# Energy Trust Free Ridership Methodology

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## *Background*

The California Evaluation Framework states:

> *Free riders are project participants who would have installed the same energy efficiency measures if there had been no program. How free ridership is handled is a critical component of making the evaluations cost effective and accurate. Uncertainty surrounding free ridership is a significant component of net energy and demand savings uncertainty.*[1]

Free rider rates are also important inputs in program planning and redesign. Free rider rates provide important information that signals when program changes should be made in such aspects as incentive levels, target markets, efficiency levels, eligibility requirements or when the program should be terminated. This information helps programs evolve, retain their impacts, and remain relevant in the market.

Methods for calculating and adjusting for free ridership have changed over time. Estimation techniques vary from simple self reports to elaborate econometric decision models as well as the use of comparison groups to adjust for, but not directly estimate, free ridership. With self reports, the initial, simple yes/no question of, "Would you have done it without the program?" has evolved into a battery of questions that attempt to model the nuances of the decision-making process and extract the influence of the program. Multiple questions with a range of answers for each question require methods for weighting and scoring, as well as an algorithm to arrive at a final estimate of free ridership.

Energy Trust has utilized an assortment of different methods to estimate free ridership using participant self reports. These methods have been shown to have various weaknesses and biases. Suggested approaches developed in other parts of the country to address these shortcomings have tended to increase data collection requirements.

To address the shortcomings of these other methods and increased data requirements, Energy Trust staff has developed a method for calculating free ridership that is simple, transparent, and unbiased. A goal in developing this method was the ability to apply it to all programs and their markets. An added goal was the ability to obtain the self-reported results through a reduced set of survey questions. These questions are now part of Energy Trust's Fast Feedback survey, a short phone survey administered shortly after program participation on an ongoing basis. The survey has been running continuously

[1] The California Evaluation Framework, Prepared for the California Public Utilities Commission and the Project Advisory Group, June 2004.
http://www.calmac.org/publications/California_Evaluation_Framework_June_2004.pdf.

since Q2 2010 for most major Energy Trust programs. In piloting this survey, Energy Trust staff reasoned that the timing of the survey, as well as its brevity (the survey averaged 5 minutes in 2012), would increase participant response rates. The survey is administered about one month after participants receive their incentive checks; staff believes that this survey yields more accurate information since the experience of working with Energy Trust is still fresh in the respondent's mind and the chances are greater that the person most directly involved in the project is the survey respondent.

## *Energy Trust Free Ridership Methodology*

As a starting point for developing the methodology, Energy Trust evaluation staff has used the belief that the key question to be answered is whether the participant was influenced by the program. This is relatively easy to determine if only a few yes/no questions are asked and answers are consistent (e.g. "The program had no influence" and "I would have taken the action if the program had not existed" or, "The program had a critical influence on my decision" and "The action would not have taken place without the program"). If a more nuanced approach is used, such as allowing for degrees of influence, providing a "don't know" option, and/or increasing the number and scope of questions, the calculation becomes more difficult and requires a set of rules and algorithm.

The rules and algorithm that Energy Trust has developed use as their basis the Laplace Criterion. The Laplace Criterion states that "in the absence of any prior knowledge, we must assume that the events have equal probability," assuming, of course, that the events are mutually exclusive and collectively exhaustive.[2] This means that if it is not absolutely clear if the program had an influence on the participant's action/decision, equal odds are given to the outcome that the program had an influence and the outcome that the program did not have an influence. In these cases the probability of the program having influence is 50% and the probability of it NOT having an influence is 50%. In other words the participant has a 50% chance of being a free rider.

The 50% free rider outcome is only an outcome in a subset of the cases, as both influence and participant intent in the absence of the program (i.e., how the project would change) might have a range of possible answers. To address all possible outcomes, a set of assumptions was developed that create the framework for calculating unbiased free rider scores. We discuss each assumption and any implications below.

- Assumption 1: Respondent is truthful.
    - Implication 1: Consistent responses have easily calculated free rider rates of 0% and 100%.

[2] The Laplace Criterion is based on Bernoulli's Principle of Insufficient Reason which states that if we are ignorant of the ways an event can occur (and therefore have no reason to believe that one way will occur preferentially compared to another), the event will occur equally likely in any way. Keynes referred to the principle as the principle of indifference, formulating it as follows: "if there is no known reason for predicating of our subject one rather than another of several alternatives, then relatively to such knowledge the assertions of each of these alternatives have an equal probability."

- Implication 2: Participants that provide inconsistent or contradictory responses (e.g. participant answers, “Program was critical to the project moving forward” and, “Project would have moved forward exactly the same in absence of the program”) are viewed as having answered questions truthfully. With no additional information both answers are given equal validity.

