# Avoiding Being (Too Much of) A Victim of Your Own Success: Mitigating Free-ridership Losses Through Better Spillover Assessment

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## ABSTRACT

Increasing trade ally[1] promotion of, and consumer recognition of, the value of energy efficient equipment may be indicators of an energy efficiency program's success. Both tend to increase the adoption of energy efficiency without program support, but they also can increase free-ridership assessed through self-report by increasing program participants' internal attributions for energy efficient investments. This concern is heightened by certain cognitive biases that may exaggerate internal attributions.

To maintain program cost-effectiveness and continue to deliver energy savings, program administrators should attempt to recapture some of the energy savings "lost" to free-ridership by properly accounting for "spillover" savings, which result from energy efficiency gains occurring outside the program but because of program influence. But many program administrators do not attempt to account for spillover or do so in a way that likely underestimates it.

The authors used an improved approach to assessing spillover savings for two utility programs. This approach assesses a program's indirect influence on consumers by assessing the program's influence on trade allies' recommendations and the influence those recommendations have on customers. This approach identified spillover electricity savings that were equivalent to 12% of the gross lighting savings in a U.S. commercial program and 18% of gross savings in a Canadian residential heat pump program.

### Introduction

Increases in the promotion of efficient equipment by equipment vendors and contractors (trade allies) and in consumers' recognition of the value of energy efficient investments may be seen as indicators of an energy efficiency program's success. Both trends – increased trade ally promotion of equipment and increased consumer recognition of energy efficiency's value – should tend to increase the adoption of energy efficiency equipment and activities without program incentives or other support, what is known as "spillover" effects. At the same time, however, increasing consumer recognition of the value of efficiency may also reduce program-attributable savings by increasing the appearance of free-ridership – that is, use of program incentives or other support to undertake energy efficiency investments or activities that would have been done without that support. That is, as consumers grow to recognize the value of energy efficiency, they may be more likely to attribute their decision to make efficient investments internally rather than to program influence and, thus, to claim that they would have made the same investments without the program.

[1] Throughout this paper, we use "trade allies" to refer collectively to equipment vendors, such as distributors and manufacturer representatives, and installation contractors. As will become clear below, the distinction between vendors and contractors is important to the spillover assessment approach.

The loss of program-attributable savings from assessed free-ridership can reduce program cost-effectiveness, making it difficult to continue offering programs. This concern is heightened by several psychological tendencies that may exacerbate the tendency to provide internal attributions for energy efficient investments, which may increase self-reported free-ridership. These tendencies include a bias toward giving a socially desirable or acceptable response to interview questions (the "social desirability" bias), a tendency to make internal attributions to successful outcomes and external attributions to unsuccessful ones, and a motive to make attitudes consistent with actions to avoid cognitive dissonance. We and our associates have described these tendencies, and how they might inflate assessment of free-ridership, in more detail elsewhere (Peters and McRae 2008; Bliss et al. 2017a). Briefly, in an environment where adopting sustainable practices is looked upon as a positive behavior, the social desirability bias would tend to motivate respondents to report that they would have taken energy efficiency measures even if they did not receive program support. Even absent the social desirability bias, where investing in energy efficiency is seen as a "successful" outcome, the bias toward internal attribution of success would motivate respondents to take credit for such investments, thus potentially inflating the likelihood that they would have done the same thing without program support. Finally, given that free-ridership typically is assessed after the investment is made – that is, after the respondent had already committed to an action – the minimizing cognitive dissonance would provide a motive for increasing positive attitudes toward energy efficiency, which again may promote a response that suggests free-ridership.

The concerns about bias in self-reported free-ridership are not merely theoretical. We have found evidence that program participants self-report as free-riders despite evidence to the contrary. For example, one evaluation explored the process by which residential customers decided to buy a program-incented heat pump. About one-third of surveyed program participants reported they contacted a contractor either with the plan to buy some other type of heating or to ask for the contractor's recommendation but then decided on a heat pump after the contractor recommended one and told them about the program incentive. Despite the fact that those respondents reported no prior plans to buy a heat pump – and, in fact, reported exactly the opposite – about two-thirds of them then said they would have bought the heat pump without the program (Bliss, McClaren, and Folks 2018). One possible explanation for the above is that program participants do not count a *program trade ally's* influence on them as *program* influence.

