the third section discusses the non-energy benefits. Figure 1 shows the three primary cost and benefit categories that make up the LIPPT.

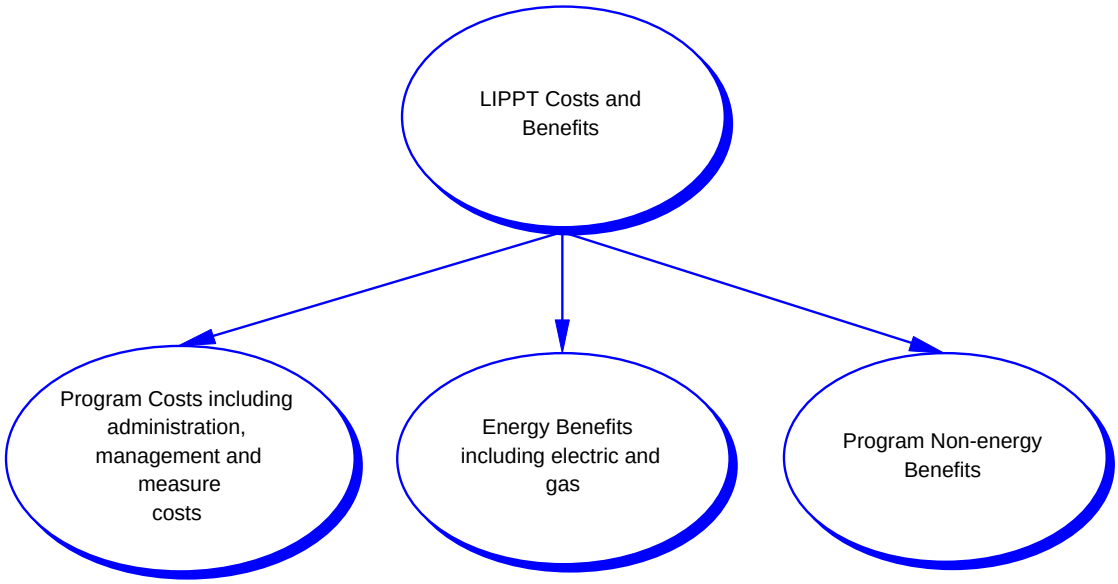


Figure 1 LIPPT Costs and Benefits

General LIPPT Equation

The general equation for the LIPPT cost effectiveness test is:

Cost Effectiveness = (Energy Benefits + Non-energy Benefits) / Cost(s),

Where:

- **Energy Benefit** is the net present value of all program related energy benefits
- **Non-energy Benefit** is the net present value of all program related non-energy benefits
- **Cost** is the net present value of all program related costs

Definitions of Costs and Cost-Related Equations

The following section discusses the denominator of the general cost equation. California's Reporting Requirements Manual (RRM) Working Group Report for Low-income Assistance Programs segregates cost variables into eighteen different cost variables.

Figure 2 illustrates the eighteen variables grouped into five categories, including: 1. Direct Energy Efficiency Services, 2. Pilots Programs, 3. Energy Efficiency Supporting Services, 4. Indirect Services and 5. Oversight costs. These costs are represented on the program cost reporting table presented later in this section, see Table 11. The four costs categories sum to the total program cost displayed in the general equation.[3] See Figure 2 below, for an illustration of the five cost categories and the 18 cost variables.

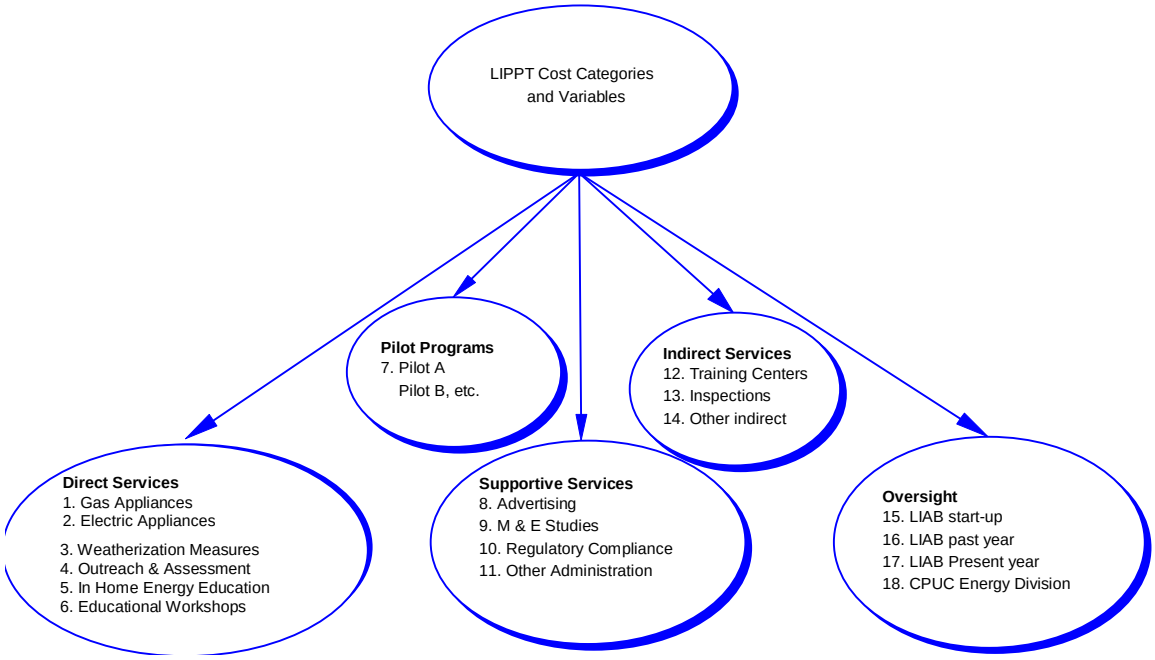


Figure 2 Cost Variables

The general formula for summing the program costs is described below and includes the 5 categories described above and the 18 variables included within the cost categories. However, not all programs will have costs in all 18 of the variables, or in all of the five cost categories. The cost equation is presented as:

[3] Cost inclusions or exclusions for each variable may vary from utility to utility.

Cost = Direct Energy Efficiency Services + Pilots + Energy Efficiency Supporting Services + Indirect Services + Oversight

Where,

- COST = the sum of all costs,
- Direct Energy Efficiency Service = the sum of all costs related to the direct delivery of energy efficiency services,
- Pilots = the sum of all pilot program costs included within the program being examined. Pilot programs may be sub-programs within a larger general program.
- Supporting Services = the sum of all related program implementation support costs other than staff training and inspections
- Indirect Services = staff training and inspections
- Oversight = the sum of all program related regulatory oversight costs. This includes oversight costs related to the Low-Income Advisory Board (LIAB), California Public Utilities Commission (CPUC) costs, and others as applicable.

Direct Energy Efficiency Services

The Energy Efficiency Direct Service Cost is the sum of the first five energy efficiency cost variables included in Table 11 and are expressed in the following equation:

Energy Efficiency Direct Service Costs = Gas Appliances + Electric Appliances + Weatherization Measures + Outreach & Assessment + In Home Energy Education + Educational Workshops

These variables are defined as follows:

- 1. Gas Appliances = costs related to all LIEE Program gas appliance tune-ups, repairs or replacements. This category excludes inspections and training. (Furnace inspections costs are included in cost variable #9.)

- 2. Electric Appliances = costs related to all LIEE program electric appliance tune-ups, repairs, or replacements. This category excludes inspections and training. These are included in cost variables #9 and #8, respectively.

- 3. Weatherization Measures = Costs related to all LIEE program weatherization measures. This category excludes inspections and training.

- 4. Outreach & Assessment = costs associated with community outreach and program promotion to attract participation in a given LIEE program. This cost variable includes all costs associated with door-to-door outreach, pre-participation audits, and similar costs. This costs excludes "In Home Energy Education and Education Workshops and inspections (See also #4 and #9 below.)

- 5. In Home Energy Education = costs for conducting in-home educational efforts for a LIEE program.

- 6. Education Workshops = costs for organizing, recruiting customers for, and/or conducting education workshop efforts for the LIEE program.

Pilot Program Costs

The costs for pilot programs funded as a sub-set of the program being assessed are included in this variable. These are not separate programs, but smaller test versions of the program for which cost effectiveness is being considered. Pilot program costs should not be included in the energy efficiency direct service variable described earlier. The pilot program costs are added separately to a sum as indicated in the following equation:

Pilot Costs = Pilot A + Pilot B etc..

- 7. Pilot program costs are included in the cost accounting Table 11 as variable number 7. This does not mean that two pilot programs are required, or that only two programs can be presented in a program year. The number of rows required for pilot programs can be contracted or expanded as necessary.

Energy Efficiency Supporting Services

There are four variables in this third group of cost variables. This cost variable group covers aspects of expenditures for a given LIEE program that are not directly attributable to measure installations. The seven cost variables in the energy efficiency supporting services cost variable are summed as follows:

Energy Efficiency Supporting Services = Advertising + M&E Studies + Regulatory Compliance + Other Administration

The following definitions apply to these variables.

- 8. Advertising = Advertising costs attributable to the LIEE program. This cost variable includes LIEE program advertising or promotion costs to promote the specific program being assessed, or a portion of these costs associated with multiple LIEE programs. This variable includes items such as mass media advertising (e.g., TV, newspaper, radio) and direct mail.

- 9. M&E Studies = Measurement and evaluation (M&E) costs that are attributable to the LIEE program efforts are recorded here.

- 10. Regulatory Compliance = The LIEE program costs related to compliance of regulatory issues, but not affiliated with the actual program delivery. These costs include, but are not limited to, the involvement of the utility law department, program managers providing testimony or preparing for testimony, supervisory effort for regulatory issues, attending meetings associated with program compliance, and other similar costs.[4] However, these costs exclude costs that are included in the category "Oversight" (see variables15-18 described below).

- 11. Other Administration = Additional administration costs that are allocated to the LIEE program and that are not covered by other more specific categories. Allocations to Other Administration should be supported by a description of the costs and how it apply them to the program being assessed, when appropriate.

Indirect Services

Indirect services include costs that are associated with the general operations of a program, but are not a direct part of implementing a program. Generally these costs are utility support costs that are incurred in order to offer low-income programs in California or costs associated with offering a wider range of programs, of which a portion of the costs support the low-income program being evaluated. Costs included in this category include costs associated with providing training and inspections or other internal indirect operational costs.

The following definitions apply to these variables.

- 12. Training Center = Costs attributable to the LIEE program for services to train and certify LIEE implementers, or costs associated with Training Centers that are distributed to the program being assessed.

[4] These may or may not have been charged to the LIEE program in past assessments and may not be included in the LIEE program budget.

- 13. Inspections = Costs for pre and post-program inspections associated with the installation of measures for the LIEE program. This cost includes furnace inspections.

- 14. Other Indirect Costs = Indirect costs represent the overhead costs of operations that are attributed to the LIEE program based on a cost allocation or for such costs directly attributable to the program being assessed. All recorded operational program costs that support the LIEE program being examined should be counted whether budgeted to the program or not. Indirect costs are costs not attributable to other variables. The portion of the costs that are not part of the LIEE budget should be clearly footnoted.

Oversight Cost

There are four program oversight cost variables that are associated with program budgets that are reported separately in California. These are costs related to the Low-Income Advisory Board (LIAB) and the California Public Utility Commission (CPUC) that are not included in the previous variable. The sum of the 4 oversight cost variables is presented in the following equation:

Oversight Cost = LIAB Start-up + LIAB Past Year + LIAB Present Year + CPUC LIEE, where:

- 15. LIAB Start-up = Costs by the LIAB required to oversee the LIEE program efforts that have carried over from the LIAB start-up into present program year costs.

- 16. LIAB Past Year = Costs by the LIAB required to oversee the LIEE program efforts that have carried over from the LIAB previous year costs into present program year costs.

- 17. LIAB Present Year = Costs by the LIAB required to oversee the LIEE program efforts.

- 18. CPUC Energy Division LIEE Costs = Costs by the CPUC Energy Division required to oversee the LIEE program efforts.

Table 11 summarizes the 18 cost variables included in the five cost variable areas. Costs may be entered separately by gas only, electric only, or both fuels combined. Costs are also segregated by labor, non-labor and contract costs consistent with California's current reporting methods.

Note: Labor and non-labor are considered internal costs, while contract costs are classified as external costs.

Table 11 LIEE Cost Variables (Electric and Gas Combined)

	Labor Costs			Non-labor Costs			Contract and Out-sourced Costs			TOTAL
Cost variables	Gas	Electric	Both fuels	Gas	Electric	Both fuels	Gas	Electric	Both fuels	
Energy Efficiency Direct Services										
1- Gas Appliances										
2- Electric Appliances										
3- Weatherization Measures										
4- Outreach and Assessment										
5- In Home Energy Education										
6- Educational Workshops										
Efficiency direct SUB-TOTAL										
Pilots										
7- Pilot (A)										
Pilot (B)										
Pilots SUB-TOTAL										
Energy Efficiency Supporting Services										
8- Advertising										
9. M&E Studies										
10- Regulatory Compliance										

11- Other Administration Efficiency Support SUB-TOTAL				
Indirect Services 12. Training Centers 13 Inspections 14- Other Indirect Services Indirect SUB-TOTAL				
Oversight Costs 15- LIAB Start-up 16- LIAB Past Year 17- LIAB Present Year 18- CPUC Energy Division LIEE Oversight Costs SUB-TOTAL				
TOTAL COSTS				

Using the Cost Table to Feed the LIPPT

Table 11 displays the currently reported LIEE program cost variables in the far-left column. Internal and outsource costs are included, where applicable, in each of the eighteen cost variables. Also included are administrative vs. implementation cost categories. This table combines both gas and electric fuels together, however utilities may use single fuel source tables as appropriate. The eighteen cost variables listed in Table 11 are also reported into labor, non-labor, and contract expenditure components. The method for breaking the cost variables down into these three components is defined by the following.[5]

Labor and Contract Components

The labor component of a cost variable is any internal direct or indirect (administrative and/or implementation) cost, unburdened by overhead, that represents labor hours. The non-labor components of the cost variable are all direct internal (administrative and/or implementation) costs not covered, but included under labor. Program flyers or other program literature is included in this non-labor category. The Contract component of a cost variable is all out-sourced costs (administrative and/or implementation). Contract costs do not need to be further broken out by labor/non-labor or administrative vs. implementation. This category includes costs associated with contractor employees.

[5] The utilities made a joint filing to the PUC on May 17, 1999 addressing these definitions LIEE programs. The definitions presented here add specificity for the purposes of accuracy.

Chapter 3 Estimating Energy Benefits

This section describes the Energy Benefit variables for the draft LIPPT equation. The energy benefit is the first term in the numerator of this equation and represents the utility-specific energy savings for each LIEE program to be assessed. It assumes that, energy savings reported by the four investor owned utilities, is climate adjusted for the weather conditions associated with the reporting utility. As described earlier, the general LIPPT equation is as follows:

LIPPT B/C = (Energy benefits + Non-energy benefits) / Cost

Because incorporating a wide range of non-energy benefits into the cost effectiveness calculation is one of the major goals of this project, the cost effectiveness calculations include methods for distributing energy savings across the types of measures installed through the LIEE programs. This is desirable because different types of measures produce different non-energy benefits which are dependant on both the type of measures installed, and the savings from these measures. Likewise, to improve the accuracy of the California cost effectiveness calculations in general; it is advisable to establish benefits at the measure level so that benefits can be estimated over the useful life of each measure, rather than an arbitrary estimate of 20 or 30 years based on the expected life of a program's major measures.

Estimating Savings When Annual Measure-specific Savings are Reported

Program related energy savings can be reported at the measure level, and compared to the effective useful life (EUL) of each reported measure. See Table 13 in the Appendix for examples of energy savings and measure EULs.[6]

The general algorithm for computing the net present value of the total future energy savings across all program measures is as follows:

$$\sum_{m=1}^{M} \sum_{f=1}^{2} \sum_{t=1}^{EUL_m} \left[Number_m * Impact_{m,f} * Avoided\,cost_f * (1+e)^{t-1} * \left(\frac{1}{(1+d)} \right)^{t-1} \right]$$

[6] EULs are defined in the M&E Protocols and in the Bill Savings Report entitled "Joint Utility Low-income Energy Efficiency Program Costs and Bill Savings Standardization Report: Final Report, Report Date: March 5, 2001."

Where,

- m represents measure type
- f is the fuel type (gas or electric)
- t is the time period in years
- EUL_m is the effective useful life in years for measure type m (See Table 13 in Appendix A for example)
- $Number_m$ is the number of measure type m installed
- $Impact_{m,f}$ is the gross impact per year for measure type m by fuel type f * (gas--therm or electric--kWh)
- Avoided $cost_f$ is the utility's avoided energy costs and includes energy costs, T&D costs, and environmental externality costs (gas--$/therm or electric--$/kWh) in year 1of the analysis period
- e represents the energy cost escalator rate and is set to 3%, a rate equal to the inflation rate, however both the inflation rate and the energy escalator rate can change independently
- d represents the nominal discount rate of future energy savings and is set by the CPUC at 8.15 percent. This rate is based on a real discount rate of 5 percent and an inflation rate of 3 percent and is computed by the following algorithm:

  nominal discount rate = $\{[(1 + \text{real discount rate})*(1 + \text{inflation rate})] - 1\}$[7]

The net present value for each measure is computed by adjusting the future savings for each measure to the net present value and then summing the net present values over the useful life of the measure. The program savings is then calculated by summing the net present values of all of the measures installed during the program year. This method allows for a net present value estimate to be calculated differently for each measure depending on the useful life of each measure and summed to the program's total net present value.

[7] Based on *Low-income Energy Efficiency Program Costs and Bill Savings Standardization Draft Report*, January 16, 2001, p. 8

Chapter 4: Estimating Non-Energy Benefits

Introduction

In order to develop a method for calculating cost-effectiveness estimates for the generic California Low Income Energy Efficiency (LIEE) Programs, the consultants conducted a quantitative assessment of non-energy benefits. The study enabled a review of the literature and the development of a methodology to determine credible categories of non-energy benefits associated with residential low-income programs. The consultants developed a quantitative spreadsheet modeling approach for estimating non-energy benefits and applied it to derive NEB and cost-effectiveness estimates for a low-income weatherization and education program. The work was developed to support estimates of cost-effectiveness for the programs; however, the NEB research can also be used to assist in program design and outreach, and to target programs to customers that lead to the maximum combined energy and non-energy benefits.

The methodology and quantitative estimates developed served several purposes:

- To identify and quantify the categories of non-energy benefits associated with the program;
- To estimate the benefits from three separate perspectives: utility, participant, and society;
- To provide information and a modeling approach to internalize non-energy benefits into program decision making; and
- To use the estimates as input to computations of cost-effectiveness.

The non-energy benefits (NEBs) are calculated and presented in terms of per household savings, first year savings, and net present value over the program analysis period Sources for the savings included both the measure installation effects (lower usage, more efficient equipment, etc.) and education components.

There are several especially complicated aspects of trying to assess non-energy benefits for a broad public benefits test in assuring that the benefits included are based on credible and defensible data, and that the benefits are non-overlapping. To keep the valuation methods clear, we employed a construct for valuing benefits from different perspectives or actors that could comprise the different aspects of "public benefits'. This was a crucial element in making sure we did not duplicate or double-count benefits. Therefore, the benefits are organized into three perspectives representing three different valuation methods:

- Utility related benefits are valued at the savings or avoided costs to the utility. The types of values assigned include savings in labor costs from fewer bill-payment related activities, and similar types of savings associated with a reduction in utility efforts.

- Public or Societal benefits are benefits that do not directly accrue to participants or to the utility, but are beneficial to society in general. Examples include environmental benefits, regional economic multipliers, and similar types of benefits.
- Participant benefits, are benefits received by the people participating in the program. These include benefits that save time for participants, such as reduced calls to the utility company to have their power reconnected, reduced moves from homes as a result of keeping the power turned on and other similar benefits. In valuing benefits that are savings to participant's time the time savings are valued at the minimum wage.

Applying distinctly different valuation methods for the different sets of benefits helps assure that benefits are not double-counted, and that all appropriate NEBs are considered and included. These three NEB valuation categories identify the classifications of benefits included in the LIPPT, however some benefits apply to more than one category. For example, we included estimated benefits from reduced bill-related calls made by the utility in the utility benefits estimations and also include reduced calls from participants to the utility in the participant benefits estimations. In this example, both the utility and the participant benefits from reduced energy related calls because both are caused by the program, and the estimated benefits are non-overlapping. Similarly, we estimated savings from shutoffs and reconnects using both utility and participant valuation methods as these benefits also apply across both categories. From the utility side, we estimated the net savings in utility labor that is not reimbursed by customer reconnect fees. From the participant side, we included these reconnect fee payments (if any), as well as the time associated with reconnection activities and lost service related to the shutoff. Throughout the report, we took care to maintain a distinction between the benefits estimated across different categories of beneficiaries.

The benefits included in the LIPPT are derived from a range of program associated impacts, including:

- Avoided arrearages, debt reduction, collection savings, and financing-related savings,
- Avoided gas leaks,
- Avoided administration or customer support costs,
- Avoided subsidies,
- Avoided transmission and distribution losses,
- Environmental improvements and economic externalities,
- Health and safety benefits,
- Customer water savings,
- Improved household value and savings from reduced mobility,
- Reduced transaction costs, and other sources.

Where available, quantitative estimates were developed using cost data from the California utilities. These data were augmented with data from an extensive review of the existing literature on similar costs and benefits from other programs. Thus, a combination of California data and data from studies for low-income weatherization

programs from around the country were used to develop the most reliable, but conservative proxies were used to value the non-energy benefits for a wide variety of NEB categories.

Developing Estimates of Non-Energy Benefits

This study gathered information from a combination of the literature and utility-based sources to accomplish several key objectives, these include:

- Developing a cost effectiveness test that more accurately reflects the range and value of program derived benefits;
- Developing an approach to identify the range of benefits for each set of benefit categories;
- Developing and applying a methodology to estimate the non-energy benefits associated with low-income LIEE programs;
- Developing a tool that can be used to compare the benefits associated with alternative program designs in a way that can be used to directly support program design decisions; and
- Identifying non-energy benefits that should be the targets for further research.

In the efforts to accomplish these objectives the consultants attempted to strike a balance between identifying a fixed value for each benefit and still present the range of values described in the literature when setting a fixed value was problematic. In this effort the consultants focused on a process to develop reliable, credible, documented estimates of key non-energy benefits, but also to explore the range or orders of magnitudes for benefits categories that may not have as high a degree of certainty associated with the identification of a single fixed value.

We developed estimates of a wide range of NEB categories, some of which may not be included in the cost-effectiveness calculation because the NEB values are unreliable, because they may not apply to a specific program, or because the research done to date is not rigorous enough to support the use of that benefit in a cost effectiveness test. Those categories for which we were unable to develop high quality estimates but which may have potentially significant impacts are presented in a later section of this report and can be used to help prioritize future research to support the next versions of this test.

The first step in the process to identify NEB values was to identify the types of non-energy benefits that can be associated with a California LIEE program and that can be quantified for use in a cost effectiveness equation. Next, quantitative estimates related to each of these benefit areas were assembled from the literature and reviewed. Where possible, quantitative data was related to key factors (costs, customer counts, benefits, etc.) based on the specific types of LIEE-related programs offered previously by the California Utilities. Because LIEE programs are constantly being refined, it was not

always possible to develop specific estimates for some NEB categories that apply to all programs all of the time, however in developing the tests we included a range of benefits that can be turned on and off as needed to reflect the conditions of each program being studied and allows the test to be modified as the programs change.

Analytical Approach

As mentioned in the introduction, the analytical approach for estimating benefits is based on two key inputs, including: multiplying (1) the *value* of a non-energy benefit times (2) the expected *change in incidence* for that benefit as a result of program participation.

This approach allowed the consultants to incorporate quantitative information from the literature, as well as to insert tailored or utility-specific information or information from closely-related California programs when available. This two-part calculation also allowed us to create a flexible modeling tool that could be easily adjusted and adapted for scenario analysis. Parameters related to changing number of participants, changes in program designs or target audience changes, or other program changes can be readily changed within the model and the impacts on non-energy benefits from each of three separate perspectives can be analyzed and evaluated.

The non-energy benefits included in the LIPPT are calculated as "per participant household" benefits. This makes it easiest to scale the benefits up and down based on program participation rates. However, the benefits can be translated into other terms (including total program terms or percentage “adders”), depending on the analytical application.[8] The program's non-energy benefits are used in computing payback, benefit-cost ratio, and net present value to assess LIEE program cost-effectiveness.

The sections below discuss, in turn, important areas of non-energy benefits. They are generally sorted into the three valuation perspectives discussed earlier:

- Utility-related benefits valued in terms of utility[9] cost savings;
- Public or societal non-energy benefits, accruing to the broader public, and not specifically the utility or the participants; and,
- Participant benefits, in which the benefit is realized by the participant.

Each NEB discussion includes an explanation of the logic underlying the benefit category and the value set for the benefit. A table describing the preferred method for estimating the benefit is included, along with a review of the relevant literature, and a discussion of the logic behind the NEB estimation approach used. In conducting the research, we also reviewed past studies recommending methods to assess hard-to-measure benefits

[8] To develop percentage adders, the dollar value of the NEB can be divided by the dollar value of the energy savings. This can then be applied at the kilowatt-hour level as a percentage adder for NEBs.
[9] and ratepayer

(including Megdal (1994), Skumatz (1996 and 1998), Skumatz and Dickerson (1999), and Skumatz, Dickerson, and Coates (2000), Hall (1999 and 1998), and others), studies that identified methods and priorities for future research (Megdal (1994), Skumatz (1996), Hall (1998) and others), and the array of methods used to calculate estimates. We also indicate cases for which the ideal data are not available and whether there is literature to support identifying estimates for the development of proxy values.

Each section includes a table demonstrating the specific method and numbers used to estimate the NEB value used in the LIPPT. The numbers presented in this table are proxies based on averages for the utilities and are base on assumptions about the specific LIEE program designs. The model that underlies the computations in this report allows the user to compute specific non-energy benefits for each utility territory separately, and to incorporate changes in program design assumptions as the LIEE programs are developed and refined.

An appendix, providing a list of the literature reviewed for this effort, with quantitative estimates of the benefit values is attached. The following sections correspond to the three perspectives – first utility/ratepayer, then societal, and finally participant benefits.

Developing the Non-Energy Benefits Component of the LIPPT

A great many reports were reviewed for this effort. Unfortunately most of these reports did not provide well-documented estimates of for the benefit categories needed for this study. Many of the reports reviewed speculated about a number of non-energy benefits or identified benefit categories for which research was needed to document the existence of the benefit. While the consultants believe that the literature does support the creation of cost effectiveness tests using the estimated program induced savings reflected in the literature, it is clear that some benefits need additional research to quantify the benefit to the level needed for a cost effectiveness test. More rigorous evaluation in this field is needed if estimates of non-energy benefits are to improve. However, this study uses only the benefits for which the consultants agree that there is sufficient research to support the use of the benefit in the LIPPT and to identify a value that can be used to quantify the benefit.

Based upon our review of previous work, discussions with other researchers, and other project efforts, the consultants developed a draft cost benefit model for the RRM Working Group's Cost Effectiveness Subcommittee, (provided as a separate deliverable for the project). The detailed program costs and energy benefits calculations are described in the earlier sections of this report. This section deals with the non-energy benefits and how they are calculated.

Data Sources

The computations of NEBs are based on several sources of data:

- **Program Information**: This includes background information on the proposed program design(s) for the LIEE program, including participant characteristics, measures included, number of participants, etc.

- **Utility Costs and Information ("Value")**: This includes utility-specific information on costs and benefits for a variety of important categories; for instance, carrying costs on arrearages, costs per customer call, fees/costs for shutoffs, etc. This information was gathered through a data request to the utilities, following in-house computations by the utilities to develop estimates of these factors. These values can vary for each of the utilities. In some cases, all input information was not available for each utility. In these cases, the researchers used averages or similar adjustments based on the data provided by other utilities.[10]

- **Estimates of Impacts/Reductions ("Incidence")**: This includes information on the expected changes in the occurrence of the benefits category from program participation. For example, after program participation, what level of reduction in number of calls to the utility could we expect because bill payment difficulties would be reduced? This factor, scaled to the number of participants and the marginal cost per call can be used to compute the reduction in utility costs for calls from a particular program. These estimates are derived from sources assessed to be the most appropriate for the LIEE programs. Where information for similar LIEE programs is available, that information is used in the computation. In order to feed the computation, we strove to locate information from similar low-income programs in which the benefits were more rigorously estimated.

- **Primary Data Collection**: For several categories of benefits, useful information was not available from the literature, from California's previous programs or from the utilities. As a result, telephone survey efforts to LIEE participants were used to supplement missing data. Because of budget and time considerations the consultants focused their data collection efforts on few specific participant-related benefits and relied on the literature to provide information and data on other categories of benefits. For example, there was limited information available on a several factors of interest such as hardship benefits to participants. Accordingly, we focused the primary data collection efforts for this project on gathering California-specific data to develop credible estimates of these type of benefits. A comprehensive literature review provided supplemental data on other relevant NEB estimates.

[10] Note that in some cases, we have incorporated best available estimates of the information needed. For example, the utilities may not have been able to provide the arrearages for low-income customers specifically. In cases like these, we used the best information available, which was, in many cases, the information for the average residential customer, as opposed to specific information for low-income residential customers.

Terms and "Units": What We are Computing

One of the most confusing aspects of previous work on NEBs is that different benefits are measured in different and varying units. Some researchers present benefits in present value terms; others in annual terms, and so on. This makes it difficult to readily determine which benefits have relatively large or small per participant impacts. The development of the LIPPT relies on the benefit values used by Skumatz (1996, 1997, 1999, 2000) and others and presents all benefits in the same terms; estimated *annual benefits for an average participating household*, rather than a mixture of present values, annual program benefits, one-time benefits, etc.

The literature presents much of the analysis in both dollar terms and "percentage adder" terms. The "percentage adder" term is confusing and is not understood outside of a small group of people familiar with these types of evaluations. The "adder" term usually is associated with equating a benefit as an additional percent of a specific program characteristic, such as the cost of program installed energy efficiency measures, the cost of a certain subset of measures, the cost of the program as a whole, or some other baseline from which a percent of costs are calculated and assigned as the value for the non-energy benefit being examined. Given that the goal of this project is a new cost-effectiveness test that uses the best documented values for calculating non-energy benefits, we chose to present the NEB estimates in dollar terms.

Horizons or Time Periods for the Benefits – Annualizing and NPV

In some cases, benefits are assumed to occur annually over the life of the achieved energy savings, such as a reduction in pollution as a result of the associated energy savings. For items that have some level of customer dissatisfaction and may be removed by the participant, the benefit lasts only as long as the retrofit remains installed. Water savings that are eroded by participants taking out their low-flow showerheads is an example of a benefit that has an eroded life expectancy. For the case of water savings, research suggests that most of the faucet aerators and showerheads have an expected lifetime of approximately three (3) years. For this reason, we set the horizons for benefits related to this measures at three years.

For other benefits, professional judgment was made to determine the appropriate time horizon of the benefit. For example, some argue that reductions in arrearages last as long as the energy savings; after all, the reductions in bills remain as long as the energy savings lasts, continuing to help residents avoid arrearages and payment difficulties.[11] Others argue that the bill, payment, and shut-off related benefits should only be counted for a few years. There are several reasons a shorter horizon might be adopted. The studies that have been conducted on arrearages (as well as safety, and some other topics) tend to be one-year or one-time impact studies. Thus, it may be improper to assume that these benefits accrue year after year until the program's measures reach the end of their

[11] One additional enhancement would be to reduce the energy savings (and related benefits) over time by the degree of technical degradation associated with the measures. This is a very appropriate and straightforward enhancement.

useful lifetimes given that there are no studies which affirm or assess this. In addition, some believe that it is unrealistic to think that a small reduction in energy costs provide a lasting impact on the participant's ability to manage their household budgets effectively, and as a result, participants soon find themselves in the same financial conditions that they were in during the period the bill reductions were first realized. Also, since program participants move frequently and other low-income persons may not reoccupy a "treated" dwelling it is arguable that the program may only have a short-term impact on low income participants' bills.[12] As such, the consumers themselves may be responsible for the continuation of good payment behavior, as opposed to this being a continued benefit that is attributable to the program. However some studies (Hall, 1999) using participant bill payment histories for a mid-western utility weatherization program have documented continued bill payment improvements more than a year after program participation. In these cases the consultants used professional judgment along with consultations with the Cost Effectiveness Subcommittee to establish reasonable lifetimes for the non-energy benefits included in the LIPPT.

To make the presentation as clear and as consistent as possible and to establish conservative values that can withstand challenge, we have constructed the LIPPT so that most benefits have similar lifetimes over which the non-energy benefit is calculated. To do this the consultants have set the non-energy benefit calculation period of (10) years for all benefits with one measure with customer acceptance issues. This exception is a 3 year lifetime for water-related benefits.

At the end of each section (utility, societal, and participant), we present the adopted lifetimes (horizons) for each benefit, and show the difference that the horizon assumption makes for the estimated benefit value.

The LIPPT computations require information on two "horizons". The first is the horizon we have discussed; the number of years we expect the specific NEB benefit to last. This is used to translate benefits that may accrue for varying periods of time to comparable "annualized" benefits. Note that we have applied perspective-related discount rates to these "annualizing" computations. We assumed that the utility benefits are discounted using 8.15% as the discount rate. For annualizing societal or public benefits, we used a discount rate of 3%, a figure that represents a longer-term view usually assigned to public benefits and choices. A higher discount rate was used to annualize participant benefits. The Cost Effectiveness Subcommittee discussed this value and agreed that the participant benefits discount rate should be set at the cost of borrowing money for low-income

[12] Users need to determine whether the benefits they want to measure from the program are only those accruing to low-income customers, or those that accrue from a program designed to help low-income customers, but that over time, may diffuse to some non-low-income customers. Other discussion items included concerns about whether programs that had the weatherization work conducted mainly by low-income assistance groups or community-based organizations would be valued differently. Although this may be appropriate, there was insufficient information on differences between programs that did vs. did not take this approach to estimate different NEB proxies. In addition, many of those benefits would be economic-related, and (as the reader will discover) we have taken a very conservative approach on those benefits categories.

customers, typically ranging from 18% to 25% or higher. However, the upper end of these ranges were discussed as being to too high for the LIPPT, and potentially inappropriate for valuing a social-type program. Values at 10% and higher were discussed, but ultimately, a discount rate of 18% (the low end of which low-income customer can typically borrow money via credit card transfers) was agreed upon by the Subcommittee. In some cases, we include participant benefits that are measured as a one-time benefit and essentially is a net present value in itself. In those cases, we have applied the discount rates and program evaluation lifetimes to turn the benefit into annualized terms, which are ultimately summed back up into the NPV, included in the LIPP test.

The second time horizon required is the time period over which the benefit is amortized. This may be 10 years; 20 years, or another time period. This is the period over which the benefit is calculated when computing the net present value for the stream of benefits calculated using the methods described in the text below. That is, the benefit may be only last 3 years, but the benefit is amortized over a longer period to calculate the net present value of the benefit over the life of the program. This allows the net present value of the non-energy benefits to be equalized over the life of the program impacts and provide a method for comparing non-equivalent programs to one another.

The final items needed for the computations of the total net present value (NPV) are the discount rate to be applied to the test (used to translate future benefits into present values), and the number of participants in the program. The overall discount rate used is a program assumption; the results presented in this section assume an overall LIPPT societal discount rate of 8.15%, however this rate can be changed in the model as needed.

In summary, the proxy values for the NEBs are presented in the following terms:

Dollar benefits in annual terms per average participating household.

These values are then converted into total net present value (NPV) terms and used in the computation of the LIPPT, and the benefit-cost ratio assessment**.**

Selection of NEB Proxies

The Cost Effectiveness Subcommittee was particularly interested in deriving NEB proxies that represented the best research available and were defensible. However, the Committee was also interested in assuring that the estimates were conservative, so that the credibility of the concept of the LIPPT was not negatively affected by making overly optimistic assumptions. Therefore, when alternate computation methods resulted in different values, we selected the value that was more defensible or more conservative (lower) in terms of the computed NEB proxy.

Individual Measure Benefit-Cost Ratios

The Cost Effectiveness Subcommittee requested the consulting team to develop a method for distributing the NEBs across the individual energy efficient measures for the purpose of developing measure-specific benefit cost ratios. While the consulting team recommend that this not be done as part of the LIPPT because of the lack of measure-specific research on NEB, the consulting team accomplished this goal by developing a matrix that distributes the NEB into each measure installed by the program. The matrix was developed by examining the relationship between each measure to identify which NEB the measure would effect. In this examination a determination was made as to weather or not each measure has or does not have impacts on each NEB. Since there are around 30 NEBs and 130 measures in the current LIPPT model, about 4,000 NEB-measure relationships are computed in the matrix.

Each of these NEB-measure relationships were assigned a value of either "1" or "0." A "1" was assigned to those NEB-measure relationships where the measure has at least some impact on the NEB. Alternatively, a "0" is assigned to those relationships were the measure has no impact or a negative impact on the NEB. Please see Table 12 below, a small sample of the matrix contained in the LIPPT model.

In this example, all energy efficient measures have an impact in lowering collection costs, because any measure that saves energy indirectly lowers the collection cost associated with unpaid utility bills. However, only gas furnace replacement and repair reduce emergency gas service calls.

Table 12 Example of NEB & Measure relationships used to compute individual measure benefit-cost ratios.

Energy Efficient Measure	7G. Lower Collection Costs	7H. Red'n in emergency gas service calls
Furnace Filters - mult fam (Gas)	1	0
Furnace Filters - sing fam (Gas)	1	0
Furnace Repair (Gas)	1	1
Furnace Replacement (Gas)	1	1
Low Flow Showerhead (Gas)	1	0
Water Heater Blanket (Gas)	1	0
Water Heater Blanket - mobile (Gas)	1	0
Water Heater Blanket - mult fam (Gas)	1	0
Water Heater Blanket - sing fam (Gas)	1	0
Water Heater Pipe Wrap (Gas)	1	0

Once these values are assigned in the matrix, a computation that allocates the total dollar value of the NEBs across the program installed measures is computed by attributing the

NEBs to measures weighted according to how much energy savings is attributed to each measure (for energy saving measures) multiplied by the 1s and 0s in the matrix. In this way the allocation of NEBs into the measures is driven by the level of energy savings distributed across all measures, but adjusting for weather or not each measure impacts specific NEB.

In other words, the NEBs portion of savings is allocated to each measure in proportion to what the energy savings is for that measure, however, this NEBs savings is adjusted (reallocated among the measures) by the number of NEBs on which the measure impacts. A similar structure is designed for water benefits so that water associated NEB are only distributed into the water saving measures.

Once the dollar amount of the NEB are distributed across the energy efficient measures, an additional measure B/C Ratio (that includes NEB benefits) is computed. The equation for computing this new B/C ratio for a given energy efficient measures is:

B/C Ratio = NPV of measure Energy Benefits + NPV of NEBs attributable to measure / Measure Cost

It should be noted that the overall B/C ratio (computed in the LIPPT model) is not the weighted sum of individual measure B/C ratios, or based on individual measures generally.

Chapter 5: Non-Energy Benefits from the Utility Perspective

Each of the key categories of utility and ratepayer benefits is addressed below. A summary of the rationale for including each benefit and for estimating the value of the NEBs are included in the discussion.

Carrying Cost on Arrearages

Utilities realize financial savings when customer bills are paid on time. Energy efficiency programs help reduce customer bills, improving the likelihood that customers will be able to keep up with payments. In addition to the LIEE program's technology components, many LIEE programs include an education component, designed to help customers adopt behaviors that will lead to additional (and hopefully, long-lasting) reductions in their energy bills.[13]

A walkthrough of the computation method across all California utility territories (using some base assumptions regarding program design and savings) is presented in the following table.

Table V-1: Preferred Computation Method, Sources, and Availability Issues

Carrying Cost on Arrearages	Preferred Data Element Source	Avail.	Status	Best Alternate Source Available
Annual average arrearage level for eligible low-income customers	Direct utility tracking / utility records, panel survey, or process/impact evaluation if no "eligibility" indicators	n/a	total arrears only -- including res and comm'l/I, not from all utilities	see next item
Percentage reduction in average participant arrearages after program	Impact evaluation pre/post with control group	similar	multiple studies from similar programs elsewhere should be available from utility filings, etc, but not provided for some utilities	use dollars of arrears reduction from other studies or percentages, scale for California rates; Dollar range -$5 to $311; range percent 0% to 90%.
Interest Rate	Utility cost records / time records	assume		

[13] This benefit is applicable here because we are considering gas and electric customers. Those with oil or other fuels that essentially require up-front payments would not realize these benefits. This same consideration applies to several other benefits categories as well.

The greatest number of studies containing original, quantitative research were found in the area of arrearages. This includes work by Response Analysis Corporation/NIMO (1990), Quaid and Pigg (1991), Khawaja and Ballou (1992), Hart (1993), Rosenberg and Feblowitz (1993), Hall/Hagler Bailly (1993), Brown, et.al. (1994), Harrigan and Gregory (1994), Monte de Ramos (1994), Magouirk (1995), Blasnik (1997), RLW Analytics (1997), Pye (1998), Hall/TecMarket Works (1998), and others.[14] In our literature search we located more than 30 different estimates for the reduction in arrearages; some specified in percentage terms, and others in dollar terms. Megdal (1996) and Peters (2000) point out three methods for evaluating changes in arrearages. These include: pre/post comparisons of average arrearages; regression analyses that incorporate factors for program features and demographics; and discrete choice models that includes these factors and assess the probability of a customer having arrearage problems. The studies we identified and reviewed almost universally used pre/post comparisons of average arrearages.[15] These studies examined payments impacts for a variety of programs, and incorporated analyses of reductions in incidence and levels of arrearage, payment patterns, and carrying costs. As summarized in Peters (2000), the steps involved in these studies included: selecting a random sample of treatment and comparison group homes; calculate the differences between amount billed and amount paid for each month in the pre- and post- periods (the arrearage level); annualize the arrearage figures for pre- and post-periods for participant and comparison groups and determine the average across each category; and estimate the net change in arrearage in either dollar terms or percent reduction terms.

These studies provide information on an important component of the computations; the reduction in arrearage balances that can be attributed to the program, which can then be valued by the carrying costs for the utility (interest rate). Accordingly, this benefit reflects the improvement in the utility's finances (and reduction in ratepayer revenue requirements) that result because of the reduction in arrearages.

Based on the studies we reviewed in the literature, we find that the average dollar value reduction from LIEE programs varies broadly. The estimates vary because of differences in program specifications, program effectiveness, utility rates, up-front arrearage balances, and other factors.

However, when we restricted our search to only programs that were not targeted at customers with bill payment problems, the average impacts on arrearages were lower. Reviews of the literature found 22 studies estimating reduction in arrearages in percentage terms that applied to low income programs that were not targeted at customers with bill payment programs. Some of the studies using reliable estimation methods for programs that did not target payment troubled customers include Brown (1993), a large-

[14]Megdal (1994) attributes no real costs to utilities resulting from arrearages because the costs are recovered through rates under traditional cost of service regulation, unless financing arrearages adds to the cost of capital financing.

[15] Monte de Ramos, et.al. (1993) used a PRISM technique regressing participants and non-participants in models including bill payment behavior and arrearages. A new study being completed by Blasnik for Public Service Colorado employs discrete choice modeling techniques.

sample study of a nationwide program that found a 90% reduction in arrears. Quaid and Pigg (1991) and Hoch (1991) studied a Wisconsin Gas Company weatherization program and found a 100% reduction in non-payment plan customer arrearages (although sample sizes were small). An evaluation of Ohio's WAP evaluation found a 63% reduction in arrears for a program that included comprehensive weatherization, home repairs, and education. Khawaja et.al. (1992) studied PP&L programs in two states and found a 17% and 61% reduction in arrearages. Magouirk (1995), in a study that did not have access to a control group, found a reduction in arrearages of 26%. In another study with access to a control group, Monte de Ramos (1993) found a reduction of 12% in arrears for a Columbia Gas Low Income Usage Reduction Program. Other studies were also reviewed.

The estimated impacts in this literature ranged from 0% reduction to 90% reduction in arrearage balances. The average value for these studies was 26% reduction, and the median for programs not targeted at customers with bill payment difficulties was 18%. We used the percentage reduction figures (rather than dollar reductions) because we wanted to account for differences in rate levels and other factors that differ between the utilities sponsoring the studies. The point estimates for carrying cost on arrearage balances for LIEE programs are based on (1) an assumed reduction in arrearages and (2) California utility-specific information on the percentage of customers in arrears and arrearage balances for customers eligible to participate in the LIEE program. In addition, the appropriate interest rate that reflects the carrying cost of capital was taken from data provided by the California utilities.