- Assumption 2: It is inconsistencies between stated program influence and stated intentions of what would have happened in absence of the program that need to be resolved.
  - Implication: Only data that clearly provides information on either program influence or the participant’s intent in absence of the program will be used in the free rider calculation.
  - Example 1: Respondent states, “Project would not have been as energy efficient without the program” and also states “Program had no influence.”
  - Example 2: Respondent states, “Project would not have changed in absence of the program” and states, “Program had critical influence.”

- Assumption 3: Equal probabilities are given to inconsistent answers.
  - Implication: Event probabilities are additive since the two possible events being considered are “Project went through with program influence” and “Project went through without program influence.”
  - Example 1: Respondent states, “Project would not have been as energy efficient without the program” and also states “Program had no influence”. The first statement implies that the program had significant influence and the second implies that it did not; therefore, “Program had no influence” has a 50% chance of being true, and “Program had influence” has a 50% chance of being true. Therefore, without additional information the free rider probability is 50%.

- Assumption 4: Questions with a range of qualitative answers will have free rider scores distributed equally across the range. Questions with a range of quantitative values for answers will use actual values – or if the answer is a range, the midpoint – to calculate the free rider score.

- Assumption 5: In cases where the answer is “don’t know” all of the possible answers have equal probabilities of being true.
  - Implication 1: This will create a range of possible free rider estimates for all participants that answer “don’t know” to one of the questions.
  - Implication 2: To obtain the range, only scenarios involving the maximum and minimum values need to be run.
  - Implication 3: If no information is available to any of the questions (i.e. both responses are “don’t know”) the observation is not included in the analysis.

Assumption 2 might be considered by some as limiting in that it only focuses on the inconsistencies around the influence of the program and the stated intentions of how, if at all, the project would have changed in the absence of the program. Factors such as

experience with the program, length of time project was planned, or experience with energy efficiency are often factored into the free rider estimation. However, they are not used to resolve inconsistent answers as their relationship to the project in question is not clear and their inclusion in any weighting scheme or use in adjusting probabilities is not straightforward.

Participation in the program in the past is not sufficient to determine that the project under consideration would have gone through without the program's help, incentives, or studies. Past participation may have involved an end-use technology that has little relevance to the current project. On the other hand, past participation may have involved incentives and other program assistance that were needed to move the current project forward. Therefore past program participation might be a good predictor of future participation but cannot be considered a clear indicator of free ridership. Even past experience with the same technology for which no incentive was received may not be a clear indicator that the participant is a free rider. To make this assumption, the participant's economic conditions and investment criteria would need to remain unchanged, a reasonable assumption for only a short period of time. Over longer periods, economic conditions and investment criteria both change. Also, "comparable" equipment and technologies might not in fact be comparable; and past experience with the program may not have been positive. For example, installation of additional VSDs through the program would be a sign of program success if the customer had poor experiences with VSDs in the past. Since past participation and past experience do not have a straightforward interpretation without further investigation, their use in calculating free ridership is inappropriate.

**Example of Free Rider Calculation**

A project's free ridership score is composed of two elements: a stated intent / project change score and an influence score. These scores are calculated based on respondents' answers to three questions in Fast Feedback.[3] We discuss the calculation of each score below.

*Stated Intent in Absence of the Program / Project Change*

The stated intent / project change score is based on the respondent's answer to a question about how the project would have changed in the absence of the program: "Which of the following statements describe the actions you would have taken if Energy Trust incentives and information were not available?"

Possible responses to this question, which vary somewhat by program and measure, fall into one of three categories representing different levels of change:

1. Participant would have done exactly the same thing (no change)
2. Project would have changed but retained some energy efficiency features (some change)

[3] Residential participants are only asked two questions; they are not asked about budget availability in the absence of program incentives.

3. Project would have made other changes with no significant energy efficiency component (significant change)

Energy Trust staff assigned a number between 0 and 1 to each category, where 0 indicates no free ridership and 1 indicates the project was a full free rider (see Table 1). Changes that might have retained some of the energy efficiency features of the project were scored at the midpoint as no reliable information on the efficiency level was available.

Table 1. Free Rider Scoring of Stated Intent / Project Change

| | Free Rider Score |
|---|---|
| No change in project | 1 |
| Some change | 0.5 |
| Significant change | 0 |
| Don't know* | - |

*See "Free Rider Rate" section below for information about "Don't know" responses.

Since respondents can select multiple responses to the question, their answer choice with the lowest score is selected. For non-residential projects, a follow-up question is asked of respondents who answered that they would not have done anything differently in absence of the program: "In the absence of the Energy Trust incentive, would your firm had made funds available to cover the entire cost of the energy efficient equipment and design?" If the respondent selects "Yes," their project change score is 1; if they select "No," there is not enough information about what their actions would have been, so the response is treated as "Don't know" (see "Free Rider Rate" section for information about the treatment of "Don't know" responses).