One part of the solution to the above may be to devise better assessments of free-ridership, such as by making them less subject to the biases toward internal attribution or possibly making the trade ally's influence more explicitly an aspect of program influence. This could reduce the savings "lost" to free-ridership.

In addition, though, it is important that utilities and other program administrators quantify and take credit for energy efficiency gains that occur outside the program but because of program influence – that is, "spillover" savings. By adding to a program's net savings total, assessment of spillover savings may recapture energy savings lost to free-ridership. But while many evaluators have argued that spillover energy savings may be significant (e.g., Haeri and Khawaja 2012; PWP and Evergreen Economics 2017), many program administrators do not attempt to account for them (Kushler, Nowak, and Witte 2014). And when spillover is assessed, the methods used often produce low estimates. Based on a recent literature review and expert interviews, PWP and Evergreen Economics (2017) note that estimated participant spillover usually falls below 5% of gross savings, while non-participant spillover estimates "vary widely."

One possible cause of underestimating spillover is that assessment methods often rely on either end-user or trade ally reports, neither of which by themselves can provide an accurate picture of program influence. Program participants may be able to report on the program's direct influence on their subsequent un-rebated energy efficient investments, but they may not be aware of how the program *indirectly* influenced them via its influence on the recommendations they received from trade allies. This is even more the case for program non-participants, who may not even be aware of the program and so may think (incorrectly) that the program had no influence on them when in fact a program affiliated trade ally had influenced them. On the other hand, while trade allies can speak to the program's influence on their practices, that is only one part of the program's indirect influence – the other is their own influence on their customers – and they cannot report on the program's *direct* influence on end-users (See Bliss, Sage, and Diebel 2017 for a detailed discussion of these issues.)

The authors used an improved approach to assessing spillover savings for two utility programs, one focusing on commercial U.S. customers and the other, on residential Canadian customers. This approach assesses a program's indirect influence on consumers by assessing the program's influence on trade allies' recommendations and the influence that those recommendations have on customers. The following sections describe how we developed and applied this approach to assess lighting spillover in a large commercial energy efficiency program and how we simplified and adapted it for the residential program.

## Development of New Spillover Approach for Nonresidential Lighting Program

Following describes the spillover assessment approach we developed to apply to a utility's commercial lighting savings, and the results we obtained from applying that approach to the 2015 program year. We have repeated the approach in each subsequent year with comparable results.

### Brief Description of the Program and Rationale for Assessing Lighting Spillover

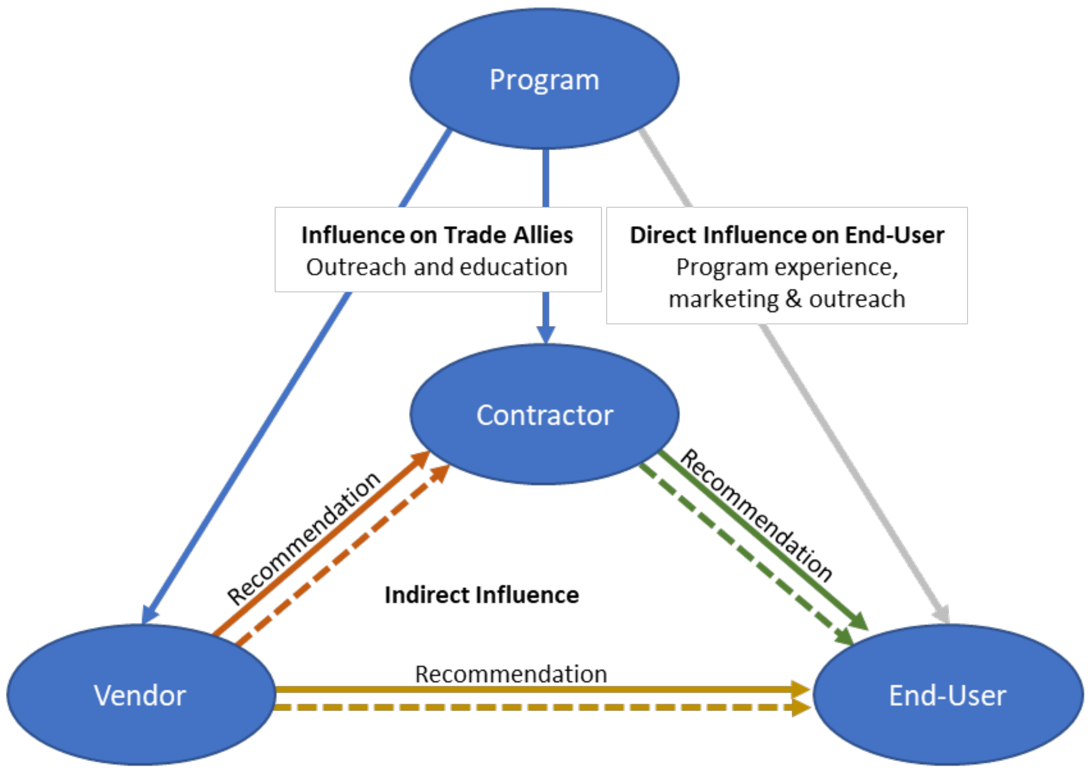
The program in question provides downstream incentives for a wide range of equipment types to commercial and industrial customers of a large utility in the U.S. Midwest. The program offers both prescriptive and custom incentives. Traditionally, lighting has made up a large share (three-quarters or more) of the program's energy savings. That fact, together with the fact that a large majority of lighting equipment sales and savings can be quantified on a per-unit basis (as opposed to, say, custom-built HVAC measures), made lighting equipment a natural area for assessing spillover savings.