Table V-2: Computation Method and Proxies Used for This Project

Reduced Carrying Costs on Arrearages -- Utility Perspective (7A)

	California-Wide	Computation Description	Source
Item 1	$164.40	Average Arrearage per Low Income Customer	California Utility Data Sheet
Item 2	28%	Times Estimated Program-Induced Percentage Reduction in Arrears	Selected Research Value (see Yellow table for value and alternates)
Item 3	8.15%	Times Appropriate Utility Interest Rate for Carrying Charges	California Utility Data Sheet
Item 4	$3.76	Equals Proxy for NEB: Reduced Carrying Cost on Arrearages -- in Annual Terms	Computed (Item1*Item2*Item3)
Item 5	10	Input: Assumed Years for the Benefit	Assumptions Table
Item 6	1.0	Item 4 Multiplied by Adjustment Factor for Appropriate Horizon	Derived from horizon and discount assumptions from Program Assumptions Table

Item 7	$3.76	Equals Proxy for NEB: Reduced Carrying Cost on Arrearages in Dollars per participant per year	Computed -- annualized dollars per average participating household per year

Benefit to Utility/Ratepayer: Reductions in the interest or carrying charges on reduction in arrearage balances from program participants reduces revenue requirements for rates and results in savings to the utility.

Summary/Justification of NEB: Direct and conservative estimates were available on the arrearage balances for the California utilities. Numerous studies in the literature, using reliable pre/post estimates with control groups, were available to estimate the reduction in arrearage balances attributable to similar low income weatherization programs around the nation. Direct computation using these inputs and appropriate carrying charges were used to develop the NEB proxy, valuing the reduction in arrearages from the program in terms of savings in financial carrying costs to the utility.

Bad Debt Write-Offs

Annual write-offs of non-collectibles by utilities represent a real cost to utilities and ratepayers. Again, LIEE programs can help make energy bills more manageable for program participants, potentially reducing the bad debt for these customers. The preferred data elements and sources for estimation are:

Table V-3: Preferred Computation Method, Sources, and Availability Issues

Bad Debt Write-off	Preferred Data Element Source	Avail.	Status	Best Alternate Source Available
Annual low-income write off	Direct utility tracking / utility records, panel survey, or process/impact evaluation if no "eligibility" indicators	n/a	total write-offs only for utilities -- not for this group some studies	may need to use average for all accounts
Net Reduction in average participant write-offs after program	Impact /process evaluation pre/post with control group	similar	from similar programs elsewhere	Range for studies 8% to 36%.

Write-offs were examined in Quaid and Pigg (1991), and Magouirk (1995) and Blasnik (1997) and Clark County, Washington (1990). Magouirk estimated two parts to these savings, including reductions from the size of debt written off, and from the total number of accounts written off. His estimates show an 18 percent reduction, leading to Public Service Colorado savings estimates of $3.29 per participating household given the reduction in the level of write-offs, and $2.77 given the reduced number of accounts written off. Blasnik (1997) examined a Louisville Gas and Electric program and examined the net reduction non-payments of bills, finding a reduction of 8%. A study in Clark County, Washington (1990) found that there was a decrease of 30% in write-offs for program participants, saving the utility over $300,000 per year. We determined that the number of accounts written off would not be used to compute savings under this benefit category; instead, if this impact led to fewer calls or collection activities, we would incorporate those benefits under those separate categories. Again, we used the

percentage reductions, given that there may be differences in the level of rates and bills in the utility territories covered by the studies.

Based on a review of three published studies addressing bad debt reductions, we found that the average reduction in write-offs ranged from 8% to 36%. We selected the average of the studies, or 20.7% expected reduction in bad debt in our computation of the proxy for this benefit category.

Table V-4: Computation Method and Proxies Used for This Project

Reduced Bad Debt Written Off -- Utility Perspective (7B)

	California-Wide	Computation Description	Source:
Item 1	$2.33	Average Bad Debt per Low Income Customer	Computed
Item 2	20.7%	Times Estimated Program-Induced Percentage Reduction in Bad Debt Write-offs	Selected Research Value (see Yellow table for value and alternates)
Item 3	$0.48	Interim Proxy value for NEB: Bad Debt Written Off	Computed (Item1*Item2)
Item 4	10	Input: Assumed Years for the Benefit	Assumptions Table
Item 5	1.0	Item 3 Multiplied by Adjustment Factor for Appropriate Horizon	Derived from horizon and discount assumptions from Program Assumptions Table
Item 6	$0.48	Proxy for NEB: Bad Debt Written Off	Computed -- annualized dollars per average participating household per year

In developing point estimates of these impacts for the LIEE programs, we calculated the product of the following inputs: (1) estimates of the California utility annual residential write-off per household; (1) the average percent reduction in bad debt written off from available studies, annualized using benefit time horizons and utility discount factors. Assuming that the percentage of bad debt written off is not simply proportional to the number of customers, but might be expected to be higher for customers who are more financially at risk (the target population for LIEE), our point estimate probably understates the value of this non-energy benefit to the utilities.

Benefit to Utility/Ratepayer: The utility realizes higher revenues through lower level of written off balances from program participants and this reduces revenue requirements for all ratepayers.

Summary / Justification of the NEB: Direct utility information was available on bad debt write-offs. Using the average value estimated by several published studies for reductions in bad debt write-offs subsequent to implementation of similar low income weatherization programs were used to approximate the benefits from the LIEE programs. The majority of the studies of reduced write-offs used reliable pre-post evaluation methods with control groups.

Fewer Shut-Offs and Reconnections

The LIEE program's combination of installed technologies and education is expected to lead to an improvement in customer's abilities to pay their bills, and as mentioned before, to lower arrearage and write-off balances. As a corollary, we anticipate a similar reduction in the number of customers with service disconnects as a result of non-payment. This saves additional utility costs, reflected in ratepayer savings. Peters (2000) points out that utility costs increase dramatically as poor payment behavior leads to site visits, disconnections and reconnects. As one example in Pennsylvania, Peters, citing Colter (1994) reports that notices cost $0.75, which escalated to $1.28 for telephone contact, and to $18.09 for a premise visit. Shutoffs cost $21.92 and reconnection cost $43.84. Clearly, savings result if these latter steps can be avoided.

Table V-5: Preferred Computation Method, Sources, and Availability Issues

Shutoffs	Preferred Data Element Source	Avail.	Status	Best Alternate Source Available
Average annual number of shutoffs per eligible low-income account	Direct utility tracking / utility records, panel survey, or process/impact evaluation if no "eligibility" indicators	n/a	only shutoffs for all accounts, C&I	May need to use average for all accounts
Reduction in percent of low-income customers shutoff	Impact /process evaluation pre/post with control group	similar	some limited studies from similar programs elsewhere / not strong	Magouirk, Blasnik and others have results; 1% - 84% disconnections avoided through program; (value of reduced disconnects range from some of these studies ranged from $41 to $117).
Utility marginal cost to shutoff	Utility cost records / time records	adapt	available for one utility	May need to adjust / proportion for other utilities

Table V-6: Preferred Computation Method, Sources, and Availability Issues

Reconnects	Preferred Data Element Source	Avail.	Status	Best Alternate Source Available
Average number of reconnections per eligible low-income accounts annually	Direct utility tracking / utility records, panel survey, or process/impact evaluation if no "eligibility" indicators	n/a	only reconnects for all accounts, C&I	may need to use averages across all accounts, but that will likely misrepresent low-income. May need to ask utilities to look again if high priority
Reduction in percent of low-income customers reconnected annually	Impact /process evaluation pre/post with control group	n/a		adapt from studies of disconnects above and scale with utility-reported differences in counts of disconnects / reconnects (although utility data includes residential and commercial)
Net Utility marginal cost to reconnect (net of reconnection fee)	Utility cost records / time records	adapt	available for one utility; fee also available	Can use the data to adjust for other utilities
Average additional payment made prior to reconnect (period the payments are moved forward or received when they would previously have been written off)	Utility records or impact/process evaluation pre/post with control group	n/a		derivable from utility-specific policies or possibly interviews with utility staff or non-utility assistance agencies

Magouirk (1995), Skumatz (1996), Blasnik (1997), Pye (1998), Blasnik (1999), Howat and Oppenheim (1999), and others developed or cited estimates of the avoided value of reductions in customer shutoffs due to their specific low-income programs. Impact studies that formed the basis for these valuations examined the change in average number of shutoffs for customers before and after participation in low income weatherization programs, often using control group changes to identify net changes. In the literature review, we identified eight studies with data related to the reduction of utility service disconnections. Blasnik (1997) examined Ohio's Low Income WAP program and found a 67.8% decrease in net disconnections (decreasing from 3.7% to 1.2% after adjustments for a control group). Khawaja et.al. (1999), in a study for NFG's Low Income Residential Assistance Program found that the average disconnects fell by 68% (decreasing from 85 to 27), and the control group figures increased 12%, for a net change in disconnects of 80%. Howat and Oppenheim (1999) cite work by Grosse (1997) that found a Wisconsin Public Service program that included visits by customer service advisors led to a reduction of 76 disconnects per 10,000 customers, or an 80% reduction in shutoffs (no control group was used). Blasnik's 1999 study of Ohio's WAP program found a reduction of 5.4% using a study of 12,000 participants. Magouirk (1995) found a reduction of 50% in shutoffs comparing pre- and post- behavior from Public Service Colorado's ESP program participants (but without a control group). Blasnik's Louisville Gas and Electric Evaluation (1999) found a reduction in shutoff notices and shutoffs of

23%. Proctor (1997) found a reduction in shutoff rates of 84% for a program targeted at customers with arrears.

These studies found impacts from 1% to 84% attributable to aspects of the low income weatherization or weatherization and education program. The average of these studies was 34.2% reduction, and the median was 30.4%. We selected a value somewhat more conservative than the average of the studies (23%), which was derived from a Blasnik's 1997 evaluation of Louisville Gas and Electric's program and showed results in the conservative range of results from other studies.

While there is some data available on the percent reduction of disconnections, none addressed the issue of reconnections. We find that the data from the California utilities shows that the number of reconnects is smaller than the number of disconnects (as would be expected). We assumed that the percentage reduction in disconnects can be applied to the reconnects as well, for lack of other data on the topic.

For the estimate of the value to the utility, we used the utility's marginal cost for shutting off service. For the reconnect benefits, we used the net marginal cost ; that is, the marginal cost of performing a reconnect minus the reconnect fee that the utility assesses before they reconnect service, if applicable.[16]

[16] Note that for utility costs for disconnects, reconnects, calls, notices, and other changes, we used the utility's marginal costs. It may be argued that jobs could be lost, leading to unemployment benefits, and other costs. We decided to omit these changes, assuming they would not be large, and selected the marginal cost approach as conservative and defensible.

Table V-7: Computation Method and Proxies Used for This Project

Reduced Shutoffs -- Utility Perspective (7C)

	California-Wide	Computation Description	Source
Item 1	0.0279	Average Shutoffs per Low Income Customer per year	California Utility Data Sheet
Item 2	23.0%	Times Estimated Program-Induced Percentage Reduction in Shutoffs	Selected Research Value (see Yellow table for value and alternates)
Item 3	$8.29	Times Utility's Net Marginal Cost per Shutoff	California Utility Data Sheet
Item 4	$0.05	Equals Proxy for NEB: Reduced Net Costs for Shutoffs -- in Annual Terms	Computed (Item1*Item2*Item3)
Item 5	10	Input: Assumed Years for the Benefit	Assumptions Table
Item 6	1.0	Item 4 Multiplied by Adjustment Factor for Appropriate Horizon	Derived from horizon and discount assumptions from Program Assumptions Table
Item 7	$0.05	Equals Proxy for NEB: Reduced Net Costs for Shutoffs	Computed -- annualized dollars per average participating household per year

Table V-8: Computation Method and Proxies Used for This Project

Reduced Reconnects -- Utility Perspective (7D)

	California-Wide	Computation Description	Source
Item 1	0.0192	Average Reconnects per Low Income Customer per year	California Utility Data Sheet
Item 2	23.0%	Times Estimated Program-Induced Percentage Reduction in Reconnects	Selected Research Value (see Yellow table for value and alternates)
Item 3	$22.70	Times the Utility's Net Marginal Cost per Reconnect. Part 1 is Marginal Cost per Reconnect	California Utility Data Sheet
Item 4	$17.93	Part 2 of Net Marginal Cost -- Subtract Any Utility Reconnect Fee	California Utility Data Sheet
Item 5	$4.76	Equals Computed net marginal cost to utility for reconnects (Item 3 minus Item 4)	Computed from Item 3 minus Item 4
Item 6	$0.02	Equals Interim Proxy for NEB: Reduced Net Costs of Reconnects	Computed (Item1*Item2*Item5)
Item 7	10	Input: Assumed Years for the Benefit	Assumptions Table
Item 8	1.0	Item 6 Multiplied by Adjustment Factor for Appropriate Horizon	Derived from horizon and discount assumptions from Program Assumptions Table
Item 9	$0.02	Equals Proxy for NEB: Reduced Net Costs of Reconnects	Computed -- annualized dollars per average participating household per year

The estimate of the benefit from fewer disconnects is computed by multiplying the number of disconnects per average residential (preferably low-income) customer, times the percent of reduction in shutoffs expected after the program (we selected as the default a conservative number computed in Blasnik, 1997, a 23% reduction based on a pre/post analysis using control groups), times the marginal cost to the utility for each avoided shutoff (data provided by the utilities). The benefit from reconnects are similar, with the exception that the marginal "value" figure is the marginal cost of reconnects minus the residential reconnect fee.

Benefit to Utility/Ratepayer: Lower utility costs are incurred if less staff time is needed to shutoff and reconnect customers (unless the reconnection fees more than cover the costs of termination and reconnect).

Summary / Justification: The average number of shutoffs and reconnects was available for at least some of the California Utilities. A conservative value from among a number of published studies on the reduction in disconnections resulting from similar programs was used to estimate the average shutoffs and reconnects that could be avoided through the LIEE. We used utility-supplied data on the marginal cost in terms of staff travel and on-site time, valued at current utility wages for these staff. From this value, we subtracted the reconnection fees paid by terminated customers prior to reinstatement of service to derive the utility's net marginal benefit from shutoffs and reconnects avoided through the program.

Fewer Notices and Customer Calls

Installed energy technologies and energy education efforts lead to more affordable energy bills. This, in turn, leads to more on-time payments and fewer customer calls and notices from the utility. Both of these benefits result in savings in staff time and materials to the utility, ultimately reflected in ratepayer savings.

Table V-9: Preferred Computation Method, Sources, and Availability Issues

Fewer notices	Preferred Data Element Source	Avail.	Status	Best Alternate Source Available
Number of notices annually per eligible low-income participants (pre)	Direct utility tracking / utility records, panel survey, or process/impact evaluation if no "eligibility" indicators	n/a	only total R+C/I from utilities	may need to use averages across all accounts, but that will likely misrepresent low-income. May need to ask utilities to look again if high priority
Percent reduction in notices annually to participants (post, vs. control group)	Impact /process evaluation pre/post with control group	n/a or adapt studies	can assume it is proportional to reduction in number of customers with bad debt or arrearages	Data on reduction in number of accounts written off for bad debt ranges from 5%-18% reduction; reduction in accounts classified as bill payment problems ranges 8%-15%; change in number of payments 10%-115%. Also Blasnik (1997) notes 27% reduction in collection-related activities
Utility marginal cost to process notice	Utility cost records / time records	adapt	available for one utility	may have to proportion for other utilities

Table V-10: Preferred Computation Method, Sources, and Availability Issues

Fewer customer calls	Preferred Data Element Source	Avail.	Status	Best Alternate Source Available
Average number of calls to utility (for billing related issues) per eligible low-income customer (pre)	Direct utility tracking / utility records, panel survey, or process/impact evaluation if no "eligibility" indicators	adapt	total residential calls for all reasons, not low-income, not billing only	may need to use residential averages
Reduction in percent of billing calls to utility by participants	Impact evaluation pre/post with control group	n/a or adapt studies	can assume it is proportional to reduction in number of customers with bad debt or arrearages	Data on reduction in number of accounts written off for bad debt ranges from 5%-18% reduction; reduction in accounts classified as bill payment problems ranges 8%-15%; change in number of payments 10%-115%. Also Blasnik (1997) notes 27% reduction in collection-related activities.
Utility marginal cost per billing call	Utility cost records / time records	yes	Utilities provide costs, and one has costs for billing calls separately -- not low-income/ pro-portion	

Relatively little published work is available in the area of savings from fewer late payment notices or customer calls from the utility. In addition, this data may be considered sensitive because the level of these costs could be interpreted to reflect a specific utility's activities or customer relations efforts. In a competitive market companies do not like to discuss the their level of customer interaction and contact.

The current literature does not specifically provide a large number of studies with estimates of reductions in notices and customer calls. Blasnik (1997) provides information on reduced collection activities (27%) after program participation and Skumatz (1996) and Howat and Oppenheim (2000) use estimates adapted from Magouirk on reductions in accounts written off and utility-based cost data to develop estimates of reductions in these costs. Hart (1993) has published information on total credit and collections-related costs (estimated at $50.76 per customer per year). However, we located 25 estimate values culled from studies with related information, including reductions in the number of participants who are classified as payment troubled customers, reductions in “cycle visits”, reductions in collection activities, and similar data. With few exceptions, these studies examined changes in aspects associated with bill payment behavior for a sample of participants before and after participation in a program compared to a control group of similar customers. The studies we examined

focused on bill-payment behavior that we believed can be related to collection activities that affect notices, calls, and other collection-type activities.

For example, two studies, Peters, et.al. (1999) in a study for Massachusetts Electric, and RLW Analytics (1997) in a study for Detroit Edison, noted that there was no change in the percent of bills paid on time or average payments by participants. Using billing analysis techniques, RLW Analytics and TecMarket Works (1997) found a 0.5% change in customer bills paid on time after weatherization for the Detroit Edison program. Khawaja, et.al, (1992) found an 4% increase in good payment behavior after examining pre and post averages adjusted for a control group for Washington PP&L program participants. A Wisconsin Gas evaluation conducted by Hagler Bailly (1993) found a 4% to 7% increase in bills paid on time, examining pre and post behavior with control groups. Studies by Harrigan and Gregory (1994) for Niagara Mohawk found a 10% increase in payments made (pre/post with control), a result similar to that found by Khawaja et.al. (1992) found for PP&L (pre-post with control group). Work by Blasnik (1997) for Louisville Gas and Electric found a reduction of 15% in late payments, a 39% decrease in notices, and 38% reduction in late payments. Blasnik (1997) in work for Ohio's WAP program found a reduction of 27% in collection activities for program participants. Oppenheim and MacGregor (2000), citing work by ScanAmerica for Equitable Gas in Pennsylvania (1996), note a decrease of 67% in missed payments, and a 38% increase in the proportion of bills paid found by a study for the Pennsylvania PUC (1995) on a Low Income Usage Reduction Program. Quaid and Pigg (1991), studying a program in Wisconsin found a 69% reduction in number of accounts in arrears after adjustment for control groups. The number of accounts provides a proxy for number of accounts needing collection activities. A study of Clark County Washington (1990) of the GOSP program found an 81% reduction in the number of homes behind in payments. Harrigan and Gregory (1994) studying a Niagara Mohawk program found a 99% increase in the number of payments made for a group receiving weatherization and education. They examined payments before and after the program, and adjusted for control group changes.

We used these data as proxies or stand-in values, recognizing that normal bill collection activities and calls would be reduced in proportion to the improvement in bill payment behavior for program participants. These studies found changes in accounts with payment difficulties and collection activities ranging from 0% to 99%. The bulk of the estimates ranged from 7% to 39% reductions, the average was 24.7%, and the computed median value for the estimated reductions was 10%. In computing the default and proxy for this NEB value, we used the mean of the values from the literature review. The mean of 24.7% reduction statistically identical to the 25% reduction in calls reported by the California participant survey conducted in association with this research. It was also very similar to the 27% reduction in collection activities found by Blasnik's 1997 study of Ohio's WAP program, and "collection activities" is a measure that is particularly close to the changes we are trying to measure for this proxy.

We also include a set of activities related to collection efforts that may not be covered by the notices and customer calls analysis. In the case of the California utilities, the third

entry, the utility collection costs, were not separately estimated because the number of calls and notices combine all of these types of efforts. Data are not available separately for "regular" bill payment related calls and those associated with more aggressive collection activities (see next section). The benefit is a real and separate benefit, but at this point data are not available to estimate separate NEBs for both categories.

Table V-11: Computation Method and Proxies Used for This Project

Reduced Notices -- Utility Perspective (7E)

	California-Wide	Computation Description	Source
Item 1	1.100	Average Notices per Low Income Customer	California Utility Data Sheet
Item 2	24.7%	Times Estimated Program-Induced Percentage Reduction in Notices	Selected Research Value (see Yellow table for value and alternates)
Item 3	$5.50	Times the Utility's Marginal Cost per Notice.	California Utility Data Sheet
Item 4	$1.49	Equals Interim Proxy for NEB: Reduced Costs of Notices per household per year	Computed (Item1*Item2*Item3)
Item 5	10	Input: Assumed Years for the Benefit	Assumptions Table
Item 6	1.0	Item 4 Multiplied by Adjustment Factor for Appropriate Horizon	Derived from horizon and discount assumptions from Program Assumptions Table
Item 7	$1.49	Equals Proxy for NEB: Reduced Costs of Notices in terms of per household per year	Computed -- annualized dollars per average participating household per year

Table V-12: Computation Method and Proxies Used for This Project

Reduced Utility Calls -- Utility Perspective (7F)

	California-Wide	Computation Description	Source
Item 1	1.865	Average Calls per Low Income Customer per year	California Utility Data Sheet
Item 2	24.7%	Times Estimated Program-Induced Percentage Reduction in Calls	Selected Research Value (see Yellow table for value and alternates)
Item 3	$3.42	Times the Utility's Marginal Cost per Customer Call	California Utility Data Sheet
Item 4	$1.58	Equals Interim Proxy for NEB: Reduced Net Costs of Customer Calls	Computed (Item1*Item2*Item3)
Item 5	10	Input: Assumed Years for the Benefit	Assumptions Table
Item 6	1.0	Item 4 Multiplied by Adjustment Factor for Appropriate Horizon	Derived from horizon and discount assumptions from Program Assumptions Table
Item 7	$1.58	Equals Proxy for NEB: Reduced Costs from Customer Calls in per household per year terms	Computed -- annualized dollars per average participating household per year

For estimation purposes, we used (1) California utility-specific information regarding the marginal cost of processing calls and notices (where available) and (2) the average of the collection activity-related impacts found in the literature. Information was not available on the percentage of calls that were from eligible customers, so the resulting point estimate likely understates the savings from this source - it may be likely that low-income customers call the utility regarding late payments, notices, etc. more frequently than the average residential customer.

Benefit to Utility/Ratepayer: Lower utility costs are incurred if a percentage of notices and calls are rendered unnecessary because of reductions in bad debt and arrearages from program participation.

Summary / justification: The utilities supplied information on average residential calls and notices per year. Using published studies that examined reductions in bill payment problems subsequent to participation in similar low income weatherization programs, we derived information on the expected reduction in calls and notices to the utility for program participants. The utilities provided estimates of the marginal costs for fielding customer billing calls and sending notices. These data allowed derivation of a proxy NEB using direct computation methods.

Collection Costs

To the extent that a utility expends efforts in attempting to collect late or non-payments (e.g., hiring a collection agency, or assigning additional staff), the utility also realizes some financial savings related to improved payment patterns resulting from low-income weatherization programs. If fewer accounts are in arrears or written off, then collection activities and costs are also reduced. To the extent that the utilities go to outside firms to conduct collections work, many of these firms charge on the basis of a percentage of the monies recovered. Internal utility costs for collection activities are included in previous estimates; in this item we estimate savings from reductions in costs associated with outside collection activities.

Table V-13: Preferred Computation Method, Sources, and Availability Issues

Utility Collection Costs	Preferred Data Element Source	Avail. Status	Best Alternate Source Available
Percent of eligible / participant customers with arrearages reaching collection level	Direct utility tracking / utility records, panel survey, or process/impact evaluation if no "eligibility" indicators	n/a	likely incorporated into and inseparable from the other calls accounted for above
Reduction in percent of participant customers with arrearages reaching collection level	Impact evaluation pre/post with control group	n/a	likely incorporated into and inseparable from the other calls accounted for above
Number of calls and other activities made to garner payment (not including above) per collection customer	Utility cost records / time records	n/a	likely incorporated into and inseparable from the other calls accounted for above
Utility marginal cost per call and other collection activity made by utility	Utility cost records / time records	available for adaptone utility	may have to proportion for other utilities

Table V-14: Preferred Computation Method, Sources, and Availability Issues

Outside Agency Collection Costs	Preferred Data Element Source	Statu Avail.s	Best Alternate Source Available
Annual average amount of eligible customer arrearages forwarded to collection agency (pre)	Direct utility tracking / utility records, panel survey, or process/impact evaluation if no "eligibility" indicators	n/a	not yet provided by utilities -- have them re-investigate if this is deemed high priority for C/E
Reduction in percent of participant customer arrearages forwarded to collection agency (post, with control)	Impact evaluation pre/post with control group	n/a	assume proportional to reduced arrearages if high priority for C/E.
Percent of recoveries retained by collection agencies as their fees	Utility cost records	n/a	re-query utilities or survey collection agencies and ask about rates for similar volume clients

Again, the only literature specific to collection costs is Hart (1993) which identified total collection costs at $50.76. The summary of literature below reflects the wide array of "related" impacts, as described in (and used in) the previous section on notices and calls.

These studies found changes in accounts with payment difficulties and collection activities ranging from 0% to 99%. The bulk of the estimates ranged from 7% to 39% reductions, the average was 24.7%, and the computed median value for the estimated reductions was 10%. In computing the default and proxy NEB value, we used the mean of the values from the literature review. Again, this value closely reflects the change in calls found in the California participant survey conducted for this project (25%), and reflects the change in collection activities needed as estimated in a study for Louisville Gas and Electric.

Given that these costs are often based on the revenues recovered, we propose to adapt related estimation methods. Although we reasoned that the reduction in bad debt anticipated from the program is an appropriate starting place for the calculation for reduced collection costs, we have not undertaken efforts to develop these estimates in this study. Information on "collection" related costs and activities is not available from the utilities, but rather, is embedded in the sections addressing the specific activities (calls, notices, etc.). Therefore, no separate proxy is developed for this non-energy benefit (NEB).

Table V-15: Computation Method and Proxies Used for This Project

Reduced Collection Costs -- Utility Perspective (7G)

	California-Wide	Computation Description	Source
Item 1	$0.00	Times the Utility's Net Marginal Cost For Collection Activities (beyond other notices and calls).	California Utility Data Sheet
Item 2	0%	Times Estimated Program-Induced Percentage Reduction in Collection Costs	Selected Research Value (see Yellow table for value and alternates)
Item 3	$0.00	Equals Interim Proxy for NEB: Reduced Net Costs of Other Collection Activities	Computed (Item1*Item2)
Item 4	10	Input: Assumed Years for the Benefit	Assumptions Table
Item 5	1.0	Item 3 Multiplied by Adjustment Factor for Appropriate Horizon	Derived from horizon and discount assumptions from Program Assumptions Table
Item 6	$0.00	Equals Proxy for NEB: Reduced Net Costs of Additional Collection Activities	Computed -- annualized dollars per average participating household per year

Benefit to Utility/Ratepayer: Lower utility costs are incurred if the need for outside collection activities is reduced.

Summary / Justification: Although the utility would realize savings from reductions in additional collection activities because participant bill-payment behavior is improved, we were unable to identify data for separate bill collection activities by the utilities above and beyond average bill-related calls and notices. Therefore, this benefit is assumed to have zero net to add above and beyond the estimates already included in benefits from fewer calls and notices.

Safety and Health Benefits

Emergency Gas Calls and other Health and Safety Benefits

On-site LIEE program visits can help reduce safety and health problems in several ways. To the extent that LIEE programs conduct safety checks, replace gas appliances as needed and/or inspect and replace faulty gas connectors, benefits accrue to both the utility and the customer in the form of a reduction in safety related problems and emergencies and/or rapid response actions for the utility.

Table V-16: Preferred Computation Method, Sources, and Availability Issues

Gas Emergency Calls	Preferred Data Element Source	Avail.	Status	Best Alternate Source Available
Average number of gas emergency calls (visits and calls) per eligible customer (pre)	Direct utility tracking / utility records, panel survey, or process/impact evaluation if no "eligibility" indicators	n/a		may not need if use reductions from other studies.
Reduction in percent of participant customers with gas emergency calls (post, with control)	Impact evaluation pre/post with control group	similar	study available for similar program (Magouirk)	Magouirk tabulates numbers and changes in specific safety related calls pre/post weatherization (no control group); Adapt Magouirk by scaling cost per reduction for ratio of CA costs to CO costs for calls.
Marginal Cost per gas emergency call (visit and phone)	Utility cost records / time records	adapt	available for one utility	may have to proportion for other utilities

Magouirk (1995) finds significant savings from the avoided emergency gas calls to program participants because gas connections are checked and upgraded when necessary. Based on Public Service Colorado's costs, Magouirk estimates savings of $15.58 per participating household.

Table V-17: Preferred Computation Method, Sources, and Availability Issues

Flex Connectors	Preferred Data Element Source	Avail.	Status	Best Alternate Source Available
Installed cost per flex connector	Cost of flex connectors for program	yes	utilities or supply sources	Benefit not considered important, and will not be part of the program.
Percent of eligible / participant customers currently receiving flex connectors annually after calling for replacement / problems	Direct utility tracking / utility records, panel survey, or process/impact evaluation if no "eligibility" indicators	n/a	not many sources	not many sources; Magouirk has CO data, but program may differ and time has elapsed since Product Safety notice; likely not very appropriate -- may eliminate this benefit.
Percent of eligible / participant customers receiving flex connectors proactively from program annualized	Impact evaluation pre/post with control group	assume	program design	
Avoided cost of separately replacing flex connector in another specific on-site call	Utility cost records / time records	yes	at least one utility has provided minutes for range of types of calls	can be adapted for other utilities

In addition, Magouirk estimates savings from the one-time pro-active replacement of flex connectors (savings were estimated as $5.01 per household). The annual value of these savings can be calculated based on the (1) costs of the connectors ($7 each in Public Service Colorado's case), and (2) the expected lifetime of the benefit and the discounted annual savings. Magouirk's estimate of savings from the associated reduction in emergency gas calls is $1.98. These were relevant savings given the design of Colorado's program, but are not relevant for the California utility LIEE program. This benefit is omitted for the LIEE test.

Table V-18: Preferred Computation Method, Sources, and Availability Issues

Health and Safety - Insurance	Preferred Data Element Source	Avail.	Status	Best Alternate Source Available
Average annual claims from residential gas fires per (eligible low-income) residential customer -- maximum of deductible	Direct utility tracking / utility records, panel survey, or process/impact evaluation if no "eligibility" indicators	n/a	may be available with calls to utility	re-query utilities if priority may be adaptable from Brown steps (see below) or valued using ratio between CA and CO costs and proportioned using Magouirk study. Also Blasnik notes specific safety issues / frequencies found in program inspections.
Percentage reduction in average annual claims from residential gas fires per eligible / participating customers after program (post, with control) OR base on steps from Brown (1993): 1) estimate elderly and non-elderly occupants; 2) fire death rates from insurance data	Impact /process evaluation pre/post with control group Participant survey and insurance data	n/a adapt	may be adaptable from Brown or Magouirk or other studies participant survey and insurance data sources	found in program inspections. Alt method per Brown (1993)
Step 3) percent of deaths avoidable from program (Brown assumed all)	Impact /process evaluation pre/post with control group	assume	no hard data; better to assume less than 100% avoided	Alt method per Brown (1993)
Step 4) expected earnings valuation for elderly and non-elderly residents and value property losses	economic and insurance data	yes		Alt method per Brown (1993)

Several studies can be used to identify program-induced reductions in health and safety related risks. Magouirk's (1995) valuation was based on original research of the percentage reduction in calls after the program (a reduction in households needing on-site calls fell from 27 percent prior to the program to 7 percent after the program). In addition, a study by Blasnik (1997) for Louisville Gas and Electric found that a number of health and safety issues were identified by on-site staff, including gas leaks (23 percent of participants), inadequate draft for space or water heaters (26 percent), high carbon

monoxide levels (9% total with 7% at very high levels). In addition, Blasnik found that 23% of participants had some form of a gas leak in their homes. Adding in the range of other problems found on the site visits, Blasnik's numbers could show a high of 57% of participants with problems (including inadequate ventilation for space or water heaters, high carbon monoxide levels and other problems). Magouirk (1995) also noted a reduction in calls to the utility related to a list of health and safety issues. Clearly, some health and safety problems can be averted through LIEE programs, although few studies look at health and safety problems added to the home as a result of program participation, such as increased levels of CO, CO^2, organic carbons, and radon gas, or increased levels of bio-hazards such as mold spores, pet dander, etc. In addition, few studies look at the health effects of increased or decreased concentrations of particulates such as dust, paint particles and oxides that may concentrate in the home as a result of reduced air changes per hour.

Finally, because explosions and fires can lead to multi-million dollar claims, significant savings can be realized from energy programs (particularly at gas utilities) by reducing these types of risks. Brown (1993) (restated in Megdal 1994) developed estimates of the savings from this source, concluding non-energy benefits from reduced fires would be on the order of $3 in net present value 1989 dollars. Megdal (1994) summarizes the steps involved in the Brown estimates as five steps:

> 1) Estimate the occupants (elderly and non-elderly) in participating homes; 2, Use published fire death rates for elderly and non-elderly, stating that about ten percent are caused by residential heating equipment, to estimate reductions in fire deaths; 3) assume that most of these deaths would be avoided through the program if the program addresses technology and safety issues; 4) value the expected earnings from the elderly and non-elderly residents using data from the Statistical Abstract, and apply the steps to estimate the property value of reduced fires (assuming 25% of fires are avoided, and property values for low-income residents is one-half the national average). The net present value of these computations (in 1993) was $3 per participant.

This benefit may apply in the case of both gas and electric customers if the program repairs or replaces heating appliances, or by reducing the risk of customer shutoffs, which can lead customers to adopt unsafe heating practices in response. Risk is also reduced for gas households in much the same way.

In developing the estimate for the non-energy benefits, we note that many large utilities self-insure for claims up to certain values (on the order of $10 million annually). In these cases, if losses from residential claims can be reduced (and these claims fall below the level of the deductible), this provides direct and full-value savings to the utility and its ratepayers. Beyond these deductible limits the utilities would not realized further direct savings. However, although Skumatz (1996) used this approach, information on insurance claims was not available for use in this study, so other methods were used to derive proxy values for this benefit.

Megdal (1994) suggests that several assumptions made in the Brown fire and safety computations are optimistic and should be revised. This includes modifying the assumption that all fires would be avoided through the program. This is an area that can benefit from additional study. For example, the actions of tightening homes for efficiency can have detrimental effects on indoor air quality, but estimates of these impacts are not readily available.

The estimates for the gas flex connectors depend on whether these types of flex connector checks will be conducted as part of the LIEE program, and whether, in response to the U.S. Consumer Product Safety press release issued several years ago, the utilities have already checked or replaced a large percentage of these connectors, or if they have other programs that routinely check and replace these connectors. Therefore, these benefits are excluded for the LIPPT.

In developing our estimation method for the proxy value for reduced gas emergency calls, we examined the literature for data to use in our calculations. The literature includes several studies that address changes in incidence and value from safety-related aspects of the program. Three estimates were available on the percent reduction of gas emergency calls or trouble calls to homes needing gas appliance repairs or maintenance. These values ranged from a low of a 23% reduction to a high of a 57% reduction. The literature review also found a Colorado study that identified a reduction in problem calls of from 25.9% to 66%, with an average of 46%. The computed mean for these values is 35.7% reduction. For the computation of the proxy value, we used the conservative 23% estimate from a 1997 report using on-site visits to examine gas leaks found for a group of participants in Louisville Gas and Electric's program.

We further tempered these computations using information on the percent of gas emergencies calls that were avoided through programs. Assumptions could be made that the program avoided all potential emergencies. Magouirk (1995) noted a 25.9% to 66% reduction in gas emergency calls after the weatherization program using pre and post participation data (no control group was available). To be conservative, we applied the low 25.9% figure in our calculations.

Other studies in the literature developed estimates of the value of health and safety benefits of LIEE programs. Brown (1993) estimated a net present value of $3 from reduced fires for a nationwide low income weatherization program (using computation methods described above); Magouirk (1995) estimated a $7 savings attributable to the pro-active replacement of flex connectors in a Colorado program.

The benefits from reduced gas emergency calls are estimated from data provided, and are applied only to the percent of overall participants that have gas checks or gas appliances in place. Other health and safety benefits are addressed in other perspectives, including issues related to indoor air quality.

Table V-19: Computation Method and Proxies Used for This Project

Reduced Gas Emergency Calls -- Utility Perspective (7H)

	California-Wide	Computation Description	Source
Item 1	10%	Percent of Participants Receiving Gas Services	Program Assumptions Table
Item 2	23.0%	Percent of Eligible Customers Needing Gas Appliances Fixed	Selected Research Value (see Yellow table for value and alternates)
Item 3	25.9%	Times Percent of Emergencies Avoided through Program Activities	Selected Research Value (see Yellow table for value and alternates)
Item 4	$76.08	Times Utility Marginal Cost Per Emergency Call Avoided	California Utility Data Sheet
Item 5	$0.45	Equals Interim Proxy for NEB: Reduced Net Costs of Reduced Gas Emergency Calls	Computed (Item1*Item2*Item3*Item4)
Item 6	10	Input: Assumed Years for the Benefit / Translating total benefit into annual stream	Assumptions Table
Item 7	0.15	Item 5 Multiplied by Adjustment Factor for Appropriate Horizon	Derived from horizon and discount assumptions from Program Assumptions Table
Item 8	$0.07	Equals Proxy for NEB: Reduced Costs from Reduced Gas Emergency Calls per household per year	Computed -- annualized dollars per average participating household per year

Table V-20: Computation Method and Proxies Used for This Project

Health and Safety Savings -- Utility Perspective (7I)

Computation Method 1 -- Based on Insurance Claims

	California-Wide	Computation Description	Source
Item 1	$0.00	Total Dollar value of Residential H&S Claims from fire and other emergency claims per year -- UNDER deductible (exclusive of insurance reimbursements)	Not currently available from utilities -- would be on California Utility Data Sheet. User entry if known
Item 2	0	Divided by Appropriate number of Customers	California Utility Data Sheet - not yet available. User entry if known
Item 3	0.00	Equals Average H&S Claim dollars shared across Low Income Customer	Computed (as Item1/Item2) (input formula when data available)
Item 4	0%	Times Estimated Program-Induced Percentage Reduction in H&S emergencies	Selected Research Value (see Yellow table for value and alternates)
Item 5	$0.00	Equals Interim Proxy for NEB: Health & Safety Benefits	Computed (Item3*Item4)
Item 6	10	Input: Assumed Years for the Benefit / Translating total benefit into annual stream	Program Assumptions Table
Item 7	0.15	Multiply Item 5 times this Adjustment Factor for Appropriate Horizon	Derived from horizon and discount assumptions from Program Assumptions Table
Item 8	$0.00	Equals Proxy for NEB: Health & Safety Benefits	Computed -- annualized dollars per average participating household per year

Table V-21: Computation Method and Proxies Used for This Project

Health and Safety Savings -- Utility Perspective (7I)

Computation Method 2: Based on Homes with Safety Issues

	California-Wide	Computation Description	Source
Item 1	59.5%	Percent of Homes with Safety Problems	Selected Research Value (see Yellow table for value and alternates)
Item 2	0.0%	Times Estimated Program-Induced Percentage Reduction in H&S emergencies	Selected Research Value (see Yellow table for value and alternates)
Item 3	$0.00	Times Dollar Value of each avoided incident	Not currently available from utility data
Item 4	$0.00	Equals Interim Proxy for NEB: Health & Safety Benefits	Computed (Item1*Item2*Item3)
Item 5	10	Input: Assumed Years for the Benefit / Translating total benefit into annual stream	Program Assumptions Table
Item 6	0.10	Multiply Item 4 times this Adjustment Factor for Appropriate Horizon	Derived from horizon and discount assumptions from Program Assumptions Table
Item 7	$0.00	Equals Proxy for NEB: Health & Safety Benefits	Computed -- annualized dollars per average participating household per year

The point estimate of non-energy benefits from reduced emergency gas calls associated with the LIEE programs were derived using: (1) utility estimates of cost per emergency gas calls and (2) the reduction in the number of calls needed per participating household before and after the program for those receiving relevant gas services.[17] Whatever method used, the costs from avoided phone calls can be included, but have not been separately estimated here. Utility costs for gas emergency calls were available from at least one of the California utilities, and reductions parallel to those assumed for the on-site visits were used to develop the proxy NEB value. This proxy will be larger for utilities with programs that focus on avoidance activities, and smaller for other LIEE programs.

[17] Previous work in Skumatz, (1996) used a second method relies on using the costs calculated for Public Service Colorado's program (Magouirk, 1995), and "scaling" them to California utility estimated costs per call. Colorado estimated reductions per participating at $15.58 per participant based on assumed costs per call of $77.91.

Benefit to Utility/Ratepayer: The utility and ratepayers directly save if the program helps avoid expensive emergency gas calls (on-site and phone and other health and safety problems.

Summary / Justification: Using program design assumptions on the number of program participants receiving gas weatherization services and checks, and information from the literature on 1) the percent of customers in similar programs that needed gas appliances fixed and 2) the percent of gas emergencies avoided through other weatherization programs, we computed the average number of gas calls that could be avoided. We valued these avoided visits at utility-supplied marginal costs for gas emergency calls avoided to develop a proxy for the utility costs from this program-derived health and safety benefit. Data were not available to estimate the avoided utility costs from avoided gas fires that would be reimbursed from utility deductible funds (that is, below the thresholds that would be picked up by utility insurance). This and similar benefits were not included in the computations of NEB proxies because data was not available to support it and because it may be construed as a transfer from the utility to the participants that suffer the fire losses and deaths.

Transmission and Distribution Savings

DSM programs also lead to savings in the form of transmission and distribution losses that do not occur because the power does not have to be delivered. Of course, this needs to be tempered by the level of "take back", if any, by the program participants. However, the energy savings estimates included in the model have already computed the savings net of this take-back effect.

Table V-22: Preferred Computation Method, Sources, and Availability Issues

T&D Loss Reduction	Preferred Data Element Source	Avail.	Status	Best Alternate Source Available
Net energy savings from program per participant	Impact evaluation pre/post with control group	assume	based on impact evaluations from similar previous (CA) programs, measures	
T&D loss percentage	Utility studies, EPRI, etc.	yes	studies available	Use range of 6-7%; but determine if value is to utilities, given T&D different company in dramatic flux -- Use long
Utility avoided cost for energy savings per kWh	Utility cost records	adapt	from one or more utilities	term averages or recent agreements set by state.

The Northwest Power Planning Council (NWPPC, Harris (1996)) provides guidance for utilities comparing conservation to new power alternatives in the form of estimates that it attributes to transmission and distribution. The estimates they use are 7.5 percent for

T&D losses, and 2.5 percent for transmission deferral for a total of 10 percent savings applied to the program's avoided costs.

Numerous other estimates place the direct T&D losses ranging from between 6 and 7.5% of distributed power. Computing the kWh savings from the program and multiplying by the avoided T&D cost of power, we derive an estimate of the T&D savings from the program. Given that California utilities no longer handle both transmission and distribution, for these estimates, we assumed that 4 to 5% would represent the avoided distribution loss, and the remainder would represent the transmission losses, which could be argued to provide savings to society. These values for reduced losses would be applied to the avoided cost of the kilowatt-hours saved through the program.

However, CPUC Resolution E3542 provides estimated T&D avoided cost values that can be used for California Utility program filings. This Resolution includes values for T&D per megawatt hour, and these values provide a direct method of computing savings from T&D losses avoided through California LIEE programs. This computation method and value is presented below. However, given that the LIPPT test includes values for energy savings that include T&D costs, we have set the benefit value to zero in the LIPPT to avoid double-counting this benefit.

Table V-23: Computation Method and Proxies Used for This Project

Reduced Transmission and Distribution Losses -- Utility Perspective (7J) Method 1: Valuing T&D Loss Reductions at Negotiated Values from Regulatory Filings

	California-Wide	Computation Description	Source
Item 1	308	Net Electrical Energy Savings Per Household per Year (kWh/yr)	Program Assumptions Table
Item 2	$0.0057	Avoided T&D costs per kWh - levelized cost for period	CBEE / CPUC, Appendix E for Statewide C/E Input Values
Item 3	1.77	Equals Interim Proxy for NEB: Reduced T&D Losses	Computed (Item1*Item2)
Item 4	10	Input: Assumed Years for the Benefit	Assumptions Table
Item 5	1.0	Item 3 Multiplied by Adjustment Factor for Appropriate Horizon	Derived from horizon and discount assumptions from Program Assumptions Table
Item 6	$1.77	Equals Proxy for NEB: Reduced T&D Losses per household per year	Computed -- annualized dollars per average participating household per year

Benefit to Utility/Ratepayer: Less power through the lines means lower losses and lower power purchase and generation needs.

Summary / Justification: Negotiated values for avoided T&D costs were assigned by the CPUC for the California utilities to use in program year filings. Although they could be assigned as proxies for the T&D benefits from the program, we recognize that for the current computation of the LIPPT benefit-cost test, the avoided costs used to value the energy savings include this benefit and would, therefore, double-count this benefit.