*Program Influence*

The influence score is based on respondents' answers to questions about the influence of various elements, including Energy Trust incentives, program representatives, contractors or salespersons, studies, and other elements which are specific to programs or measures.

Respondents rate each element on a 5 point scale, where 1 is "not at all influential" and 5 is "extremely influential." The answer choices are given a value between 0 (element's influence was a 5, extremely influential) and 1 (element's influence was a 1, not at all influential) – see Table 2 below. The score for the most influential element is taken as the influence score.

Table 2. Free Rider Scoring of Program Influence

| | Free Rider Score |
|---|---|
| Extremely influential (5) | 0 |
| 4 | 0.25 |
| 3 | 0.5 |
| 2 | 0.75 |
| Not at all influential (1) | 1 |
| Don't know* | - |

*See "Free Rider Rate" section below for information about "Don't know" responses.

*Free Rider Rate*

With the outcomes of being influenced or not being influenced by the program having equal probabilities, the free rider rates associated with each outcome are additive:

Free Rider Rate = probability(Program had influence) +
probability(Program had no influence)

Free Rider Rate = 50%*(Score associated with stated intent / project change) +
50%*(Score associated with program influence)

Free Rider Rate = Free rider rate for stated intent / project change outcome +
Free rider rate for program influence outcome

Tables 3 and 4 below show all possible free rider rates for each outcome. The rate is obtained by multiplying the free rider score by 50%.[4] In cases where information is lacking (e.g. participant stated that they did not know if they were influenced), all of the outcomes associated with that question have equal probability of being true. This will result in the participant having a range for the free rider rate (0-50% for stated intent / project change, and 0-50% for program influence). The range is estimated for all respondents with indeterminate answers by calculating the maximum and minimum values for each participant. The resulting high and low estimates will then delineate the range of free ridership. If responses to both questions informing the stated intent / project change score and the influence score are "don't know," a free rider rate is not calculated.

Table 3. Free Rider Rates for Project Change / Stated Intent

| | Free Rider Score | Free Rider Rate (50%*Free Rider Score) |
|---|---|---|
| No change in project | 1 | 50% |
| Some change | 0.5 | 25% |
| Significant change | 0 | 0% |
| Don't know* | - | 0-50% |

[4] For the stated intent / project change question, 50% represents the probability that the program had no influence. For the program influence question, 50% represents the probability that the program had influence.

Table 4. Free Rider Rates for Program Influence

| | Free Rider Score | Free Rider Rate (50%*Free Rider Score) |
|---|---|---|
| Extremely influential (5) | 0 | 0 |
| 4 | 0.25 | 12.5% |
| 3 | 0.5 | 25% |
| 2 | 0.75 | 37.5% |
| Not at all influential (1) | 1 | 50% |
| Don't know* | - | 0-50% |

Table 5 shows all the different possibilities for free rider rates estimated using the algorithm described above. In cases where a "don't know" response is provided, there is a range of potential free rider rates. In these cases, we use the midpoint of the range to obtain the free ridership estimate.

Table 5. Free Rider Rate Possibilities

| Program Influence | Free Rider Rate for Program Influence | Stated Intent / Project Change | Free Rider Rate for Stated Intent / Project Change | Free Rider Rate |
|---|---|---|---|---|
| 5 | 0% | Change | 0% | 0 |
| 4 | 12.5% | Change | 0% | 12.5% |
| 3 | 25% | Change | 0% | 25% |
| 2 | 37.5% | Change | 0% | 37.5% |
| 1 | 50% | Change | 0% | 50% |
| 5 | 0% | Partial | 25% | 25% |
| 4 | 12.5% | Partial | 25% | 37.5% |
| 3 | 25% | Partial | 25% | 50% |
| 2 | 37.5% | Partial | 25% | 62.5% |
| 1 | 50% | Partial | 25% | 75% |
| 5 | 0% | No change | 50% | 50% |
| 4 | 12.5% | No change | 50% | 62.5% |
| 3 | 25% | No change | 50% | 75% |
| 2 | 37.5% | No change | 50% | 87.5% |
| 1 | 50% | No change | 50% | 100% |
| 5 | 0% | DK | 0% to 50% | 0 to 50% |
| 4 | 12.5% | DK | 0% to 50% | 12.5% to 62.5% |
| 3 | 25% | DK | 0% to 50% | 25% to 75% |
| 2 | 37.5% | DK | 0% to 50% | 37.5% to 87.5% |
| 1 | 50% | DK | 0% to 50% | 50% to 100% |
| DK | 0% to 50% | Change | 0% | 0% to 50% |
| DK | 0% to 50% | Partial | 25% | 25% to 75% |
| DK | 0% to 50% | No change | 50% | 50% to 100% |
| DK | NA | DK | NA | NA |