### Approach and Methods: Multiple Pathways of Influence

As indicated above, our approach is based on the recognition that neither trade ally nor end-user has a complete picture of program influence. This is complicated by the fact that there are multiple potential sales channels and influence pathways. Equipment vendors, such as distributors and manufacturer representatives sell to installation contractors (who sell to end-users) but they may also sell directly to end-users. In the former case, the indirect program influence is the function of the program's influence on the vendor, the vendor's influence on the installer, and the installer's influence on the end-user. This is further complicated that, at any point in the sales channel, the buyer (the installer or end-user) may specify the desired equipment without asking for a recommendation. In such cases, there may not be an opportunity for an actor to exert influence. If the buyer specifies the equipment throughout the sales channel, only direct program influence is possible. Figure 1 shows the various possible pathways of program influence represented by these scenarios.

Since the program's indirect influence via any pathway is a function of the influence of each actor upon the next actor, then the indirect influence may vary from pathway to pathway.

As described in detail in Bliss et al. (2017b), we used data from a survey of 33 vendors and 29 contractors as well as program tracking data to estimate the total sales of un-rebated high-efficiency equipment in each of five scenarios: 1) vendor sells directly to end-user with recommendation; 2) vendor sells directly to end-user without recommendation; 3) contractor sells to end-user with both vendor and contractor recommendation; 4 ) contractor sells to end-user with only contractor recommendation; and 5) contractor sells to end-user with no recommendation. Specifically, the survey asked vendors and contractors to report the total number of units of each lighting type they sold to end-users, the percentage of sales in which their customers reported plans to apply for program incentives, and the percentage of their sales in which they made an equipment recommendation.




Vendor sells to contractor with recommendation. Contractor recommends equipment to end-user. Indirect influence is the product of program influence on vendor, vendor influence on contractor (via recommendations), and contractor influence on end-user (via recommendation).

Vendor sells to contractor without recommendation. Contractor recommends equipment to end-user. Indirect influence is the product of program influence on contractor and contractor influence on end-user (via recommendation).

Vendor sells directly to end-user with equipment recommendation. Indirect influence is the product of program influence on vendor and vendor influence on end-user (via recommendation).

Vendor sells to end-user without recommendation **or** contractor sells to end-user with or without recommendations, contractor does not recommend equipment to end-user. Without recommendation to end-user, there is no indirect influence.

Figure 1. Pathways of program influence on end-users.

For each survey respondent, we generated two estimates of the number of un-incented units of each lighting measure. One came from multiplying the reported total number of units sold by the estimated percentage sold without plans to apply for incentives.[2] The second estimate came from subtracting the number of incented units identified in the program tracking database from the total reported number of units sold. To generate the most conservative estimate of total spillover, for each respondent and each measure, we selected the lower of the two estimates of un-incented units sold.