Subsidies Avoided

The program's effect on reducing energy bills leads to a direct reduction in the burden on the Utility's low-income rate subsidy program. The value of the subsidy savings should be based on the specific design of a Utility's assistance program, and on the amount of the program's anticipated energy savings. For example, the California CARE program provides a 15 percent discount off residential rates for qualified customers. These costs are subsidized by ratepayer funds. To the extent that dollars are saved by a reduction in the need for the subsidy, and are not distributed to other low-income customers for other purposes, a reduction in the need for subsidies can lead directly to a reduction in subsidies paid.

Table V-24: Preferred Computation Method, Sources, and Availability Issues

Subsidies avoided	Preferred Data Element Source	Avail.	Status	Best Alternate Source Available
Low-income subsidy per account for eligible low-income customers (pre)	Direct utility tracking / utility records, panel survey, or process/impact evaluation if no "eligibility" indicators	n/a	not yet available / provided from utilities	Determine from filings if available
Percent of participants receiving low-income subsidy	Utility and program records	n/a	not yet available / provided from utilities	Determine from filings if available
Reduction in energy use per participant (post, with control)	Impact evaluation pre/post with control group	assume	based on impact evaluations from similar previous (CA) programs, measures	

Figures from the literature document a range of energy savings associated with a variety of low-income energy programs; in particular, Harrigan and Gregory (1994), Brown et.al. (1993), Cohen and Goldman (1992), and others. The savings estimates from this literature range from a low of 4 percent to Magouirk's (1995) bill reduction figure of 22

percent. Programs with educational components tended to produce higher savings, and other literature indicates that the savings from educational efforts tend to be long-lasting enough to include as a persisting benefit (Skumatz, 2000).

Table V-25: Computation Method and Proxies Used for This Project

Reduced Utility Rate Subsidies -- Utility Perspective (7K)

	California-Wide	Computation Description	Source
Item 1	$48.45	Bill savings per participating household per year	Program Assumptions Table
Item 2	15%	Times rate subsidy percentage	California Utility Data Sheet
Item 3	100%	Percent of participants on "CARE" subsidy	Program Assumptions Table
Item 4	$7.27	Equals Interim Proxy for NEB: Reduced Utility Rate Subsidies	Computed (Item1*item2*item3)
Item 5	10	Input: Assumed Years for the Benefit	Assumptions Table
Item 6	1.0	Item 4 Multiplied by Adjustment Factor for Appropriate Horizon	Derived from horizon and discount assumptions from Program Assumptions Table
Item 7	$7.27	Equals Proxy for NEB: Reduced Utility Rate Subsidies	Computed -- annualized dollars per average participating household per year

The total reduction in subsidies avoided is calculated using: (1) the annual per-participant program subsidy percentage, and (2) the expected bill savings attributable to the program.

Benefit to Utility/Ratepayer: Lower bills for low-income participants reduces draw from rate subsidy program, reducing subsidy from other ratepayers.

Summary / Justification: Direct information is available from the utilities on the percent of bills subsidies offered to residents. Coupled with program assumption information on the percent of participants receiving the CARE subsidy and the average bill savings, direct computations of the savings from this NEB were generated.

Table V.26: Summary of Computed Proxy Values from Ratepayer Perspective

Utility-Related Benefits: Benefits Valued At Utility Costs And Savings

		Annualized Benefits per Participant
7A	Reduced Carrying Cost on Arrearages (interest)	$3.76
7B	Lower Bad Debt Written Off	$0.48
7C	Fewer Shutoffs	$0.05
7D	Fewer Reconnects	$0.02
7E	Fewer Notices	$1.49
7F	Fewer Customer Calls	$1.58
7G	Lower Collection Costs	$0.00
7H	Red'n in emergency gas service calls	$0.07
7I	Utility Health & Safety - Insurance savings only	$0.00
7J	Transmission and/or distribution savings (distribution only)	$0.00
7K	Utility Rate Subsidy Avoided (CARE) payments	$2.77
	Subtotal	$10.22

Chapter 6: Non-Energy Benefits from the Societal Perspective

Benefits from conservation efforts accrue not only to the utility and to participants, but also to the "public at large" or societal benefits. These benefits include direct and secondary economic impacts, environmental benefits, and a variety of other societal benefits. In some cases, societal benefits are actually transfer payments among sectors within society, so the cost-effectiveness test (LIPPT) computations will exclude benefits categories that double count or represent transfers. The design of the California LIPPT is structured so that societal benefits are included in the utilities avoided cost of the energy saved and, as a result, are not counted again in the societal benefits perspectives. As a result, societal benefits are excluded in the California LIPPT model accompanying this report. However, the broad list of benefits is presented in this report so that the reader can understand the range of benefits from the societal point of view.

Economic Benefits

Societal benefits may accrue as secondary benefits to the local or regional economy as a result of a LIEE program. These benefits may include increased employment, earnings, and generated tax revenues; increased economic output, and decreased unemployment payments.

Table VI-1: Preferred Computation Method, Sources, and Availability Issues

Economic Benefits	Preferred Data Element Source	Avail.	Status	Best Alternate Source Available
Program expenditures per participant	Program records	assume		
Net Economic multiplier (direct)	California-based input/output modeling of programmatic impacts; Research studies / impact studies	similar	selecting best from available studies	Best studies assume that funding is diverted from other activities, not newly created funds; large range for multipliers currently: 74%-320% in terms of total output per program expenditure dollar.
Net Economic multiplier (indirect, not included in above)	California-based input/output modeling of programmatic impacts; Research studies / impact studies	similar	selecting best from available studies	Best studies assume that funding is diverted from other activities, not newly created funds.
Net Economic multiplier (jobs, not included in above)	California-based input/output modeling of programmatic impacts; Research studies / impact studies	similar	selecting best from available studies	Best studies assume that funding is diverted from other activities, not newly created funds.

Several agencies have attempted to develop estimates of these types of benefits. Pigg and Dalhoff (1994) provide estimates for economic impacts to the State of Iowa based on different program design aspects. These authors noted that the net economic impact of Iowa's low-income weatherization expenditures of $11.1 million was $14.1 million in industry output, $7.1 million in personal income, $7.6 million in value added, and the creation of 381 jobs. Dalhoff (1996) notes that 64 cents of every dollar spent on the program remained in Iowa as income. Megdal (1992) conducted detailed work developing these types of multipliers for the City of Austin Texas. Additional analysis of economic multipliers and economic impacts has also been conducted in Minnesota, New York, and other locations. Some of these studies have attempted to separate benefits to the local economy from broader economic impacts.

Brown et.al. (1993) also examined these types of economic benefits. The Brown estimates (in net present value terms) include: $55 in taxes from direct employment; $506 in income from indirect employment, and $82 in reduced unemployment benefits from a weatherization program.

Multipliers for both direct and indirect economic and employment benefits have been estimated by numerous studies, and the estimates vary widely. The range of benefit estimations is presented in the Table below, however values are not presented in consistent terms. Some values are reported as program expenditures, while other estimates are based on impacts per one million dollars of energy savings. Most estimates are based on the results from input-output models. However, one key difference between estimates is in the assumptions they make about whether program expenditures and savings streams represent new funds moving into the economy or if they are subtracted from other uses before they are spent on the program or other (Megdal, 1994 phrases this as assuming all investments are “free”). The contractors for this project recommend that economic impact analysis look at both sides of the impact equation. It is impossible to improve an energy program related economy by taking dollars away from an existing economy without harming the economies from which the dollars are removed. Economic impact estimates can be generated based on what types of industries or activities are assumed to be displaces on both sides of the equation. In fact, it could be argued that some program designs can lead to negative net economic benefits once the harm to the economies that provide the program dollars are counted. However, several of the reports reviewed for this effort suggest that typical low-income economies create more jobs and allow more turnover or re-spending in the local or regional markets than dollars paid to energy suppliers, however none of these studies have examined net impacts when the dollars are removed from local economies in the form of public benefit charges on all customer bills. Ignoring the fact that these economic benefits must be “net” leads to overestimates of these impacts.

A review of the available, although admittedly flawed, data on this topic finds that there are four studies estimating direct output multipliers. These studies show estimated impacts of 43% to 91% as program expenditure multipliers (with an average of 63%). Six studies estimating total economic impacts identified multipliers ranging from 74% to 320%, with a mean of 197%. Four studies examining multipliers for program energy

savings identified multipliers ranging from 37% to 120%, providing a mean of 73%. Finally, job creation multipliers were estimated in nine studies. These studies estimated between 5.6 and 71 jobs were created per one million dollars in program expenditures, with an average of 33 jobs per million dollars in expenditures. Unfortunately few studies provided net impact multipliers.

In a more simplistic vein the Northwest Power Planning Council (NWPPC) established a policy related to the calculation of economic benefits from demand-side management (DSM) programs. The NWPPC policy attributes a 10 percent "adder" to the cost of purchased power as an estimate for secondary economic benefits for conservation-based efforts. The NWPPC assumes that a conservation program leads to expenditures within the local area that have greater local impacts than if new power is purchased from outside. This factor is ordinarily assigned to the avoided costs for the program. Discussions with NWPPC staff (Harris (1996) indicates that this economic benefits factor may understate benefits from certain types of programs, and in particular, for low-income weatherization programs. The 10 percent factor was developed for the "average" DSM program; however, weatherization programs tend to use more local supplies and are may be more labor intensive, indicating the factor for LIEE programs in general might appropriately be higher.

Transfer Payments Avoided: Additional societal benefits are realized from lower unemployment benefits because of the potential job creation impacts of LIEE programs. As mentioned above, job multiplier figures based on these factors, but not adjusted for net impacts, range as high as 71 jobs per one million dollars in energy savings.

Table VI-2: Preferred Computation Method, Sources, and Availability Issues

Transfer payments avoided	Preferred Data Element Source	Avail.	Status	Best Alternate Source Available
Program expenditures per participant	Program records	assume		
Net jobs multiplier	California-based input/output modeling of programmatic impacts; Research studies / impact studies	similar	selecting best from available studies	Best studies assume that funding is diverted from other activities, not newly created funds; large range for job multipliers, depending on assumptions -- range 8.5-52 jobs per million spent.
Unemployment benefits per year	State economic records	yes	state unemployment department	

Another method of calculating these benefits is to work with the estimates of number of jobs created from the program, and compute the transfer payments avoided. Full employment situations complicate calculations; however, we assume that the jobs created will shift some employees “up” in jobs and free up lower jobs for currently unemployed workers. Work for Iowa, Minnesota, and others provide estimates of the number of jobs

created for every million dollars spent on the program. Although one of these studies makes an error in assuming that the money is "new" money and not displaced from elsewhere, others provide more rigorous results. Most of these studies are somewhat outdated, but because they are in terms of jobs they can be updated to current salary levels, etc. The other information needed is data on the level of benefits provided and the terms for unemployment benefits.

The methods being applied to compute the economic benefits for the LIEE program follow. It is important to note that all benefits should be "net" of the economic impacts they draw from the expenditures being replaced. Because of concerns about the methods used to compute economic benefits, we estimated the proxy using the lowest figures – both for economic benefits and job creation benefits. In some computations, we eliminated this benefit from the NPV totals included in the LIPPT.

Table VI-3: Computation Method and Proxies Used for This Project

Economic Impacts and Multipliers -- Societal Perspective (8A)

	California-Wide	Computation Description	Source
Item 1	$511.23	Program Expenditures per Participant	Program Assumptions Table
Item 2	0%	Times Direct or Total Economic Multiplier	Selected Research Value (see Yellow table for value and alternates)
Item 3	0%	Add Indirect Multiplier, if appropriate (direct entry from number in Table for Item 2)	Selected Research Value (see Yellow table for value and alternates)
Item 4	5.6	Add Jobs Multiplier, if appropriate, per million in expenditures	Selected Research Value (see Yellow table for value and alternates -- for Item 4, farther right table)
Item 5	0%	Times percent of jobs assumed to be "new" or pulled from unemployment ranks -- Direct Entry by User	Assumption
Item 6	0.00	Multiply Jobs multiplier times Unemployment benefits per created job -- Currently Direct Entry -- Not included currently	Survey of Unemployment in California
Item 7	0.00	Equals Proxy for NEB: Economic & Job Creation Benefits	Computed (as Item1*(Item2+Item3+Item 4*Item5*Item6/1million)
Item 8	1	Input: Assumed Years for the Benefit	Assumptions Table

Table continued

Item 9	0.11	Multiply Item 7 by this computed Adjustment Factor for Appropriate Horizon	Derived from horizon and discount assumptions from Program Assumptions Table
Item 10	$0.00	Equals Proxy for NEB: Economic & Job Creation Benefits	Computed -- annualized dollars per average participating household per year

We reviewed studies from a number of states, including Iowa (Pigg, 1994, Dalhoff, 1996), Nationwide (Brown, 1994), Wisconsin (Hagler 1993), New York (Eisl, cited in Pye, 1996), Tellus, and others. These studies almost universally neglect to examine the impacts of the conservation investments "net" of the output and jobs that would be created in the sectors of the economy the money is being diverted from. Early work for the City of Austin (Megdal) took care to develop estimates using the "net" impacts of conservation programs on the economy. However, unfortunately, these results are fairly regional, and rather dated. Because the design of the studies available have major flaws, and none of the studies relate to California programs, we have elected to exclude these NEB proxies, and included a zero value for the economic benefits from this NEB in the computed LIPPT test benefit-cost ratio.

We have also elected not to include a number of related economic-type benefit categories that have been proposed by others. Numbers are relatively weaker for benefits including the societal benefits from: reduced homelessness, lower burdens on building inspectors, maintenance of the real estate tax base, and others.

Benefit to Society: Investment in programs can have net economic and job creation benefits, with ripple effects in taxes, transfer payments, and other economic output.

Summary / Justification: Although investment in low income weatherization programs can have benefits in terms of production of additional insulation and other weatherization and job creation benefits for installers, program administrators, and manufacturers of weatherization measures, we find that the studies that estimate these benefits are too flawed to use in generating proxy estimates for this benefit. The published studies, on the whole, neglect to subtract the jobs and output lost from diverting the funds spent on conservation from the other sectors of the economy that now have lower expenditures. Thus, the estimates do not represent net benefits from the program. In fact, it is possible that the net economic benefits might be negative, but that is impossible to tell from the studies available, and no studies are available for California. This represents an area that would benefit from further study and estimation work.

Environmental Benefits

DSM programs can provide environmental benefits to the region and to society, particularly due to their role as a pollution abatement strategy. These include assisting in meeting Clean Air Act requirements, reduction in acid rain, and a variety of other environmental benefits. Preferred inputs are provided below.

Table VI-4: Preferred Computation Method, Sources, and Availability Issues

Environmental Benefits	Preferred Data Element Source	Avail.	Status	Best Alternate Source Available
Average power generation fuel mix for the program year	Utility records	adapt	estimates from one utility based on impact evaluations from similar previous (CA) programs, measures	
kWh per participant reduced through the program	Impact evaluation pre/post with control group	assume		
Pollution/emission generation factors by generation fuel type	Environmental studies	yes	multiple sources using California data / accepted values	
Dollar value per ton emission constituent	Environmental studies / Commission records, cap and trade values	yes		
Alternative Method: Negotiated "adders" for gas and electricity saved	Regulatory Agency	Yes	Available from regulatory filings in State	

A number of reports include information on emissions based on generation fuel, including Ottinger et.al. (1990), and Consumer Energy Council of America Research Foundation (1993), Tellus (1993), Hall, Galvin, Enbridge, Woolf, Tellus, and others. Brown, et.al. (1993) develops quantitative estimates of these benefits relative to the low-income weatherization assistance program. Brown attributes a net present value of $172 (1989 dollars, discounted at 4.7 percent over 20 years). The Northwest Power Planning Council (NWPPC, Harris, 1996) provides policy guidance to utilities in the area regarding valuing the benefits from conservation relative to new power. The NWPPC assigns a 15 percent "adder" for environmental benefits associated with conservation programs. This factor is applied to the avoided costs of their programs.

Information is certainly available on several critical components that can be used to derive estimates fairly directly. This includes: the air emissions from each kWh of electricity from a variety of fuel sources, and dollar values for important pollutants and

greenhouse gas (GHG) constituents -- either based on calculated risk, or "cap and trade" values for some limited materials. However, the valuation of environmental benefits is actually extremely complicated. The value of an environmental benefit may be dramatically different depending on the air shed zone, time of day, number of persons in and near the air shed, quality of air, and numerous other factors. The tons of emissions for each greenhouse gas (GHG) constituent varies based on the generation fuel type. Deriving estimates using these generation inputs would require several simplifying assumptions: 1) even though the power may not be generated in California, the benefits still accrue to society, and 2) even though power sources are currently varying dramatically, we are using data provided by the California utilities on "average" power generation fuel mix.[18]

However, in the State of California Board for Energy Efficiency (CBEE) provided recommendations to the California Public Utilities Commission (CPUC) regarding direct environmental externality adders for use in cost effectiveness computations. These values were presented in CPUC Resolution E-3592. Because negotiated numbers exist for California, and these are the "adders" submitted with the program year filings, this is the basis by which we developed the estimates of environmental non-energy benefits. These values increase from $0.062 per kilowatt-hour in 2000 to $0.105 per kilowatt-hour by 2018. The values increase from $0.055 per therm in 2000 to $0.093 per therm in 2018. These figures were applied to the energy savings associated with the program.

This computation method and value is presented below. However, given that the LIPPT test includes avoided cost values for the energy savings calculations that include the environmental benefit, we have set the benefit value to zero in the LIPPT to avoid double-counting this benefit. This may lead to an undercounting of these benefits because the utility environmental externality rates added to the energy costs are less than the rates provided in CPUC Resolution E-3592.

[18] Note that some emissions may not have values if they are non-criteria materials. Also note that, at this point, we are omitting any environmental effects from natural gas measures.

Table VI-5: Computation Method and Proxies Used for This Project

Environmental / Emissions Benefits -- Societal Perspective (8B)

	California-Wide	Computation Description	Source
Item 1	308	Kilowatt hours saved per average participant (per year)	Program Assumptions Table
Item 2	20	Therms saved per average participant (per year)	Program Assumptions Table
Item 3	$0.0071	Environmental Adder for Kilowatt Hours (levelized cost over period covered)	CBEE / Utility Filings for PY 2001 and Forecast Filings
Item 4	$0.0622	Environmental adder for Therms saved (levelized cost over period covered)	CBEE / Utility Filings for PY 2001 and Forecast Filings
Item 5	$3.39	Equals Interim Proxy for NEB: Environmental / emission benefits	Computed -- Item1*Item3+Item2*Item4
Item 6	10	Input: Assumed Years for the Benefit	Assumptions Table
Item 7	1.0	Item 5 Multiplied by Adjustment Factor for Appropriate Horizon	Derived from horizon and discount assumptions from Program Assumptions Table
Item 8	$3.39	Equals Proxy for NEB: Environmental / emission benefits	Computed -- annualized dollars per average participating household per year

We have elected not to include a number of other environmental-related benefits categories that have been proposed by others. Although theoretical cases may be made for some of these benefits, computations of proxy values for benefits including: fuel subsidies, reduced reliance on imported supply, and other benefits would necessarily be based on more tenuous input numbers.

Benefit to Society: Reductions in energy use lead to decreases in harmful emissions, which have economic value especially as communities struggle to meet air quality attainment goals.

Summary / Justification: The CPUC has provided California utilities with agreed-upon cost numbers to use to represent emission and environmental benefits from avoided generation. These figures – available for both gas and electricity – were applied to the assumed kilowatt hour and therm savings from the program and used as the proxy NEB for environmental benefits.
This valuation method was preferred for several reasons. First, it is California-based. Second, the current power environment makes it difficult to make reliable assumptions about the power supply mix (percent generated from gas, oil, coal, etc.) for generation. This is an essential input to deriving estimates of tons of emissions. In addition, estimates of the tons of emissions from various power generation sources are dependent on the specific efficiency and technology involved. And finally, the literature includes a great deal of information on values for emissions – some based on health benefits or avoidance costs, and others based on cap and trade values. However, the values for several of these emissions vary and cause very large "swings" in the computed dollar value of benefits (e.g. CO_2), significantly limiting their usefulness in developing an NEB proxy for this category.

However, because the avoided cost values used for the energy saving for the default LIEE program includes the environmental benefit, we set this NEB value to zero to avoid double-counting.

Health and Safety

One inherent risk that may be reduced through weatherization programs derive from carbon monoxide exposure. This may occur if 1) CO monitors are installed, or 2) equipment is inspected during the site visit. Preferred inputs to the computations are presented below, along with appropriate measurement methods. However, CO monitors are not installed through California programs so this value is not included in the LIPPT.

Table VI-6: Preferred Computation Method, Sources, and Availability Issues

Heath and Safety Improvements	Preferred Data Element Source	Avail.	Status	Best Alternate Source Available
Average cost of health crises annually per eligible account (pre) related to measures included in the program	Impact /process evaluation pre/post with control group	n/a	possibly insurance records or other sources	see next cell below for alternate method
Percent reduction in average costs annually for health crises for participants from program (post, with control) attributable to the measures included in the program	Impact /process evaluation pre/post with control group	n/a	Brown uses information on cost of crises from WI, 100% reduction in crises from program.	Blasnik uses value of the CO and other H&S measures installed per participant -- Appropriate valuation. Therefore, consider using cost of the installed measures.

Brown (1996) cites work in Wisconsin that notes that 4 to 5 “crises” (in this case carbon monoxide related crises) occur per heating season per 400,000 customers in a service territory, and that crises are about twice as likely in low-income households as in the average residential customer’s household. Brown also notes that the average "crises" cost about $5,000 per incident.

Reducing these emergencies through carbon monoxide monitors leads to benefits for the society (through reduced emergency calls and health benefits) as well as to participants whose health is no longer harmed from this source. Certainly, this interpretation understates health benefits from programs; it does not incorporate the benefits of reduced illnesses, hospitalization, lost income, and quality of life issues related to weatherization programs. As discussed earlier, negative impacts may also arise from the program. Indoor air quality issues may also develop, and it would be most appropriate to consider and compute the net benefits associated with these impacts. While California programs do not install CO monitors, and as such there are no benefits associated with CO monitor installations, there may be impacts associated with reducing air exchanges in participant’s homes.

Another method of estimating the value of the health and safety improvements made could be to assume that the cost of making the improvements represents their value. Blasnik uses this method, including the cost of the health and safety-related measures installed as the proxy for the value of the health and safety benefits of the program efforts. For that program, the health and safety improvements cost is $317. This valuation approach is logical and is provided as one estimate of the NEBs for this category.

We also explored the value of the NEB proxy that would be computed applying another valuation method. The Brown work also develops an estimate that can be adapted for California and updated. In this case, the steps involved developing estimates of: (1) the estimated likelihood of a crises in eligible households, coupled with an assumption that all carbon monoxide risks for these households would be eliminated, and (2) the estimated value of the crisis avoided. For this estimation method, we adopted an assumption that somewhat less than 100% of the health and safety incidents would be avoided. The results of the computations of NEB proxies for both methods are provided in the following tables.

Table VI-7: Computation Method and Proxies Used for This Project

Improved Health and Safety Improvements -- Societal Perspective (8C)
Method 1: Value of Health and Safety Equipment Installed spread over the life of the measures (selected method)

	California-Wide	Computation Description	Source
Item 1	$0.00	Cost of Health and Safety Equipment Installed through the Program	Program Assumptions Table
Item 2	0%	Percent of participant homes with H&S measures installed	Program Assumptions Table
Item 3	$0.00	Cost of CO monitors installed	Program Assumptions Table
Item 4	0%	Percent of participant homes with CO monitors installed	Program Assumptions Table
Item 5	$0.00	Equals Proxy for NEB: Health and Safety Improvements per household per year	Computed: Item1*Item2+Item3*Item4
Item 6	7	Input: Assumed Years for the Benefit / Translating total benefit into annual stream	Program Assumptions Table
Item 7	0.16	Multiply this adjustment factor times Item 5 to represent appropriate horizon	Derived from horizon and discount assumptions from Program Assumptions Table
Item 8	$0.00	Equals Proxy for NEB: Health and Safety Improvements per household per year	Computed -- annualized dollars per average participating household per year

Table VI-8: Computation Method and Proxies Used for This Project

Improved Health and Safety Improvements -- Societal Perspective (8C)

Computation Method 2: Valuing Avoided Crises -- Data less reliable (method not selected as default)

	California-Wide	Computation Description	Source
Item 1	0.000011	Average crisis per household	Selected Research Value (see Yellow table for value and alternates)
Item 2	$5,650	Cost per avoided crisis	Selected Research Value (see Yellow table for value and alternates)
Item 3	66%	Reduction in crises per household	Selected Research Value (see Yellow table for value and alternates)
Item 4	$0.04	Equals Proxy for NEB: Health and Safety Improvements	Computed
Item 5	7	Input: Assumed Years for the Benefit / Translating total benefit into annual stream	Program Assumptions Table
Item 6	0.12	Multiply this adjustment factor times Item 4 to represent appropriate horizon	Derived from horizon and discount assumptions from Program Assumptions Table
Item 7	$0.29	Equals Proxy for NEB: Health and Safety Improvements per household per year	Computed -- annualized dollars per average participating household per year

Note that, although these benefits are real to society, they bear similarities to health and safety benefits computed for utility-related savings and participant valued benefits. However, the utility-related benefits included are purely the cost savings from sending staff on fewer gas related emergency calls, because the program solved a percentage of these problems pro-actively. The health and safety benefits computed using participant values (which are described later in this document) use the value of deaths and injuries prevented through program activities. These computations represent distinct and non-overlapping benefits, and therefore, can be included as NEBs appropriate to a broadly-defined public benefits test.

In the case of the default design for the California LIEE programs, we have included no health and safety benefits as these measures are seldom installed by the programs. Therefore, the value of this benefit is zero in the California LIPPT calculations.

Benefit to Society: Heath and safety improvements improve the quality of life for residents of the State, and may help reduce burdens on social infrastructure.

Summary / Justification: We used the assumption that the value of the health and safety (H&S) benefits for the installation of H&S equipment is approximated by their installed costs. Other valuation methods, based on estimates of reduced H&S incidents were rejected because the data were deemed less reliable and were not California or program-based. The level of the benefit was computed to be zero because no H&S equipment is included in the default program design.

Water and Wastewater Savings

Water is a managed resource in California, and development of new supply is costly. To the extent that LIEE programs include measures that save energy for hot water and secondarily save water, everyone in the water supply district benefits. The volume of conserved water can be valued at the water district's avoided cost of conserved water. Deferring development of a dam or new water source (and waste water treatment facility computation) has significant benefits to communities and is an important strategy for keeping rates low.

Table VI-9: Preferred Computation Method, Sources, and Availability Issues

Water and wastewater savings - societal	Preferred Data Element Source	Avail.	Status	Best Alternate Source Available
Average annual water usage reduction per participant household from program (ccf) (post, with control)	Impact /process evaluation pre/post with control group	yes	base on assumed measures installed, red'ns per measure, published water conservation data.	Needs some additional discussion with water conservation officials on appropriate "base" usage assumptions for California equipment and codes
Avoided cost of next water source per ccf	Water / sewer utilities in territory	yes	survey of utilities	

The calculations for water savings are straightforward. Given the number of aerators and low flow showerheads installed per household, we estimate the water savings per household per year. These savings are "net" estimates; that is, they take account of tendencies to take longer showers when the flow is reduced. Given water savings estimates for the LIEE program measures, the avoided cost of the water and wastewater saved is used to estimate the associated NEB. Note that for the "societal" benefit, we do include the wastewater savings, even though monthly waste water bills often do not change based on usage, but are based on an annual "baseload" level of usage, carried throughout the year. This is because the we are focusing on the societal perspective for

this benefit rather than the participant savings valued later in this report, and the societal avoided cost of treatment facilities (and the need for new capacity) is related to usage.[19]

Importantly, SERA and other surveys indicate that some water saving measures have a relatively short expected on-site lifetime – on the order of three years. This is because of the customer acceptance rate for low-flow technologies is shorter than the technical potential for these technologies. Therefore, to be conservative, only three years of savings are included in the LIPPT calculations.

As noted, water and wastewater savings also provide direct bill savings to the program participants. Therefore, it is important to develop estimates that are non-overlapping. The benefit to society should be valued at the avoided costs that are above and beyond that charged through current rates. Although in California, the avoided cost for the next source of supply would likely be high, we need to mitigate this with two factors. First, the program provides savings for only three years, based on the average lifetimes reported. Second, short term avoided cost for water supply (the variable operation cost) is generally quite low. This value is recovered fully through rates. Other avoided cost information, representing the cost of new water supply or the construction of new wastewater treatment facilities was not available from the California utilities. Therefore, we assigned a value of zero as the avoided cost of water savings to society above and beyond that recovered through current residential rates. As a result, the NEB proxy included in the LIPPT for this benefit is set at zero.

Table VI-10: Computation Method and Proxies Used for This Project

Reduced Water / Wastewater Resources -- Societal Perspective (8D)

	California-Wide	Computation Description	Source
Item 1	100%	Percent of households receiving faucet aerators (times number of aerators per household)	Program Assumptions Table
Item 2	1,168	Times water savings per aerator (in gallons per year)	SERA Research, Water Conservation / Utility Literature
Item 3	100%	Plus percent of households receiving low flow showerheads	Program Assumptions Table
Item 4	4,271	Times water savings per showerhead (in gallons per year)	SERA Research, Water Conservation / Utility Literature

[19] To be conservative, we do not include avoided wastewater costs for the participant benefit, even though they would likely have lower "baseload" usage, and therefore lower rates.

Item 5	5,439	Equals water savings per average participating household in gallons per year	Computed
Item 6	7.3	Divided by 748 translates from gallons to CCF (hundred cubic feet of water) or "units" used for rates	Equality: One hundred cubic feet = 748 gallons
Item 7	$0.00	Times Combined Water and Sewer Rates: First, Water Rates per "unit". Assumed to be "0" because avoided cost over the term of the water benefits are fully recovered through residential rates.	SERA Water Rate Survey, California
Item 8	$0.00	Avoided cost per "unit"	SERA Water Rate Survey, California
Item 9	$0.00	Add Sewer Rates (may be "0" if bills don't change with water use)	Selected Research Value (see Yellow table for value and alternates)
Item 10	0%	Adjust wastewater rates to avoided cost. Multiply wastewater rates times avoided cost/billed rates	SERA Water Rate Survey, California
Item 11	$0.00	Equals Interim Proxy for NEB: Water and Sewer Bill Savings	Computed (as Item6*(Item8+Item9+Item10)
Item 12	3	Input: Assumed Years for the Benefit	Assumptions Table
Item 13	0.3	Item 11 Multiplied by Adjustment Factor for Appropriate Horizon incorporating discount rate	Derived from horizon and discount assumptions from Program Assumptions Table
Item 14	$0.00	Equals Proxy for NEB: Water and Sewer Bill Savings	Computed -- annualized dollars per average participating household per year

Benefit to Society: Reduced water and wastewater use can help delay the development of a dam or next water supply, a source of real financial savings to the communities.

Summary / Justification: The public benefit from avoided resource development can be very high, and would be appropriately valued at the avoided costs net of the costs covered by residential rates (valued elsewhere). However, the program's water benefits are assumed to be short term (three years). The short term avoided cost for water and wastewater utilities is quite low (e.g. the marginal cost of pumping and chemicals) and is fully recovered from rates. Longer term avoided costs, which might be expected to be high, were not available from the relevant water utilities, and would probably not be relevant because the program provides only short term water savings (3 years).

Table VI.11: Computed Proxy Values of NEBs from Societal Perspective

Societal / Public Benefits: Benefits Beyond Utility And Participants

	NEB Category	Annualized Benefits per Participant
8A	Economic impact (direct and indirect employment)	$0.00
8B	Emissions / Environmental	$0.00
8C	Health and Safety Equipment (CO and Other H&S)	$0.00
8D	Water and wastewater (avoided)	$0.00
	Subtotal	$0.00

Chapter 7: Non-Energy Benefits from the Participant Perspective

Introduction and Literature

The literature contains a limited amount of information useful in developing estimates of the non-energy benefits associated with the California Low-income Energy Programs (LIEE) from both the utility and societal perspective. However, with the exception of Brown et.al. (1993) there is a significant shortage of information on quantitative estimates of non-energy benefits from the customer point of view. Although a few authors developed lists of the types of benefits that they hypothesized LIEE programs create, and conducted a few surveys asked about whether customers perceived improvements in some areas, Brown's work represents the only numeric attempt at valuing these benefits until work conducted for PG&E in 1995 and 1996.

Categories of Benefits

Weatherization and other LIEE programs deliver important benefits to the participants. The literature[20] presents an overlapping list that includes the following (presented in the terms the authors used):

Table VII-1: Assembled Participant-Side Non-Energy Benefits from the Literature

Participant Non-Energy Benefits Hypothesized in the Literature	
• Improved indoor environment and comfort • Improved health and safety • Reduced noise • Labor and time savings • Improved process control • Increased amenity or convenience • Water savings, sewer savings, and waste minimization • Direct and indirect benefits from downsizing of equipment • Reduced mobility • Increased housing value • Lower use of alternative fuels (e.g. wood) • Improved service from equipment / housing stock	• Housing stock value, extended lifetime of dwelling, and neighborhood preservation • Housing stock (reduced fire, etc.) • Reduced foreclosures and evictions • Reduced transactions costs • Fewer illnesses and lost time / income / education • Fewer service terminations, interruptions, fees, lost rental value, lost value of service, cost to restart, fewer calls • Lower arrears, fewer calls, lower concerns regarding bills, bill-payment issues • Self esteem • Quality, comfort, aesthetics

Additional, very specific benefits are identified in the literature for each of a range of measures and interventions based on telephone surveys with LIEE participants (Skumatz,

[20] Including Brown, et.al. (1993), Mills and Rosenfeld (1994), Megdal (1994) and Skumatz (1996), Khawaja, Koss, and Rice-Powers (1998).

1999, 2000). The participant-side benefits have been grouped in various ways in the literature, but, to minimize issues of double-counting, we find it convenient to group them as presented in the following table. However, benefits could not be estimated for all the categories.

Table VII-2: Participant Side Non-Energy Benefits For This Study

Participant Side Non-Energy Benefits Proxies Considered For This Study
• Improved Bill-payment and termination-related benefits o Fewer bill-related calls to the utility o Decreased number of notices and shutoffs for non-payment o Fewer service terminations: including value of service, cost to restart, lost rental value during termination o Fewer bill payment concerns / hassles o Avoiding moves/relocation of household – direct expenses and benefits for near and longer-term incomes for residents (and children)
• Education-related benefits o Greater control over bills / energy use o Reduced transactions costs / locating equipment, what to look for o Other value of education: persistence of savings, understanding, etc.
• Housing stock improvements o Housing stock value / neighborhood preservation o
• Health, and safety o o Safety issues (fires, etc.) and implications for housing value o Reduced illnesses: including fewer lost days at work and school, greater income, greater education and related benefits
• Equipment-Related Improvements o Reliability and maintenance of equipment-related changes o Greater service from equipment – more options and features: better control over temperature, more options on equipment
• Other utility savings o Water and sewer bill savings o Savings on other non-energy bills
• Other benefits and negatives of the program o “Control” over the bill o Comfort benefits o Noise reduction benefits o Maintenance improvements o Value of benefits to environment o “Hassle” of the program o Other benefits or costs

Methods of Generating Estimates

Estimates have been generated for a number of these categories; for example, water savings, bill and termination benefits, health and safety, housing stock improvements, etc.[21] However, estimates have not been generated for many of the "softer" benefits, especially those related to concerns, comfort, hardship, "control" over bills, program participation hassles, maintenance issues, environmental benefits, education benefits, and several others. In this work, we intend to derive estimates using two methods:

- **Computational Methods**: These methods will be used to derive estimates related to utility calls, termination costs, lost rental value, avoided moves, housing value, safety and health issues, water/sewer bills, and similar benefits. These computations involve methods similar to those applied to the utility and environmental benefits: such as "value" multiplied by "impact", or change expected from the program. For example, we might examine the value of the time involved in making calls to the utility, times the reduction in the number of customer calls because arrearages have been reduced.

- **Participant Surveys**: Surveys of a number of participants in similar programs within the State of California will be used to develop quantitative estimates of values associated with a number of these benefits categories, including: number of calls to the utility, "concern" about bills, comfort, noise, appearance of the house, reliability and maintenance, options and features of the appliances/measures, environmental issues, changes in sickness, value of the education provided (if any), feelings of control over bills and use of energy, water savings, savings on non-energy bills, "hassles" associated with participating in the program, avoiding moves and the relocation of the household, number of notices and shutoffs for non-payment, bill-payment frequency benefits, and other benefits.

In some cases, we estimate the benefits using both of the methods described above and compare the results for the NEB categories to determine the most supportable estimate.

Importance of Participant-Side Benefits

Ignoring non-energy benefits to the LIEE program participants significantly understates their value to the participant and to society at large. Previous research indicates these benefits are important to program participants. Thus, benefit tests that ignore these benefits may lead to reduced or under-valued public benefit investment decisions for these programs. Quantifying and assessing these benefits can help program designers improve the focus and technology selections for their programs in a way that increases participant value. Targeting and design can be adjusted to maximize the total energy and

[21] Primarily in Brown, et.al. (1993) and Skumatz (1996-2000). Howat and Oppenheim (2000) also provided adapted numbers from Skumatz.

non-energy benefits for a given program budget. This is a benefit to all involved; utility and ratepayers, society, and participants. Finally, low-income programs are frequently undertaken for policy reasons, reasons that are beyond costs and benefits. Understanding the nature of these benefits helps understand the value of the program to each of these three sectors. Measures of reductions in "hardship" and other benefits of participation helps provide a more complete picture of the non-energy benefits accruing from LIEE programs. This project is designed to develop credible estimates of these benefits.

The few existing studies that attempt to measure these hard-to-quantify benefits indicate that this category of NEBs may be fairly large. Many of the types of benefits (comfort, noise, safety, control, service, and others) were valued highly by program participants. Using detailed customer interviews with large samples of participants in both the PG&E territory and Seattle City Light territory, Skumatz (1997), and Skumatz, Dickerson, and Coates (2000) found that these NEBs represent benefits valued on the order of 50% and more of the energy savings. Given this order of magnitude, it is clear that ignoring these benefits can understate the value the customer places on the programs. This work also articulated the importance of understanding these benefits for program targeting, marketing, and design. In addition, these studies pointed out that water benefits and other fairly quantifiable benefits provide additional savings for participants.

Discussion of Survey Approach

For this study, we intended to build on these past studies, and wanted to explore quantitative approaches to develop more refined estimates of important auxiliary participant benefits.

"Willingness to Pay" Surveys

The bulk of the research on NEBs has concentrated on utility and environmental benefits (adapted from regulatory proceedings related to emissions and values). Other than a few estimates of housing value improvements (Brown/ORNL, and others that adapted her results), the literature quantifying hardship and participant benefits is virtually non-existent. Because of the lack of supporting data, SERA designed and conducted a telephone survey with California LIEE program participants to develop value estimates associated with many of the participant benefits provided through the California programs.

The literature uses "willingness to pay" (WTP) surveys to develop estimates of hard to measure benefits; for example, public goods like parks or green areas. This WTP approach was used as a key component in developing LIPPT estimates of hardship and other difficult to measure benefits. The question presented to participants generally took the form "what is the amount you would be willing to pay (per month) for the <*insert benefit*> you obtained after it was weatherized". We asked participants for dollar amounts. For those who could not directly assign a dollar value, we asked them whether

the benefit was worth more or less than "x" dollars per month, if they said more, then we asked them the same question using a higher dollar value until we were able to "bracket" their best approximation of their value for the NEB. This is a "willingness to pay" approach, and there is considerable literature on the strengths and weaknesses of this approach. While the questions can be hard for some respondents to answer, through careful question construction, answers can be determined and the values associated with the benefits (positive and negative) can be estimated. This approach was used to develop estimated values for a number for NEBs included in the LIPPT, including assessments of "comfort" and "hardship."

Data Gathering

A sample of 321 participants from recent, LIEE programs in each of the utility service areas were contacted by telephone. Respondents were asked to enumerate the non-energy benefits they recognized from the program. Then, for each of a set of key benefits (including those they identified on their own) we asked whether that benefit occurred and how important it was. We then asked them value this benefit by asking their "willingness to pay" (WTP) for the benefit. Finally, for the entire set of benefits, we ask respondents to tell us their willingness to pay for the entire set of changes (positive and negative). This was used to check for the consistency of the answers to the individual benefits categories that they provided earlier. This approach provided specific dollar values to use in the LIPPT for participant-valued benefits.

The following are the categories that were valued in the participant survey:

- Number of calls to the utility
- "Concern" about bills, etc.
- Comfort
- Noise
- Appearance of the house (internal and external)
- Reliability and maintenance
- Options and features of the appliances/measures
- Environment
- Changes in sickness
- Value of the education provided (if any)
- Feeling of control over bills / energy use
- Water savings and savings on other non-energy bills
- "Hassle" of the program
- Avoiding moves/relocation of household
- Number of notices and shutoffs for non-payment
- Value of avoided outages

In order to make the assessments as fair and balanced as possible, the questionnaire design took pains not to pre-judge whether there were positive or negative changes associated with the program. Both positive and negative values were reported. The

survey included participants from all four utility service territories, and requested information on demographics and location, that can be used for refining benefit estimates based on specific program designs. Data from this survey was used in deriving several of the proxy values for the NEBs described in this section.

Improved Bill Payment and Termination-Related Benefits

Fewer Bill-Related Calls to the Utility

As participants realize energy savings from LIEE program participation, their bills decrease. As a result participants presumed to be better able to pay their bills. Without payment problems, participants may reduce the number of contacts with the utility to address bill payment issues. On the utility side, we developed estimates of the utility cost savings from a decrease in customer contacts. However participants themselves also save time when telephone calls and direct contact about a bill problem is not needed. These are the benefits estimated here. The "hardship" related benefits participants may realize from being less worried about the bills are discussed in a later section of this report.

A review of the literature found no studies directly addressing a reduction in the number of utility calls caused by a LIEE program. However, we found more than two dozen estimates from studies that addressed related topics, including reductions in the number of accounts with bill payment difficulties, reductions in number of accounts written off for bad debt, and collection-related reductions for LIEE program participants. These benefits are discussed in the utility benefits section presented earlier in this report. Estimates for these benefits ranged from no change (0% reduction) to a 99% reduction. The majority of studies ranged from a 7% reduction to 39% reduction for collection-related benefits, which we assume can be applied proportionally to calls and other collection-related or bill-related actions. The average impact from these studies is a 24.7% reduction. In addition, we were able to check this value using the data from the willingness to pay survey. Based on the responses from participants, we estimated a 25% reduction in calls to the utility after participation in the LIEE program. This corroborated the average from the studies. Therefore, we were comfortable using the 24.7% figure in the computation for a proxy value for the NEB of "fewer calls to the utility."

Table VII-3: Preferred Computation Method, Sources, and Availability Issues

Fewer bill related calls to utility	Preferred Data Element Source	Avail.	Status	Best Alternate Source Available
Average bill-related calls to utility per eligible low-income account	Direct utility tracking / utility records, panel survey, or process/impact evaluation if no "eligibility" indicators	adapt	total residential calls for all reasons, not low-income, not billing only	May need to use residential averages
Percent reduction in bill-related calls to utility from program participation (post, with control)	Impact /process evaluation pre/post with control group	adapt	can assume it is proportional to reduction in number of customers with bad debt or arrearages	Data on reduction in number of accounts written off for bad debt ranges from 1%-84% reduction; reduction in accounts classified as bill payment problems ranges from 8%-15%; change in number of payments 10%-115%. Also Blasnik (1997) notes 27% reduction in collection-related activities
Average participant value (WTP) for reduced billing related calls, annualized	Participant WTP survey	WTP		
OR valued at average time per call valued at minimum wage	OR utility records and economic data	yes	one utility provided minutes by call type; econ data on wages	

This 24.7% figure is the same reduction assumed for the utility benefit, except for the participant perspective the benefit it is valued by the participant, while the utility benefit is valued at the utility's marginal cost per call.

To be conservative, we have valued the participant time at minimum wage. This can be modified by users in two ways. They can assign a "premium" to the value of time, if the user assumes that leisure time is more valuable than working time. Attendees of the Public Workshop recalled studies conducted in the 1970s that assigned the value of non-employment related time up to four times the value of employment related time for low-income customers. A second method of adjusting the values is be to compute the average wage per "eligible" household (using the 150% of poverty eligibility criteria) and use that as the average wage value instead. Obviously, both numbers can be adjusted as appropriate, depending on the user's confidence in various studies and techniques. We use the conservative assumption of minimum wage, with no added value for a "leisure time premium".

Table VII-4: Computation Method and Proxies Used for This Project

Reduced Utility Calls -- Participant Perspective (9C)

	California-Wide	Computation Description	Source
Item 1	1.865	Average Calls per Low Income Customer per year	California Utility Data Sheet
Item 2	24.7%	Times Estimated Program-Induced Percentage Reduction in Calls	Selected Research Value (see Yellow table for value and alternates)
Item 3	3.5	Times average minutes per call	California Utility Data Sheet
Item 4	$6.75	Times minimum wage rate	California data
Item 5	1.0	Times "premium", if any, for leisure time valuation relative to minimum wage -- multiple for value of time	User entry -- number should range between 1 and perhaps 4 based on feedback from RRM members. Conservative value default=1.
Item 6	$0.18	Equals Interim Proxy for NEB: Reduced Net Costs of Customer Calls	Computed (Item1*Item2*Item4*Item5*Item3/60)
Item 7	10	Input: Assumed Years for the Benefit	Program Assumptions Table
Item 8	1.0	Multiply Item 6 by this Adjustment Factor for Appropriate Horizon	Derived from horizon and discount assumptions from Program Assumptions Table
Item 9	$0.18	Equals Proxy for NEB: Reduced Costs from Customer Calls in per household per year terms	Computed -- annualized dollars per average participating household per year

Fewer Service Terminations.