The survey asked vendors and contractors to rate the program's influence on their recommendations, and asked contractors also to rate vendors' influence on their recommendations, on a scale from 1 (no influence) to 5 (great influence). We converted each rating to an influence value from 0% (a rating of 1) to 100% (a rating of 5). Separate surveys of program participants and non-participants provided an estimate of the influence of the program, vendors, and contractors on end-users, similarly converted to values ranging from 0% to 100%. For any sales channel, we calculated the program indirect influence as the product of the influence value for each actor on the next one in the channel. For example, where a vendor sells to a contractor with an equipment recommendation, and the contractor sells to the end-user with a recommendation, we calculated the indirect program influence as:

Program influence on vendor (0%-100%)
x vendor influence on contractor (0%-100%)
x contractor influence on end-user (0%-100%)

Program direct influence is possible in all scenarios, while indirect influence is possible only in scenarios in which an equipment recommendation is made to the end-user. In scenarios where both direct and indirect influence were possible, we calculated program influence as the greater of the two. In all cases, indirect influence was greater than direct influence.

For all five scenarios, we multiplied the number of un-incented units of each measure by the program influence operating in that scenario to yield an estimate of the number of program-influenced, un-incented units of that measure. We then multiplied the number of program-influenced, un-incented units by the kWh savings associated with each measure, as established by the state's technical reference manual, to get the total spillover savings.

Note that since this method solicits reports of all un-rebated equipment sold by vendors and contractors and solicits influence ratings from both participants and non-participants, it produces an estimate of total spillover. We refer interested readers to Bliss et al. (2017b) for additional details on the methods.

## Results: Nonresidential Lighting

The end-user surveys produced a weighted mean program direct influence (across both participants and non-participants) of 56%. Mean indirect influence, in those scenarios in which end-users received equipment recommendations, was higher: 85%, when vendors sold directly to end-users, and 62% when vendors sold to contractors, who sold to end-users. Applying these influence percentages to the un-rebated savings in the various scenarios produced a total spillover savings value for the surveyed vendors and contractors of 12,061,250 kWh, which represented more than 12% of the gross ex ante lighting savings for that program year.

[2] One minus the reported percentage of sales for which customers planned to apply for incentives.

## Application of Approach to Residential Heat Pump Program

We adapted the above approach in 2016 to assess spillover heat pump sales in a residential program that offers rebates and loans for both central and ductless air source heat pumps. As in the original approach, we surveyed trade allies to obtain reports of sales made without program rebates or loans (in this case, of residential heat pumps) and to assess program influence on their recommendations of heat pumps.

### Brief Description of the Program and Simplified Delivery Model

The program offers a rebate of $1,200 for a central air source heat pump, a rebate of $800 for a ductless air source heat pump, or a loan of up to $6,500 at 1.9 percent interest over 10 years for the purchase of either type of heat pump. Customers may receive either the loan or the rebate, but not both. To qualify for the loan or rebate, customers must replace an existing electric heating system with an ENERGY STAR® certified heat pump model with a minimum capacity of one ton, a Seasonal Energy Efficiency Ratio (SEER) of at least 15, and a Heating Seasonal Performance Factor (HSPF) of at least 8.5. The program promotes the program through its website, direct mail, a newsletter, online media, events (such as home shows), and contractor outreach.

While we did not adapt this approach specifically to be limited to nonparticipant spillover, we believe it consists mainly, if not entirely, of nonparticipant spillover as it is unlikely that someone who used program support to purchase a heat pump would then purchase another one without that support. We separately surveyed program participants to assess spillover and obtained no reports of additional heat pumps purchased without a rebate. We did not survey equipment distributors, as this program dealt directly with installation contractors and did not conduct any specific outreach to distributors. Figure 2 illustrates the simplified indirect influence pathway in this program, which informed our adapted method.