Providing customers with LIEE services and education that reduces energy use also helps customers reduce bills and presumably improves their payment record. As a results participants experience fewer arrearages and are less likely to be disconnected as a result of non payment (TONP).

Table VI(-5: Preferred Computation Method, Sources, and Availability Issues

Avoided shutoffs / disconnections	Preferred Data Element Source	Avail.	Status	Best Alternate Source Available
Average annual disconnections per eligible low-income customer (pre)	Direct utility tracking / utility records, panel survey, or process/impact evaluation if no "eligibility" indicators	n/a	only shutoffs for all accounts, C&I	May need to use average for all accounts
Percent reduction in average annual disconnections for participants from program (post, with control)	Impact /process evaluation pre/post with control group	similar	some limited studies from similar programs elsewhere / not strong	Magouirk, Blasnik and others contain results on reductions. Other studies do not value participant benefits, only utility savings.
Average participant value (WTP) for each reduced disconnection , annualized	Participant Willingness to Pay (WTP) survey	WTP		

Table VII-6: Preferred Computation Method, Sources, and Availability Issues

Fewer restarts	Preferred Data Element Source	Avail.	Status	Best Alternate Source Available
Average annual restarts per eligible low-income customers (pre)	Direct utility tracking / utility records, panel survey, or process/impact evaluation if no "eligibility" indicators	n/a	only reconnects for all accounts, C&I	may need to use averages across all accounts, but that will likely misrepresent low-income. May need to ask utilities to look again if high priority
Percent reduction in average annual reconnections for participants from program (post, with control)	Impact /process evaluation pre/post with control group	n/a		adapt from studies of disconnects above and scale with utility-reported differences in counts of disconnects / reconnects (although utility data includes residential and commercial)
Average participant value (WTP) for each reduced restart OR Reconnection fee plus cost of additional payments to be reconnected.	Participant WTP survey OR reconnect fee plus required arrearage payments	WTP	Utility reconnect fee (available) plus arrearage required on payment (n/a)	

Table VII-7: Preferred Computation Method, Sources, and Availability Issues

Lost housing value during shutoffs	Preferred Data Element Source	Statu Avail.s	Best Alternate Source Available
Included in shutoff valuations above			

Valuing these benefits can be accomplished in several ways. In previous work for PG&E Skumatz (1996) explored the following methods.

- Value-of-service surveys by utilities often ask for responses from customers regarding what they would be willing to pay to avoid service termination. These figures provide a customer-based value on service disruption, and provide area- and utility-specific information. Note, however, although these responses generally address unanticipated outages, and responses would be expected to differ based on income group.

- Another method would be to estimate the cost to residents of getting power restored, including the cost of borrowing and lost time in arranging reconnection.

- A third method examines the lost value of the dwelling from it being uninhabitable for the term of the service disconnection. Precedent for this type of valuation is based in state and local housing ordinances, which at least in some areas, specify the formula to be used to value lost services from landlord neglect and loss of essential services (Colton, 1996b; Tackett, 1996).

Another method of valuing this benefit is to conduct a survey and ask participants to establish an estimated dollar value in terms of willingness to pay (WTP) to not be shut off.[22] This can provide a direct method of assessing the participant value of this benefit.

Benefits accrue to residents when shutoffs are reduced. Homes with no electric power provide a substantially lower quality of life and this has impacts related to the ability of the home to be occupied. When this occurs in rental homes the home has lower or "lost rental value." Calculating lost value requires information on average rent paid by the resident, percent of housing "service" lost from the shutoff (lower heat, no windows, but still have a place to live, so less than 100% lost service level), and the length of time of

[22] To some extent, it is unclear how appropriate the question would be since paying would stop the TONP, but with work, this could be used as a fairly direct method of achieving a dollar value for the benefit category.

the average shutoff. The utilities did not have information on the average length of shut-off, so further estimation of these benefits was not conducted.[23]

[23] One reviewer was skeptical of this benefit, arguing that the loss of rental value was a "choice" that the resident made in not paying their bill.

For reconnects, we can estimate the participant NEBs based on two components:

- Lower (fewer) reconnect fees paid, and
- The borrowing cost (interest) associated with the payments they need to make on their bill in order to be reconnected.

Although we might make a conservative assumption on the relevant interest rates (for example, 18% credit card rates could be called conservative estimate), the utilities did not have data on the dollar value of the payments required on overdue bills to have service reconnected, so this aspect of the benefit was not computed. The model (and table below) provides LIPPT users or utilities that have this information with a place to incorporate these values and compute more comprehensive NEB estimates.

The participant willingness to pay survey provided an estimate of the value that residents report placing on reduced shutoffs. The overall average across all respondents was $21.41. One complexity introduced from using willingness to pay surveys is that residents may not be very good at separating the benefits associated with fewer terminations, from those benefits associated with fewer reconnects. In this case, only a combined benefit may be calculated. The computed proxy value for this benefit, using information from the utilities on the number of shutoffs, and an assuming a 24.7% reduction in shutoffs from the program, would provide an estimated benefit of about $1.30 per participant. Although this computation is derived from California and other data, the resulting proxy value is higher than that computed using the other methods discussed. Therefore, to be conservative, for the computation of benefits participants derive from reduced shutoffs used in the LIPPT, we used the methods shown in the following two tables.

Table VII-8: Computation Method and Proxies Used for This Project

Reduced Shutoffs -- Participant Perspective (9B)

	California-Wide	Computation Description	Source
Item 1	0.0279	Average Shutoffs per Low Income Customer per year	California Utility Data Sheet
Item 2	23.0%	Times Estimated Program-Induced Percentage Reduction in Shutoffs	Selected Research Value (see Yellow table for value and alternates)
Item 3	$0.00	Times Customer Value per shutoff	fill in from WTP survey or use Value of Service study. See Yellow table referenced
Item 4	$0.00	Plus Rental value of Home per month (if user wants value included: otherwise enter "0")	User entry; conservative default=0
Item 5	0%	Times percent of home's service that was lost through the shutoff	User entry. Conservative default = 0%; RRM discussion
Item 6	0%	Times percent of month that the power was shutoff (period with lower service from home) -- in Percent of month	User entry -- need data from utilities or conduct interview with customer service staff. Conservative default value=0
Item 7	8.0	Plus Hours resident spends getting power returned	User entry -- need data from utilities or conduct interview with customer service staff. Conservative default value=8
Item 8	$6.75	Times minimum wage	Program Assumptions Sheet
Item 9	1.0	Times "premium" above minimum wage that customer values their time	Multiple of minimum wage at which participants value their leisure time: RRM discussions indicate value between 1 and 4 -- User entry. Conservative default=1.
Item 10	$0.35	Equals Proxy for NEB: Reduced Net Costs for Shutoffs -- in Annual Terms	Computed (Item1*Item2(Item3+Item4*Item 5*Item6+Item7*Item8*Item9)
Item 11	3	Input: Assumed Years for the Benefit	Assumptions Table
Item 12	0.5	Item 10 Multiplied by Adjustment Factor for Appropriate Horizon	Derived from horizon and discount assumptions from Program Assumptions Table
Item 13	$0.17	Equals Proxy for NEB: Reduced Net Costs for Shutoffs	Computed -- annualized dollars per average participating household per year

Table VII-9: Computation Method and Proxies Used for This Project

Reduced Reconnects -- Participant Perspective (9D)

	California-Wide	Computation Description	Source
Item 1	0.0192	Average Reconnects per Low Income Customer per year	California Utility Data Sheet
Item 2	23.0%	Times Estimated Program-Induced Percentage Reduction in Reconnects	Selected Research Value (see Yellow table for value and alternates)
Item 3	$17.93	Times utility reconnect fee	California Utility Data Sheet
Item 4	$0.00	Plus required payment	User fill in this number unless source found
Item 5	$0.18	Times interest rate time required payment	Interest rate for borrowing rate assuming participants borrowed the required payment; temporarily credit card interest rate -- User entry currently
Item 6	$0.08	Equals Interim Proxy for NEB: Reduced Net Costs of Reconnects	Computed (Item1*Item2*Item3+Item1*Item2*Item4*Item5)
Item 7	10	Input: Assumed Years for the Benefit	Assumptions Table
Item 8	1.0	Multiply Item 6 by this Adjustment Factor for Appropriate Horizon	Derived from horizon and discount assumptions from Program Assumptions Table
Item 9	$0.08	Equals Proxy for NEB: Reduced Net Costs of Reconnects	Computed -- annualized dollars per average participating household per year

Reduced Homelessness and Mobility

High energy costs can make it difficult for residential customers to keep up with all of their household bills, and this may include rent or mortgage payments. There are several costs associated with homelessness and mobility, some direct, and some less direct.

Table VII-10: Preferred Computation Method, Sources, and Availability Issues

Reduced direct moving costs	Preferred Data Element Source	Avail.	Status	Best Alternate Source Available
Average annual moves per eligible low-income customers (pre)	Impact /process evaluation pre/post with control group	n/a		possibly available from past impact evaluation surveys for similar programs / ineligibles for impact survey -- but info may not have been retained; Only need termination information if use method in next cell below.
Percent reduction in average annual moves for participants from program (post, with control)	Impact /process evaluation pre/post with control group	n/a or adapt		adapt using information from Brown on home abandonment after service termination (32% electricity, 22% gas) and information on reduction in terminations; Have some service termination information; method will underestimate effect because only abandonments.
Net out of pocket costs for average move (new first/last month rent plus security deposit plus direct moving costs/truck rental, etc. less rebated security deposit)	Participant survey or impact / process evaluation	n/a or adapt	participant survey or information from housing authority / assistance sources or evaluation	
Average hours spent looking for new dwelling	Participant survey	adapt	participant survey or information from housing authority / assistance sources	
Minimum wage	Economic data	yes	economic data	
Interest rate for borrowed down payment (if borrowed)				

Brown et.al. (1993) notes that efficiency improvements can play a role in reducing evictions, by maintaining low-income housing availability, and therefore, tenancy. Brown estimates that weatherization efforts may, conservatively, prevent two vacancies per 100 LIEE participants. Rough calculations from Brown (1993) related to the avoided cost of reduced mobility averaged less than $1 per weatherized dwelling

Direct costs for a move include the cost of the move, the expense and time searching for a new dwelling, the costs associated with securing a new location (damage deposits, first

and last rent, etc.), and the time spent arranging for new services, change of address, etc. The components involved in estimating these benefits are included in the table below.

Table VII-11: Preferred Computation Method, Sources, and Availability Issues

Indirect impacts from fewer moves - education/earnings	Preferred Data Element Source	Avail.	Status	Best Alternate Source Available
Average annual "frequent movers" per eligible low-income customers (pre)	Impact /process evaluation pre/post with control group	n/a or adapt	weak information from studies (Colton)	little other than Colton available directly on point.
Percent reduction in average annual "frequent movers" for participants from program (post, with control)	Impact /process evaluation pre/post with control group	n/a or adapt	weak information from studies (Colton)	
Change in education dropout rate for frequent moving households	Impact /process evaluation pre/post with control group	adapt	weak information from studies (Colton)	
Discounted value of earnings differential for dropouts vs. completed school	Economic / education data	yes	education data	
Average number of children 5-18 in participating households	Participant survey / records	adapt	participant survey or use census data for area low-income hh's	possibly available from past low-income program impact surveys from utilities

In considering indirect benefits associated with reduced moves, in another interpretation of the data (Skumatz, 1996) increased that estimate to a reduction of 7.5 moves per 100 participants. Based on a recent study of Head Start families by Colton (1996), it can be argued that one of the most important benefits that may accrue from reducing household mobility is associated with reducing high school dropout rates. Colton (1996) notes that households he classifies as "frequent movers" have high school dropout rates four times as high as families that move less frequently. Colton notes that in his study, 40 percent of the families were "frequent movers", and 50 percent of households that moved frequently cited high energy bills as an important factor in moving. To the extent that the LIEE program reduces household mobility, previous work for PG&E calculates the non-energy benefits from lower dropout rates, valued by the difference in wages for high school graduates compared to dropouts.

The secondary literature that forms important parts of these calculations are admittedly not strong. Therefore, we developed estimates based on the information available. This area is also suggested as a priority for future research, especially since some information (See Skumatz, 1996) indicates the indirect and secondary impacts of moving lead to lower education attainment by residents and their children, affecting lifetime earnings for the affected low-income children.

The weakest link is the impact of energy bills on moving. There is some limited literature on this issue. For example, Pye (1996) cites a Philadelphia study showing that over a 5 year period, 32% of homes of residential electric customers with service terminated were abandoned within a year, and 22% for gas customers. Low-income homes were found to be abandoned twice as frequently as others. Brown (1993) estimates a 47% reduction in occupancy changes after weatherization (using a control group study). Blasnik (1997) estimates that six moves per 1000 participants (0.006 moves per participating household) were avoided through the low-income weatherization program in Louisville. This estimate was derived examining the turnover in new party meters pre and post with a control group. Note that the program in Louisville had a very low percentage of renters (only 16%). Therefore, the 0.6% figure is probably lower than the level that would be achieved in programs with more renters. However, this data can be used to develop reasonable estimates of the direct avoided move-related benefits for participants.

In addition, the willingness to pay (WTP) survey conducted in association with this project provides another source of estimates of the participant benefits from avoided moves. In response to the question about whether the work done on their home helped them avoid having to move to another home, 8% of respondents reported “yes, maybe”, and another 16% reported “yes, definitely”. Three-quarters reported no, and another 2% refused or didn’t know. Thus, conservatively, one in six residents reported a move was definitely avoided. Ninety percent reported that the move was due to the energy savings or the program measures installed in the home; only 10% stated the avoided move was due to other reasons. The estimated willingness to pay based on the survey responses was $19.46. An estimate of the value of avoided moves based on the survey could then be computed as 16% of participants were able to avoid a move, multiplied times 90% caused by the program, multiplied by a value of $19.46 WTP. This would result in an estimated NEB proxy of $2.80.

This result is approximately twice the value computed based on the literature and very conservative assumptions regarding costs of moves described in the table below. However, the survey results provide additional evidence that this estimate is probably conservative, and we include this conservative value in the computation of the proxy NEB for the LIPPT benefit cost ratio.

Table VII-12: Computation Method and Proxies Used for This Project

Avoided Direct Moving Costs -- Participant Perspective (9H)

	California-Wide	Computation Description	Source
Item 1	0.0060	Number of moves per participant avoided	Research Studies: select from / see Yellow Table
Item 2	32	Times Search time per move in hours (direct entry at this time)	No data; 32 hours as default until data available. Conservative
Item 3	$6.75	Times minimum wage	Program Assumptions Sheet
Item 4	1.0	Times "premium" for participant value of leisure time over minimum wage	User entry -- number should range between 1 and perhaps 4 based on feedback from RRM members
Item 5	$0.00	1 month rent (direct entry at this time)	No entry as default; conservative value
Item 6	18%	times interest rate (direct entry currently)	Default value: 18%, credit card rate
Item 7	$1.30	Equals Interim Proxy for NEB: Benefits from Avoided Moves	Computed - Item1*Item2*Item3+Item1*Item4*Item5
Item 8	10	Input: Assumed Years for the Benefit	Assumptions Table
Item 9	1.0	Item 6 Multiplied by Adjustment Factor for Appropriate Horizon	Derived from horizon and discount assumptions from Program Assumptions Table
Item 10	$1.30	Equals Proxy for NEB: Benefits from Avoided Moves	Computed -- annualized dollars per average participating household per year

We are omitting other indirect or hard to measure benefits that are related to this category; specifically, we suspect that frequent movers also have difficulty progressing and being promoted at jobs if they are frequently disrupted. This is not an estimate included in this test.

Benefit to Participants: Participants benefit from an array of home and service-related improvements made under the program, resulting in fewer bill payment and termination problems, fewer evictions, and greater service from the dwelling.

Summary / Justification: We used utility-supplied data on the average number of calls, shutoffs, and reconnects as the basis for the valuation of these benefits. Using published studies on the reduction in bill payment related activities from similar low income weatherization programs. The California utilities also had information on the average length of calls. Using these data, we computed the reduction in amount of time residents spent on the phone addressing bill-payment issues, which we valued at minimum wage. Using published information on the percent of shutoffs avoided through similar programs, we estimated the number of shutoffs and reconnects avoided due to the program. Making assumptions about the time and effort needed to get service restarted (valued at minimum wage) and including the cost of the reconnect fee charged by the utility, we derived an estimate of the proxy for avoided disconnects and reconnects in terms of participant costs and values. The value for shutoffs was also computed using results from the participant willingness to pay survey, and although generally similar values were computed, we used the more conservative estimates in the computations of benefits and costs. A conservative estimate was also generated for avoided moves from the program. Using data from the literature (which was relatively thin on this topic), we made conservative assumptions about the amount of time involved in searching for a new residence, which was valued at minimum wage. We compared this estimate to the values estimated from the willingness to pay survey. Estimates from these two sources differed by only about $1.50 and we selected the more conservative value for use in the test.

Education Related Benefits

Feeling of Control Over Bills / Energy Use

Similar to the bill payment / hassle benefits, the education that participants receive from the program may help them feel more in control of their energy use. This may be an important benefit to customers by helping them avoid getting into bill payment difficulties in the future to a degree beyond what they would experience simply through more efficient equipment.

Table VII-13: Preferred Computation Method, Sources, and Availability Issues

Education-Related Benefits -- Feel in "control" of bills	Preferred Data Element Source	Statu Avail.s	Best Alternate Source Available
Average participant value (WTP) for added "control" over usage and bills from program (separate from bill payment concerns above), annualized	Participant WTP survey	WTP	

In a published study, Green and Skumatz (2000) conducted a detailed analysis of more than 80 papers and interviewed more than 70 professionals to analyze the impact of education on energy use, and the results on retention of education effects. The analysis found that a number of programs showed additional energy reductions from programs that included education components. However, the authors noted that few of the studies

had reasonable sample sizes or well-designed control groups, compromising the robustness or transferability of the results. Hall and Reed (1997) conducted an evaluation for Detroit Edison that demonstrated increases in efficiency actions by residents after programmatic education. In addition, there was a reported increase in the customer's perceived ability to pay bills (Hall and Reed 1995, 1997). In addition, in Skumatz, Dickerson, and Coates (1999) the authors describe the results of detailed interviews with several hundred participants in low income and other programs. The work, based on an enhancement on "willingness to pay" surveys, showed that participants report that "feelings" of control over the bill are greatly enhanced by education and programmatic actions that give them greater control over their bills. In fact, the study found that this was among the top several benefits reported for three different types of programs. The study went on to assign quantitative values to this and other traditionally difficult-to-measure non-energy benefits.

Most of the studies reviewed concentrated on assigning portions of the energy savings to the education aspects of the program, and energy savings are excluded from this non-energy benefits portion of the analysis. Thus, we need to concentrate on the aspects of "control" over the bill. This is a hardship / perception benefit, and other than the studies mentioned, there has been little work in this area, and there is some resistance in the field to attempt to place economic value on people's "feelings" although there is general support for placing a value on experienced hardship, when that hardship leads to economic impacts or reduced quality of life. We incorporated some "hardship" and "feelings" questions into the willingness to pay survey (WTP), and this benefit is incorporated under "other" hardship benefits addressed later in this report.

Reduced Transactions Costs

Customers gain benefits from not having to educate themselves about conservation measures, not having to locate the items in the marketplace for purchase, and the reduction in transaction costs from having efficient products more widely available. It is questionable if low-income customers would actually take the same actions installed in the program if the program were not available and it is questionable if customers would have educated themselves about the value of the measures without the program. However, the sample data elements and sources are described below, as well as weaknesses in the data available for use in this study.

Table VII-14: Preferred Computation Method, Sources, and Availability Issues

Reduced Transactions Costs to Obtain Replacements	Preferred Data Element Source	Avail.	Status	Best Alternate Source Available
Number of measures installed with transaction cost savings per participating household	Program records	assume	limited	Only CFL data available thus far (Feldman); may be only relevant item because others
Estimated transactions cost benefit per measure installed		limited	preliminary studies on only limited	items may not involve these types of transactions as

measures frequently.

As an example, Feldman (1996) developed preliminary estimates of the transaction costs benefits to residents from programs including compact fluorescent bulbs. Feldman makes assumptions about the percent of persons in the territory that would be predisposed to fluorescents, the amount of time they would have to invest learning about bulbs, finding stores that carry them, and the time and money expended purchasing the bulbs. Valuing time at $6 per hour, Feldman estimates the reduced transactions costs of from $1.25-$5 per bulb. He also explores the costs involved in a generic information program and other related costs; and also notes that one commenter argues that his estimates may understate benefits by as much as a factor of four.

Recognizing that bulbs are only one component of programs, the Feldman estimates serve as a very conservative bound for the non-energy benefits from reduced transactions costs. In deriving estimates of the participant benefits from reduced transactions costs due to a LIEE program, it is important to remember that educational components are a significant part of the program's efforts, and that participants may receive a great deal of education both about measures and behavioral changes. To remain conservative, our estimates for customer benefits for the LIEE were based on: (1) the number of compact fluorescent lamps (CFLs) installed per household in the program, and (2) the estimate of reduced transaction costs per bulb from Feldman's work. To take account of the wider range of measures and educational efforts for LIEE (for example, the LIEE includes efficient refrigerators, heating system upgrades, etc.), compensate for more measures that CFLs in California LIEE programs we conservatively doubled the resulting calculated non-energy benefit.

Table VII-15: Computation Method and Proxies Used for This Project

Reduced Transactions Costs from Measures -- Participant Perspective (9J)

	California-Wide	Computation Description	Source
Item 1	0.5	Average number of CFLs per household	Program Assumptions Sheet
Item 2	100%	Times percent of households with CFLs installed	Program Assumptions Sheet
Item 3	$1.25	Times estimated value of Transactions cost from CFLs	Feldman, 1998 as default: $1.25; user may specify alternate value if preferred
Item 4	$0.63	Equals Proxy for NEB: Reduced Transactions Costs from CFLs in annual terms	Calculated (as Item1*Item2*Item3)
Item 5	0	Input: Assumed Years for the Benefit	Assumptions Table: Omitted per RRM as default
Item 6	0.0	Multiply Item 4 by this computed Adjustment Factor for Appropriate Horizon	Derived from horizon and discount assumptions from Program Assumptions Table
Item 7	$0.00	Equals Proxy for NEB: Transaction Cost Benefits	Computed -- annualized dollars per average participating household per year

After discussions with the RRM Working Group's Cost Effectiveness Subcommittee, this benefit was omitted from the computations. The benefit is conceptually difficult for people to support, and work has only been conducted on one isolated measure (CFLs). Therefore, the value included as the proxy NEB for this benefit is zero.

Benefit to Society: Program-provided education can help customers understand their energy use, help them feel in better control of their bills, and help them reduce the risk of getting into bill payment trouble. Participants may also realize other education benefits.

Summary / Justification: The available literature on these benefits was not of sufficient depth to justify incorporating benefits from these categories.

Housing Stock Improvements

Property Improvements, and Health and Safety Benefits

LIEE programs often provide a number of services that improve the dwelling's value and longevity. These services include some shell-related measures that may improve aesthetics and value. In addition, some upgrades and measures may decrease maintenance requirements. Improvements and repairs to the shell provide benefits to residents, and can be seen to have corresponding benefits in terms of property value enhancements; quite separate from their potential impacts on energy bills.

Table VII-16: Preferred Computation Method, Sources, and Availability Issues

Property Value Benefits	Preferred Data Element Source	Avail.	Status	Best Alternate Source Available
Value of repairs to home as part of program	Assessed valuation improvement, annualized	adapt	assessed value not available -- appropriate substitute value is cost of repairs	cost of repairs is best and most defensible number -- use program assumptions.

Brown et.al. (1993) provided quantitative information on non-energy benefits related to the National Weatherization Assistance Program. The Weatherization Assistance Program allowed expenditure of some resources on building rehabilitation and basic repairs; the study estimated that the average amount spent per household on structural repairs in 1989 was $126. This amount was assumed to represent the benefit in terms of maintenance to homes. Brown noted that these expenditures varied by building fuel type, dwelling type, and other considerations.
We believe that the best proxy for estimating these property value benefits is by recognizing the dollar value of the structure repairs.

Additional property values deriving from energy savings-based multipliers are cited in the literature (Nevin, etc). This literature implies that the value of the house increases by a factor of 10 to 20 times the annual bill savings and therefore generally equates bill savings to increased housing value. Therefore, these benefits are explicitly omitted from this test. Instead, the housing value benefits (direct and indirect) for the LIPPT will be included as the dollar value of non-energy technology improvements to the property that are installed through the LIEE program, and not directly or indirectly equated with energy savings.

Table VII-17: Preferred Computation Method, Sources, and Availability Issues

Aesthetic Benefits	Preferred Data Element Source	Avail. Status	Best Alternate Source Available
Average participant value (WTP) for added aesthetic improvements to home from program, annualized	Participant WTP survey	WTP	

Table VII-18: Preferred Computation Method, Sources, and Availability Issues

Reduced maintenance	Preferred Data Element Source	Avail.	Status	Best Alternate Source Available
Net Reduced hours and costs of repairs after program participation	Impact /process evaluation pre/post with control group	n/a	need participant survey or evaluation	Ask in WTP survey
Minimum wage	Economic data	yes	economic data	

More difficult to measure are aesthetic and maintenance benefits to homes of participants. Participants may realize aesthetic benefits from the improvement in the condition of their home, or the equipment installed. In addition, customers may receive benefits in terms of lower maintenance costs on the dwelling. No research could be found in the literature addressing either of these issues. However, to develop estimates of these benefits, we included valuation questions in the Willingness to Pay survey. The results are discussed at the end of the participant section of this report. Whether or not the benefits are important components of the LIPPT cost-effectiveness test, these benefits may represent important customer benefits for marketing and understanding the relative importance that participants put on related aspects of the program.[24]

The amortized cost of the actual improvements to the home were included as the best estimate of the value of home repairs to the residents. These were valued only as direct improvements to the value of the home (exclusive of any energy benefits resulting from the improvements made). We assumed that the value of the repairs would be reflected directly as an increase in the sale price of the home, were it to be sold.

To be conservative, we included estimates of the most reliable and defensible aspects of property value improvements from the program, excluding any separate aesthetic or other improvements. The computation of the benefit included in the LIPPT is illustrated below.

Table VII-19: Computation Method and Proxies Used for This Project

[24] The participant willingness to pay survey provided estimates of the value of these benefits. Participants assigned an average value of $17.18 as the repair benefits, and $12.00 as the value of the aesthetic improvements. To be conservative, we included the lower computed estimates discussed in the Table as the proxy NEB for the LIPPT benefit-cost ratio.

Property Value Benefits -- Participant Perspective (9E)

	California-Wide	Computation Description	Source
Item 1	$80.00	Cost of Housing improvements	Program Assumptions Table
Item 2	100%	Time percent of customers receiving the improvement	Program Assumptions Table
Item 3	$80.00	Equals Interim Proxy for NEB: Property Value Benefits	Computed (as Item1*Item2)
Item 4	10	Input: Assumed Years for the Benefit / Translating total benefit into annual stream	Assumptions Table
Item 5	0.22	Item 3 Multiplied by Adjustment Factor for Appropriate Horizon	Derived from horizon and discount assumptions from Program Assumptions Table
Item 6	$17.80	Equals Proxy for NEB: Property Value Benefits	Computed -- annualized dollars per average participating household per year

We omitted from the LIPPT other housing-value related benefits that have been discussed elsewhere in the literature; for example, we excluded estimates for neighborhood preservation. We believe that most of this benefit is incorporated in the increase in value recognized directly by the resident through the repairs performed and the equipment received. The bulk of additional benefits on a neighborhood scale would likely only be realized if the majority of a neighborhood was updated, and that is not the normal delivery method for LIEE programs. In addition, these are indirect, ripple-type benefits that we believe would be relatively small, even if they could be estimated. These are not included in the LIPPT.

Benefit to Participants: Improvements and repairs to the home can provide property value benefits to residents. In addition, modifications to the home (and equipment) may improve the appearance of the home (internal and external), which participants may value.

Summary / Justification: The most justifiable valuation for the participant benefits from minor home repairs provided as part of the program was deemed to be the direct cost of those repairs, spread over the life of the program evaluation period. This value of home repairs may be categorized directly as a property value benefit because is the best proxy for the difference in the sale price the home would receive if it were to be sold in the previous condition. Only the repair benefits were included in the valuation; no energy savings component was included because those benefits are counted in the energy savings portion of the calculations. Default LIEE program assumptions about the average cost of home repairs conducted under the base program were used in calculating the benefit.

Health and Safety

Fires and Related Risk: Brown (1993) also notes the value of reduced fires because of improved safety checks of heating equipment, lower damage from better insulation, and decreased use of substitute heating equipment. Indoor air quality is also affected by these types of programs, with mixed results depending on whether customers are in a radon area (Brown 1993). Because of the tradeoffs between various positive and negative effects on health and safety, Brown quantifies only the benefits from a reduced risk of fires, estimating property value losses at $3 NPV. Few studies have explicitly quantified the safety benefits related to IAQ changes, and in fact, these changes may be detrimental, not beneficial, to residents. Blasnik reported the number of incidents of poor drafting found during on-site inspections associated with a low-income program, and at some point, these may provide useful numbers to support computations of changes. However, currently, sufficient data to estimate these impacts is not available.

Table VII-20: Preferred Computation Method, Sources, and Availability Issues

Improved health and safety, fires prevented	Preferred Data Element Source	Avail.	Status	Best Alternate Source Available
Average number of fires (and other non-IAQ) crises per eligible customer (pre)	Impact /process evaluation pre/post with control group	adapt	Adapt / use Brown (1993) steps	Steps in Brown were to estimate occupants (elderly and non-elderly) in home; 10% of fire deaths caused by heating equipment (update assumption)
Reduction in percent of fires (and other non-IAQ) crises per eligible customer (post, with control group)	Impact /process evaluation pre/post with control group	adapt	Adapt / use Brown (1993) steps; assume less than 100% reduction	Steps in Brown were assume all fires would be eliminated due to program; alternatively, use information on insurance premium discounts for EE households in conjunction with average premiums paid in CA by renters and homeowners
Value of lifetime earnings and property value losses OR if insurance premium discounts are used; need premiums paid by renters and owners	Insurance and economic data; update Brown	yes		Brown steps: Use economic data for earnings and property loss reductions; not needed if use insurance premium discounts (Mills)
	Insurance payments data	yes	Insurance fact book	

Table VII-21: Preferred Computation Method, Sources, and Availability Issues

Health and Safety - IAQ health issues	Preferred Data Element Source	Avail.	Status	Best Alternate Source Available
Average number of IAQ-related crises and deaths per eligible customer (pre)	Impact /process evaluation pre/post with control group	n/a	unnecessary if use alternate method through WTP survey can incorporate into WTP survey and/OR Assume value is value of the installed measure	Possibly health-related studies linking weatherization efforts or the drafting and other safety items mentioned in Blasnik to illnesses and deaths.
Reduction in number of IAQ-related crises and deaths per eligible customer (post, with control group)	Impact /process evaluation pre/post with control group	n/a or WTP		
Value of injuries or deaths prevented	Economic / insurance data	yes		

Recently, Mills (1997) pointed out that the energy and insurance industries are establishing strategic alliances, including PG&E, EPRI, ORNL and other large energy industry actors. Notably, one insurance company gave 10% reductions in premiums to energy efficient and solar homes. The justification was that the heating systems fired less often, resulting in a reduced fire hazard. If the discount represented the value of the risk reduction to the insurance firms, this would provide a very strong method for estimating the increased benefit to participants. This estimation requires only data on renter and homeowner insurance premiums, which are readily available in publications. However, the 10% figure was not based on a detailed analysis, and this benefit may no longer be available from any insurance companies.

Maintenance Safety: Improvements in safety are noted from programs related to reduced maintenance needs and risks. For example, compact fluorescent lamps (CFLs) may lead to additional benefits because they have to be replaced less frequently, and elderly customers with out-of-reach fixtures might feel the value of avoiding the risk of broken bones. This value may be substantial to elderly participants. Similarly, new metal or vinyl windows (which are frequently used for these programs because of their low cost) can significantly reduce maintenance time relative to existing, old, often damaged, wood windows. The limited studies available indicate that this is a significant benefit to residents; as they not only mention the direct maintenance issues, but also related factors, like the fact that the new windows now operate instead of being painted shut (Skumatz, 1999). This may also reduce the need for air conditioning use in some homes.

Table VII-22: Preferred Computation Method, Sources, and Availability Issues

Health and Safety - O&M injuries reduction	Preferred Data Element Source	Avail.	Status	Best Alternate Source Available
Average number of energy equipment maintenance-related injuries per eligible customer (pre)	Impact /process evaluation pre/post with control group	n/a	unnecessary if use alternate method through WTP survey can incorporate into WTP survey -- need suggested impacts	
Reduction in number/type of energy equipment maintenance-related injuries per participating customer (pre)	Impact /process evaluation pre/post with control group	n/a or WTP		
Value of injuries or deaths prevented	Economic / insurance data	adapt		

Illnesses: Finally, households with sufficient and continuous heating may tend to experience changes in the number colds and other illnesses per year. However, this relationship has not been substantiated in the literature. In addition, some researchers have indicated that participation in energy efficiency programs may increase illnesses as house are tightened. The results of the "willingness to pay" survey conducted for this project suggest that participants report a small reduction of 0.07 sick days lost from per year. This indicates that perhaps one individual in fourteen participating households may use one fewer sick days per year as a result of participating in a LIEE program.[25]

[25] Although this survey did not allow for interviewing non-participants, another similar survey just being completed by SERA is gathering data from both participants and an eligible but non-participating control group. This allows us to control for the fact that one year may have been a low "flu" year, for instance. These results will help confirm the magnitude of the results from the California willingness to pay survey.

Table VII-23: Preferred Computation Method, Sources, and Availability Issues

Reduced Illness -- lost job time from less drafty home	Preferred Data Element Source	Avail.	Status	Best Alternate Source Available
Average number and duration of colds and similar illnesses resulting in lost work time per eligible customer (pre)	Impact /process evaluation pre/post with control group	n/a	unnecessary if use alternate method through WTP survey	
Reduction in number and duration of colds and similar illnesses resulting in lost work time per eligible customer after participation (post, with control group)	Impact /process evaluation pre/post with control group	WTP	can easily incorporate into WTP survey	
Value lost work time -- minimum wage	Economic data	yes		
Average expenditures on over-the-counter remedies or medical costs per incident	Customer survey	n/a or survey	can incorporate into WTP survey	Likely less important than other costs -- may not be worth taking survey time, but can test.

Skumatz (1996) incorporates assumptions about lost work time due to colds or other illness of parents or children in participant households. Assuming household breadwinners are able to avoid days of lost time at work from parent or child illnesses or colds, significant savings may be realized if a relationship between energy efficiency program participation and illnesses can be documented. If the impact is positive, that is, provides a reduction in illnesses rather than an increase, when valued at minimum wage these benefits may be in the range upwards of $60 per year per household. However, other researchers have indicted that some LIEE programs may not provide these benefits and may, in come cases, lead to greater illnesses and more lost work. This subject is not well documented in the literature and no objective studies can be found.

For this project we have assumed that a positive relationship exists if customers report changes in illness rates as a result of participation. Our benefits are based on reports from the LIEE participant survey that SERA designed and conducted as part of this project. The questionnaire requested information about the reduction in frequency (and duration) of illnesses after the program, but did not ask participants if the change was related to program participation. For the benefit, we only include the value of the lost time from work if reported by surveyed participants. If a relationship can be documented between sickness and program participation then this estimate can be conservative because it excludes doctor and other medical fees, and assumes the illnesses are not more severe, and that lost time from work does not lead to terminations in employment. To be sure estimates are conservative, secondary levels of benefits from lost school days are not incorporated.

Table VII-24: Computation Method and Proxies Used for This Project

Health and Safety - CO Monitors -- Participant Perspective (9G)
Method 2: Illnesses and Mortality Losses from CO Problems

	California-Wide	Computation Description	Source
Item 1	0.0000030	Average annual deaths from CO problems (300 divided by population times 2.7 persons per hh)	Consumer Product Safety Commission
Item 2	0.0001500	Average annual illnesses from CO problems (15000*2.7/hh divided by population)	Consumer Product Safety Commission
Item 3	$50,000	Cost for each serious illness (stroke and heart attack)	Medical Studies - User may enter another value if preferred. Default set as $50,000 from study by Coop (Goldstein, 2001).
Item 4	$6,000,000	Value of each human life saved	Selected Research Value (see Yellow table for value and alternates)
Item 5	0%	Percent receiving CO monitors	Program Assumption Table (CO monitors not installed in California)
Item 6	80%	Assumed Percent of CO problems eliminated by program's efforts	User Input -- assumption. Default set as 80%
Item 7	$0.00	Equals Interim Proxy for NEB: Reduced costs from reduced CO illnesses and mortality	Computed as (Item1*Item4+Item2*Item3)*Item5*Item6
Item 8	10	Input: Assumed Years for the Benefit / Translating total benefit into annual stream	Assumptions Table
Item 9	0.22	Multiply Item 7 by this Computed Adjustment Factor for Appropriate Horizon	Derived from horizon and discount assumptions from Program Assumptions Table
Item 10	$0.00	Equals Proxy for NEB: Reduced Costs from CO illnesses	Computed -- annualized dollars per average participating household per year

Table VII-25: Computation Method and Proxies Used for This Project

Health and Safety - CO Monitors -- Participant Perspective (9G) Method 1: Amortized value of CO Monitors (Note: this example is for illustrative purposes only as California programs do not install CO monitors. The benefit is not counted in the California LIPPT.

	Selected Utility California-Wide	Computation Description	Source
Item 1	$30.00	Cost of Program's IAQ monitors	Program Assumptions Table
Item 2	50%	Times percent receiving CO monitors	Program Design Assumptions
Item 3	$15.00	Equals Interim Proxy for NEB: Reduced IAQ-Related Health and Safety Benefits	Computed (as Item1*Item2)
Item 4	10	Input: Assumed Years for the Benefit / Translating total benefit into annual stream	Assumptions Table
Item 5	0.22	Item 3 Multiplied by Adjustment Factor for Appropriate Horizon	Program Assumptions Table
Item 6	$3.34	Equals Proxy for NEB: Reduced IAQ-Related Health and Safety Benefits	Computed -- annualized dollars per average participating household per year

Table VII-26: Computation Method and Proxies Used for This Project

Health and Safety - CO Monitors -- Participant Perspective (9G)
Method 2: Problems and Illnesses Losses from CO Problems. Note: for illustrative purposes only, California programs do not install CO monitors. This benefit is not included in the LIPPT.

	California-Wide	Computation Description	Source
Item 1	0.0000030	Average annual deaths from CO problems / poisonings (300 divided by population times 2.7 persons per hh)	Consumer Product Safety Commission
Item 2	0.0001500	Average annual illnesses from CO problems / poisonings (15000*2.7/hh divided by population)	Consumer Product Safety Commission
Item 3	50,000	Cost for each serious illness (stroke and heart attack)	Medical Studies - User may enter another value if preferred. Default set as $50,000 from study by Koop.
Item 4	6,000,000	Value of each human death	Selected Research Value (see Yellow table for value and alternates)
Item 5	50%	Percent receiving CO monitors	Program Assumption Table
Item 6	80%	Assumed Percent of CO problems eliminated by program's efforts	User Input -- assumption. Default set as 80%

Item 7	$10.20	Equals Interim Proxy for NEB: Reduced costs from CO poisonings and deaths	Computed as (Item1*Item4+Item2*Item3)*Item5*Item6
Item 8	10	Input: Assumed Years for the Benefit / Translating total benefit into annual stream	Assumptions Table
Item 9	0.22	Multiply Item 7 by this Computed Adjustment Factor for Appropriate Horizon	Derived from horizon and discount assumptions from Program Assumptions Table
Item 10	$2.27	Equals Proxy for NEB: Reduced Costs from CO poisonings and deaths	Computed -- annualized dollars per average participating household per year

Table VII-27: Computation Method and Proxies Used for This Project

Reduced Participant Illnesses / Lost Time from Work -- Participant Perspective (9I)

	California-Wide	Computation Description	Source
Item 1	0.07	Average sick days from work reduced from program	From CA Participant Willingness to Pay Survey - Default value from survey=0.15
Item 2	$54.00	Times Minimum Wage times 8 hour day	State of California
Item 3	$3.78	Equals Proxy for NEB: Avoided Illnesses	Computed (as Item1*Item2)
Item 4	10	Input: Assumed Years for the Benefit	Assumptions Table
Item 5	1.0	Item 3 Multiplied by Adjustment Factor for Appropriate Horizon	Derived from horizon and discount assumptions from Program Assumptions Table
Item 6	$3.78	Equals Proxy for NEB: Avoided Illnesses	Computed -- annualized dollars per average participating household per year

Benefit to Participant: Participants benefit from a number of health and safety –related benefits from the program, related to illness/injury, reduced fires, and other benefits.

Summary / Justification: Computations of benefits from lower fires used data on nationwide average property damage and loss of life from fires that could be attributed to causes related to program-related electrical equipment or problems that would be corrected through the program. We used nationwide data on the average valuation for reduced mortality. We then assumed that the program would not be 100% effective in correcting all the problems and that some fires would still result. These were represented as the savings or benefits to participants from fire property and death reductions from the program, and is a relatively direct computation. Of course, as with other proxy computations, the value would be improved if California-specific data were available, or if more reliable data were available on the effectiveness of the program in preventing these fires.

For benefits from carbon monoxide monitors installed as part of the program, two alternative computations can be used if this measure is ever added to California programs. One methods assumes that the cost of the installed monitor represents a fair valuation of the benefits from the installation of the measure. An alternate computation assesses the average nationwide mortality rate and injuries from carbon monoxide, and values these at nationwide figures for lives saved and serious hospitalizations. We then only include the benefits for that percent of homes assumed to get CO monitors under the program, and the assumed effectiveness of the monitors in reducing mortality and injuries. The two valuation methods developed estimates that were not very different, and the more conservative number (the first method) was incorporated into the estimate of benefits. In the case of the LIEE programs, the default program designs exclude any CO monitors, resulting in a zero valuation for this benefit.

To assess the participant value of the reduction in lost time from the job from illnesses due to the program, we used data from the participant willingness to pay survey for the best estimate of reduced sick days after the program. No other data on this point was available from the literature. This reduction in sick days was valued at minimum wage and included as a benefit from the program.

Equipment Related Improvements

New equipment installed in a participant's home provides another source of benefits from the program. These benefits include reduced equipment maintenance, improved service from the equipment (better options and features), quieter operation, aesthetics, and other potential benefits. Of course, we are interested in positive or negative benefits; it may be that the new equipment does not have the same features as the old, and the net benefits may not be positive from this change.

Table VII-28: Preferred Computation Method, Sources, and Availability Issues

Reliability, Maintenance & Equipment Noise Reductions	Preferred Data Element Source	Avail. Status	Best Alternate Source Available
incorporated above under comfort and safety			

Table VII-29: Preferred Computation Method, Sources and Availability Issues

Greater service from new equipment	Preferred Data Element Source	Avail. Status	Best Alternate Source Available
Average participant value (WTP) for added service, options, features for new / replacement equipment, annualized	Participant WTP survey	WTP	

No literature is available estimating these benefits. The key method of addressing these benefits hinges on the participant survey, and these benefits lend themselves to the willingness to pay approach. However, the most difficult aspect of measuring these benefits is whether they are already incorporated into previous estimates (Section F that measured maintenance and noise issues related to the dwelling). Because some of these benefits were difficult for residents to distinguish, all benefits estimates derived from the California Willingness to Pay (WTP) survey are presented in section VI.J.

Benefit to Participant: Program participants may benefit from better reliability, reduced maintenance and greater service from the equipment provided as part of the program.

Summary / Justification: Benefits from this source were not derived separately, but were incorporated in estimates of overall auxiliary benefits from program participation, which are summarized in a later section.

Other Utility Savings

Water and Sewer Savings.

One additional area of significant benefits to customers from LIEE programs can be the value of the water savings from reduced usage because of showerhead and faucet aerator retrofits; especially given the high water / wastewater rates in California. In particular, participants realize direct savings through lower bills for water after the program.