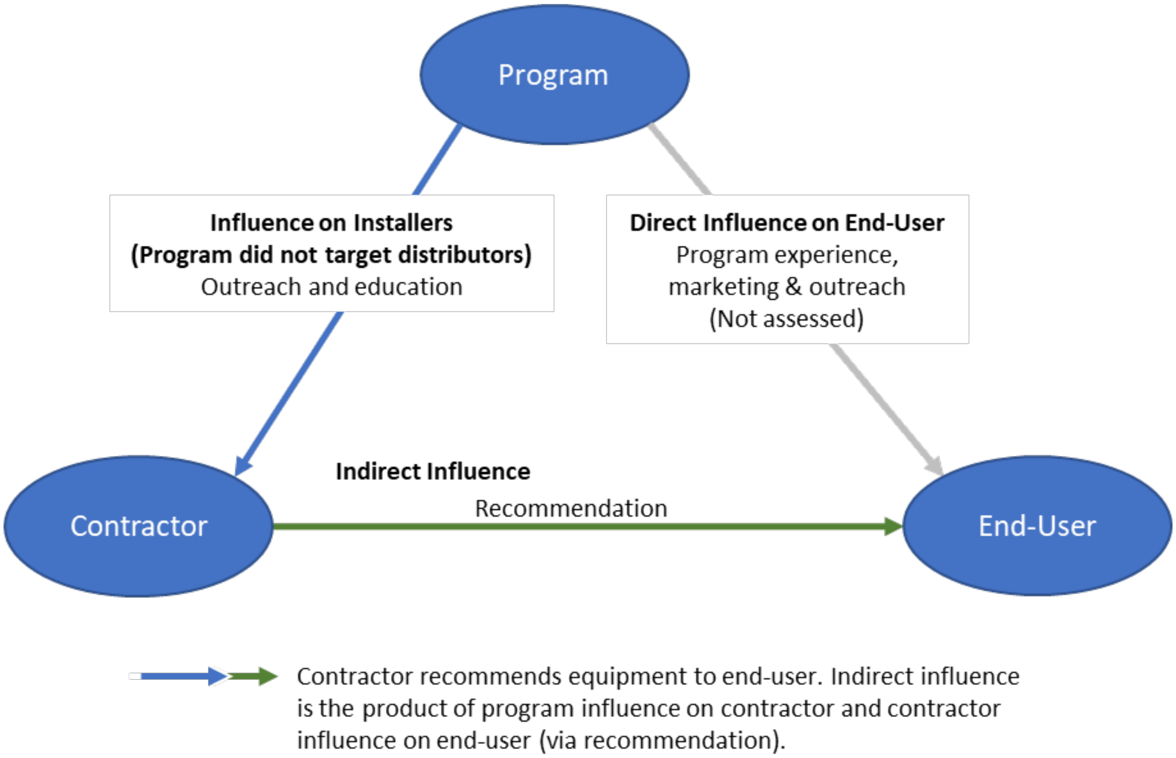



Figure 2. Influence pathway in residential heat pump program.

### Adapted Method

We identified 53 contractor companies that sold program-rebated heat pumps. We prioritized contact with those who sold the most rebated heat pumps and completed the survey with 15 contacts who accounted for 53% of rebated heat pump sales.

We used a combination of program tracking data and survey responses regarding qualifying heat pumps sold in the utility territory in the most recent program year, to estimate the number of program-influenced, un-incented heat pumps sold (Figure 3). For each contractor, we divided the number of rebated heat pumps (1) by the contractor-reported percentage of qualifying heat pumps sold with a program rebate or loan (2). This gave us both the total reported number of qualifying heat pumps sold and the number sold without a rebate or loan (3).[3]

[3] Information from contractors confirm that they are largely actively involved in completing rebate and loan applications, so it is reasonable to assume they have a good sense of what proportion of heat pumps receive rebates or loans.