Table VII-30: Preferred Computation Method, Sources, and Availability Issues

Water and Sewer Savings	Preferred Data Element Source	Avail.	Status	Best Alternate Source Available
Average annual water usage reduction per participant household from program (ccf) (post, with control)	Impact /process evaluation pre/post with control group	yes	base on assumed measures installed, red'ns per measure, published water conservation data.	Needs some additional discussion with water conservation officials on appropriate "base" usage assumptions for California equipment and codes
Residential water and wastewater rates	Published water rate surveys for territory	yes	published water rate survey	

Skumatz (1996) developed estimates of the reduction in residential water use from specific programmatic information on new showerheads and faucet aerators installed and gathered information on water and sewer rates from communities in the territory. Valued at residential rates, water savings can represent strong non-energy benefits to customers through direct reductions in their water bills. Note that these savings accrue for both the water as well as wastewater or sewer bills.[26]

For this program, the consultant conducted surveys of California utility water and waste water rates, as well as the net water savings from installed faucet aerators and low flow showerheads. Although we gathered information on wastewater rates, the conservative estimates included here exclude those benefits. This is because many waste water utilities in California charge rates that do not vary based on the monthly consumption; rather, the wastewater rates are set annually based on an average of consumption in the low periods of the year (winter). These volumes; assumed to represent normal household usage excluding irrigation and other summer peak use; are used to represent the water that goes to the wastewater facility. If the faucet aerators and low flow showerheads had a longer expected useful lifetime (our survey work indicates they are left in place an average of three years), we would incorporate this benefit for at least two years. However, in generating these conservative estimates, the value has been omitted entirely.

In developing an estimate for the water savings benefits to participants from the LIEE program, we used (1) information on the number of new showerheads and aerators installed per dwelling through the program, (2) the expected water savings per household

[26] Avoiding the need to develop new capacity for water supply and waste water treatment provide benefits to society separately from the participant bill savings. A discussion of these benefits, best valued at avoided costs that are not recovered through rates, is included in previous discussion under societal- or public benefits. Using these different valuation methods avoids double-counting benefits.

from each showerhead and aerator, and (3) residential retail water (excluding sewer rates) for indicator communities in each of the four utility territories (gathered from water utility rate surveys).

Table VII-31: Preferred Computation Method, Sources, and Availability Issues

Other utility savings	Preferred Data Element Source	Avail.	Status	Best Alternate Source Available
Net reduction / increase in other utility services (waste, etc.) from program participation	Impact /process evaluation pre/post with control group	n/a or survey	can ask in WTP survey	
Residential utility rates for affected services	Rate survey for utilities in relevant territory	yes	survey of relevant "other" utilities in territory	

It is also possible that benefits (or additional costs) accrue to other utility services from participation in the program. For example, if the new or removed equipment requires disposal via hazardous waste sites (e.g. fluorescents), this can be more expensive or troublesome. Depending on the measures included in the design of the program, these benefits can be computed. However, no estimates for this benefit is included in the LIPPT.

Table VII-32: Computation Method and Proxies Used for This Project

Reduced Water / Wastewater Resources -- Participant Perspective (9A)

	California-Wide	Computation Description	Source
Item 1	100%	Percent of households receiving faucet aerators (times number of aerators per household)	Program Assumptions Table
Item 2	1,168	Times water savings per aerator (in gallons per year)	SERA Research, Water Conservation / Utility Literature
Item 3	100%	Plus percent of households receiving low flow showerheads	Program Assumptions Table
Item 4	4,271	Times water savings per showerhead (in gallons per year)	SERA Research, Water Conservation / Utility Literature
Item 5	5,439	Equals water savings per average participating household in gallons per year	Computed (Item1*Item2+Item3*Item4)
Item 6	7.3	Divided by 748 translates from gallons to CCF (hundred cubic feet of water) or "units" used for rates	Equality: One hundred cubic feet = 748 gallons
Item 7	$1.61	Times Combined Water and Sewer Rates: First, Water Rates per "unit"	SERA Water Rate Survey, California
Item 8	$0.00	Add Sewer Rates (may be "0" if bills don't change with water use)	Selected Research Value (see Yellow table for value and alternates)
Item 9	$11.67	Equals Interim Proxy for NEB: Water and Sewer Bill Savings	Computed(Item6*(Item7+Item8))
Item 10	3	Input: Assumed Years for the Benefit	Assumptions Table
Item 11	$0.48	Item 9 Multiplied by Adjustment Factor for Appropriate Horizon incorporating discount rate	Derived from horizon and discount assumptions from Program Assumptions Table
Item 12	$5.65	Equals Proxy for NEB: Water and Sewer Bill Savings	Computed -- annualized dollars per average participating household per year

Benefit to Participant: Reduced water and wastewater use provides direct bill savings to the participants, as can savings in other utility bills, if applicable.

Summary / Justification: The customer benefits from reduced water bills were computed as the estimated water savings from included measures, valued at benchmark residential rates for the utility territories. Given that the types of water conservation measures installed under these programs tend to be removed relatively quickly, we adopted only a short term horizon for these benefits. In addition, we excluded the waste water savings, which can be significant. This is because wastewater bills are generally computed base don baseload usage amounts, which are updated only annually for residents. Thus, the benefits from the program would not be realized until the second year of the three years that they would be expected to keep the measures in place. Thus, this portion of the benefits was excluded to assure the estimates would be conservative.

Other Benefits and Negatives from the Program: Hardship Benefits and Net Advantages Provided by the Program

Hardship benefits are a key concern in valuing the benefits from a low income assistance program. In fact, the types of benefits participants realize may be classified into several categories:

- Hardship benefits, and
- Net advantages provided by participation in the program.

One of the ways in which efficiency programs provide assistance to low-income customers is through the lower energy bills. High bills and arrearages lead to notices and dunning calls potentially from the utility, but probably also from other creditors. Lower bills are easier for residents to pay, and residents may be able to more easily pay not only the energy bill, but other bills as well. This may provide significant improvements to residents in terms of lower bill payment hassles, and actual psychic benefits from not feeling under the gun on their energy bills. This may be considered an important contributor to the hardship types of benefits that the RRM is interested in estimating.

However, anything that is a perceived benefit means it will be difficult to estimate. The best source of information for gaining a reliable handle on this benefit value is through customer surveys. As mentioned, following on work presented in Skumatz (1998, 1999, 2000), the consultants designed and conducted a "willingness to pay" (WTP) survey to estimate a range of participant-valued benefits, referenced previously in this document. The WTP survey requests respondents to assign a dollar value to categories of benefits. This survey was used to estimate important components of the hardship benefits and the net advantages provided by the program.

Hardship benefits can be classified as benefits that provide financial and hardship assistance to participants. This might include reductions in shutoffs and bill-payment problems, avoided lost days at work from illnesses caused by inferior housing, and savings from moves that could be avoided resulting from lower bills and improvements in the home from the program. Most of these benefits are estimated as described in other

sections of the report. However, one additional benefit that represents an important part of the hardship-related benefits is the feeling of control over the bill or reduced bill payment concerns. Developing an estimate of this benefit represents a challenge. However, given that this comprises an important part of the potential hardship benefits, we developed an estimate based on responses to the willingness to pay survey. The average benefit of $23.12 represents about 14% of the overall net benefits estimated from the willingness to pay survey. The dollar value of benefits from the willingness to pay survey have tended to be higher than those estimated based on very conservative assumptions from the literature or from estimates of direct costs. Therefore, we chose not to apply the direct $23 value as the additional hardship adder attributed by participants for greater control and lower worries from bill payment issues. Instead, we developed a percentage "adder" that can be included as an additional benefit in the LIPPT benefit cost computation (we used 10% adder on other participant benefits). Conservative estimates may omit this benefit.

Another set of benefits may be classified as "net advantages provided by the program". These may include benefits like noise reduction, greater comfort, appearance improvements, expanded features and options on new equipment compared to the old equipment, and similar benefits.

For example, LIEE programs improve household comfort by making the house warmer (and making it more affordable to keep warm), reducing draftiness, reducing noise, and other improvements. Limited work on quantification of comfort benefits has occurred, mostly addressing storm windows or storm doors retrofits. Skumatz (1996) cites one program that attributes only 25 percent of the overall benefits from storm windows to the energy portion, and only 10 percent of the overall benefits from storm doors to energy savings. Noise, comfort, and other non-energy benefits make up the majority of overall benefits from the installation of these two measures. These estimates assumed that duct, caulking and similar measures had no significant non-energy benefits; and the energy savings were assumed to fully represent the measure's benefits. Other utilities note customer willingness to pay for storm window-type measures as strong evidence of customer non-energy benefits from these measures. Noise is another important component of the benefits mentioned from weatherization programs, both on a "hypothetical" level (Mills, 1996) and based on quantitative results from participant surveys (Skumatz, 1997). Customer willingness to pay surveys provide an opportunity to quantify both comfort and noise benefits.

It is crucial to be unbiased in how the analysis of non-energy benefits is conducted. Although we have enumerated a large number of potential benefits, there may also be negative benefits associated with participating in a LIEE program. In particular, interviews with participants in other programs (Skumatz, 2000) found problems with cleanup from the contractors, problems with the "fit" of new refrigerators in the kitchen and other problems. Participants may have experienced scheduling hassles, poor workmanship by the contractors, lack of adequate clean-up or other negatives associated with their participation in the program. For example, they may find that the new equipment is noisier, or has other features they don't like. To be thorough, these

negatives should be assessed, and may have a place in the LIPPT test. Thus, these effects should be considered, and the benefits should be measured as "net" of these negative outcomes.

These benefits were included in the California Willingness to Pay (WTP) survey. The customer survey developed an estimate of the overall "net" benefits from this variety of sources as $73.09 (including $85.71 in positive aspects and a value of $12.62 attributed to negative aspects of the program). These benefits represented over 40% of the total benefits participants assigned in the willingness to pay survey ($169.32). Specifically, we found 19% of the total benefits valued by participants were assigned to comfort, 7% to noise reductions, and 7% to additional features and options on the equipment. An additional 17% of the benefits were attributed to aesthetic and repair benefits that we excluded because they might possibly overlap with aspects of the property value and home repairs NEB category. We computed a "net" adder for this group of benefits. The "net" multiplier subtracts the value assigned to assorted negative aspects that participants assigned to the program, and the net multiplier used was 25% adder to the other participant NEBs.[27] . Conceptually, they are categories of benefits that participants gain from participating in the program, and should be considered not only in the cost-effectiveness computations, but are also useful to consider when marketing programs to potential participants.

Table VII-33: Computation Method and Proxies Used for This Project

Net Hardship, Comfort, and Other Non-Energy Benefits -- Participant Perspective (9K) Participant "Hardship" Benefits beyond Those Measured Elsewhere			
	California-Wide	Computation Description	Source
Item 1	10%	Multiplier Assumed for Hardship Benefits beyond those measured elsewhere	California Participant Willingness to Pay Survey (described in Yellow Table)
Item 2	$25.75	Multiply times sum of other Participant Non-Energy Benefits	From summary sheet of model. Includes participant benefits from shutoffs, reconnects, moving, property value benefits, health and safety benefits, and others. Excludes other "soft" benefits like comfort, and excludes program rebates, if any.
Item 3	$2.57	Equals Interim Proxy for NEB: Hardship and Other Customer Benefits	Computed -(Item1*Item2)
Item 4	10	Input: Assumed Years for the Benefit Assumptions Table	

[27] These computations and results are discussed in more detail in Appendix B.

Item 5	1.0	Multiply Item 2 times this Adjustment Factor for Appropriate Horizon	Derived from horizon and discount assumptions from Program Assumptions Table
Item 6	$2.57	Equals Proxy for NEB: Hardship and Other Customer Benefits	Computed -- annualized dollars per average participating household per year

Table VII-34: Computation Method and Proxies Used for This Project

Net Hardship, Comfort, and Other Non-Energy Benefits -- Participant Perspective (9K) Participant Comfort, noise, and other benefits net of Negative Program Effects			
	California-Wide	Computation Description	Source
Item 1	25%	Multiplier Assumed for comfort and related Benefits beyond those measured elsewhere. Default is 0%	California Participant Willingness to Pay Survey. User entry in gold table. Default value is 25%
Item 2	$25.75	Multiply times sum of other Participant Non-Energy Benefits	From summary sheet of model. Includes participant benefits from shutoffs, reconnects, moving, property value benefits, health and safety benefits, and others.
Item 3	644%	Equals Interim Proxy for NEB: Hardship and Other Customer Benefits	Computed -(Item1*Item2)
Item 4	10	Input: Assumed Years for the Benefit	Assumptions Table
Item 5	100%	Multiply Item 2 times this Adjustment Factor for Appropriate Horizon	Derived from horizon and discount assumptions from Program Assumptions Table
Item 6	$6.44	Equals Proxy for NEB: Hardship and Other Customer Benefits	Computed -- annualized dollars per average participating household per year

Benefit to Participant: Participants benefit from a reduction in general hardship from program participation. The program helps reduce bills and improves their ability to meet bill payment obligations and avoid a number of negative outcomes that might otherwise have occurred without the program. In addition, participants receive specific auxiliary and indirect benefits from program participation, including comfort, improved equipment features and other benefits. These are assessed "net" of negative outcomes that they may experience as part of the program.

Summary / Justification: We assessed two general types of benefits – hardship benefits and net other advantages provided by the program. The estimates in this section derive from the results of the willingness to pay survey. Many of the benefits that might be considered as "hardship" benefits were estimated using other valuation methods described earlier. However, one remaining benefit – the reduction in bill payment concerns and better control over the bill could not be estimated using outside data. Instead, we compared the size of this benefit from the WTP survey to the sum of the other hardship benefits estimated in the WTP survey, and developed a "multiplier" that could be applied to represent these benefits. This estimate was 10%. We did not use the absolute value of the WTP dollar amounts for any of these benefits because they tended to be higher, or less conservative than the estimates based on external data.

In addition, we were able to use the results of the California WTP survey to estimate a multiplier to provide the proxy NEB for additional benefits from the program (e.g. comfort, noise and other benefits beyond the impacts that those benefits may have had on in other estimates). We examined the total of these benefits estimated from the WTP survey, and considered their NET benefits – net of negative impacts that the program was reported to have caused at the participant level (e;g. scheduling hassles, incomplete cleanup after the work, etc.). Even after subtracting these negative outcomes, the total of these additional benefits was quite large, and we developed a 25% multiplier to estimate the NEB proxy from comfort benefits.

Omitted Customer Side Non-Energy Benefits.

Customer surveys often note that a key benefit is customer feelings about helping the environment. This particular benefit, being largely perception, will not be included in the LIPPT cost-benefit test. In addition, a number of other non-energy benefits from weatherization and education programs could presumably be attributed to customers, but were not incorporated into the estimate of savings at this time. We believe they are small, hard to estimate, or too indirect. These include:

- Other medical and doctor-related savings;
- Job progression / promotion benefits and some school attendance benefits
- Value of having more usable square feet in the dwelling at all times (from improved ability to heat the dwelling), among other benefits;
- Value of other items the participants can buy with their bill savings (assumed to double count with the bill savings).

Table VII-35: Summary of Proxy NEBs from Participant Perspective

Participant Benefits: Benefits Accruing To And Valued At Participant Values And Costs

		Annualized Benefits per Participant
	Program rebate (directly from assumptions above)	$0.00
9A	Water/sewer savings	$5.65
9B	Fewer shutoffs	$0.17
9C	Fewer Calls to the utility	$0.18
9D	Fewer reconnects	$0.08
9E	Property value benefits	$17.80
9F	Fewer fires	$2.44
9G	Indoor Air quality (CO-related)	$0.00
9H	Moving costs / mobility	$1.30
9I	Fewer Illnesses and lost days from work/school	$3.78
9J	Reduced transactions costs (limited measures)	$0.00
9K	Net Household Benefits from Comfort, Noise, net of negatives	$6.44
9K	Net Household Benefits from Additional Hardship Benefits	$2.57
	Subtotal	$40.41

Chapter 8: Analysis of Non-Energy Benefits for the California Low-Income Energy (LIEE) Programs

Taking into account all the benefits presented, we present the overall annual benefits when all benefits are included in Table below. Note that a number of program design assumptions are important underpinnings of these results. This includes the measure and benefit lifetimes, percent of homes with various measures installed, discount rates, and a variety of program design assumptions.

The values of the benefits for the NEBs are presented in the tables below, applying the benefits time horizons (in years) shown on the tables.

Table VIII-1: Summary of Proxy NEBs Using Utility Valuations

Utility-Related Benefits: Benefits Valued At Utility Costs And Savings

		Annualized Benefits per Participant	Horizon for Benefit (in years)
7A	Reduced Carrying Cost on Arrearages (interest)	$3.76	10
7B	Lower Bad Debt Written Off	$0.48	10
7C	Fewer Shutoffs	$0.05	10
7D	Fewer Reconnects	$0.02	10
7E	Fewer Notices	$1.49	10
7F	Fewer Customer Calls	$1.58	10
7G	Lower Collection Costs	$0.00	10
7H	Red'n in emergency gas service calls	$0.07	10
7I	Utility Health & Safety - Insurance savings only	$0.00	10
7J	Transmission and/or distribution savings (distribution only)	$0.00	10
7K	Utility Rate Subsidy Avoided (CARE) payments	$2.77	10
	Subtotal	$10.22	

Table VIII-2: Summary of Proxy NEBs Using Public or Societal Valuations

Societal / Public Benefits: Benefits Beyond Utility And Participants

	NEB Category	Annualized Benefits per Participant	Horizon for Benefit (in years)
8A	Economic impact (direct and indirect employment)	$0.00	1
8B	Emissions / Environmental	$0.00	10
8C	Health and Safety Equipment (CO and Other H&S)	$0.00	7
8D	Water and wastewater (avoided)	$0.00	3
	Subtotal	$0.00	

Table VIII-3: Summary of Proxy NEBs Using Participant Valuation Methods

Participant Benefits: Benefits Accruing To And Valued At Participant Values And Costs

		Annualized Benefits per Participant	Horizon for Benefit (in years)
	Program rebate (directly from assumptions above)	$0.00	1
9A	Water/sewer savings	$5.65	3
9B	Fewer shutoffs	$0.17	3
9C	Fewer Calls to the utility	$0.18	10
9D	Fewer reconnects	$0.08	10
9E	Property value benefits	$17.80	10
9F	Fewer fires	$2.44	10
9G	Indoor Air quality (CO-related)	$0.00	7
9H	Moving costs / mobility	$1.30	10
9I	Fewer Illnesses and lost days from work/school	$3.78	10
9J	Reduced transactions costs (limited measures)	$0.00	0
9K	Net Household Benefits from Comfort, Noise, net of negatives	$6.44	10
9K	Net Household Benefits from Additional Hardship Benefits	$2.57	10
	Subtotal	$40.41	

Table VIII-4: Summary of Proxy NEB Totals and Net Present Value

Summary Of All Non-Energy Benefits	Annualized Benefits per Participant	Net Present Value of Benefits
Utility-Related NEBs: Benefits Valued at Utility-based Costs, Savings, or Values	$10.22	$368,460
Societal/Public NEBs: Benefits beyond those accruing to Utility or Participants	$0.00	$0
Participant NEBs: Benefits to Participants, Valued at Participant Costs and Values	$40.41	$1,456,291
Sum of Non-Energy Benefits (NEBs) Valued from All Perspectives	$50.63	$1,824,751

Variations in Results Based on Benefits Horizons: Although the bill savings return year after year (with possible adjustments based on technical degradation factors), some argue that it might be appropriate to assume the benefits would actually be accrued on a shorter horizon. As previously discussed, the rationale for shorter lifetimes for these benefits include: the studies were one-year impacts, and it is not clear the same benefits would accrue year after year; residents move frequently and low-income residents may not move in, and other reasons. If 5 year lifetimes are used instead for carrying costs for arrearages, for lower bad debt written off, shutoffs, reconnects, notices, customers calls, and collection costs, we find a 40% reduction in those benefits categories using the discount rates assumed for the LIPPT. This results in a total reduction of utility-benefits of just under $3 annually ($2.98). None of the horizons for the public or societal benefits are affected, so no change in totals are found for those valuations. However, applying a similar reduction in horizons for comparable categories valued from the participant perspective, we find reduction in benefits estimates of $3.84. This comes from a 40% savings from reducing the year horizon from 10 years to 5 on benefits from reduced shutoffs and reconnects, fewer calls to the utility, and reduced moves and illnesses,

Benefits Categories Included and Excluded: This document presented a fairly comprehensive array of benefits. Table VIII-5 discusses each of the specific NEB categories addressed in this report. As noted, some of the benefits are included and some are excluded from the LIPPT test. Reasons we considered excluding NEBs included double-counting of similar benefits, weak data underlying the computation, and concerns that the perspective is not appropriate to the focus of the LIPPT. Table VII-5 summarizes the status of the individual benefits categories.

Note that all of these benefits do not accrue strictly from the fact that the measures are efficient, but merely because old equipment is replace with any (newer) equipment. Features, options, aesthetics, and other factors that are not associated with efficiency provide some of the benefits from the program. However, it is provided as part of the program, and likely belongs in at least the participant perspective analysis. In addition,

this report proposed some benefits that could not be estimated at this point due to a lack of underlying data. In other cases, we have estimated benefits that are not included in the computation of the LIPPT benefit cost test. Estimating these additional NEBs provides additional understanding of the benefits that participants or society receive from these programs, which provides benefits in marketing and targeting. Improving targeting and design can, in turn, help improve the efficiency and effectiveness of the program – improving the program's cost-effectiveness. Finally, understanding all the benefits can also help determine whether additional work valuing these benefits is worthwhile – whether they appear to be significant or can continue to be omitted from consideration in program design and delivery.

As described throughout the document and in the Table, extreme care was used to assure that each estimated benefit valued a different type or aspect or beneficiary of a non-energy benefit from the program. Thus, we can add the benefits from the categories included and assure that we have included a number of benefits actually accruing to the program. However, we have also concentrated on including conservative and defensible estimates of benefits. As such, we have omitted a number of direct and indirect benefits, making us certain we have underestimated, and not overestimated benefits from the program.

Certainly, the efforts to be placed into determining these estimates is not the same for all categories – and the resulting certainties associated with the estimates will also not be the same across all NEB categories. A later section of the report addresses suggested research efforts to improve the ability to estimate these benefits in the future.

Table VIII-5. Benefits Included and Excluded from LIPPT Benefits Computation

Benefits Included and Excluded from LIPPT Benefit Computations		
Benefit Category	Status	Rationale for NEB Inclusion / Exclusion
Reduced Carrying Cost on Arrearages (7A) valued in terms of the cost to the utility	Included	Measured as the utility's interest savings from reduced arrearages carried. This is measured from the utility cost point of view.
Lower Bad Debt Written Off (7B) valued at utility costs	Included	Measured as the reduction in total bad debt written off for participants in the program. These represent a direct savings to the utility because extra revenues are received that would not otherwise have been received.
Fewer shutoffs (7C) valued at utility costs	Included	Reduced shutoffs are measured in terms of the net marginal cost to the utility from not having to send staff out to disconnect the account.
Fewer reconnects (7D) valued at utility costs	Included	Reduced reconnects from the program are measured only in terms of the net marginal cost to the utility from the reconnect – and is net of any reconnect fees paid by customers for the service.
Fewer notices (7E) valued at utility costs	Included	The improved payment behavior by customers leads to a reduction in utility costs for calls, notices, and other collection activities. This category measures only the reduced marginal cost to the utility because it can send fewer notices for poor payment behavior.
Fewer customer calls (7F) valued at utility costs	Included	Improved payment behavior by participants allows the utility to make and respond to fewer customer calls related to bill payment behavior. This is valued at the utility's marginal cost of fielding calls.[28]
Lower collection costs (7G) valued at utility costs	Not included because separate data were not available	Improved payment behavior by participants allows for fewer collection-related activities – internal and external—by the utility. Although real and appropriate, we were unable to gather data on the separate activities for collection above and beyond those included in the benefits from fewer notices and calls described and estimated above.
Reduction in gas emergency calls (7H) valued at utility costs	Included	On-site activities undertaken by the program pro-actively address some safety issues that could lead to expensive gas emergency calls. These benefits are valued at the marginal staff and travel cost of addressing fewer gas emergency calls. The value for this NEB is affected by the degree of safety efforts included in the utility's program.

[28] The California WTP survey provided corroboration on the percent reduction in calls after participation in the program.

Insurance savings	Not included to avoid double counting and because data weren't available	To the extent the utilities have a deductible for which they self-insure, they experience savings if fires or emergencies are avoided that are not covered by insurance. However, data to compute these reductions were not available from the utilities. In addition, we wanted to be certain not to double-count these payments. If they were included here, we would need to subtract them from the participant losses in order to achieve "net" benefits and not double-count transfers. Thus these benefits were omitted from the computations.
Transmission and/or Distribution savings (7J)	Excluded because the energy savings computations used in the LIPPT test incorporate these benefits	The utility achieves lower costs from the program because line losses are reduced for the kilowatt hours that do not have to be delivered to participants. The CPUC has adopted avoided cost figures for T&D savings, which are used in program filings for the California utilities. However, in this case, the value of this NEB is excluded from the computations because the energy savings figures applied in the LIPPT incorporate these avoided costs. Therefore, including them separately as a NEB would double-count the benefit.
Reduced Subsidy (7K) valued at utility and ratepayer savings	Included	The California utilities provide a 15% rate subsidy to qualified low income customers. This subsidy is paid by other ratepayers and the cost is incorporated into the utility's revenue requirements. Lower energy use by participants leads to lower subsidies paid, increasing public benefits. This is valued at 15% of the bill savings for eligible participants.
Economic Impacts (8A) measured in state- or public benefits terms	Not included because supporting data were unreliable	Additional expenditures in conservation programs increase employment and output in weatherization-related industries and in program and implementation staff. However, underlying studies did not generally examine only the "net" benefits from these funding diversions. It is impossible to tell from these studies how large are the "net" economic benefits, or even if they are positive or negative because they do not examine the output or employment from the industries from which the funds are diverted. No California studies were available either. Thus, these benefits are omitted. Note that there are additional benefits for programs that target low income or CBOs for doing the work. No data were available to try to quantify these benefits.

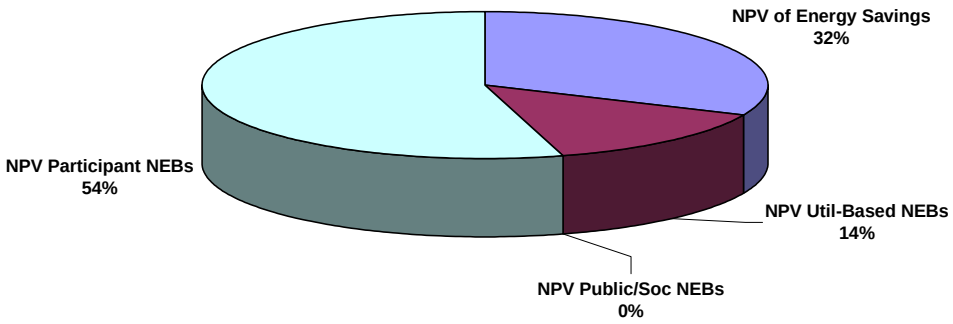
Emissions / environmental Impacts (8B) measured in public benefits terms	Excluded because the avoided cost used in the energy savings computations for the LIPPT test include this benefit.	Lower energy use leads to lower green-house gas and other harmful emissions. The CPUC has adopted agreed upon values that represent avoided costs per kilowatt hour and per therm for environmental benefits. To compute the proxy NEB for this benefit, these avoided costs were multiplied by the kilowatt hours and therms saved from the program. However, in this case, these values were excluded from the benefit-cost computations because the energy savings figures applied in the LIPPT tests incorporate these avoided costs. If the test uses avoided energy costs that exclude this benefit, this benefit should be included.
Health and Safety Benefits (8C) valued at amortized installation cost	Included, but zero value because no H&S measures are included in the LIEE program.	Installation of health and safety equipment as part of the program leads to non-energy benefits in avoided crises. These benefits should be valued in terms of the amortized cost of the installed measures over the period of the benefit-cost evaluation. However, as currently designed, the LIEE programs do not include any health and safety measures; hence this value computes to zero additional benefit.
Water and Wastewater savings (8D) valued at avoided societal costs	Included conceptually, but zero value.	Lower water use reduced water supply and wastewater treatment demands on the public water systems. This avoids the need for potentially expensive “next” supply sources like dams and new treatment facilities. However, to avoid double counting with customer bill savings from reduced water use, we included only the avoided cost of supply that was not currently recovered in residential rates. Given that the water measures only last three years, we used a conservative assumption that the near term avoided costs were small and were being fully recovered through residential rates (counted elsewhere). Thus, we avoided double-counting benefits included elsewhere.
Program Rebate	Included, if applicable	If the program provides a rebate to customers, that does provide a non-energy benefit to the participant. However, that cost needs to be treated properly in program costs to assure that it is not double-counted. In this case, no program rebates were assumed, so the cost can be included conceptually, although it has zero value.

Participant Water and wastewater bill savings (9A)	Included	Lower water and waste water use provides direct participant bill savings from those utilities. We included the full value of water savings for the three years the water measures were expected to be in place. To be conservative, we excluded the higher bill savings available from wastewater bills because the wastewater billing is adjusted only annually, so the savings would only accrue for a portion of the three years the measures were expected to be in place.
Participant value from fewer shutoffs (9B)	Included	Lower bills help reduce bill payment problems, reducing shutoffs. This reduces the time customers need to spend trying to get power restored. To be conservative, we did not include additional benefits customers realize from the reduced service they receive from their homes when power is terminated.
Participant value from fewer calls to the utility valued as time savings (9C)	Included	Lower energy use reduces bill payment problems and reduces the amount of time participants spend on the phone dealing with bill payment issues with the utility. This was computed as the saved hours that the participant no longer need s to spend on the phone, valued at minimum wage. The utility savings from these avoided calls is included separately.
Fewer reconnects (9D) valued in saved time and costs for participants	Included	Lower energy use reduces bill payment problems for participants, reducing the hassles of both terminations (above) and reconnects. This NEB was valued as the reduction in reconnect fees that customers must pay to have service restarted. Recall that the utility valuation of reconnects were computed net of these customer payments, so we have avoided double-counting this source of benefits. We did not include the additional payments made by customers to bring balances to acceptable levels. Data were not available on standard policies regarding payments.
Property value benefits from program-provided home repairs (9E)	Included	When repairs are made to the property (broken panes replaced, porch repair, etc.) the value of the property increases for the participants. That is, if they were to sell the property, the price would increase, and the best estimate of that increase in value is the cost of the repairs. We amortized these costs over the period of the benefit cost evaluation. The benefit valuation from this source specifically excludes any energy savings contributions of these repairs to avoid double-counting with the energy benefits portions of the computations.

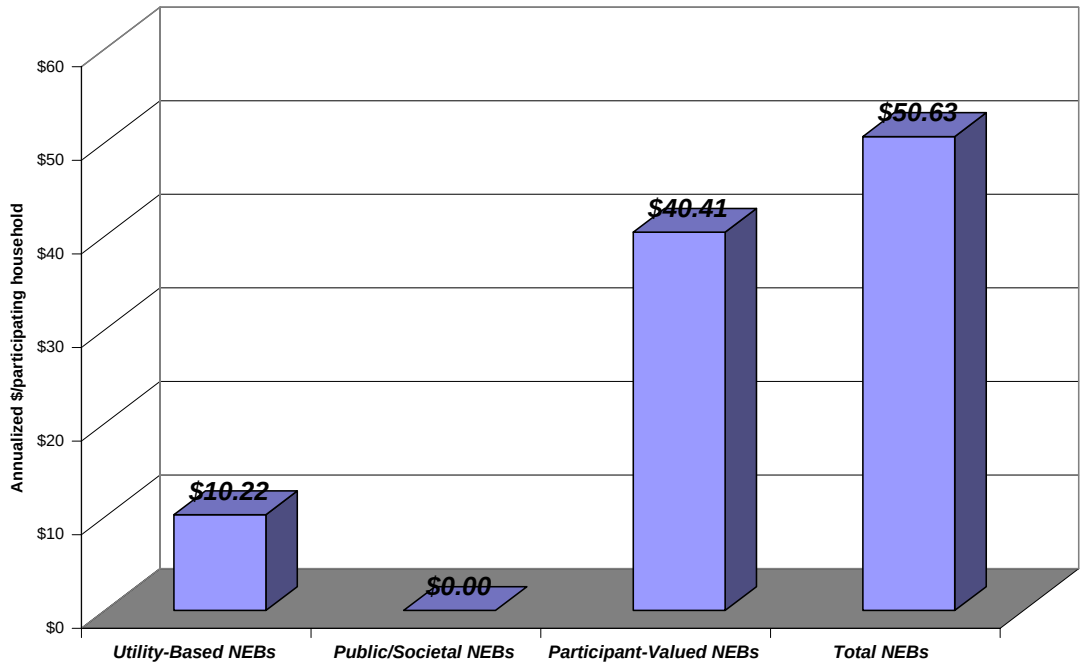
Fewer fire losses to participants and society (9F)	Included	Health and safety equipment and checks conducted through the program help reduce the risk of fires. This results in benefits to participants in terms of reduced property losses and mortality. These benefits (which can be viewed as accruing to the participants or to society) were valued at reduced losses and the lifetime earnings losses from lives that were estimated saved from the program.
Fewer health-related expenses from health and safety improvements (9G)	Included, but zero value because no health and safety measures are included in the default LIEE programs. CO monitors not installed in California programs	When health and safety measures (e.g., carbon monoxide monitors) are included in the programs, their benefits are not energy savings, but rather health and safety benefits accruing directly to the residents in terms of lower hospitalization costs and health-related expenses. These benefits can be estimated either as the amortized cost of installation of the devices or as the avoided illnesses and mortality prevented because of the presence of the H&S equipment. However, the computed value of the benefit is zero because no health and safety measures were included in the default LIEE program design
Participant savings from fewer moves (9H)	Included	Evidence indicates that utility bills and shutoffs are the cause of some customer move-outs. Avoiding moves through lower energy use allows residents to avoid a variety of direct and indirect costs associated with moves. To be conservative, we included only a portion of direct costs of moves incurred by residents (search time valued at minimum wage). Indirect benefits were omitted from the estimation.
Fewer lost sick days from work (9I)	Included	Homes that are “tighter” and less drafty and have fully functional heating systems can result in fewer sick days for residents. This includes both direct costs for sick days lost from work (which we value at minimum wage), and indirect costs from lower educational achievement from children losing days from school (not included in this computation).
Reduced transactions costs (9J)	Excluded because underlying data weak	Researchers have hypothesized that providing weatherization measures saves search and information time for residents when they ultimately need to replace measures. This has only been estimated for one measure (CFLs) in one study. Because of the shortage of research and studies, this benefit has been omitted.

Improved comfort, noise, and similar benefits to participants (9K)	Included	The most commonly reported non-energy benefit noted and recognized by participants is additional comfort in the home. Similar extra benefits provided by weatherization programs include lower noise from added insulation, additional features on replacement equipment, and similar benefits. A proxy for these benefits, net of negative aspects of the program, was included in the computations. This proxy was based on the results of the California Willingness to Pay (WTP) survey results.
Reduced other hardship benefits – control over bill and energy use (9K)	Included	A key benefit associated with low income weatherization programs is reduction in hardship. Some of these benefits are reflected in other categories, including reduced calls, shutoffs, reconnects, moves, and other categories included above. Additional hardship benefits accrue from participants gaining greater control over their bill, and reduced worries and concerns from this source. We used a multiplier derived from a willingness to pay (WTP) survey of California participants to estimate the extra benefits from this remaining portion of the hardship benefits.

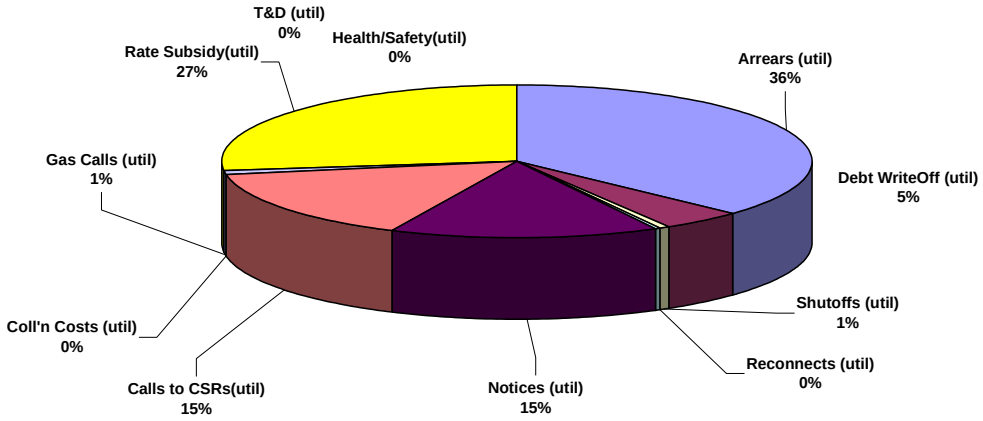
Overall Benefits: Net Present Value (NPV) of Benefits for LIEE Program: Energy and Non-Energy Benefits (NEBs)



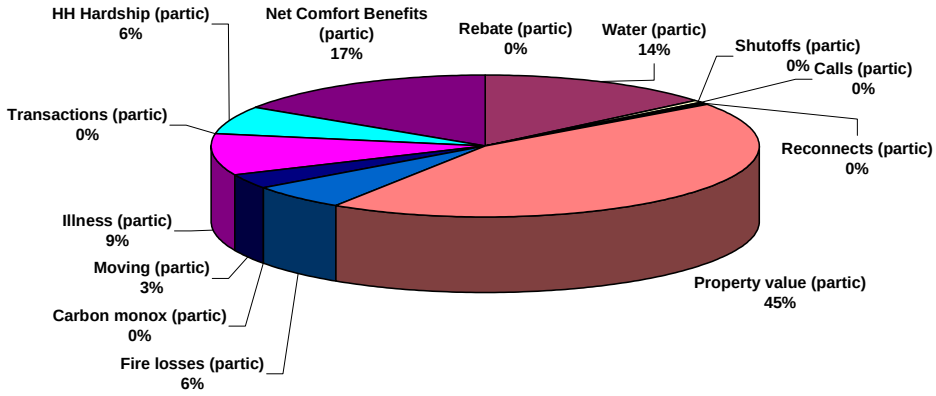
NEB Overall Benefits from LIEE Program



Utility NEBs for LIEE Program



Participant NEBs for LIEE Program



Research to Support Continuing NEB Estimations

This chapter lists data gathering and tracking activities that would provide high quality data for use in computing the list of benefits included in the section estimating NEBs. If detailed and reliable, and California-program-specific data are desired for the future, a number of activities will need to be instituted shortly – "pre" program adoption. A number of data elements will also rely on evaluations that assess pre and post participation for a sample of program participants compared to a control group of otherwise eligible customers that elected not to participate. Finally, other activities, including input/output modeling are listed.

Although these activities may appear substantial, they can be limited to those items that are highest priority for the LIPPT. Further, once they are specifically estimated for these programs, they will likely be adaptable to future programs inside and outside California, using some of the tailoring assumptions we have incorporated here. To the extent that they are not available in the future, proxies may again be used, as in this study.

California-Based Economic Input/Output Modeling of Programmatic Impacts

Most economic impact studies of energy program have examined gross impacts and do not consider the negative impacts of taking dollars out of one economic stream and placing them into the energy efficiency program stream. In some cases an energy program can be expected to have negative economic impacts, while other times the impact can be positive. Future studies in this area need to examine the net impacts associated with moving dollars between different economic streams. The "net" economic multipliers associated with the California LIEE programs are the desired quantifiers. Items to be measured using this method include:

- Net direct economic / output multiplier
- Net indirect economic / output multiplier
- Net jobs multiplier

Market-Specific, Program/Customer-Specific Information

There is a wide range of data that can be tracked and used to feed the LIPPT. Much of this information is not tracked, is tracked for classes of customers (residential, commercial, industrial, or all customers combined) but not for low-income customers, is or is difficult to obtain, track or estimate. Information that can improve the accuracy of estimating program benefits to low-income customer include:

- Number of low-income customers (eligible for the program)
- Annual average arrearage level for eligible low-income customers
- Annual low-income write-offs
- Average annual number of shutoffs per eligible low-income account

- Average number of reconnections per eligible low-income accounts annually
- Number of notices annually per eligible low-income participants (pre) and tracking
- Average number of calls to utility (for billing related issues) per eligible low-income customer (pre) and tracking
- Percent of eligible / participant customers with arrearages reaching collection level
- Annual average amount of eligible customer arrearages forwarded to collection agency (pre) and tracking
- Average number of gas emergency calls (visits and calls) per eligible customer (pre) and tracking
- Percent of eligible / participant customers currently receiving flex connectors annually after calling for replacement / problems
- Average annual claims from residential gas fires per (eligible low-income) residential customer -- maximum of utility's relevant deductible level
- Low-income subsidy per account for eligible low-income customers (pre) and tracking

Pre and Post-Program Impact and Process Evaluations with Control Groups

Conducting a comprehensive impact and process evaluation of the LIEE programs will provide key data that are now being adapted from other studies for the LIPPT. Whenever possible evaluations should examine program impacts using pre- and post-program comparisons against changes from a similarly-eligible control group. Program-specific data that can be useful for documenting California program impacts are listed below.

- Net Reduction in average participant write-offs after program (pre/post with control)
- Percent reduction in notices annually to participants (post, vs. control group)
- Percentage reduction in average annual claims from residential gas fires per eligible / participating customers after program (post, with control)
- percent of deaths avoidable from program (Brown assumed all)
- Average cost of health crises annually per eligible account (pre) related to measures included in the program
- Percent reduction in average costs annually for health crises for participants from program (post, with control) attributable to the measures included in the program
- Average annual water usage reduction per participant household from program (ccf) (post, with control)
- Percent reduction in bill-related calls to utility from program participation (post, with control)
- Percent reduction in average annual disconnections for participants from program (post, with control)
- Percent reduction in average annual reconnections for participants from program (post, with control)
- Average annual moves per eligible low-income customers (pre/post, control)

- Percent reduction in average annual moves for participants from program (post, with control)
- Average annual "frequent movers" per eligible low-income customers (pre)
- Percent reduction in average annual "frequent movers" for participants from program (post, with control)
- Change in education dropout rate for frequent moving households
- Net Reduced hours and costs of repairs after program participation
- Average number of fires (and other non-IAQ) crises per eligible customer (pre)
- Reduction in percent of fires (and other non-IAQ) crises per eligible customer (pre, post, with control group)
- Average number of IAQ-related crises and deaths per eligible customer (pre)
- Reduction in number of IAQ-related crises and deaths per eligible customer (post, with control group)
- Average number of energy equipment maintenance-related injuries per eligible customer (pre)
- Reduction in number/type of energy equipment maintenance-related injuries per participating customer (pre)
- Average number and duration of colds and similar illnesses resulting in lost work time per eligible customer (pre)
- Reduction in number and duration of colds and similar illnesses resulting in lost work time per eligible customer after participation (post, with control group)
- Average annual water usage reduction per participant household from program (ccf) (post, with control)
- Net reduction / increase in other utility services (waste, etc.) from program participation
- Percentage reduction in average participant arrearages after program
- Reduction in percent of participant customers with arrearages reaching collection level
- Reduction in percent of participant customer arrearages forwarded to collection agency (post, with control)
- Reduction in percent of participant customers with gas emergency calls (post, with control)
- Percent of eligible / participant customers receiving flex connectors proactively from program annualized
- Reduction in energy use per participant (post, with control)
- Net out of pocket costs for average move (new first/last month rent plus security deposit plus direct moving costs/truck rental, etc. less rebated security deposit)

Participant Willingness to Pay Survey and Other Participant Surveys

Willingness to pay surveys can help document the value of a program-induced benefit to participants. Data that can be collected using willingness to pay surveys include:

- Average participant value (WTP) for reduced billing related calls, annualized

- Average participant value (WTP) for each reduced disconnection , annualized
- Average participant value (WTP) for each reduced restart
- Average participant value (WTP) for reduced bill payment concerns from program, annualized
- Average participant value (WTP) for added "control" over usage and bills from program (separate from bill payment concerns above), annualized
- Average participant value (WTP) for added aesthetic improvements to home from program, annualized
- Average participant value (WTP) for added comfort from program, annualized
- Average participant value (WTP) for reduced internal / external noise from program participation, annualized
- Average participant value (WTP) for added service, options, features for new / replacement equipment, annualized
- Average participant value (WTP) for feeling of helping the environment, annualized
- Average participant value (WTP) or willingness to be paid for hassles or negative features associated with participation in the program, annualized.
- Average participant value (WTP) for added service, options, features for new / replacement equipment, annualized
- Average hours spent looking for new dwelling
- Average number of children 5-18 in participating households
- Average number of elderly and non-elderly occupants

Utility Program Records

Program records can provide information to feed low income cost effectiveness tests. These include information on:

- Program expenditures per participant
- Number of measures of each type installed per participant
- Number of measures installed with transaction cost savings per participating household

Utility Cost Records

Utility cost records can also be used to obtain or calculate benefits resulting from LIEE programs. Utility cost records can, in some cases, be structured to provide information on:

- Percent of recoveries retained by collection agencies as their fees
- Utility avoided cost for energy savings per kWh
- Utility Interest or Discount Rate for arrearages, etc.
- Utility marginal cost to shutoff
- Net Utility marginal cost to reconnect (net of reconnection fee)
- Utility marginal cost to process notice

- Utility marginal cost per billing call
- Number of calls and other activities made to garner payment (not including above) per collection customer
- Utility marginal cost per call and other collection activity made by utility
- Marginal Cost per gas emergency call (visit and phone)
- Avoided cost of separately replacing flex connector in another specific on-site call

Other Utility and Program Information

Additional information that can be used to calculate program benefits in the LIPPT include general information about the utility or the utility's customers. These include:

- Average power generation fuel mix for the program year
- Average additional payment made prior to reconnect (period the payments are moved forward or received when they would previously have been written off)
- Percent of participants receiving low-income subsidy
- T&D loss percentage
- Number of participants

Other Information from Third Party Sources Which is Generally Available and Adaptable Already for These Applications

Additional information that is needed to calculate LIEE program benefits that are not typically tracked by electric or gas utility companies include:

Water and other utility information:

- Avoided cost of next water source per ccf
- Residential water and wastewater rates
- Residential utility rates for affected services

Economic data

- Unemployment benefits per year
- Discounted value of earnings differential for dropouts vs. completed school
- Change in education dropout rate for frequent moving households

Insurance / loss data

- Value of lifetime earnings (for elderly and non-elderly) and property value losses best-suited to low-income homes in California
- premiums paid by renters and owners (available from insurance fact book)
- fire death rates

Environmental Factors:

- Pollution/emission generation factors by generation fuel type

- Adopted / Accepted / vetted emission valuations for use in California applications

Sample of Methods for Measuring Non-Energy Impacts

There is a wide range of methodologies that can be used to assess and quantify the non-energy program impacts of California's Low-income Programs. This section provides a small sampling of the type of evaluation efforts, and the data that can be collected to document program accomplishments that are in addition to the energy and environmental evaluation methods already included in California tests. This section is not meant to be all-inclusive, but exemplary of the type of evaluations that can be employed to document California's Low-income program benefits. Also included in the methodologies are sample price estimates to conduct the research. Of course, evaluation costs are dependent on the program(s) being evaluated, the ability to locate, track or acquire specific information in California, and the size of the territory targeted. However these estimates provided a relative price range for the methodologies.

Sample evaluation methodologies are described for the following topics:

- Emergency calls to participant homes
- Costs for repairs and troubleshooting
- Fewer illnesses in homes of participants
- Reduced occupant fire loss
- Impacts on arrearages and uncollectables
- Fewer shutoffs, reconnects and service terminations
- Reduced bill collection costs
- Improved value of housing stock
- Reduced loss of rental value or rental income
- Community economic benefits
- Value of reduced building deterioration
- Reduced household damage (freezing pipes, etc.)
- Nursing home avoidance

Emergency Calls to Participant's Homes

In some cases low-income programs can reduce the number and frequency of emergency calls to participant's homes when compared to non-participants. The evaluation of program impacts on emergency calls is simple and straight-forward and involves comparing the number and cost of participant emergency calls and the reasons for those calls with the identical data for a matched group of non-participants.

Typically, emergency calls are provided directly to the utility company or fuel provider and are made by the customer. In class 1 utilities these calls are typically tracked in the utilities

customer information systems as an emergency visit or problem visit. With other providers, such as bulk fuel providers, this information my also be kept, partially kept or not tracked at all. In addition, with bulk fuel providers the data is often not easily obtained, even if it is maintained, without individually searching customer records for evidence of a call or problem. In other cases emergency calls may go to friends, relatives, police or fire departments or to the city in which the customer lives. Because of the diversity of how the calls are made and how the data is maintained or collected, a varied approach or a combination of approaches for estimating the impact of emergency call reductions can be made.

The first and simplest method to collect emergency call data is to request the data from utilities that maintain the data and spread the results of this request across all appropriate customers in accordance with their participation or non-participation and distribution in the population. Typically customer contacts are documented in a company's tracking system, with codes that describe the nature of the contact. This is especially true for class 1 utilities that have more extensive tracking systems than other energy providers.

Because many utilities will not provide customer-specific information without a signed customer release form, program managers may need to obtain permission to collect the data from the participant during the enrollment process. In other cases the utility can provide the data for the population of participants and non-participants as a whole, without needing specific customer release forms, as the data cannot be linked to an individual customer and does not pose a confidentiality problem.

To obtain emergency response data the program needs to give the information provider a list of participants and non-participants, including their names, addresses, account numbers, telephone number and other identifiable search characteristics. The information provider can then search their records electronically or manually to collect the information.

Another approach is to conduct a participant and non-participant survey and ask the customer if they have had such a situation, who they called, what they did, what response was provided and the estimate of damage if appropriate. Because many customers handle their own emergency calls this method can identify a wider range of emergency actions and responses than just those documented by the energy provider or a public organization.

These evaluation methods can estimate the number of emergency calls and the impacts of the program on the call rate. The method can also be used to estimate the value of the damage by obtaining specific customer information on the detailed aspects of each emergency call and estimating the call and damage costs.

Once the occurrence and cost data is collected and the difference in the emergency call rate and costs between a test group and an equivalently match control group are known, costs for the type of emergency call can be associated with the call rates and the results added to a benefit cost calculation.

The cost data can then be projected over the target population and used to estimate program wide impacts including customer benefits, energy provider benefits and societal benefits.

Costs for Repairs or Troubleshooting

Low-income programs provide clients with new and upgraded systems and technologies that, as a result of their age and technology improvements, need little repair and maintenance compared to older technologies in non-participating homes. The process for estimating repair and troubleshooting costs is easily implemented through surveys. The use of pre- and post-program surveys with a group of participants and a matched group of non-participant to estimated program impacts is useful. The pre-program survey can be conducted at the time of enrollment to collect pre-program system repairs and troubleshooting costs for both the participant and non-participant groups. This data can be reexamined one or more years after program participation to document the level of post-program costs for the participant group and a matched sample of non-participants. The key here is identifying a matched non-participant group that can be surveyed during each of the pre- and post-program periods. A control group can be established to use later program enrollments pre-program period as a rolling normalized evaluation period and the post-program period as the improvement period. Or, a client eligibility control group can be identified, or a geo-coded control group can be established for this effort.. The use of a control group is recommended to provide non-program induced changes, but may not be necessary to provide estimates of gross impacts.

In addition to the survey effort the participant and control group, and the time periods associated with each should also be provided to the energy providers that maintain service call data so that they can provided supportive data on there involvement in providing repair or troubleshooting customer support.

Fewer Illnesses in Homes of Participants

Measuring the benefits from reduced illness is a difficult effort. In addition, attempts to equate the health of participants Vs the health of non-participants would requires a massive multi-year study using thousands of participants and non-participants. In this study each participant would require monitoring of there health and environmental conditions including eating habits, exposure to disease, hereditary factors and a host of other conditions. Medical science has demonstrated that resistance to illness is a complicated series of interacting events, only part of which are related to the household's immediate environment. In some circumstances illness can be increased through low-income program measures while in other cases health can be improved. For example, the act of cooking produces air-borne carcinogens that we would expect to be absorbed in greater concentrations in weatherized homes. Likewise air-borne virus concentrations can be impacted as a result of low-income program measures, on the other hand, a more comfortable home, may, in some circumstances, improve the health of the occupants.

It should be noted that, the resistance to and occurrence of illness can be both negatively and positively impacted by changes in the household environment provided through low-income programs. We do know of at least one component of typical low-income programs, that is related to health issues that can be tracked and measured. This component is the occupant injury rate that can be reduced as a result of participation in the low-income program. In many homes portable or permanent space heaters and primary heating system have very hot surfaces that when touched can cause minor or sever burns. In one program evaluation in Chicago we found the burn rate for children and adults to be so great that insurance companies would not insure occupants for injury or personal loss associated with the space heating systems found in a specific neighborhood. In this case one of the best approaches is to conduct a pre- and post-program survey on the incidents of injuries associated with heating systems.

Reduced Occupant Fire Loss

Many of the homes that participate in low-income programs have primary heating systems that are poorly maintained or do not operate properly. Likewise, in many homes the primary heating system may not be fully or completely installed or properly reassembled after the last "service". In addition, it is not unusual to find heating systems that are surrounded by combustible items such as paper, bedding materials, clothing, rags, paper towels, sawdust, dehydrated animal evidence and other combustible items. Unfortunately, in most low-income homes the heating systems use internal air for combustion and actually draw household air, an potentially other items, into the combustion chamber in order to burn the primary fuel. If the heating system is not properly configured, reassembled or maintained, a fire hazard exists in those homes. This hazard is so great that most city fire codes require the primary heating system to be isolated from any combustible item by from 36 to 56 inches and require that all building surfaces located within this perimeter be constructed of fire proof materials. Unfortunately, very few homes maintain this standard. However, these standards are typically required for low-income program contractors who service primary heating systems and replace or repair these systems. In most states contractors cannot leave a fire hazard in place relating to the equipment they are servicing or replacing without assuming part of the legal liabilities associated with that fire hazard. As a result, participants who have their primary heating systems serviced through the program are less likely to have a heating system related fire. The act of participating, as provided through the actions of the program's installation contractors, directly leads to a reduced fire hazard in participating homes if the contractors are performing in accordance with most local and state fire codes.

In addition to the primary heating systems, low-income programs often reduce the need for small portable space heaters that use liquid or electrical fuel as their energy source or for secondary wood stoves or fireplace use. While in some areas local codes prohibit the use of these items, they are non-the-less commonly used. Because participation in the program usually increases the energy efficiency of the home, the need for and use of auxiliary portable space heaters provide a potential reduction in the rise of fire damage as a result.

Evaluating the reduction in fire damage associated with program participation can be from very easy to very difficult depending on the ability to contact clients after participation and the condition and accessibility of public fire records.

We propose a dual methodology be used to evaluate the reduction in fire damage associated with participation. Because participant and non-participant surveys are a standard feature in most evaluations, the opportunity to talk with the client about their fire histories should be added to the enrollment survey instruments. As with most program evaluation data needs the survey should focus on both a test and control group. Participants can be asked about their past histories pertaining to this subject at the time of enrollment and periodically following participation (one, three & five years). This can then be compared to identical data for non-participants or if less rigor is acceptable, the pre- and post-program survey can focus only on the participant population. Changes in time-series data can be used to estimate fire loss impact. Unfortunately, this will require finding the participant one to five years after participation. With fire loss, in some cases the participant has moved as a result of the fire. This means there is a higher probability of finding minor fire damage because major fire damage may have resulted in a move. However, the effort can be worth the results as the program can gain a better understanding of the loss and the extent of damage through discussions with the households experiencing some level of fire loss.

An approach that can supplement or replace the customer contact method is the examination of public fire records maintained by state and local officials. However, the ability to obtain these records and conduct the research can change from location to location within the state. We recommend that the program staff work with state an local fire officials to identify areas where public fire records can be searched by address, client, occupant names, and building owner. The program participation files and a file of matched non-participants can electronically or manually linked to the public fire records so that all matching fire responses can be visually inspected and tallied. The key to this method will be to find a state or local database that covers areas where the program has concentrated its efforts over several years and for which several hundred participants and matched non-participants can be identified. If the state records can be electronically or manually searched, then state-wide participants and non-participants can be searched. If the search can be conducted electronically, the evaluation can be accomplished for less than $10,000. If the search must be done manually, the program should plan for an extensive manual records examination that can cost in excess of $50,000 with multiple evaluators conducting multiple searchers across multiple sites.

Because most fire records include an estimate of damage it may be possible to identify the cost savings associated with the “average fire reduction”. In addition, if the program has obtained a general records release from participants, the program can down-load the name, address and telephone number for individuals from the public fire records in the participant group and contact them for more complete estimates of fire loss and associated expenses. In some cases it may be possible to survey individuals in the non-participant group to obtain non-participant loss information, if the study can be demonstrated to serve a larger “public good” that would allow the release of non-participant contact information. However, it will be necessary to review public records access laws to determine what conditions allow for the collection of non-participant information without a signed release to acquire that information.

During the survey contacts with participants and/or non-participants the interview can request information on changes to insurance premiums and the ability to obtain fire insurance following a fire. The customer contact method can also help to identify areas of the state where insurance companies may be "black-balling" neighborhoods because of higher insurance risks. While we were conducting similar research in Chicago we were able to identify a neighborhood where several insurance companies had "black-balled" the neighborhood and were refusing to cover homes in the neighborhoods because of increased fire and injury risk associated with poor quality primary heating systems.

In addition to property loss, there may also be a reduction in fire related injuries or deaths and the expenses associated with these losses. Typically these losses are also contained in the state or local fire damage reports and estimates of costs and be made for each case examined by contacting the individuals experiencing the injury or the family of individuals that died in the fire. (Additionally local newspapers will almost always contain a description of the loss within 24 to 48 hours of the loss.) The interview should be structured to obtain a full range of detailed information regarding the losses for that household. If this is not possible, a simpler but less rigorous method would be to contact insurance regulators or companies and obtain information on projected losses for the average home or the average home with family incomes within the eligibility range. Insurance rate and risk assessment centers are very familiar with these estimates and will typically share the information if approached correctly.

Once the loss levels and rates are quantified, cost estimates can be obtained from public response organizations (fire departments, medical response teams, police support, shelters, etc.) that can be applied across the frequency and extent of the loss. Typically the individual public response organizations can provide estimated financial impact on their operations for the type of calls identified in the study.

Impacts on Arrearages and Uncollectables

Participants in low-income programs often have their energy bills reduced by between 15% to 25% for a period of 20 years or more. This reduction, in theory, frees up discretionary income that is not available to the participant prior to their participation, when energy bills are higher. As a result, some of the savings from the reduced bills may go to reducing arrearages or help avoid arrearages by increasing on-time payments.

Evaluating arrearage impacts on the customer is a simple and straight forward comparison of payment histories for participants against a matched sample of non-participants, for a period of at least one year prior to the program and one year after the program. Most energy service companies can provide information on billing dates, billing amounts, payment dates, and payment amounts. However, in some cases the acquisition of this data may require considerable effort on the part of the energy provider. In the case of class 1 utilities this information is usually contained in the customer information system or a financial database that is maintained on-line or in storage, or in another ancillary system. This data can typically be obtained from cooperating utilities via a request for the information or by a

request to produce the information from the state regulatory office overseeing utility operations. In the case of measuring arrearage impacts for class 1 utilities, confidentially does not need to be a factor and release forms are typically not needed. This is because the utility can down-load the required payment information from a pre identified group of participants and non-participants in a way where the files contain only billing and payment histories without identifying the individual customers for which the information applies. In the case of for-profit bulk fuel or small energy suppliers, these firms can typically provide billing and payment histories if the cost to collect the information is provided so that a profit on the data collection effort is available. However, because of the accounting expertise and systems in these small businesses cover a wide range of conditions, many small firms are unable to construct historic payment histories or will require significant efforts to search and isolate customer-specific billing data. Evaluators should not expect for-profit companies to provide free services beyond what they are required to do by law, however in many cases small companies can provide this information for between $7.00 and $20.00 per hour. Here again the data can be provided not linked to individual customers, unless information release forms have been obtained to document customer approval. To collect this information it may be necessary to provide customer account numbers to the fuel suppliers. This information is almost always collected during the program enrollment process. If the information is not collected, the program may need to contact the customer to obtain the information or the energy provider may need to search by name and address. This can increase the evaluation costs and complicated the data collection process.

If control group identification is a problem the control group can consist of homes on the waiting list or homes that have more recently taken part so that their pre-program payment histories can be used for both the pre- and post-non-participant group's evaluation periods. The basic design for this comparison is to compare the pre- and post-program payment histories with identical period payment histories for the control group to see if there is a difference in payment amounts or on-time payments as a result of participation.

Evaluation of arrearage impacts have been completed for as little at $4,500 in an project we conducted for a mid-western utility where we have received a clean dataset of payment histories in the formats ready for analysis, where no data handling resources are required. On the other hand, evaluations of arrearage impacts can be as high as about $60,000, were multiple organizations working across multiple geographic areas need to collect and compile information across multiple formats where each customer's record must be reviewed, cleaned and formatted for analysis.

Some energy companies maintain customer information systems with payment codes instead of payment amounts and dates. The payment codes typically indicate if the account is up-to-date, or if there is an arrearage present in the account, or other general information on the customer's payment condition. Unfortunately, these general codes do not provide the information needed to conduct an arrearage impact evaluation because they typically do not give specific payment and payment date information that can be compared to billing date and billing amount information. Systems that track payment histories through general payment codes should not be used to study arrearages because they do not permit the examination of arrearage payment progress or reductions in arrearages. We do not encourage examination of

arrearage impact through the use of general payment codes. Evaluators need to insist on precise billing dates and amounts and payment dates and amounts for this analysis.

Reduced arrearage levels help everyone. The customer is helped by avoiding additional charges, companies are helped through a reduction in operating costs and society in general is helped through energy bills that do not need to include the costs to carry problem accounts.

Fewer Shutoffs, Reconnects and Terminations

Low-income programs that lower bills for customers can also decrease the number of customer shut-offs, reconnects and terminations as a result of increased ability to pay bills. We have worked with energy companies that estimate savings in the area of $30 to $70 per shut or reconnect and the same cost spread for terminations that require a field visit to shut of the fuel and a customer service representative to terminate the account. We have also seen bulk fuel estimates that range from zero costs to several hundred dollars per termination when there is a financial loss associated with the termination that includes lost revenues from uncollected bulk fuel deliveries.

Here again, the methodology can be simple. The energy company's estimation of the cost of the connect or disconnect can be summed according to the difference in the number of shut-offs and reconnects between a pre- and post-period test group and an equivalently matched control group. Like the arrearage analysis, this should be conducted using data from at least one year prior to participation and at least one year following participation. However, in addition to savings from reducing the number of connects and disconnects there may also be a larger savings from a reduction in theft of energy.

In one Midwestern utility a study of the costs for shut-offs and reconnects found that over half (67%) of the low-income shut-offs, illegally reconnected themselves within seven days, bypassing the meter in almost all cases. This theft cost the utility company increased loss of income from the power that was taken, and an associated inability to determine the extent of the theft. In many cases the act of the shut-off was the incentive for the illegal reconnect resulting in undocumented consumption that was not recorded on the meter and therefore was not recovered even after a reconnect. That is, the disconnect induced a level of theft that was uncollectable. This cost of the lost energy should be included in the analysis of the benefits associated with connects and disconnects. Unfortunately evaluating theft losses requires conducting on-site studies of the level of illegal connects and the amount of energy that is taken. Fortunately, this activity is typically limited to class 1 utilities that have already conducted such studies and in many cases the evaluation can rely on utility estimates that are documented in cost recovery or rate cases. If the utilities do not have this type of data, the evaluation will need to plan for the collection of this information and use the result of the study to estimate program impacts when the pre- and post-program differences are determined. To determine this cost of theft disconnected customer homes must be visited to project the date of the theft, the length of time of the theft and the lost revenues associated with the theft. This can be done by random allocation for the visits with multiple visits to

establish dates and periods. The home visit should not take any action other than look at the electric lines or gas valves and record the findings.

Reduced Bill Collection Costs

Reductions in bill collecting costs can be identified by using the energy companies estimates of billing costs. This data, like the arrearage estimates and shut-off estimates can be driven by the difference between the test group and control group estimates of payment studies. As we stated earlier, these can be done without identifying the individual client, and later program participants can be used as the control group. However, here again, the key is to deal with the energy suppliers information about the difference in bill payment histories. Once the bill payment histories are completed the per-company estimates can be applied to the estimation of the occurrence for their customers. The two key areas to examine are the costs to bill and re-bill customers. However, in many cases there are very little costs associated with the computer putting a past due figure on a bill that is already going out anyway. But in many cases companies produce additional bills, reminders, and warnings that are mailed to the customer. It is not unusual for these extra mailing to cost between $1.00 and $5.00 per mailing per customer when all costs are loaded on the effort. Each company can provide an estimate of these costs when requested. However, the request should be made in a way that prompts the companies contacted to include all loaded costs.

In many cases bill collection is turned over to a 3rd party through a collections contract between the supplier and the collection agent. Typically the agent collects a fee per customer or a percent of the collection or both. However, each company may have different contract provisions with the collection agencies. These collection fees can run from $25.00 a customer to several hundred dollars per customer and can fluctuate a great deal within a single collection company depending on the level of debt and the collection activities. Here again, the program can establish average, per-customer estimates of collection costs when working with the energy supplier and use these costs to estimate impact when the pre- and post-program comparisons are made. Contact with collection agencies or social service agencies can often identify the costs associated with different collection contract for energy companies because social services agencies often help people out of debt by working directly with collection agencies to come to an agreement on the debt that has accumulated.

Improved Value of Housing Stock

Low-income programs fund the installation of home improvements that result in a reduction of energy use. It is often hypothesized that these improvements also increase the value of the home and, as a result, improve the value of the low-income housing stock.

There are several ways which this hypothesis can be tested to identify if housing values change as a result of program participation and, if so, by how much. The general methodology for these examinations are all founded on an identical approach consisting of comparing differences across a pre- and post-program examination of a test and control

group. However, different methodologies focus on the use of different data for the study. Examples of methods to test this issue are described below:

Comparative Appraisals

This methods utilizes licensed real estate appraisers for a test and control group where two or more appraisal firms are employed to make pre- and post program appraisals across the test and control groups. The appraisals are assigned at random but structured so that an equal number of pre- and post- program appraisals are employed across both the test and control groups so that firm-specific approaches are minimized. Difference between the pre-and post-program appraisals, as adjusted by the control group of non-participants, are used to estimate the program impacts on housing value. This type of study can typically be contracted for between $100 and $150 per home plus analysis and reporting or about $60,000 -$80,000 for 200 test and 200 control group homes. Control group homes can be identified through random geo-coding efforts that place homes similar to the test group into the control group. The drawback of this approach is that the energy efficiency of a home, in many cases, has little impact on the appraised value of a home compared to other criteria such as neighborhood, appearance, level of non-energy related maintenance and other conditions. However, it is a reliable method that will compare impacts to retail housing values without regard to changes in demand by market sub-segments that may be more focused on energy efficiency. If the program changes retail housing values we would expect that change to be reflected in the difference between pre- and post-program appraisals when compared to the same information for a control group.

Pre-and Post Rental Rate Comparisons

Another method of estimating housing value impacts is to conduct rental assessment appraisals for the test and control group homes rather than real estate sales appraisals. Because energy efficient homes may be in greater demand and because renters typically stay longer in an energy efficient home, the appraisal method can employ rental estimation techniques rather than sales estimates. The rental estimates can then be converted to a net present value for the home as income property. In these appraisals the utility costs of the home are included in the rental value estimation causing clear differences in the estimated value of the property from a rental perspective. This method links the energy efficiency of the home to the value of the home as a rental property and is easily compared across the test and control group as the difference in the net present rental value of the home. This study can be conducted for the same price as the real estate appraisal method.

Customer Value Surveys

This method employees survey questions to both the test and control group pertaining to the owner's or occupant's value of the home before and after low-income program improvements. Like most surveys, it is fast and inexpensive, but subjective. This

methodology is fast and inexpensive and can be conducted for about $25 per home surveyed plus analysis and reporting expenses or about $25,000 to $35,000 per study.

A better approach to this question is to conduct all three evaluations and equalize there results across the three methods following an agreement on the per-method weighting system to be used.

Reduced Loss in Rental Value or Rental Income

High utility costs are often a driver of renter relocations. In several of the low-income customer surveys we have conducted in the past, energy costs are often identified at the primary or a secondary reason why a renter elects to move. This being the reason for forced moves instead of being as a result other personal changes (change in income, new job location, need for more or less room, etc.). As a result, homes that are energy efficient have higher occupancy rates, are in higher demand and experience less turn-over than energy inefficient homes. For low-income families, utility costs often account for a significant percent of monthly expenses and a reduction in energy costs often means an increase in discretionary income. For these reasons, energy efficient low-income rental housing is a premium commodity that is valued by the low-income population. Measuring the impacts of reduced rental value and income can be handled in one or more of the following ways.

Landlord Survey

The first method involves surveying landlords for both participants and non-participants to obtain both quantitative and qualitative information pertaining to rental value, number of moves, average time between moves, and average vacancy rates. The difference in these data can be used to estimate program induced impacts. The test group can consist of landlords for early program participants and the survey can be designed to cover the previous two years. The control group can consist of later program participants (last couple of months and clients on waiting lists). The data for the control group can be adjusted to account for post program time periods. Typically landlord information is maintained in program records and these individuals can be readily identified. If this information is not in the tracking system, there are typically a number of local housing assistance agencies that can help locate renters in weatherized and non-weatherized homes. One-on-one interviews with landlords will help identify renter impacts associated with the program.

Customer Survey

A customer survey is also a way to obtain renter information. In this case the survey would be conducted in the same way as the landlord survey, but target clients instead of landlords for the control and test group. The groups identification methodology can be conducted in

the same way as the landlord survey but use the renter as the contact point rather than the landlord. The questions would focus on the same benefit / cost issues. However, in the customer survey approach the questionnaire can be structured to get at more qualitative measures in addition to some quantitative issues.

Professional Interviews

This method focuses on conducting interviews with professionals within the low-income housing markets to explore rental demand and value issues. These interviews can include personnel responsible for low-income housing at the local and community levels who are familiar with housing and housing associated issues. Typically these individuals work with low-income clients in locating and acquiring housing and with housing costs. These individuals are routinely approached by clients who request assistance in finding lower cost homes. The professional opinions of a group of from 30 to 50 of these professionals can provide a qualitative assessment of housing issues and estimate financial impacts of energy costs on rental demand and rates. Professional interviews can typically be conducted for about $250 to $300 each, including limited analysis and reporting. Converting the interviews from personal contacts to telephone surveys can reduce the costs of the interview but also reduce the level and quality of data that can be obtained.

In conducting these interviews the study should identify approximately half of the individuals to be interviewed through local housing contacts. The remaining interviews should be conducted with others that are recommended as a result of the first interviews. The study can identify 15 to 25 low-income housing professionals and then conduct 15 to 25 more interviews with individual recommended by the first interviewees. This method helps identify the right mix of individuals that can provide good quantitative and qualitative information.

Federal Housing Payment Examinations

In some cases federal and state housing programs that make payments directly to landlords or reimburse occupants can be compared to a master list of low-income participants to compare the approved housing costs for each home weatherized to the approved cost of non-participating homes. These two datasets can be used to compare the average subsidized rent payment for weatherized and non-weatherized homes. PG&E would need to identify the local or state agencies that maintain this data and verify that advanced data search routines using name, addresses, and geo-coding match routines can be employed.

Economic Benefits

In estimating the impacts of energy program services it is important to identify dollars that are diverted from one economic stream to another. The reason for identifying economic stream changes is because the typical economic stream associated with a fuel supply is often different than the economic stream associated with other paths. With fuel supplies, for

example, a higher proportion of dollars are exported out of a give area, such as California. However, with other economic paths, such as rent payments, food costs, car payments, child care costs and the like, more of the dollars spent may stay within a local economy, providing a greater level of economic activity than what would be expected if the payments are used for energy supplies. However, this is not always the case. In order to identify economic multipliers associated with reductions in energy bills it is necessary to know how the money saved is being spent and the difference in the local economic impact for both economic systems. This difference is not easy to calculate and most states have spent hundreds of thousands of dollars trying to identify the difference in the impact between different economic streams. In Illinois, for example, the Department of Commerce and Community Affairs has developed an economic stream comparison model that projects the impact of dollars through different economic streams. In this model it is possible to input different expenditure levels across different economic streams and look at the projections for the local economy. While most reductions in energy expenditures produce increased local dollars, this is not always the case.

During interviews we conducted with Vermont officials, we were informed of the Consumer Expenditure Survey from the Bureau of Labor Statistics, (Department of Labor). This database projects expenditures across different income groups and identifies how spending across the groups differ as a function of income. Using this dataset, it is possible (in the case of the State of Vermont) to examine how household expenditures differ as a function of income. This dataset can be also be used to project the difference in the incremental expenditures for low-income families who's financial position is improved by reduced energy bills. This can be accomplished by projecting the savings from energy programs as an increase in disposable income and compare the economic streams for the different income levels and multiply these impacts by the specific local economy multipliers associated with the difference between the pre- and post-program income streams. Local economic multipliers are often already available.

Value of Reduced Building Deterioration

Reduced building deterioration is often a direct or indirect result of the low-income program. The program itself or ancillary program add-ons can directly impact building deterioration by installing non-energy efficient measures. For example, holes in roofs are typically patched prior to adding ceiling insulation and holes in walls are almost always plugged or patched prior to a weatherization, as are foundation openings, poorly operating doors and other such actions. These program benefits can directly combat building deterioration. If pride of ownership is increased such that the occupants takes additional "free-driver" measures or if the program induces an increase in attention to the effects of deterioration then deterioration impacts for the building can be multiplied through participation.

Changes in building deterioration are difficult to measure, but can be included in real estate assessment studies that specifically identify and rate a given set of deteriorating factors across an assessment of test and control homes. A building deterioration, or building

condition inspection can be conducted at the time of enrollment followed by an identical inspection 2 years after program participation to estimate changes in deterioration indicators. The control group for this same examination can be identified through public sector low-income programs and a similar set of inspections can be provided to these buildings if they have not participated in the program over the following 2 years. The difference in the estimated value of the structure as a result of deterioration and the presence or absence of deterioration indicators (holes in home, broken windows, paint pealing, rotting wood, etc.) can then be calculated using estimates of the cost to repair the difference in deterioration across the test and control homes.

Reduced Household Damage

Weatherized homes are much less susceptible to damage associated with freezing pipes, cracked walls, or structural joint damage from free-thaw conditions. Past customer surveys have identified large and significant reductions in the number and severity of weather associated damage following low-income measures. Programs that aggressively pursue a wide range of low-income measures and that support per-unit low-income budgets that significantly improve the energy efficiency of the home may see large drops in weather associated damage. Identifying the impacts from low-income can be conducted via a simple pre-and post-program survey of the frequency and extent (financial and mechanical) of the damage. The client can be asked about these items during the enrollment process and then after one or two years following participation. A control group can be used to increase the rigor of the study, but a simple pre- and post-program frequency and damage estimate obtained through participant surveys would be an acceptable approach to quantifying this effect.

Nursing Home Avoidance

Nursing home avoidance is a complicated issue involving the interactions of a host of intervening variables one of which may be the condition, comfort and energy efficiency of a home. A home that is energy inefficient can be both hot in the summer and cold in the winter causing discomfort for persons who may need to live in a more controlled environment. We know of no evaluation that has seriously addressed this issue but we would not be surprised if in a small number of cases, the energy efficiency of the home was a contributing variable in the decision if and when to move to a nursing home.

To measure this aspect we would suggest a simple an inexpensive interview procedure to gauge importance of the issue in the decision to move. For this procedure we suggest conducting interviews with a group of nursing homes so that at least 25 nursing homes are visited and at least 5 individuals in each home are interviewed. The interviews can be conducted as a group to obtain cross fertilization of ideas and perspectives. The interviews can focus on the reasons for moving into the home and the drivers of the decision process.

Factor analysis can then be conducted on the strength of the drivers for the move and to estimate the significance of the energy efficiency of the home in the decision process.

Once the factor analysis provides the distribution of the importance of energy efficiency to the move compared to the other variables identified during the interviews the economic impacts can be distributed across the relative importance of the different drivers for the move. The financial benefits and detriments can be discussed and examined during the interview process. In planning the interviews, ample time should be provided for identifying which patients to include in the interviews to assure a fair mix of patients. In addition, the interview should be structured as a social function to gain the positive support of the patients. The interview should be planned to last from 2 to 3 hours each group to allow for building relations among the participants. The interview should be handled by an experienced interviewer familiar with interviewing elderly populations. A monetary contribution to the nursing home of about $200 per interview should be planned to gain the attention and assistance of the facility manager. Following each interview the results of the interview should be discussed with an administrator of the nursing home to test the accuracy of the information obtained in the interview. This type of evaluation can be accomplished within a small evaluation budget, typically ranging from $25,000 to $50,000.

Measuring Education Benefits

Several studies have used pre-post evaluations, with and without control groups, to attribute energy savings to educational efforts associated with weatherization programs. These studies have suffered from low sample sizes. This is an area that would benefit from significant additional work. Green and Skumatz (2000) provide recommendations on several evaluation methods that could be used to upgrade these estimates, including meta studies, pre-post, and statistical techniques that should be considered for future efforts.

Measuring Participant-Expressed Benefits

Multiple approaches are available to estimate values of other benefits associated with program participation. For the purposes of this report we are labeling these "side benefits." Approaches to measure "side-benefits" include willingness to pay surveys, customer expressed value surveys, scaling surveys, and approaches that ask customers about the value of their benefits "relative" to other, known factors. The consultants assessed recent enhancements and current controversies associated with these approaches with experts from a number of major universities. The results of an ongoing survey in New England,[29] which is using multiple approaches in one survey, should help settle some of the controversy on the most robust and reliable approaches to use in these surveys. "Willingness to pay" has an extensive literature behind it, but customers have a demonstrated difficulty quantifying some benefits, and the results can be inconsistent. Recent literature has pointed out the weaknesses in traditional scale survey approaches (very important, somewhat important, etc.), and this

[29]Just-completing work by SERA for Northeast Utilities.

literature is moving toward “anchoring” these scales and using “relative” comparisons to provide greater reliability in the results.

Whichever specific technique is found to be most robust, customer phone surveys can be used to gather the data. These surveys can be conducted for a total of about $35 per complete, and require sample sizes on the order of 300-400 to provide reliable results. If stratification for different service territories, climate zones, or other subgroups is needed (residential vs. low income, etc.), then larger sample sizes are required. However, to provide the most reliable information, control group surveys are also need to provide a baseline for some of the benefits categories. For instance, the results on changes in illness, or changes in noise would be stronger in cases where the level of increase for similar residents that did not receive the program can be subtracted to get “net” effects for the program under study. The total budget, including control group, would be on the order of $25,000 - $45,000.

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Appendix A: Program Reported Data and Energy Cost Projections

Table 13 Example of energy savings, useful life and number of measures installed

Measure Name	Electric Savings (kWhs/Yr)	Gas Savings (therms/Yr)	EUL (Effective Useful Life)	N (number of installed measures)
Measure A	50	153	15	1,504
Measure B	112	0	20	3,312
Measure C	0	47	16	2,598
Measure D	26	0	4	5,645

Table 14 California average projected avoided cost rates 1999 to 2018

	Gen	T&D	Env Ext	Total	Gas	Env Ext	Total
	$/MWh	$/MWh	$/MWh	$/MWh	$/therm	$/therm	$/therm
1999	33.1	4.7	6.0	43.8	0.319	0.053	0.372
2000	34.1	4.9	6.2	45.2	0.330	0.055	0.385
2001	34.9	5.1	6.4	46.4	0.339	0.056	0.395
2002	37.2	5.3	6.6	49.0	0.348	0.058	0.406
2003	38.5	5.5	6.8	50.8	0.358	0.060	0.418
2004	40.0	5.7	7.0	52.8	0.369	0.062	0.431
2005	41.5	6.0	7.2	54.7	0.380	0.063	0.443
2006	43.3	6.2	7.4	56.9	0.391	0.065	0.456
2007	45.0	6.5	7.6	59.1	0.404	0.067	0.471
2008	46.8	6.8	7.9	61.4	0.416	0.069	0.485
2009	48.7	7.0	8.1	63.9	0.429	0.071	0.500
2010	50.8	7.3	8.3	66.5	0.442	0.073	0.515
2011	53.0	7.6	8.6	69.2	0.452	0.076	0.528
2012	55.3	7.9	8.8	72.1	0.461	0.078	0.539
2013	57.7	8.3	9.1	75.1	0.472	0.080	0.552
2014	60.2	8.6	9.4	78.2	0.482	0.083	0.565
2015	62.7	9.0	9.7	81.4	0.493	0.085	0.578
2016	65.4	9.3	9.9	84.7	0.504	0.088	0.592
2017	68.2	9.7	10.2	88.2	0.516	0.090	0.606
2018	71.1	10.1	10.5	91.8	0.528	0.093	0.621

Note: These costs are CBEE Recommended Input Values for PY99 Cost-Effectiveness Evaluations.

Appendix B: Summary of Results of Survey of California Program Participants on Willingness to Pay

ABSTRACT AND SUMMARY

In order to provide more California-based data as inputs for the LIPPT cost-effectiveness estimates, a survey of participants in recent California weatherization programs was conducted. The survey asked questions about measures installed and removed, reasons for participating in programs, changes caused by program participation, dollar valuations attributable to these changes, demographics, and other questions. Most critical to the LIPPT research were the quantitative results regarding changes attributable to the program. They were asked about changes in sick days, about whether moves were avoided, and about a wide range of other changes (positive and negative) they may have experienced because of the program. The questionnaire also asked respondents to estimate the value, in terms of their willingness to pay (WTP) for particular changes or benefits they attributed to the program. These WTP values could then be used to estimate the average dollar value associated with a variety of the program's impacts.

The survey found that the most commonly reported changes due to the program were:

- Comfort improvements, which 57% of participants said were improved by the program. Comfort improvements the most commonly mentioned benefit from the program reported by participants.
- Additional features or options on the new equipment (37%)
- Helping the environment (36%)
- Reliability and maintenance of the equipment (31%)
- Appearance of the home (30%)
- Avoiding a move (24%).

Respondents assigned the highest average WTP values to: Comfort, education and control over the bill; reduced shutoffs, avoided moves, and home repairs. Participants were first asked to assign WTP values to each benefit separately. Then they were asked to estimate the value of all the benefits and negatives together. The WTP values for the total of the individual responses was almost $700 annually; however, the average WTP assigned for the sum of all benefits was only about $170, about one-quarter of the value they assigned individually. For the remaining analysis, we "rescaled" the WTP benefits, maintaining the relative WTP benefits sizes, but scaling them downward (to one-quarter of their values) so they summed to the stated total for "all" benefits. The total dollar values computed using WTP methods are 3.5 times as large as the default energy savings used for the LIEE proxies, and are also considerably larger than the estimated non-energy benefits for the utility and the general public or society. The absolute value of the WTP benefits attributed by participants is high, making it difficult to incorporate the absolute values into the NEB analysis for this project, because of our policy for using conservative values. However, the survey provided relative values and relationships between benefits categories that could be useful and provide important data for use in the LIPPT project.

The benefit categories of most concern to the RRM were those that could be classified as "hardship" benefits. Aspects of this type of NEB were important willingness to pay (WTP) estimates. Some aspects of these hardship benefits could be estimated from other sources, and were estimated using independent data as described in other portions of the report. This includes shutoffs and reconnects, collection-related activities like calls or notices, and similar hardship aspects. However, other aspects of hardship benefits could not be estimated using other methods. We developed a list of benefits that might be termed "hardship". As mentioned, many of the individual categories that represent hardship benefits were also estimated in the LIPPT model. The major missing category – improvements in control over the bill -- represented about 14% of all the WTP benefits estimated by survey respondents. We used this information to develop a proxy in the form of a multiplier on other participant benefits that could represent this remaining aspect of the hardship benefits. We assigned a conservative 10% multiplier.

Survey respondents also assigned a very significant dollar total to categories of benefits that represent "extra" features or benefits provided by the program. These extra benefits include improvements in comfort, reduced noise, extra features or options on the equipment that weren't present on the old equipment, and other similar benefits. However, these extra benefits need to be assessed net of the negatives provided by the program, a negative WTP value that was also assigned by survey respondents. Summing the WTP values for these extra benefits and subtracting the assigned WTP for the negative impacts resulted in a subtotal for net extra benefits that represents more than 40% of the total benefits participants attributed to the program. Clearly, these benefits are highly valued by participants, and represent important "public" benefits from the program. Using these results, we incorporated a 25% multiplier as a proxy for these benefits. This multiplier excluded two sources of benefits that might be considered to overlap with benefits estimated via other methods.[30]

In summary, we used a subset of the results from the survey in refining the LIPPT model estimates.

- We used the participant-specified estimate of the number of sick days avoided through the program in developing estimates of the value of sick days avoided in the LIPPT model (.07 days avoided per participant).
- The participant-specified estimate of the number of calls to the utility avoided through the program was very similar to the levels reported in the literature. This data served as a confirmation of the estimate of the level of program-induced changes in calls that is applied in the model.
- We used a 10% multiplier on other participant benefits as a proxy to represent the aspect of hardship benefits related to greater control over bills and lower worries about bills resulting from the program.

SURVEY RESULTS

[30] Specifically, we excluded the appearance and maintenance-related benefits from the multiplier to be certain we did not double-count benefits measured in the property value section.

A survey was designed by Skumatz Economic Research Associates (SERA) and revised with input from the RRM. The survey's objective was to identify changes, benefits, and negatives attributable to the program that could be quantified. The survey was administered to 321 participants divided evenly between the four utilities: 80 at PG&E and SDG&E, 79 at SCE, and 82 at SCG. The survey was pretested on February 23, and after refinement, telephone surveying occurred between March 1, 2001 and March 7, 2001. Calls were made between 4 and 9 p.m. on weekdays, and between 11 a.m. and 9 p.m. on weekends. A computer-assisted telephone interviewing system was used for data collection and sample management. Up to five callbacks were made before a sample point was abandoned and replaced. Out of range responses were automatically controlled by the questionnaire programming, and interim responses to questions with an "other" category were typed in verbatim.

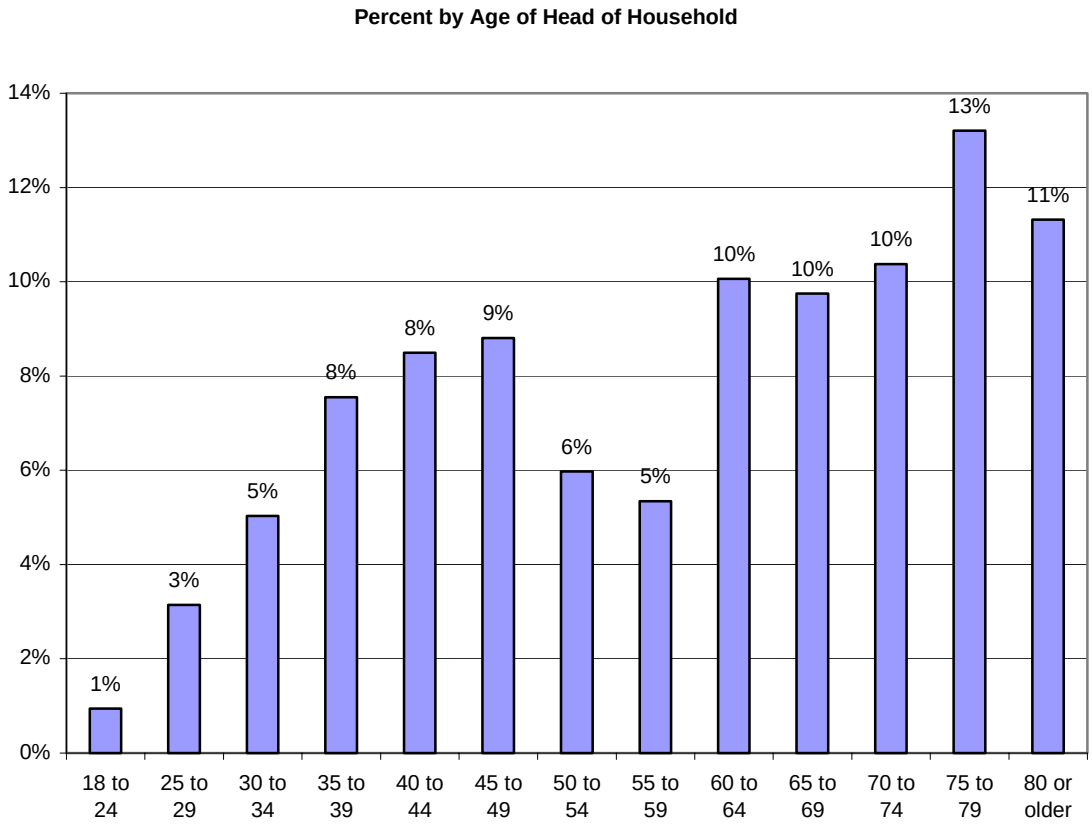
Background and Demographics

Overall, the majority of participants surveyed (55%) lived in single-family dwellings; 17% lived in mobile homes, and 26% in apartments. The main heating fuels were natural gas (75%), electricity (20%). Others reported were small amounts of bottled gas, oil, and other heating. Natural gas (85%) and electricity (12%) were the main water heating fuels. Although the respondents were equally divided among utility companies, most of the respondents were in South Coast (43%) or Inland (39%) climate zones.

Single-family respondents were more common in the SCG territory, and less common in SCE territory. A higher percentage of SCG respondents reported natural gas as their main heating fuel (89%) and as their main water heating fuel (98%). Higher percentages of electric space heating were reported from SCE and SDG&E respondents (22% and 28%). SCE respondents had higher percentages of natural gas and lower percentages of electric water heating (87% and 10%). Three-fifths (61%) were homeowners, and 39% were renters. Nearly half reported their homes had two bedrooms (46%), and a third (31%) had three bedrooms. Fifteen percent had one bedroom, and 7% had four or more bedrooms, and fifteen percent (15%) have household members that are homebound due to health reasons.

One third (36%) of the respondents reported there was only one person living in the home, and 29% reported two residents. Nine percent (9%) reported three residents, 12% reported four residents, and 15% reported five or more residents. There were significantly more respondent homes with five or more residents in the SCG and SCE territories. The age of head of household was fairly evenly distributed over the age categories (see graph below). Half the homes reported residents that were 65 or older, 37% reporting one, and 12% reporting two elderly residents. Half the responding homes reported having residents under 18. Seventeen (17%) reported one, 15% had two, 13% had three, and 5% had four or more residents under 18. Both SCG and SCE participants reported more residents under 18. One third (34%) had residents under age 5, with one-quarter with one under five, 9% with two under age 5, and 2% had three under age 5.

Figure 1



Ability to Pay Energy Bills

When asked about the importance of electricity bills in relation to other household expenses, 65% rated them as extremely important, and 22% rated it as important. On a scale of 1 to 5, where 1 means not at all important, and 5 means extremely important, respondents gave an average score or 4.49. A total of only 2 percent gave a score of less than 3. The average score for the importance of gas bills was 4.24, with 57% reporting these bills as extremely important, and 22% rating them as important. Only 7% gave a score of less than 3.

About half the respondents reported an increase in concern about their bills after participating in the program (47% for electric bills, 53% for gas bills). Concerns about electric bills were lower for 17%, and lower for 10% for gas bills.

About one third (37%) found it difficult to pay their electric bills in the past. For those with previous difficulties, most said there was not change after the program (60%). About one-fourth (26%) found their ability to pay had improved; 14% said it had gotten worse. One third (36%) of those with previous difficulties agreed with the statement that it had become harder to pay their bill. Forty percent said they found it easier to pay the bills now: twenty nine percent (29%) said they found it easier to pay the bill and can now

make payments they previously missed, and 11% said they found it easier to pay bills, but are still missing payments. One quarter of those with previous problems said there was no change and they were always able to make payments.

Reported Measures Installed

The survey asked which measures the respondents recalled having installed. Table 1 summarizes those results. Note that the totals sum to more than 100% because respondents had multiple measures installed.

Table 1. Percent of Respondents Reporting Measure Installed

Type of Measure	Percent with Measure
CFL	76%
Refrigerator	23%
Aerators	47%
Low Flow Showerheads	70%
Water Heater Blanket	31%
Furnace	12%
Caulking	77%
Insulation	34%
Home Repairs	21%
Other	26%

Respondents reported removing a total of 5% of measures. Two percent removed weather-stripping, 1% removed light bulbs, 1% removed showerheads, and 1% removed other items. Given that the survey concentrated on participants from program years 1999 and 2000, we would not expect a very high percent of the measures to have been removed.

Although 84% reported adding no new equipment since the program, a number of homes added equipment since participating in the weatherization programs. This included addition of refrigerators (6%), washers (5%), dryers (3%), stoves, dishwashers, and air conditioners (2% or less each). Ninety percent (90%) have added no conservation measures since program participation. The measures that were added (each 3% or less) included weather-stripping, CFLs, caulking, fluorescents, electronic thermostats, or other measures.

Changes from the Program

When asked if calls increased or decreased, they 35% indicated they decreased after participation in the program; and 60% said they stayed the same. Five percent reported increasing their calls to the utility after the program. The percent stating they decreased their calls was higher for PG&E and SCE (both exceeding 40%).

Participants were asked if the number of sick days they had to take off from work changed after the program. Sixteen percent (16%) reported a change, with 26% of those reporting somewhat fewer sick days and 56% reporting many fewer sick days. When

asked whether their children had more or fewer sick days from school, 25% reported no change, and 35% said they had no children in the household. The remaining 40% reported a change in children's sick days, and 84% reported fewer sick days (56% reported many fewer sick days). Eleven percent (11%) reported an increase in children's sick days and 5% stated no change at this point.

Benefits from the Program

One of the first questions asked was whether program participation had led to any benefits to their family; this question was first asked in an unprompted format. Comfort-related benefits were the most commonly mentioned. Twenty-five percent (25%) stated that the program led to their homes being warmer in the winter and cooler in the summer. Another 17% stated their house was less drafty, and 4% stated the house heated up more quickly. Savings was the second most commonly mentioned change. One quarter (24%) stated they had a decrease in utility costs or that they used less energy. One percent noted their family had been healthier, and 18% noted other benefits including generally positive comments on lights, weatherization, doors, refrigerators, windows, soundproofing, less leaky roofs, and the helpfulness of the program. Very few (5 or fewer) mentioned negative effects. Another quarter (23%) mentioned no specific benefits.

When asked which measures led to the benefits they mentioned, weather-stripping was the most commonly mentioned (62%). Attic insulation and low energy light bulbs were each mentioned 18% of the time. Approximately 10% attributed the improvements to repaired doors or windows (11% and 9% respectively), and another 9% mentioned the showerheads and aerators. Eighteen percent (18%) mentioned other sources of the benefits, including: the refrigerator, air conditioners or swamp coolers, heater replacement, and other basic measures installed under the program. Six percent (6%) said they didn't know which measures were responsible. Higher percentages of SCG customers attributed the savings to door and window repair and replacement efforts (25% and 21% respectively), and SCE and SDG&E customers more commonly reported "other" measures as the cause of the impacts. SCG customers were less likely to cite low energy light bulbs as the source of improvements.

More than 80% of the respondents cited no negative aspects associated with the program. Those citing problems mentioned general dissatisfaction with the work done (8%), fixtures or appliances that have not been repaired or replaced (4%), weather-stripping that was not properly installed (3%), that repairs were already needed (1%) or other comments (2%). For that group reporting negative outcomes, the negative aspects were attributed to weather-stripping (33%), light bulb replacement (13%) heater/furnace replacement (10%) or other sources. One quarter (27%) couldn't say what aspect of the program led to the negative outcomes. When asked if they could recall any other positive or negative aspects of the program, four-fifths said no (83%).

The next phase of the questionnaire asked whether they found changes in any of a list of areas. They were then asked whether the changes were better or worse than before the program, and whether it was somewhat or much better or worse. The survey was careful

not to assume that the changes would be positive; respondents could say the change was for the better or worse for any category mentioned. The percentages of participants noted changes due to the program are shown in Table 2. Note that in some cases, the changes for the better and worse don't add to 100%. After stating a change, a few sometimes said there was no change when asked whether it was better or worse.

Table 2. Percent of Participants Reporting Changes due to the Weatherization Program

	Yes, changed	Changed for Better (for those reporting changes)	Changed for Worse (for those reporting changes)
Comfort	57%	97%	2%
Noise inside the home	16%	76%	14%
Noise from outside the home	23%	93%	1%
Appearance of the home	30%	88%	7%
Reliability or maintenance of equipment	31%	96%	3%
Upkeep on home	23%	96%	3%
Different features or options	37%	88%	6%
Help the environment	36%	98%	1%
Illnesses	16%	82%	18%
Avoided a move	24%[31]		
Notices	13%	39%	34%
Shutoffs	14%	81%	19%
Ability to Pay Electric Bills	40%	64%	36%
Concern about Electric Bills	64%	27%	73%
Concern about Gas Bills	63%	16%	84%

Again, comfort benefits were the most-frequently mentioned, with virtually all those respondents reporting changes citing an improvement in comfort. The next most frequently-mentioned benefits included improved ability to pay bills, different features or options, helping the environment, reliability and maintenance of the equipment, and appearance of the home. In all these cases, the vast majority noted improvements from the program. For those that stated their new equipment had different features, we asked them to specify which of the equipment had different options. In response, they mentioned refrigerators (26%), showerheads (22%), light bulbs (18%), furnaces/heaters (11%), locks on roofs (9%), washers (4%), thermostats (4%), stoves (3%), weather-stripping (3%), dryers (2%), and other (15%).

A high percentage of respondents noted changes in concern about the electric or gas bills, with a majority reporting greater concerns. It is difficult to say whether they were now more concerned because they felt greater obligation after the program, because they were now more aware, or for other reasons.

Education Aspects

[31] 8% said yes, maybe a move was avoided; and 16% said yes, definitely.

Four-fifths (82%) reported receiving a handout explaining ways to save energy; and half (54%) recalled that the program representative talked with them about ways to reduce energy use in the home. On a scale from 1 to 5, where 1 means the information was not at all useful, and 5 indicates the information was very useful or valuable, respondents reported an average of 3.96 (with higher scores of 4.26 reported for PG&E respondents). Six percent (6%) stated the information was not at all useful; 47% called it very useful or valuable (and 19% gave the information a score of "4". One in five (21%) gave the information a neutral "3" and 6% gave it a "2". A higher percent of SDG&E respondents were neutral on the information (31%).

When asked whether the information was useful in increasing control over their energy use and energy bills, 37% reported it was very valuable, and 49% found it somewhat valuable. Only 14% found it not at all valuable. A somewhat higher percent of SDG&E respondents (20%) reported the information was not at all valuable. A little more than half of all respondents (57%) stated they received tips from the program representative was useful in helping them consume less energy. Only 4% reported receiving a drip or water use gauge. Of those receiving a drip gauge, over 90% reported they used it.

Program and Program Satisfaction

One in five respondents got the referral from a neighbor, friend, or family member (this percentage was higher for SCG and SCE). Twelve to sixteen percent got the referrals from a utility mailing, a phone call (27% for PG&E), or door-to-door solicitations. Contractors were responsible for 8% of referrals, 7% heard about it from the apartment manager or home owner's association (21% for SDG&E), and 5% found about the program from the utility staff when they called about the bill. Other referral methods mentioned included community assistance agencies, radio or newspaper ads, or calls to the utility.

When asked about the most important reason for participating in the program, participants reported:

- Billing related: To save money on their bills (39%) or learn how to use less energy (10%), or to show the utility they want to reduce bills (2%)
- For equipment: for free equipment (19%) or to get new equipment (8%)
- Other: to make the house more comfortable (4%), family health issues (2%), "other" reasons (13%), or in some cases, they didn't make the decision themselves (4%).

Only 8% of the participants reported they had previously participated in other energy conservation programs.

There was very high satisfaction with the workers that delivered the program services. On a 5-point scale, where a score of 1 means very dissatisfied, and 5 indicates very satisfied, respondents gave program workers a score of 4.24. Fully 81% of the respondents gave the program a 4 or 5. Nine percent (9%) were dissatisfied or very dissatisfied.

Negative Aspects of the Program

The vast majority of respondents reported no hassle or scheduling problems in arranging for the work to be done (91%). Only 4% reported that the workers did not clean up after themselves satisfactorily after finishing their work. For the few reporting problems, 38% said it was no problem at all; half (49%) said it was somewhat troublesome. Only 14% called the problems from scheduling hassles and cleanup problems were very troublesome.

WILLINGNESS TO PAY AND QUANTITATIVE RESULTS FROM THE CALIFORNIA WEATHERIZATION PARTICIPANT SURVEY

We asked participants to report their willingness to pay or assign a value for a variety of benefits categories. They were asked for a dollar value, then for those that couldn't respond, we walked them through a battery of questions asking whether their willingness to pay was higher or lower than a series of dollar values. Then again, we asked them to assign a specific value. From the dollar value responses or their final answers about what range the dollar value fell into, we were able to construct a willingness to pay value for each benefit category. We assigned a dollar value of zero for all those that indicated no benefits, refused, or didn't know.[32] We asked respondents to state values for each benefit category, and then asked them to assign a WTP value for the total of all the benefits and negative impacts they derived from the program. Table 3 shows the weighted average of computed benefits, weighted by the number of low-income customers in each utility's territory.[33]

These benefits show that the amount reported for the sum of "ALL" benefits is considerably less than the sum of all the individual benefits they report. In fact, the reported total for "all" benefits is about 25% of the total of the individually reported benefits. Thus, we have provided adjusted WTP dollars per year results in Table 3. The third column of numbers adjusts the values for the individual categories of benefits downward so the sum equals the total reported by participants for "all" benefits. These are the values that we used in the remainder of the analysis.

Table 3. Willingness to Pay (WTP) Results

Type of Benefit	WTP Results	Percent Reporting the Benefit	Adjusted Benefits	Percent of Total WTP Benefits
Comfort	$ 128.60	76%	$ 31.67	19%
Education/Control	$ 93.88	55%	$ 23.12	14%
Shutoffs	$ 86.93	51%	$ 21.41	13%
Moving	$ 79.00	47%	$ 19.46	11%

[32] Prior to analyzing the results, we examined the distribution of the responses and eliminated approximately the top 1% as outliers to assure the computed averages weren't skewed by outliers.
[33] In computing the benefits, we omitted outlier values.

Repairs	$ 69.75	41%	$ 17.18	10%
Notices	$ 65.76	39%	$ 16.20	10%
Illness	$ 65.13	38%	$ 16.04	9%
Negatives	$ (51.23)	-30%	$ (12.62)	-7%
Features/Options	$ 50.66	30%	$ 12.48	7%
Noise	$ 50.32	30%	$ 12.39	7%
Appearance	$ 48.67	29%	$ 11.99	7%
All	$ 169.32	100%		
Sum	$ 687.47		$ 169.32	
Percent "all" represents of "summed total"	25%			

We first compared the participants' total WTP as indicated by the survey results to the total bill savings customers estimated for the LIEE program to examine the size of the reported WTP figures relative to the energy savings. We found that the participants' valuation of the non-energy benefits ($170) [34] was 3.5 times as large as the default bill savings benefits ($48.45). These are fairly high valuations for benefits.

These results were fairly consistent across the four utilities, with results a little higher for SCG and lower for SDG&E. The five climate zones also showed fairly consistent values, except for lower results for the desert area (although the sample size was small for this group).

Total benefits from homes with chronically sick members were higher than for non-sick households by about 15 percent; there was little difference in WTP totals reported between elderly and non-elderly homes. However, homes with children reported total benefits almost 50% higher than those without children. These checks and results indicate that participants were able to answer the WTP questions with some consistency, and we saw higher values reported by groups that logically could be expected to have higher values. In addition, these results for subgroups indicate that if program designers wanted to maximize benefits from the program, they might consider targeting to homes including invalids or children.

Comparing to LIPPT Model Results

In this section, we compare the estimated WTP benefits for NEB categories with benefit values estimated via the estimation techniques we incorporated into the LIPPT model. These comparisons are summarized below.

- **Illness**: Respondents provided an estimate of the change in the number of sick days they lost from work before vs. after the program. We computed the average reduction

[34] In addition, the respondents reported non-energy bill savings (water bill savings) of $11.58, discussed later in this section.

in the number of sick days lost from work as 0.071.[35] We valued this reduction in sick days using minimum wage, which results in a per-participant value of $3.83 per year. As a comparison, the illness value assigned using the WTP results was $16.04. This figure represents 38% of the total benefits reported in the WTP survey. The estimate derived from the LIPPT represents about 10% of the total participant values. As we have done throughout the analysis, we used the lower, more conservative figure in our computations for the LIPPT cost-effectiveness test.

- **Moving**: One of the few studies that estimated avoided moves per participant (Blasnik, 1997) reported that 0.006 moves per resident were avoided through a previous program.[36] In the WTP survey, 16%-24% of the participants reported that the program helped them avoid moves. The results are reported in Table 4.

Table 4. Do you think that the work done on your home in any way helped you avoid having to move to another home?

Yes, maybe	8%
Yes, definitely	16%
No	75%
Don't know/ refused	2%

Thus, one in 6 residents responding to the survey reported that a move was definitely avoided, and another 8% said it was avoided, maybe. One-third said this avoided move was due to the energy savings, another 30% said it was due to the work done on the home, and 30% said it was due to both actions. Therefore, 90% said the avoided moves were due to the program and about 10% said it was due to other reasons. The computed average value of avoided moves from the WTP survey was $19.46. These results are considerably higher than the conservative values estimated in the model ($1.30). In the model, we derived the value of avoided moves as the multiple of the number of moves avoided per average participant (0.006 moves avoided) times a default number of hours spent looking for new housing times minimum wage, for a total of $1.30 average per participant. To test the range of results that could be used for the value of reduced moves from the program, we could substitute the survey-derived value for the reduction in moves. If we substituted the percent of participants avoiding moves from the WTP results (0.16 rather than 0.006), multiplied times the percent of these avoided moves that are attributed to the program (90%), and multiplied by the value of hours of search time avoided, our model would compute a value for avoided moves of $31.20. We can also test the computed values that would be derived using the WTP-derived value of reduced moves ($19.46). Assuming 16% of moves were avoided (times 90% due to the program), we could multiply by the

[35] Again, we examined the distribution of responses prior to analyzing the data. We found positive and negative numbers, all of which were included, but one outlier value was excluded from the analysis.
[36] This study, of the Louisville Gas and Electric program, estimated a reduction in six moves per 1000 participants. Note that this is a low estimate because that program had only 16% renters, and the homeowners had been there on the order of 13 years.

WTP value of avoided moves ($19.46), and the resulting proxy NEB would be $2.80. Finally, we could use the value of moves from the WTP in association with the number of moves avoided from the literature (0.006). This would result in a proxy value of $0.12. The model currently computes a value of $1.30. We retain this figure as a reasonable and very conservative value for the LIPPT computations.

- ***Water savings***: The LIPPT model-estimated value for water bill savings is $4.73 (when the 3 years of benefits are annualized over a 10 year period). This value was computed using the water savings from aerators and showerheads, multiplied by the water rates charged in California. The annual value for bill savings to average participants was computed as $11.67. The WTP value is computed as $11.58 for those reporting savings. However, only 44% of the participants reported having aerators installed; 1% reported having showerheads installed. Adjusting for those reporting zero savings and counting only those with measures installed (we use 22% for a rough comparable calculation), we find adjusted savings would be $2.55. Because we can document each step of the computations in the LIPPT model (savings from devices, measure lifetimes, and billing rates for water), we retain the NEB proxy derived in the LIPPT model as defensible and reasonably conservative.

- ***Notices***: The model does not include a value from fewer notices to residents. The (adjusted) willingness to pay value is $16.20. This is higher than all the benefits from the utility-valued benefits (which include benefits from utility costs for notices). Because it may have been difficult for respondents to separate these from other types of billing changes, we have not incorporated this additional benefit into the computations.

Shutoffs: In the WTP survey, we found shutoffs were valued at $21.41 for the average participant. The value for just those reporting a value was $60. If used as an average across all participants, these would be very high values (and would exceed most other NEBs). We can, however, compare the results if we used this WTP value as a proxy for the value of avoided shutoffs within the context of the computations in the NEB model. If we used the average shutoffs per customer from the California utilities (0.279) and multiplied by the reduction reported by other studies (23%) and multiplied by the reported value from reduced shutoffs, we get a value from $1.37-$3.85. Our current estimate, based on spending 8 hours working to get the power turned back on, generated a value of $0.35 one-time benefit, discounted to an annual stream of $0.14. The value currently in the model is more conservative, and is the one used in the LIPPT test.

- We also asked the survey respondents to estimate the number of reduced calls per year. They reported an estimated reduction of 25.6%. Our current version of the LIPPT model uses an average from other studies of 24.7%. Customers report that they make an average of 2.05 calls per year, somewhat higher than the utility-supplied estimates of 1.865 calls per year. However, the data from the utilities includes the average across all residential customers. Because the difference was so small, and because the data from the utilities is more documentable, we retained the estimate from the existing model, and the data from the WTP survey served as confirmation of the suitability of those values.

Multiplier "Check"

As a "check", we also asked customers to note the value of their benefits in terms of multiples of their bill savings. The average benefit (assuming 0 for those reporting no multiple) is 20% of bill savings. The value for those reporting multipliers is 96% of savings. Using the savings from the program design, we would see total NEBs from the participant point of view as $9.69 (or $46.51 for just those reporting a multiplier). This is considerably lower than the $170 reported by the WTP survey.

When we counted the participant benefits computed by the LIPPT model, we found computed average benefits was on the order of $27. Of course, this estimate excluded important benefits that are included in the WTP and multiplier estimates.

We can also compare the reported estimated energy savings for the participants. We found that the average electricity savings reported was $16.77/year. The gas savings estimates were $16.42. The combined gas and electric savings were $33.94/year. Those reporting savings were not far off from the LIEE program design estimates used as default values in the model ($48.45). However, if these values are spread across all those reporting no response, the dollar values are considerably lower ($5.59 for electricity, and $2.76 for gas).

Using the "multiplier" times the estimated savings derives benefits on the order of $6.80/year, considerably lower than our modeled estimates ($27) and lower than the WTP estimates.

Hardship Benefits

Hardship benefits were a key concern of the RRM. We could classify the WTP benefits into several categories.

Hardship reductions: We could propose that hardship benefits include a variety of those computed in the model – shutoffs, calls, reconnects, and the benefits of control over the bill and reduced concerns. These benefits are presented in Table 5 and discussed below.

Table 5. Willingness to Pay (WTP) Results for Potential Hardship Benefits

Type of Hardship-Related Benefit	WTP value for Hardship Benefit (in dollars per year)
Fewer shutoffs	$21.41 (22%)
Fewer notices	$16.20 (17%)
Greater control over bills	$23.12 (24%)
Fewer illnesses	$16.04 (17%)
Avoided moves	$19.46 (20%)
Total	$96.23 (57% of total)

These represent relatively high benefits for customers. In the LIPPT model, we proposed documented valuation methods for most of these benefits, including moving, illness, and shutoffs. We omitted values from benefits from reduced notices from the model, believing customers may have a hard time separating these benefits from the other "billing-control-related" benefits. The crux of the remaining benefit is the feeling of control over the bill or reduced bill payment concerns. This represents about 14% of the total WTP benefits presented by the survey, and about 23% of the subset of benefits listed here.

Given that participants view this portion of the benefits as about 14% of their benefits, we had several options:

1) Omit the benefits, because they represent between 10-15% of the benefits
2) Apply the 10-15% multiplier to the other computed participant-side WTP benefits
3) Apply the dollar savings estimated from the WTP survey.

We rejected Option 3) as providing a number that is too large and would swamp other key benefits. Instead, we decided to include a 10% multiplier to the total of other participant benefits, which can then be turned off for scenarios that should omit these benefits.

Net Advantages provided by the Program: Non-hardship benefits include benefits like comfort reductions, noise reductions, appearance improvement, reduced maintenance, and improved features or options. These are all positive items deriving from the program that are not related to hardship. These additional benefits can be valued NET of the negatives from the program. The WTP survey shows adjusted benefits in the levels shown in Table 6.

Table 6: Net Advantages Provided by the Weatherization Program (not currently included in the LIPPT model)

Category of Program Advantage	Willingness to Pay Value (in dollars per year)
Comfort improvement	$31.67 (43%)
Noise reduction	$12.39 (17%)
Appearance improvements	$11.99 (16%)
Improved features or options	$12.48 (17%)
Reduced maintenance	$17.18 (24%)
Negatives from the program	-$12.62 (-17%)
Total net advantages provided by the program	$73.09 (43% of total)

The total of these advantages provided by the program represent 43% of the benefits recognized and valued by participants. We used these data to develop a proxy measure for these benefits into the public benefits test.

Comfort was the NEB most commonly-mentioned by the California survey respondents, and, based on the results of the WTP survey, it is also the most highly valued NEB for

participants. Comfort accounts for 19% of the total participant side WTP benefits estimates. Noise reduction represents another 7% of the benefits, and improved equipment features or options represent another 7% of the benefits. The combination of appearance improvements and reduced maintenance represent another 17% of the benefits valued by participants. However, to avoid all chance for double-counting, we determined to eliminate these last two benefits from the proxy. Some may argue that the appearance improvements are at least partially incorporated into the property value benefit, and at least some of the maintenance benefits also may be incorporated into the household repairs and improvements, which are valued elsewhere.[37] To be certain we didn't overestimate the participant benefits, we developed the multiplier as a "net" multiplier; that is, we subtracted the negative effects participants associated with the program.

Based on the results of the California WTP survey, the total share of WTP benefits associated with comfort, noise, and added features net of negatives is 26%. Therefore, we have incorporated a 25% multiplier to represent the participant benefits from these features.

Resulting Changes Recommended for LIPPT Model

As a result of the survey, we incorporated the results of the WTP survey into the model as follows.

- We used the survey's estimated change in number of sick days with lost time from work, valuing the days at the minimum wage as a proxy for lost wages.
- We added a hardship benefit from the WTP survey, using a conservative adder to other participant-valued benefits of 10%. This can be turned "on" or "off" using the check boxes in the model.
- We retained the estimates in the model for customer calls, with 24.7% reduction, valued at time spent on phone. The reduction in calls also remained the same for the utility cost side.
- Moving costs were retained as the model currently estimates them; an alternate computation method could be considered that uses the data from the WTP survey, derived by multiplying 16% avoided moves times 90% of the moves avoided because of program-related reasons times a value of $19.46 per move, for an annual computed NEB proxy benefit of $2.80.
- No change in water savings estimates was included in the model.
- Notices were still excluded from the participant portion of the model. We assumed that it was difficult for customers to separate this benefit from the other bill-payment-related benefits, which are incorporated into the hardship adder mentioned above.
- Shutoffs values were computed as already valued in the LIPPT model.. Incorporating the results of the WTP survey in the model would increase these hardship benefits by

[37] Clearly, there are some remaining maintenance benefits that are provided because of measure replacement. However, we determined to be conservative and excluded them from the multiplier.

a multiple of 10. However, this alternate computation method could be considered in future versions of the model.

- There was some discussion regarding the suitability of incorporating "soft" benefits in a cost-effectiveness test. However, these benefits clearly represented high value features delivered by the program. We developed a multiplier that omitted factors that could overlap with NEBs estimated in other categories. Taking a "net multiplier" approach like the hardship benefits, we included a 25% multiplier to be applied to the total of other participant side benefits.[38] Note that the magnitude of these benefits indicates that participants value these improvements, a factor that should be considered when designing programs.

[38] We applied the benefit to the sum of the participant NEBs excluding the hardship multiplier value.

Appendix C

Discussion of Non-consensus Issues by Committee Members

During the course of the development of the LIPPT there were a number of issues in which the RRM Working Group's Cost Effectiveness Committee members and public comments did not reach consensus concerning how the test should operate or how benefits should be incorporated into the test. This section presents a review of these issues and identifies the resolution of the issues leading to the completion of the project.

One test or three.

Issues: There was a lack of consensus on building one test. Some members of the Committee indicated that they wanted three separate versions of the LIPPT, rather than the single version that the consultants were instructed to develop. Opinions on this issue reflected a need to design one Utility LIPPT, one Society LIPPT and one Participant LIPPT, similar to the current cost effectiveness tests except the LIPPT versions would incorporate the non-energy benefits associated with each test.

Current resolution: The consultants were instructed to build a single test that had a broad public benefits or public purpose function, but the Committee will consider developing three additional versions of the LIPPT to satisfy the needs for three different perspectives to the test.

No double-counting of benefits

Issue: There was concern expressed by some Committee members that adding up the benefits to identify a grand total for all non-energy benefits is not appropriate because of the overlapping values of some of the non-energy benefits. The concern involved not double counting benefits by including values for a benefit in more than one benefit category.

Current resolution: The consultants and the Committee worked together to identify all areas where benefits could be double counted and develop benefit value calculation methods that do not double count benefits across categories.

Which benefits to count

Issue: There was not consensus on which non-energy benefits to include in the test. The Committee reviewed possible non-energy benefit categories multiple times with the consultants. Because agreement could not be reached, the Committee instructed the consultants to design the test so that each non-energy benefit could be turned "on or off," allowing each utility to turn on or off the benefits that they thought should be used. However, members also agreed that there was a need to use similar values when calculating cost benefit ratios.

Benefits that apply to some, but not others

Issue: There was a lack of consensus about which values to include in the test because of differences in program designs and installed measures. Some Committee members reported not installing measures that provided non-energy benefits in specific benefit categories. These members saw little need to incorporate benefits categories that do not apply to them. At the same time other members reported including measures that provide a benefit within that same category.

Resolution: The Committee agreed that because each user can modify the test to set non-applicable benefit categories to zero ($0.00), utilities that did not install the type of measures that provide benefits within a specific benefit category could set that benefit category to zero and it would not be counted in the LIPPT.

Which energy costs to use

Issue: Some Committee members thought that energy savings should be valued at the rates program participants pay for the energy, or the full retail value. Other members thought that the utilities avoided rates should be used to value energy saved.

Resolution: The consultants were instructed to use the utility's avoided rates in the LIPPT by a majority of the Committee.

Discussion of Issues From the Public Input Workshop

In addition to non-consensus items among Committee members there were also issues and comments expressed by attendees during the Public Workshop. The following issues were identified in the workshop.

CPUC added costs

Issues: There was expressed concern that the California Public Utilities Commission added substantial costs to the operations of LIEE programs and that these costs need to be fully counted.

Resolution: There were program cost categories designed into the test to input costs associated with regulatory oversight and reporting.

Counting measure-specific savings

Issue: There were recommendations that the test not count measure-specific savings or calculate measure specific cost effective ratios. The comment identified a lack of trust in the ability to predict savings at the measure level, and indicated that if savings are counted at the measure level over-counting or double-counting savings could occur.

Resolution: The Committee advised the consultants to have the LIPPT calculate energy cost effectiveness at the measure level because this was a primary goal of the project. In addition the measure-specific energy savings currently reported by the utilities are reported at the measure level.

How to value water benefits

Issue: A utility staff attendee indicated that the consultants may be valuing water benefits different from what many California households pay. He indicated that in some places water bills are a fixed amount and are not calculated using a per hundred gallon fee as indicated in the draft LIPPT.

Resolution: The consultants indicated they would identify a way to value water costs reflective of the best way for California and that they would check how costs are calculated for number of key locations in this effort.

Air quality benefits

Issue: One attendee of the workshop indicated that programs may provide benefits for indoor air quality and that these should be counted.

Resolution: The consultants will review the current literature and identify studies that report changes in indoor air quality and incorporate this value into the test if benefits can be documented.

Climate adjusted energy savings

Issue: A utility staff attendee indicated that California has several climate zones and that each utility serves areas with different climates. This individual wanted to make sure that the information included in the LIPPT calculations reflect California and utility-specific conditions.

Resolution: The Committee indicated that the energy savings reported to the CPUC each year is adjusted for utility-specific, weather conditions. In addition, the consultants indicated that the non-energy benefits are calculated using the best research findings available and that these finding will be adjusted for California conditions whenever possible. The Committee and consultants also reported that the project incorporates a California participant survey to value several of the participant benefits.

Soft and fuzzy numbers

Issue: A utility staff attendee indicated that some of the non-energy benefits included in the LIPPT are "soft" or "fuzzy" numbers and that their use by others in the past is not a reason for their use in California, unless the estimates can be adjusted to California conditions.

Resolution: The Committee and the consultants agreed that the LIPPT should incorporate non-energy benefit values that are grounded in the best research available and that whenever there is a question on the legitimacy of a value the consultants will go with a more conservative value that acts to understate the benefit, so that benefit values included in the LIPPT will be conservative and defensible.

Beware of secondary benefits

Issue: One attendee indicated that utilities should beware of valuing secondary program benefits and indicated that secondary benefits "are the last refuge of scandal."

Resolution: The consultants noted they are instructed to take a conservative approach to valuing secondary benefits and that they will be careful to use non-energy benefit values that can be justified and that can withstand peer review.

How long to count benefits

Issues: A utility staff attendee suggested that non-energy benefit values not be calculated over the life of the install measure, as this can lead to "run-away" accumulation of benefits that may not actually exist.

Resolution: The consultants will value non-energy benefits over a life that is less than the expected useful life of the measures installed by the program so that benefits values are conservative when compared to the energy measure lifetimes. They will set benefit calculation and amortization periods at conservative levels.

Counting the hassle factor

Issues: A CPUC attendee asked if and how participant "hassle" benefits will be valued in the LIPPT and suggested that this is an benefit category that should be valued in the test. A utility staff attendee indicated that the hassle factor was a big factor in keeping customers out of the LIEE programs.

Response: The consultants indicated that the research plan included a California LIEE participant survey in which survey respondents were asked to value the "hassles," reduced or created, that are associated with the California LIEE programs. These results will provide the basis for valuing the positive and negative hassle factors.

Three tests or one

Issue: An attendee indicated that the LIPPT covers too much and that it needs to be broken into three individual tests including a utility test, a societal test and a participant test.

Resolution: This concern was also expressed by utility staff. The Committee agreed that this is something they will consider once the single test is developed and they have a chance to experiment with the test. It may be that the Committee will request the model be broken into three parts and that they will have four versions of the LIPPT. However the Committee agreed that the LIPPT is a test with a wider perspective than previous tests and is designed for assessing public purpose programs. However, the Committee reserved the right to modify the test into three separate tests if needed.

Make this a two phase project

Issue: A public attendee of the workshop indicated that the development of the LIPPT should be broken into two phases. The first phase should focus on improving the energy benefit estimations so that they are more reflective of actual savings. The second phase should be valuing the non-energy benefits once the energy savings are more accurate.

Resolution: The Consultants indicated that in their opinion the energy savings are a reasonable estimate of savings and that the LIPPT is a starting point; a tool for putting cost and benefit issues on the table and taking the best crack at them with currently available data. The LIPPT should be viewed as a version 1, in an on-going string of improvements to take place over the next several years. As new and improved evaluations take place in California the LIPPT can evolve to include the best data available. However, there is a good body of research currently available from which a best estimation approach can be used to develop version 1 of the LIPPT to include both energy and non-energy benefits. The body of non-energy benefits research is too large to be ignored by the Committee at this time. The consulting team has conducted a lengthy and extensive review and has categorized over 125 research publications presenting non-energy benefits from low-income programs. The consultants have worked to incorporate the best of this research into the non-energy benefits estimates for version 1.

Separate hardship from the test

Issue: An attendee indicated the cost of measures that are designed to reduce hardship should be separated from measures that are designed to save energy in the LIPPT so that they are not evaluated in the same test.

Resolution: The RRM Cost Effectiveness Subcommittee has instructed the consultants to build the test consistent with the current reporting and tracking methods used by California utilities. The committee will take under advisement this recommendation.

Don't include CAS programs

Issue: An attendee indicated that the costs and benefits of CAS programs should not be a part of the LIPPT.

Resolution: The RRM Cost Effectiveness Subcommittee will take under advisement this recommendation.

Improve the energy savings estimations

Issue: An attendee indicated the methods of determining energy savings are not acceptable and have serious unstated conceptual errors and assumptions.

Resolution: The method for determining energy savings is consistent with current utility M&E evaluation and reporting requirements established by the CPUC. The LIPPT does not establish or calculate energy savings. This is done by each utility, outside of the LIPPT. The energy savings estimates identified by each utility, as currently reported, are incorporated into the LIPPT. The LIPPT does not address energy savings estimation methods, but only incorporates their values into the test.

Don't distribute non-energy benefits to specific measures

Issue: An attendee indicated that the non-energy benefits should not be distributed over the individual energy measures to come up with a non-energy benefit value for each measure. Doing so will lead to serious errors in these estimations.

Resolution: The RRM Cost Effectiveness Subcommittee will take under advisement this recommendation. However, the consultants agree that this is an important issue in that there are no currently available studies that assess the non-energy benefits values associated with specific measures. To do so now could end in an error prone procedure.

Adjust savings for measure decay

Issue: An attendee indicated that summing energy savings over the estimated useful life of a measure is not an accurate method for calculating energy savings. Measure savings should be calculated over a period that is adjusted for measure decay.

Resolution: The RRM Cost Effectiveness Subcommittee will take under advisement this recommendation.

Calculate energy savings by California region

Issue: An attendee indicated that energy and load savings should be calculated by region, based on region-specific billing studies and only then be used to feed the LIPPT.

Resolution: The RRM Cost Effectiveness Subcommittee will take under advisement this recommendation.

Use only participant load benefits and costs

Issue: An attendee indicated that only participant load benefits and costs should be used for the LIPPT and that other costs and benefits should go into other tests.

Resolution: The LIPPT is not a load, demand, or participant test, but a public benefits test and, at the direction of the RRM Cost Effectiveness Subcommittee, is to include a wide range of program induced benefits and their estimated values. The public is benefited by program impacts that accrue to entities beyond the participants, including society and the ratepayers. This new test is designed specifically to include these additional benefits to allow public policy makers to have a better understanding of the full range of benefits from California low-income programs.

At the end of the workshop the consulting team asked the attendees if they thought the test was on the right track, and if the direction they were taking was the right approach. Attendees were asked to raise their hands to so signify. All attendees raised their hand to signify the LIPPT was on the right track. Several attendees complemented the work lead by the RRM Working Group's Cost Effectiveness Subcommittee and indicated that the consulting team has done an excellent job. The consultants then asked if anyone thought the LIPPT was on the wrong track or had significant problems. Attendees were asked to raise their hands if they thought the test was heading in the wrong direction. No attendee raised their hand.

Appendix D: Willingness To Pay Survey

INTRODUCTION / SCREENER

INTRO Hello. My name is _____, and I'm calling on behalf of < NAME OF UTILITY – OR "The California Investor-Owned Utilities".> about your participation in the energy conservation or weatherization program.

May I speak to [NAME FROM LIST]
or someone in the home who is responsible for paying electric or gas or who is familiar with the heating equipment in your home?

[PRESS ANY KEY TO CONTINUE]

INTRO2 [IF NECESSARY - The program weatherized homes and provided other services to help eligible customers reduce energy use. Someone would have come to your home to install equipment and talked to you about energy use.]

We are evaluating the program, and I would like to ask you a few questions about it. We are not trying to sell you any type of product or service. Your answers will be kept completely confidential. This call may be monitored for quality purposes.

[IF NEW PERSON OR IF PERSON NEEDS MORE EXPLANATION- Would you be willing to answer a few questions to help your utility evaluate how well their programs are working? Your opinions are completely confidential and this will take fifteen minutes. I can either ask you the questions right now, or we can arrange a more convenient time for me to call back.]

1 OK - CONTINUE
2 CORRECT PERSON UNAVAILABLE **[SCHEDULE CALLBACK]**
9 DON'T KNOW / REFUSED **[SKIPTO THANK8 – DISPOS = 8]**

SCR1 Are you over 18 and generally familiar with your energy bills or the energy equipment in your home?

1 YES
2 NO **[ESC TO START OVER OR SCHEDULE CALLBACK]**
3 NOBODY IN HH OVER 18 **[SKIPTO THANKA - DISPOS = 22]**
9 DON'T KNOW / REFUSED **[SKIPTO THANK8 - DISPOS = 8]**

SCR2 First, I'd like to confirm that you live at (INSERT LIST ADDRESS). Is that correct?

1 YES
2 NO **[SKIPTO THANK23 - DISPOS = 23]**
9 DON'T KNOW / REFUSED **[SKIPTO THANK8 - DISPOS = 8]**

SCR2A Have you lived at this address since January 1998?

1 YES
2 NO **[SKIPTO THANK24, DISPOS = 24]**
9 DON'T KNOW / REFUSED **[SKIPTO THANK8 - DISPOS = 8]**

SCR2B Do you recall having items like insulation, caulking, lighting or a new refrigerator installed in your home last year?

1 YES **[SKIPTO GENDER]**
2 NO
9 DON'T KNOW / REFUSED

SCR2C Is there someone else in your household who would know about the work done in your home?

1 YES **[SKIPTO INTRO]**
2 NO **[SKIPTO THANK8 – DISPOS = 8]**
9 DON'T KNOW / REFUSED **[SKIPTO THANK8 – DISPOS = 8]**

GENDER ENTER RESPONDENTS GENDER

1 MALE
2 FEMALE

CHARACTERISTIC QUESTIONS

Q1 What type of home do you live in? Is it a…

[READ LIST & SELECT ONE]

1 single family home,
2 mobile home,
3 an apartment with up to 4 units in a building,
4 an apartment with 5 or more units in a building, or
5 something else? – SPECIFY
6 DUPLEX
9 DON'T KNOW / REFUSED

Q1A What is the main source of heating fuel used in your home?

[DO NOT READ LIST AND SELECT ONE]

1 NATURAL GAS
2 BOTTLED GAS (PROPANE, LPG)
3 ELECTRICITY
4 OIL
5 OTHER – [SPECIFY]
9 DON'T KNOW / REFUSED

Q1B What is the main source of heating fuel for your water?

[DO NOT READ LIST AND SELECT ONE]

1 NATURAL GAS
2 BOTTLED GAS (PROPANE, LPG)
3 ELECTRICITY
4 OIL
5 OTHER – [SPECIFY]
9 DON'T KNOW / REFUSED

Q2 As part of the program we discussed, could you confirm whether the following energy conservation measures were installed in your home?

[READ EACH ONE AND WAIT FOR AN ANSWER]

1 Compact Fluorescent Light Bulbs And/Or Fixtures?
2 Refrigerator?
3 Low-Flow Faucet Aerator?
4 Low-Flow Showerhead?
5 Blanket Or Pipe Insulation for your Water Heater?
6 Furnace?
5 Caulking and/or Weatherstripping?
8 Insulation?
9 Household Repairs Made?
10 Other Measures like a door sweep, gasket, window lock/ treatment?
11 NONE (ONLY SELECT IF NOTHING ELSE SELECTED)
12 DON'T KNOW / REFUSED

Q3 **[IF Q2<11]** Of the measure(s) you named, have any been removed since the work was done? [IF YES, PROBE- Which one?]

1 YES – [SPECIFY MEASURE] ***- OTHER***
2 NO
3 SHOWER HEADS
4 LIGHT BULBS / FLUORESCENT LIGHTS
5 INSULATION (ATTIC, WALLS, BASEMENT, ETC.)
6 WEATHER STRIPPING (WINDOWS, DOORS, ETC.)
9 DON'T KNOW / REFUSED

Q20 Have you added or replaced any major appliances since participating in the program?

[IF YES, PROBE – What were they?]

[DON'T READ LIST AND SELECT ALL THAT APPLY]

1 CLOTHES WASHER
2 CLOTHES DRYER
3 CENTRAL AIR CONDITIONER
4 ROOM AIR CONDITIONER
5 PORTABLE ELECTRIC HEATER
6 DISHWASHER
7 HOT WATER HEATER
8 REFRIGERATOR
9 FREEZER
10 NATURAL GAS FURNACE
11 PROPANE FURNACE
12 ELECTRIC FURNACE
13 OTHER - [SPECIFY]
14 NONE (SELECT ONLY IF NOTHING ELSE SELECTED)
15 DON'T KNOW / REFUSED (SELECT ONLY IF NOTHING ELSE)
16 STOVE (GAS, ELECTRIC, ETC.)

Q25 Other than the measures that were installed as part of this weatherization program, have you installed any other conservation measures since you participated in the program?

[IF YES, PROBE – What were they?]

[DON'T READ LIST AND SELECT ALL THAT APPLY]

1 WEATHER-STRIPPING ON DOORS OR WINDOWS
2 CAULKING ON DOORS OR WINDOWS
3 A LOW-FLOW SHOWERHEAD
4 A LOW-FLOW FAUCET AERATOR
5 BASEMENT WINDOW COVERINGS OR STORM WINDOWS
6 LOWERED THE TEMPERATURE ON THE WATER HEATER
7 A BLANKET ON THE WATER HEATER
8 AN ELECTRONIC OR SET-BACK THERMOSTAT
9 COMPACT FLUORESCENT LIGHT BULBS
10 FLUORESCENT LIGHT FIXTURES
11 OTHER - SPECIFY
12 NONE (SELECT ONLY IF NOTHING ELSE SELECTED)
13 DON'T KNOW / REFUSED (SELECT ONLY IF NOTHING ELSE)

NON-ENERGY BENEFITS

NINTRO Next, I'd like to ask your opinions about your participation in the program and the work done on your home.

[PRESS ANY KEY TO CONTINUE]

N1 Approximately how many telephone calls have you made to your utility company this past year for any reason?

__ ENTER NUMBER OF CALLS
99 DON'T KNOW / REFUSED

N2 Compared to before the work was done in your home as part of this program, would you say you now make more calls, about the same amount, or fewer calls to your utility company?

1 MORE
2 SAME
3 FEWER **[SKIPTO N5]**
9 DON'T KNOW / REFUSED **[SKIPTO N5]**

N2A **[IF N2 = 1 OR 3]** Would that be Somewhat or Much More / Fewer?

1 MUCH MORE
2 SOMEWHAT MORE
4 SOMEWHAT FEWER
5 MUCH FEWER
9 DON'T KNOW / REFUSED

N2B **[IF N2 = 1]** How many more calls would you estimate you now make per year?

__ ENTER NUMBER OF CALLS
99 DON'T KNOW / REFUSED

N2C **[IF N2 = 3]** How many fewer calls do you now make per year?

__ ENTER NUMBER OF CALLS
99 DON'T KNOW / REFUSED

N5 What are some of the benefits to your family that may have resulted from participating in this program and from the work done on your home?

1 BENEFITS [SPECIFY] ***- OTHER***
2 NO BENEFITS **[SKIPTO N6]**
3 USE LESS ENERGY
4 WARMER IN WINTER / COOLER IN SUMMER
5 HOUSE HEATS UP QUICKER / BETTER
6 DECREASE IN UTILITY COSTS / CHEAPER
7 LESS DRAFT IN HOUSE / NO COLD AIR FROM DOORS &/OR WINDOWS
8 FAMILY IS HEALTHIER
9 DON'T KNOW / REFUSED **[SKIPTO N6]**

N5A **[IF N5=1]** For those benefits you named, can you identify what work was done on your home that resulted in those benefits? [IF YES, PROBE- "What was done?"]

1 YES [SPECIFY] - ***OTHER***
2 NO
3 WEATHER STRIPPING (DOORS, WINDOWS, ETC.)
4 INSULATION (ATTIC, WALLS, BASEMENT, ETC.)
5 REPLACE WINDOWS / INSTALL STORM WINDOWS
6 REPAIRED / REPLACED DOORS
7 LOW ENERGY LIGHT BULBS
8 REPLACE SHOWER HEADS
9 DON'T KNOW / REFUSED

N6 Are there any things that you didn't like that resulted from this program and from the work that was done on your home? [IF YES, PROBE- "What are they?"]

1 YES [SPECIFY] - ***OTHER***
2 NO **[SKIPTO N7]**
3 FIXTURES / APPLIANCES HAVE NOT BEEN REPAIRED OR REPLACED
4 WEATHER STRIPPING NOT INSTALLED PROPERLY / STILL HAVE DRAFTS
5 IMPROVEMENTS MADE ALREADY NEED TO BE REPAIRED / REPLACED
6 DISSATISFIED WITH ALL OR PART OF THE WORK DONE (GENERAL)
9 DON'T KNOW / REFUSED **[SKIPTO N7]**

N6A **[IF N6=1]** For those you named, can you identify what part of the program or what work done on your home it resulted from? [IF YES, PROBE- "What was done?"]

1 YES [SPECIFY] -***OTHER***
2 NO
3 LIGHTING / LIGHT BULB REPLACEMENT
4 WEATHER STRIPPING (DOORS, WINDOWS, ETC.)
5 HEATER / FURNACE REPLACEMENT
6 INSULATION (ATTIC, WALLS, ETC.)
9 DON'T KNOW / REFUSED

N7 Did the work on your home result in any change in your family's overall comfort?

1 YES
2 NO **[SKIPTO N8]**
9 DON'T KNOW / REFUSED **[SKIPTO N8]**

N7A How would you rate your family's overall comfort as a result of this program? Would you consider this a change for the better or a change for the worse?

1 BETTER
2 WORSE
3 SAME **[SKIPTO N8]**
9 DON'T KNOW /REFUSED **[SKIPTO N8]**

N7B **[IF N7A<3]** Would that be Somewhat or Much Better / Worse?

1 MUCH BETTER
2 SOMEWHAT BETTER
4 SOMEWHAT WORSE
5 MUCH WORSE
9 DON'T KNOW / REFUSED

N8 Did the work inside your home result in any change in the level of noise from equipment or appliances inside the home since the work was completed?

1 YES
2 NO **[SKIPTO N8C]**
9 DON'T KNOW / REFUSED **[SKIPTO N8C]**

N8A Has the noise level inside your home gotten better or worse since the work was completed?

1 BETTER
2 WORSE
3 SAME **[SKIPTO N8C]**
9 DON'T KNOW /REFUSED **[SKIPTO N8C]**

N8B **[IF N8A < 3]** Would that be Somewhat or Much Better / Worse?

1 MUCH BETTER
2 SOMEWHAT BETTER
4 SOMEWHAT WORSE
5 MUCH WORSE
9 DON'T KNOW / REFUSED

N8C Did the work result in any change in the level of noise coming in from outside your home since the work was completed?

1 YES
2 NO **[SKIPTO N9]**
9 DON'T KNOW / REFUSED **[SKIPTO N9]**

N8D Has the noise coming in from outside your home gotten better or worse since the work was completed?

1 BETTER
2 WORSE
3 SAME **[SKIPTO N9]**
9 DON'T KNOW /REFUSED **[SKIPTO N9]**

N8E **[IF N8D < 3]** Would that be Somewhat or Much Better / Worse?

1 MUCH BETTER
2 SOMEWHAT BETTER
4 SOMEWHAT WORSE
5 MUCH WORSE
9 DON'T KNOW / REFUSED

N9 Did the work on your home result in any change to the appearance of your home, either inside or outside?

1 YES
2 NO **[SKIPTO N10]**
9 DON'T KNOW / REFUSED **[SKIPTO N10]**

N9A Do you consider this a change for the better or a change for the worse?

1 BETTER
2 WORSE
3 SAME **[SKIPTO N10]**
9 DON'T KNOW /REFUSED **[SKIPTO N10]**

N9B **[IF N9A<3]** Would that be Somewhat or Much Better / Worse?

1 MUCH BETTER
2 SOMEWHAT BETTER
4 SOMEWHAT WORSE
5 MUCH WORSE
9 DON'T KNOW / REFUSED

N10 Did the work or the new equipment change the reliability of the equipment or the level of maintenance required?

1 YES
2 NO **[SKIPTO N10C]**
9 DON'T KNOW / REFUSED **[SKIPTO N10C]**

N10A Do you consider this a change for the better or a change for the worse?

1 BETTER
2 WORSE
3 SAME **[SKIPTO N10C]**
9 DON'T KNOW /REFUSED **[SKIPTO N10C]**

N10B **[IF N10A<3]** Would that be Somewhat or Much Better / Worse?

1 MUCH BETTER
2 SOMEWHAT BETTER
4 SOMEWHAT WORSE
5 MUCH WORSE
9 DON'T KNOW / REFUSED

N10C Did the work on your house change the level of upkeep required on your house itself?

1 YES
2 NO **[SKIPTO N11]**
9 DON'T KNOW / REFUSED **[SKIPTO N11]**

N10D Do you consider this a change for the better or a change for the worse?

1 BETTER
2 WORSE
3 SAME **[SKIPTO N11]**
9 DON'T KNOW /REFUSED **[SKIPTO N11]**

N10E **[IF N10D<3]** Would that be Somewhat or Much Better / Worse?

1 MUCH BETTER
2 SOMEWHAT BETTER
4 SOMEWHAT WORSE
5 MUCH WORSE
9 DON'T KNOW / REFUSED

N11 Does the replaced equipment have different features or options compared to the old equipment?

1 YES
2 NO **[SKIPTO N12]**
9 DON'T KNOW / REFUSED **[SKIPTO N12]**

N11A Which appliance or appliances?

[OPENEND]

1 SHOWER HEADS
2 REFRIGERATOR
3 LIGHTING / LIGHT BULBS
4 LOCKS ON DOORS / DOORS (GENERAL)
5 WEATHER STRIPPING (DOORS, WINDOWS, ETC.)
6 THERMOSTAT
7 CLOTHES WASHING MACHINE
8 CLOTHES DRYER
9 STOVE (GAS, ELECTRIC, ETC.)
10 FURNACE / HEATER (GAS, ELECTRIC, ETC.)
11 OTHER
88 DON'T KNOW
99 REFUSED

N11B Do you consider this a change for the better or a change for the worse?

1 BETTER
2 WORSE
3 SAME **[SKIPTO N12]**
9 DON'T KNOW /REFUSED **[SKIPTO N12]**

N11C **[IF N11B <3]** Would that be Somewhat or Much Better / Worse?

1 MUCH BETTER
2 SOMEWHAT BETTER
4 SOMEWHAT WORSE
5 MUCH WORSE
9 DON'T KNOW / REFUSED

N12 Do you feel the work on your home in any way affected or impacted the environment? Did it help or hurt the environment, or was there no effect?

1 HELPED THE ENVIRONMENT
2 HURT THE ENVIRONMENT
3 NO EFFECT **[SKIPTO N13]**
9 DON'T KNOW / REFUSED **[SKIPTO N13]**

N12B Would you say it hurt/helped the environment Somewhat or A Great Deal?

1 HELPED A GREAT DEAL
2 HELPED SOMEWHAT
4 HURT THE ENVIRONMENT SOMEWHAT
5 HURT THE ENVIRONMENT A GREAT DEAL
9 DON'T KNOW / REFUSED

N13 Did you notice any changes in the number of colds or similar illnesses in your family after the work was done?

1 YES
2 NO **[SKIPTO N14]**
9 DON'T KNOW / REFUSED **[SKIPTO N14]**

N13A Was it an increase or decrease in illnesses?

1 INCREASE
2 DECREASE
3 NO EFFECT **[SKIPTO N14]**
9 DON'T KNOW /REFUSED **[SKIPTO N14]**

N13B **[IF N13A<3]** Would that be Somewhat or Much More / Less (Illnesses)?

1 MUCH MORE
2 SOMEWHAT MORE
4 SOMEWHAT LESS
5 MUCH LESS
9 DON'T KNOW / REFUSED

N13C Can you estimate the change in number of sick days you took from work comparing the year before the program to the year after the program?

__ ENTER NUMBER OF SICK DAYS
88 NO CHANGE
99 DON'T KNOW / REFUSED

N13D **[IF N13C NE 0,88,99]** Would that be [SHOW N13C ANSWER] more or fewer sick days after the program?

1 MORE
2 FEWER
9 DON'T KNOW / REFUSED

N13E Was there any change in the number of days your children stayed out of school comparing the year before the program to the year after the program?

1 YES
2 NO CHANGE **[SKIPTO N14]**
3 NO CHILDREN IN HOUSEHOLD **[SKIPTO N14]**
9 DON'T KNOW / REFUSED **[SKIPTO N14]**

N13F **[IF N13E = 1]** Did your children stay home from school because of sickness more or less often after the program?

1 MORE
2 LESS
3 NO CHANGE **[SKIPTO N14]**
9 DON'T KNOW / REFUSED **[SKIPTO N14]**

N13G **[IF N13F<3]** Would that be Somewhat or Much More / Less?

1 MUCH MORE
2 SOMEWHAT MORE
4 SOMEWHAT LESS
5 MUCH LESS
9 DON'T KNOW / REFUSED

N14 Did you receive a handout from the Program representative explaining ways to save energy in your home?

1 YES
2 NO
9 DON'T KNOW / REFUSED

N14A Did the program representative talk to you about other ways to reduce the energy used in you home?

1 YES
2 NO
9 DON'T KNOW / REFUSED

[If N14 > 1 and N14A > 1, SKIPTO N15]

N14B How useful was the information to you, using a "5" to indicate the information was "very useful or valuable" and a "1" if the information was "not at all useful." You may also use any number in between.

1 NOT AT ALL USEFUL
2
3
4
5 VERY USEFUL OR VALUABLE
9 DON'T KNOW / REFUSED

N14C How valuable was the information for increasing your control over energy use and energy bills? Was it very valuable, somewhat valuable, or not at all valuable?

1 VERY VALUABLE
2 SOMEWHAT VALUABLE
3 NOT AT ALL VALUABLE
9 DON'T KNOW / REFUSED

N14D Did you receive any tips from the Program representative that were useful in helping you consume less energy?

1 YES
2 NO
9 DON'T KNOW / REFUSED

N15 Did you receive a water gauge or drip gauge from the Program representative?

1 YES
2 NO
9 DON'T KNOW / REFUSED

N15A **[IF N15 = 1]** Did you use it?

1 YES
2 NO
9 DON'T KNOW / REFUSED

N16 Overall, how satisfied were you with the workers who did the work on your house? Please use a five-point scale where 1 means you were "Very Dissatisfied" and 5 means you were "Very Satisfied". You may also use any number in between.

1 VERY DISSATISFIED
2
3
4
5 VERY SATISFIED
9 DON'T KNOW / REFUSED

N16A While participating in the program, did you experience any hassle or scheduling problems in arranging for the work to be done?

1 YES
2 NO
9 DON'T KNOW / REFUSED

N17 While participating in the program, did the workers clean up after themselves to your satisfaction?

1 YES
2 NO
9 DON'T KNOW / REFUSED

N17A **[IF N16A = 1 or N17=2]** Would you say these hassles and cleanup problems were very troublesome, somewhat troublesome, or no trouble at all?

1 VERY TROUBLESOME
2 SOMEWHAT TROUBLESOME
3 NO TROUBLE AT ALL
9 DON'T KNOW / REFUSED

N18 Thinking back, do you think that the work done on your home in any way helped you avoid having to move to another home?

[IF YES, PROBE- Would that be maybe or definitely helped you avoid having to move?]

1 YES, MAYBE
2 YES, DEFINITELY
3 NO **[SKIPTO N3]**
9 DON'T KNOW / REFUSED **[SKIPTO N3]**

N18A Would you say this is due to the energy or bill savings, the work done on your home or something else?

1 ENERGY OR BILL SAVINGS
2 WORK DONE ON HOME
3 BOTH
4 OTHER - [SPECIFY]
9 DON'T KNOW / REFUSED

N3 On a scale of 1 to 5, where “1” is “least important” and “5” is “most important,” how much of a concern are your energy bills compared to other household expenses for your family?

[PRESS ANY KEY TO CONTINUE]

N3A How important is your

Electricity bill

in comparison to other household expenses for your family?

[IF NEEDED, “Please use a scale of 1 to 5, where “1” is “not at all important” and “5” is “extremely important.” You may also use any number in between.]

1 NOT AT ALL IMPORTANT
2
3
4
5 EXTREMELY IMPORTANT
9 DON’T KNOW / REFUSED

N3B **[IF Q1A OR Q1B < 3]** Gas bill

N4A-B **[IF N3A-B NE 9]** Is this concern about your bill higher, lower, or about the same as it was before you participated in the program?

1 HIGHER
2 LOWER
3 ABOUT THE SAME
9 DON’T KNOW / REFUSED

N18B Have you found it difficult to pay your electric bill in the past?

1 YES
2 NO **[SKIPTO N19]**
8 SOMEONE ELSE PAYS THE BILL – LANDLORD, GOV’T. **[SKIPTO N19]**
9 DON’T KNOW / REFUSED **[SKIPTO N19]**

N18C Has your ability to pay your electric bill been changed by participating in this program? [IF YES, PROBE- "Has it gotten better or worse?"]

1 GOTTEN BETTER
2 GOTTEN WORSE
3 NO CHANGE / STAYED THE SAME **[SKIPTO N19]**
4 NEVER HAD ANY PROBLEMS **[SKIPTO N19]**
9 DON’T KNOW / REFUSED **[SKIPTO N19]**

N18D Which of the following best describes your ability to pay your electric bill since you participated in the program ?

1 It is harder to pay my bill,
2 It is easier to pay my bill because I have missed payments in the past but I can make them now, or
3 It is easier to pay my bill, though I am still missing some of my payments or only paying part of the bill?
8 NO CHANGE / I'VE ALWAYS PAID MY BILL
9 DON'T KNOW / REFUSED

N19 Over the past year, have you experienced any change in the number of notices or reminders from your electric or gas provider regarding late bills?

1 YES
2 NO **[SKIPTO N19B]**
3 NEVER RECEIVED ANY **[SKIPTO N19B]**
9 DON'T KNOW / REFUSED **[SKIPTO N19B]**

N19A Are your receiving more or fewer notices than before you had the work done on your home?

1 MORE
2 FEWER
3 SAME **[SKIPTO N19B]**
4 HAVE NEVER RECEIVED ANY **[SKIPTO N19B]**
9 DON'T KNOW / REFUSED **[SKIPTO N19B]**

N19A1 **[IF N19A<3]** Would that be Somewhat or Much More / Fewer?

1 MUCH MORE
2 SOMEWHAT MORE
4 SOMEWHAT FEWER
5 MUCH FEWER
9 DON'T KNOW / REFUSED

N19B Are your receiving more or fewer shut-offs than before you had the work done on your home?

1 MORE
2 FEWER
3 SAME **[SKIPTO N20]**
4 HAVE NEVER RECEIVED ANY **[SKIPTO N20]**
9 DON'T KNOW / REFUSED **[SKIPTO N20]**

N19B1 **[IF N19B<3]** Would that be Somewhat or Much More / Fewer?

1 MUCH MORE
2 SOMEWHAT MORE
4 SOMEWHAT FEWER
5 MUCH FEWER
9 DON'T KNOW / REFUSED

N20 Are there any other important positive or negative effects that occur to you? [IF YES, PROBE- "What are they?"]

1 YES - [SPECIFY] - ***OTHER***
2 NO
3 HIGH COSTS / OVERALL ENERGY PRICES INCREASED
4 SAVING ENERGY / MORE EFFICIENT
5 PROGRAM IS GOOD (GENERAL STATEMENT)
9 DON'T KNOW / REFUSED

VALUE OF BENEFITS

WINT Now we're going to talk about the value of all the benefits you received in dollar terms. We're trying to gauge how valuable these programs are to customers, but please know that you will not be charged for the program's services. We are only trying to determine an equivalent dollar value for these benefits.

[PRESS ANY KEY TO CONTINUE]

W1 **[IF N7 =1]** When you think about the COMFORT-RELATED benefits you received from the program, hypothetically what is this worth to you? In other words, what is the maximum amount you might be willing to pay for these benefits?

[IF NEEDED- About how much would you pay for these benefits either per week, per month, or per year in your best estimate.]

___ ENTER AMOUNT
999 DON'T KNOW / REFUSED

W1A SELECT ONE

1 WEEK
2 MONTH
3 YEAR
4 OTHER - [SPECIFY]
5 ONE TIME / ONE TIME FEE / TOTAL
9 DON'T KNOW / REFUSED

W1B **[IF W1=999]** Can you say whether the benefits are worth…

W1B1 More or less than $10 per month **[RANDOMIZE W1B VALUES]**

1 MORE [GO TO W1B4]
2 LESS [GO TO W1B2]
3 ABOUT RIGHT [GO TO W1C]
9 DON'T KNOW / REFUSED [GO TO W1C]

W1B2 More or less than $5 per month

1 MORE [GO TO W1B1]
2 LESS [GO TO W1B3]
3 ABOUT RIGHT [GO TO W1C]
9 DON'T KNOW / REFUSED [GO TO W1C]

W1B3 More or less than $2 per month

1 MORE [GO TO W1B2]
2 LESS [PROBE GO TO W1C]
3 ABOUT RIGHT [GO TO W1C]
9 DON'T KNOW / REFUSED [GO TO W1C]

W1B4 More or less than $20 per month

1 MORE [GO TO W1B5]
2 LESS [GO TO W1B1]
3 ABOUT RIGHT [GO TO W1C]
9 DON'T KNOW / REFUSED [GO TO W1C]

W1B5 More or less than $50 per month

1 MORE [GO TO W1C]
2 LESS [GO TO W1B4]
3 ABOUT RIGHT [GO TO W1C]
9 DON'T KNOW / REFUSED [GO TO W1C]

W1C **[IF W1=999]** So now can you say the maximum amount that these COMFORT-RELATED benefits are worth to you per month?

___ ENTER AMOUNT
999 DON'T KNOW / REFUSED

W2 **[IF N8 OR N8C =1]** Again, when you think about the NOISE-RELATED benefits you received from the program, what is the maximum amount you might be willing to pay for these benefits?

[IF NEEDED- About how much would you pay for these benefits either per week, per month, or per year in your best estimate.]

___ ENTER AMOUNT
999 DON'T KNOW / REFUSED

W2A SELECT ONE

1 WEEK
2 MONTH
3 YEAR
4 OTHER - [SPECIFY]
5 ONE TIME / ONE TIME FEE / TOTAL
9 DON'T KNOW / REFUSED

W2B **[IF W2=999]** Can you say whether the benefits are worth…

[RANDOMIZE W2B VALUES LIST]

W2C **[IF W2=999]** So now can you say the maximum amount that these NOISE-RELATED benefits are worth to you per month?

___ ENTER AMOUNT
999 DON'T KNOW / REFUSED

W3 **[IF N9=1]** Again, when you think about the APPEARANCE-RELATED benefits you received from the program, what is the maximum amount you might be willing to pay for these benefits?

[IF NEEDED- About how much would you pay for these benefits either per week, per month, or per year in your best estimate.]

___ ENTER AMOUNT
999 DON'T KNOW / REFUSED

W3A SELECT ONE

1 WEEK
2 MONTH
3 YEAR
4 OTHER - [SPECIFY]
5 ONE TIME / ONE TIME FEE / TOTAL
9 DON'T KNOW / REFUSED

W3B **[IF W3=999]** Can you say whether the benefits are worth…

[RANDOMIZE W3B VALUES]

W3C **[IF W2=999]** So now can you say the maximum amount that these APPEARANCE-RELATED benefits are worth to you per month?

___ ENTER AMOUNT
999 DON'T KNOW / REFUSED

W4 **[IF N10 OR N10C =1]** Again, when you think about the REPAIRS OR UPKEEP-RELATED benefits you received from the program, what is the maximum amount you might be willing to pay for these benefits?

[IF NEEDED- About how much would you pay for these benefits either per week, per month, or per year in your best estimate.]

___ ENTER AMOUNT
999 DON'T KNOW / REFUSED

W4A SELECT ONE

1 WEEK
2 MONTH
3 YEAR
4 OTHER - [SPECIFY]
5 ONE TIME / ONE TIME FEE / TOTAL
9 DON'T KNOW / REFUSED

W4B **[IF W4=999]** Can you say whether the benefits are worth…

[RANDOMIZE STARTING W4B VALUES]

W4C **[IF W4=999]** So now can you say the maximum amount that these REPAIRS OR UPKEEP-RELATED benefits are worth to you per month?

___ ENTER AMOUNT
999 DON'T KNOW / REFUSED

W5 **[IF N11=1]** Again, when you think about the benefits FROM ADDED FEATURES that you received from the program, what is the maximum amount you might be willing to pay for these benefits?

[IF NEEDED- About how much would you pay for these benefits either per week, per month, or per year in your best estimate.]

___ ENTER AMOUNT
999 DON'T KNOW / REFUSED

W5A SELECT ONE

1 WEEK
2 MONTH
3 YEAR
4 OTHER - [SPECIFY]
5 ONE TIME / ONE TIME FEE / TOTAL
9 DON'T KNOW / REFUSED

W5B **[IF W5=999]** Can you say whether the benefits are worth…

[RANDOMIZE W5B VALUES]

W5C **[IF W5=999]** So can you say the maximum amount that these benefits FROM ADDED FEATURES are worth to you per month?

___ ENTER AMOUNT
999 DON'T KNOW / REFUSED

W7 **[IF N13=1]** Again, when you think about the benefits RELATED to REDUCED ILLNESSES AND LOST WORK DAYS you received from the program, what is the maximum amount you might be willing to pay for these benefits?

[IF NEEDED- About how much would you pay for these benefits either per week, per month, or per year in your best estimate.]

___ ENTER AMOUNT
999 DON'T KNOW / REFUSED

W7A SELECT ONE

1 WEEK
2 MONTH
3 YEAR
4 OTHER - [SPECIFY]
5 ***ONE TIME / ONE TIME FEE / TOTAL***
9 DON'T KNOW / REFUSED

W7B **[IF W7=999]** Can you say whether the benefits are worth…

[RANDOMIZE W7B VALUES]

W7C **[IF W7=999]** So can you say the maximum amount that these benefits RELATED to REDUCED ILLNESSES AND LOST WORK DAYS are worth to you per month?

___ ENTER AMOUNT
999 DON'T KNOW / REFUSED

W8 **[IF N14C < 3]** Again, when you think about the benefits from EDUCATION AND CONTROL OVER YOUR ENERGY USE AND BILL that you received from the program, what is the maximum amount you might be willing to pay for these benefits?

[IF NEEDED- About how much would you pay for these benefits either per week, per month, or per year in your best estimate.]

___ ENTER AMOUNT
999 DON'T KNOW / REFUSED

W8A SELECT ONE

1 WEEK
2 MONTH
3 YEAR
4 OTHER - [SPECIFY]
5 ***ONE TIME / ONE TIME FEE / TOTAL***
9 DON'T KNOW / REFUSED

W8B **[IF W8=999]** Can you say whether the benefits are worth…

[RANDOMIZE W8B VALUES]

W8C **[IF W8=999]** So can you say the maximum amount that these benefits from EDUCATION AND CONTROL OVER YOUR ENERGY USE AND BILL are worth to you per month?

___ ENTER AMOUNT
999 DON'T KNOW / REFUSED

W9 **[IF N16A = 1 or N17 = 2]** So, thinking about the HASSLES AND NEGATIVE ASPECTS of the program, what would you estimate as the dollars of inconvenience that came from these parts of the program? [IF NECESSARY- "Are you able to name an amount?"]

[IF NEEDED- About how much would you pay for these benefits either per week, per month, or per year in your best estimate.]

___ ENTER AMOUNT
999 DON'T KNOW / REFUSED

W9A SELECT ONE

1 WEEK
2 MONTH
3 YEAR
4 OTHER - [SPECIFY]
5 ***ONE TIME / ONE TIME FEE / TOTAL***
9 DON'T KNOW / REFUSED

W9B **[IF W9=999]** Can you say whether the inconvenience is worth…

[RANDOMIZE W9B VALUES]

W9C **[IF W9=999]** So can you say the maximum that these HASSLES AND NEGATIVE ASPECTS cost you per month?

___ ENTER AMOUNT
999 DON'T KNOW / REFUSED

W10 **[IF N18 < 3]** Again, when you think about the benefits IN REDUCED MOVES you received from the program, what is the maximum amount you might be willing to pay for these benefits?

[IF NEEDED- About how much would you pay for these benefits either per week, per month, or per year in your best estimate.]

___ ENTER AMOUNT
999 DON'T KNOW / REFUSED

W10A SELECT ONE

1 WEEK
2 MONTH
3 YEAR
4 OTHER - [SPECIFY]
5 ONE TIME / ONE TIME FEE / TOTAL
9 DON'T KNOW / REFUSED

W10B **[IF W10=999]** Can you say whether the benefits are worth…

[RANDOMIZE W10B VALUES]

W10C **[IF W10=999]** So can you say the maximum that these benefits IN REDUCED MOVES are worth to you per month?

___ ENTER AMOUNT
999 DON'T KNOW / REFUSED

W11 **[IF N18C < 3 OR N19A < 3]** Again, when you think about the benefits in ABILITY TO PAY BILLS AND REDUCED NOTICES you received from the program, what is the maximum amount you might be willing to pay for these benefits?

[IF NEEDED- About how much would you pay for these benefits either per week, per month, or per year in your best estimate.]

___ ENTER AMOUNT
999 DON'T KNOW / REFUSED

W11A SELECT ONE

1 WEEK
2 MONTH
3 YEAR
4 OTHER - [SPECIFY]
5 ONE TIME / ONE TIME FEE / TOTAL
9 DON'T KNOW / REFUSED

W11B **[IF W11=999]** Can you say whether the benefits are worth…

[RANDOMIZE W11B VALUES]

W11C **[IF W11=999]** So can you say the maximum that these benefits in ABILITY TO PAY BILLS AND REDUCED NOTICES are worth to you per month?

___ ENTER AMOUNT
999 DON'T KNOW / REFUSED

W12 **[IF N19B < 3]** Again, when you think about the benefits FROM REDUCED SHUTOFF AND RECONNECT INCIDENTS you received from the program, what is the maximum amount you might be willing to pay for these benefits?

[IF NEEDED- About how much would you pay for these benefits either per week, per month, or per year in your best estimate.]

___ ENTER AMOUNT
999 DON'T KNOW / REFUSED

W12A SELECT ONE

1 WEEK
2 MONTH
3 YEAR
4 OTHER - [SPECIFY]
5 ONE TIME / ONE TIME FEE / TOTAL
9 DON'T KNOW / REFUSED

W12B **[IF W12=999]** Can you say whether the benefits are worth…

[RANDOMIZE W12B VALUES]

W12C **[IF W12=999]** So can you say the maximum that these benefits FROM REDUCED SHUTOFF AND RECONNECT INCIDENTS are worth to you per month?

___ ENTER AMOUNT
999 DON'T KNOW / REFUSED

W13 Now when you think about ALL the benefits you received from the program – excluding the energy savings – what is the maximum amount you might be willing to pay for these benefits?

[IF NEEDED- About how much would you pay for these benefits either per week, per month, or per year in your best estimate.]

___ ENTER AMOUNT
999 DON'T KNOW / REFUSED

W13A SELECT ONE

1 WEEK
2 MONTH
3 YEAR
4 OTHER - [SPECIFY]
5 ONE TIME / ONE TIME FEE / TOTAL
9 DON'T KNOW / REFUSED

W13B **[IF W13=999]** Can you say whether the total benefits are worth…

[RANDOMIZE W13B VALUES]

W13C **[IF W13=999]** So can you say the maximum that these TOTAL benefits are worth to you per month?

___ ENTER AMOUNT
999 DON'T KNOW / REFUSED

N22 Now thinking about all the positive and negative results you mentioned from this program and the measures installed, which is more valuable to you…

[READ LIST AND SELECT ONE]

1 The money you are saving on your energy bills,
2 The combination of all non-energy benefits both positive and negative that we talked about, or
3 Both equally? **[SKIPTO N25]**
9 DON'T KNOW / REFUSED **[SKIPTO N25]**

N23 **[IF N22 = 1]** Now we'd like to get a little more numeric. How much more valuable is the energy savings on your energy bills? Would you say my energy bill savings are…

1 Only slightly more valuable than the other benefits- like 10% more valuable,
2 About 1 ½ times as valuable,
3 Twice as valuable, or
4 More than twice as valuable?
5 SAME / BOTH EQUALLY **[SKIPTO N25]**
6 ENERGY OR OTHER BENEFITS ARE NOT AT ALL VALUABLE **[SKIPTO N25]**
9 DON'T KNOW / REFUSED **[SKIPTO N25]**

N23A **[IF N22 = 1]** In addition, are you able to name a percentage to fill in the following statement…

My utility bill savings are ____ % more valuable than the other benefits.

___ ENTER PERCENTAGE
999 DON'T KNOW / REFUSED

N24 **[IF N22 = 2]** How much more valuable are the combination of all non-energy benefits? Would you say the other benefits are …

1 Only slightly more valuable than my energy bill savings- like 10% more valuable,
2 About 1 ½ times as valuable,
3 Twice as valuable, or
4 More than twice as valuable?
5 SAME / BOTH EQUALLY **[SKIPTO N25]**
6 ENERGY OR OTHER BENEFITS ARE NOT AT ALL VALUABLE **[SKIPTO N25]**
9 DON'T KNOW / REFUSED **[SKIPTO N25]**

N24A **[IF N22 = 2]** In addition, are you able to name a percentage in the following statement…

The other benefits are ____ % more valuable than my energy bill savings.

___ ENTER PERCENTAGE
999 DON'T KNOW / REFUSED

N25 Did the work on your home result in you saving money on any of your utility bills?

1 YES
2 NO **[SKIPTO N25E]**
8 DON'T KNOW BECAUSE BUDGET BILLING
9 DON'T KNOW / REFUSED **[SKIPTO PINT]**

N25A Please estimate how much per month you are saving on your electric bill.

___ ENTER AMOUNT IN WHOLE DOLLARS
998 DON'T KNOW BECAUSE BUDGET BILLING
999 DON'T KNOW / REFUSED

N25B **[IF Q1A or Q1B < 3]** Please estimate how much per month you are saving on your gas bill.

N25C **[IF Q2 = 3 or 4]** Please estimate how much per month you are saving on your water bill.

N25E **[IF N25 = 2]** Is that because the work was not successful or is that because you are using more energy or water now than before the work was done?

1 WORK WAS NOT SUCCESSFUL
2 USING MORE ELECTRICITY NOW
3 USING MORE GAS OR OIL NOW
4 USING MORE WATER NOW
5 I'M ON BUDGET BILLING
6 OTHER - [SPECIFY]
7 NO DIFFERENCE / NO CHANGE IN THE BILL
8 DON'T KNOW / REFUSED
9 ***INCREASED RATES / BILLS NOW HIGHER***

PROCESS BATTERY

PINT Now I'd like to ask some questions about the program and how it was delivered to you.

[PRESS ANY KEY TO CONTINUE]

P1 Where did you get the referral to the program?

[DO NOT READ] [SELECT ONE]

1 ADVERTISEMENT IN PAPER
2 ADVERTISEMENT ON RADIO
3 I APPROACHED A COMMUNITY ASSISTANCE AGENCY
4 UTILITY STAFF WHEN I CALLED ABOUT A BILL
5 NEIGHBOR OR FRIEND ***/FAMILY MEMBER***
6 MAILING FROM UTILITY
7 SOMEONE CALLED ME TO TELL ME ABOUT THE PROGRAM
8 CONTRACTOR
9 OTHER - [SPECIFY]
9 DON'T KNOW / REFUSED
10 APARTMENT MANAGER / HOME OWNER'S ASSOCIATION
11 CAME DOOR TO DOOR IN MY NEIGHBORHOOD
12 CALLED THE PG&E

P2 What was the single most important reason you decided to participate in the program?

[DO NOT READ] [SELECT ONE]

1 SAVE MONEY / REDUCE BILLS
2 SHOW MY UTILITY I WANT TO REDUCE MY BILLS
3 GET NEW EQUIPMENT
4 LEARN ABOUT HOW TO USE LESS ENERGY
5 FREE EQUIPMENT / INSTALLATION
6 OTHER - [SPECIFY]
7 DON'T KNOW / REFUSED
8 NO REASON – DID NOT MAKE THE DECISION MYSELF
9 FAMILY HEALTH ISSUES
10 COMFORT / MAKE HOUSE MORE COMFORTABLE

P3 Have you participated in any other energy conservation programs?

1 YES
2 NO
9 DON'T KNOW / REFUSED

DEMOGRAPHICS

DEM Finally, I have a few general questions about your home. These are necessary to help us evaluate the energy savings resulting from the program and your answers will be kept strictly confidential.

D1 Do you own your home or rent?

1 OWN
2 RENT
9 DON'T KNOW / REFUSED

D2 How many people live in your home now?

__ ENTER NUMBER OF PEOPLE
99 DON'T KNOW / REFUSED

D3 How many people over the age of 65 currently live in your household?

__ ENTER NUMBER OF PEOPLE
99 DON'T KNOW / REFUSED
[IF D3 = D2 SKIPTO D5]

D4 How many people under the age of 18 currently live in your household?

__ ENTER NUMBER OF PEOPLE
99 DON'T KNOW / REFUSED

D4A **[IF D4 NE 0, 99]** How many are under the age of 5?

__ ENTER NUMBER OF PEOPLE
99 DON'T KNOW / REFUSED

D5 What is the age of the head of household?

[IF D2 = 1] What is your age?

__ ENTER AGE
99 DON'T KNOW / REFUSED

D5A **[IF D5 = 99]** Would that be…

1 18 to 21,
2 22 to 24,
3 25 to 29,
4 30 to 34,
5 35 to 39,
6 40 to 44,
7 45 to 49,
8 50 to 54,
9 55 to 59,
10 60 or 61,
11 62 to 64,

12 65 to 69,
13 70 to 74,
14 75 to 79,
15 80 to 84, or
16 85 years or older?
99 DON'T KNOW / REFUSED

D6 Is there anyone in your household who is homebound due to health reasons? [IF YES, PROBE- "Would that be you or someone else in the household?"]

1 YES, RESPONDENT
2 YES, SOMEONE ELSE IN THE HOUSEHOLD
3 YES, RESPONDENT AND OTHERS IN HOUSEHOLD
4 NO
9 DON'T KNOW / REFUSED

D7 How many bedrooms are in your home?

__ ENTER NUMBER OF BEDROOMS
99 DON'T KNOW / REFUSED

THANK Thank you very much for your time and feedback. [SHOW UTILITY NAME] appreciates your help and the answers you've provided.

THANKA Thank you for your time, but we are only interviewing persons age 18 and over.

THANK8 Those are all the questions I have. Thank you very much for your time.

THANK23 Those are all the questions I have. Thank you very much for your time.

THANK24 Those are all the questions I have. Thank you very much for your time.

THANK25 Thank you for your time, but we have completed the number of interviews required with customers in your area.

IF (WAVE = 1) DISPOS = 30
IF (WAVE = 2) DISPOS = 31
IF (WAVE = 3) DISPOS = 32
IF (WAVE = 4) DISPOS = 33

Appendix E: Adjusting NEBs to Scale for Programs with Fewer Measures and Less Energy Savings

Automatic Adjustment Mechanisms and Links

A number of the NEB estimates were made to be specifically dependent on measures or program expenditures.

- **Measure-driven benefits**: For NEBs that are attributable to specific measures, a direct association is made in the model so the adaptations to program design changes are automatic. This includes water bill savings (two perspectives) (8D and 9A). These estimates depend directly on the percent of homes receiving faucet aerators and low flow showerheads (selected on sheet "5B"). The NEB for property value improvements (9E) is driven by the average value of the home repairs for the program, and the percent of homes receiving the home repairs (both selected on sheet "5B"). No NEBs for gas service calls (7H), health and safety improvements (multiple perspectives, 7I, 8C, 9F, 9G), or transactions benefits (9J) are estimated if the relevant measures are not installed as part of the program modeled. The percentages of these measures installed under the program are set on sheet "5B" and these cells are referred to in the NEB calculations. These NEB categories are only greater than zero when the relevant measures are installed under the program.

- **Indirect Measure-driven benefits**: As described in the report and appendices, SERA developed a willingness to pay (WTP) survey was used to obtain information to estimate some of the customer-side benefits. Among those estimated from the WTP survey are comfort, noise, and other benefits (9K) and reduced sick days (9I). It was hypothesized that these benefits were linked to tighter and more comfortable homes. It would not be expected that these benefits would be positive if the only measures installed were new lights. We developed methods to "share" benefits to specific relevant measures.[39] These methods are used to automatically adjust the

[39] We fitted conditional demand-type models to share the participant comfort/other benefits. We regressed the value of these benefits against the presence of various measures, and estimated the percentage of the benefits attributable to furnace-related measures, insulation, refrigerators, and caulking. The methodology also compares the percent of participants with each of these measures compared to the percent with the measures in the survey respondents. If the program has a smaller percent of customers with furnaces, for example, the size of the benefit from that measure would be scaled down proportionally to account for the smaller number with that measure. The combination of these two effects – the proportion of the benefit from that measure scaled down based on whether fewer participants have that measures – is used to estimate the benefit. If no participants have the measure, then the NEB from that measure is zero. To be conservative, the method does not "scale up" the benefit if more participants have the measure than the proportion found in the WTP survey – the estimates are only "scaled down". SERA was less successful in finding a good conditional demand fit for the illness valuations. Therefore, we used a simpler methodology for scaling these benefits. We attributed the benefits to the tightness-type measures by comparing whether a similar proportion of the participants had any of the measures. If the most common measures were less commonly installed than the thresholds in the WTP participants, the illness benefits are scaled down in proportion to the ratio.

NEB benefits estimates to the measures included in the program. If the relevant measures are not included, the benefit estimates are computed as zero.

- **Expenditure-driven benefits**: 8A, economic benefits (which are currently "0") are driven by the value for program expenditures, and increase or decrease based on the program's size and average expenditures per household.

A number of other NEB categories are linked directly to the energy use or savings from the modeled program. There are two types – those we have linked directly to energy or bill savings (T&D and emissions NEBs and utility rate subsidies), and those that are directly related to, but only indirectly linked to bill savings.

Directly Linked to Energy or Bill Savings

For several categories of NEBs for which the benefits accrue directly from energy or bill savings, the estimates are to the level of those savings. Specifically, T&D (7J) and environmental NEBs (8B) are computed as multiples of the kWh savings and the avoided cost per kWh used by the California utilities as part of the program filings. However, the avoided costs used to derive the energy savings incorporates these savings; to include them separately as a NEB would double count those benefits. Using different costs to assess the energy savings would lead to different settings for these NEB categories.

Indirect linked Methodology to Scale Benefits

Other non-energy benefits also accrue from the bill savings of a program. For example, without bill savings, there would likely be no reduction in the number of calls to the utility because of bad bills. This also applies to a number of other related NEB categories. The literature provided information on the impact of weatherization programs on the "incidence" of a variety of benefits – bad debt, arrearages, shutoffs, and other NEBs. However, the studies in the literature measured the size of these benefits for the specific program and program year being evaluated. SERA conducted a meta-analysis. We reviewed the variety of studies used to develop the "changes of incidence" included in the NEB module to examine options for the scaling methodology.[40]

[40] SERA examined a variety of relationships that might be used to link the size of the benefits to program aspects. The programs varied widely, and unfortunately, the information provided in the reports was inconsistent. We gathered the range of information available, and found that some reported included key program information; others omitted fairly basic program data. We examined in detail those programs that reported program savings (energy or bill savings) along with the impact changes, including electric, gas, and gas and electric low-income weatherization programs. Ultimately, after examining several possible relationships, we adopted a simplified scaling method to "size" the benefits. We focused on bill savings as a key link, because of the causal relationship we attributed between lower bills and fewer calls, lower arrearages, and other benefits. SERA used a linear proportion using the mean bill savings (put into current dollar terms) as the pivot point. We needed to have the scaling function pass through "0" so that if no measures were specified, zero values would be assigned to these NEB categories. The set of programs for which we had developed impact estimates showed an average bill savings of about $175 (in current dollars). Therefore, the benefits adjusted using "proportion of the mean" take two steps. First, the standard NEB benefit value is computed. Then, this benefit value is multiplied by the ratio of the total bill savings

We developed a two-part method for these benefits categories. First, the NEB is computed using the steps described in the report – 1) the base incidence or cost, multiplied by 2) the estimated "change in incidence" caused by the program. To review, Item 1 is usually derived from the utility or other primary sources, and Item 2 was derived from the studies in the literature. This value is still calculated, but we impose an extra step. After computation, the values for several benefit categories (7A-7G, 9B-9D, 9H, 9I, 9K) are then multiplied by the ratio of the program's modeled savings (from the assumptions page, "5B") divided by the average savings for the studies from the literature (our default was $175). This ratio "scales down" the benefits for programs that are smaller scale. A program with no bill savings would lead to zero NEBs from these categories.

- **NEBs Proportioned to Bill Savings**: Both the utility and customers derive NEB benefits from lower energy use from the program and from the resulting lower bills. This includes reduced arrearages (7A), lower bad debt (7B), fewer shutoffs and reconnects (7C, 7D, 9B, 9D), fewer calls/ notices / collection activities (7E, 7F, 7G, 9C), and reduced moves (9H). These benefits are estimated using the calculation method and values shown on the individual worksheets comprising the NEB module. Then, on the summary page (Sheet "6 NEB Results"), these benefits are proportioned downward if the modeled program results in smaller bill savings than the average of the relevant weatherization studies. We assume that the impacts on auxiliary benefits (arrearages, etc.) as the bill savings decrease, and the model's logic incorporates this tenet. In addition, the benefits derived from the willingness to pay surveys – comfort and other, and hardship benefits (9K), are also proportioned to the bill savings ratio. This was done because these benefits, based on comparisons of the WTP survey results, are computed as multiples of the savings from other participant-side benefits. Performing the bill savings adjustment keeps the benefits in proper proportion to each other.

There are three remaining issues to discuss relevant to these adjustments.

- **Switch**: The last adjustment described – proportioning the NEB estimates to the relative size of the bill savings compared to "average" programs – can be turned "on" or "off" by the user. This is accomplished by checking the box at the bottom of the blue area on worksheet "5B NEB Assumptions". In addition, the user may modify the "threshold point" from the default average ($175 annual bill savings) to some other value. When switched "off", the resulting NEB results from the individual worksheets and the revised ones incorporating the savings adjustment will be identical. (see Worksheet "6 NEB Results").

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from the program being modeled over the average bill savings from the literature ($175 as the default). This method is used for benefit categories 7A-7G, 9B-9D, 9H, 9I, and 9K. Note that this adjustment mechanism is only used for programs with savings *below* the average from the literature. To be conservative, we did not inflate the NEB estimates for program designs that deliver more savings than the average.

- **Asymmetry**: The adjustment mechanisms – proportioning the NEB estimates to the relative size of the bill savings and the indirect measure-driven benefits – are one-directional adjustments. That is, we use the comparisons of bill savings to average and the percent of participants with the measures to adjust NEB estimates downward when the program is smaller or has fewer measures or savings than the program(s) used to derive the estimates. The estimates are not increased proportionally for programs with more measures or savings compared to the programs used to derive the estimates. This keeps estimates on the conservative side.

- **Percentage of Participants Receiving Measures**: Many of the direct NEB estimates and the adjustment mechanisms are measure-driven. The input settings for these proportions are entered in the white areas on Sheet "5B NEB Assumptions". These need to be set consistently with the measures entered on Sheet "3 Measure Costs and Savings" to properly drive the NEB estimates.

Summary of Scaling Methods for the NEB Categories

Table 1 summarizes the methods used to assure that the NEB estimates would be in proportion to the size of the program modeled. The scaling methods lead to computations of lower benefit levels for programs with fewer measures and less energy savings, and zero benefits for programs with no measures.

Table 1: Summary of Scaling Methods for the NEB Categories in the LIPPT Model

Category	Scaling Method (after Base NEB Computation)
7A: Carrying Cost on Arrearages	Proportioned comparing Average Savings from Programs Cited in the Literature to modeled program savings
7B: Lower Bad Debt Write-off	Proportioned to bill savings
7C: Fewer Shutoffs	Proportioned to bill savings
7D: Fewer Reconnects	Proportioned to bill savings
7E: Fewer Notices	Proportioned to bill savings
7F: Fewer Customer Calls	Proportioned to bill savings
7G: Lower Coll'n Costs	Proportioned to bill savings
7H: Red'n in Gas Emergency Calls	Presence of specific H&S measures
7I: Utility Health and Safety / Insurance	Presence of specific H&S measures
7J: T&D Savings	Program kWh savings
7K: Rate Subsidy Savings	Program bill savings
8A: Economic Impacts	Program Expenditures
8B: Environmental / Emission Savings	Program kWh savings
8C: Health & Safety / CO & other measures	Presence of specific H&S measures
8D: Water and Wastewater Savings	Presence of specific water measures
9A: Water/Sewer Bill Savings	Presence of specific water measures
9B: Fewer Shutoffs	Proportioned to bill savings
9C: Fewer Calls to Utility	Proportioned to bill savings
9D: Fewer Reconnects	Proportioned to bill savings
9E: Property Value Benefits	Presence of specific measures – home repairs
9F: Fewer Fires	Presence of specific H&S measures
9G: Indoor Air Quality Benefits	Presence of specific H&S measures

9H: Moving Costs / mobility	Proportioned to bill savings
9I: Fewer Illnesses / Lost Days from Work	Linked to presence of specific measures and proportioned to bill savings
9J: Reduced Transactions Costs	Presence of specific measures
9K: Comfort / Noise and Other Benefits	Linked to presence of specific measures and proportioned to bill savings
9K: Other Hardship Benefits	Proportioned to bill savings