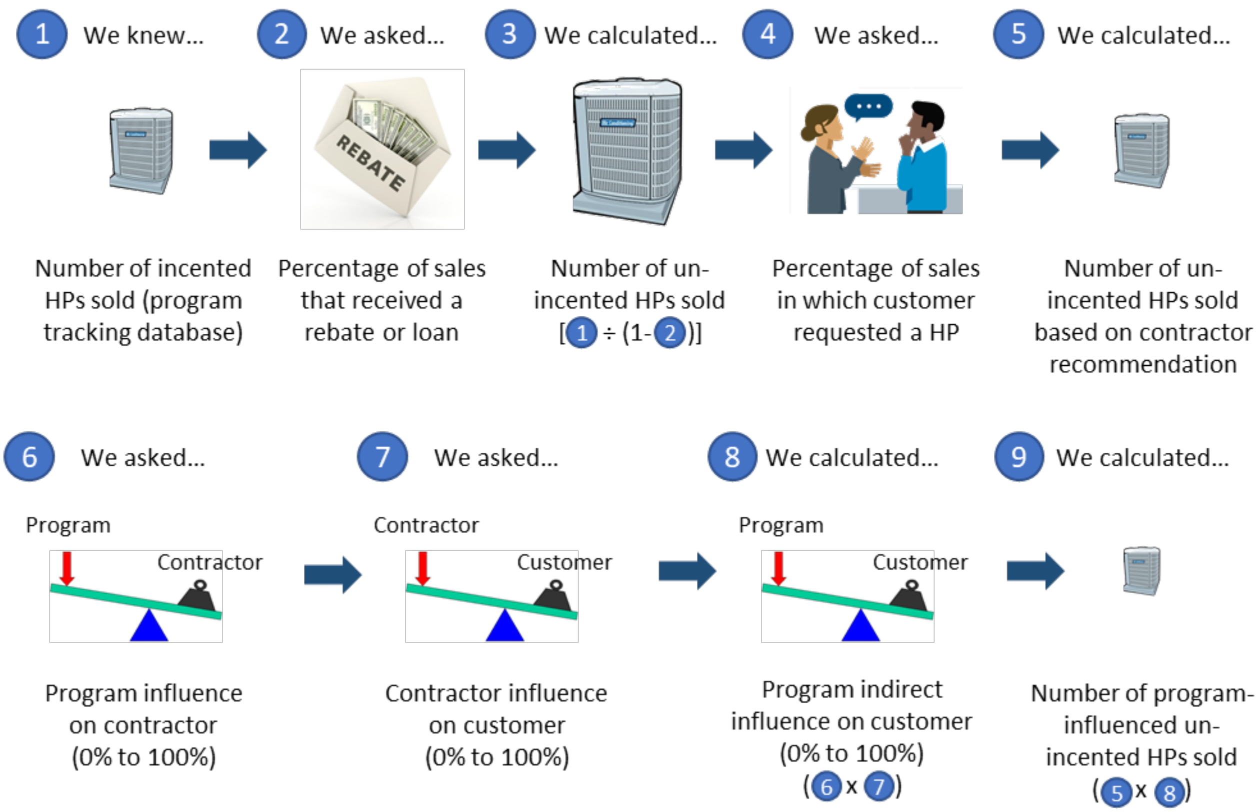



Figure 3. Process for calculating number of program-influenced, un-incented heat pumps sold.

We further asked contractors to report the percentage of their heat pump sales in which the customer specifically asked for a heat pump (4). We then reduced the count of each contractor's un-rebated heat pumps by the percentage of customer-requested heat pumps to estimate the number of such heat pumps sold because of the contractor's recommendation (5). While some portion of such sales could still represent spillover if the program had influenced the customer to request a heat pump, we were not able to assess such influence as this evaluation did not include a nonparticipant survey. Therefore, excluding such sales from the savings for un-rebated heat pumps was an appropriately conservative measure.

We asked the surveyed contractors to report the degree to which the program influenced their recommendations of rebate-qualified heat pumps, and we converted responses to a number from 0% to 100% (6).[4] Since we did not have nonparticipants' reports of the influence of contractor recommendations, we asked the contractors to estimate their level of influence on customer acceptance of the heat pump recommendations using the same scale, again converting to a number from 0% to 100% (7). We multiplied the mean estimate of program influence on contractor recommendations by the mean estimate of contractor influence on customers to obtain an estimate of program indirect influence on customer decisions (8). We multiplied that percentage by the number of un-incented, contractor-

[4] Influence was rated on a 1-10 scale, where 1 meant no influence and 10 meant great influence. We converted the scale scores to a 0%-to-100% range by subtracting 1 and dividing by 9. Thus, an influence rating of 1 becomes (1-1)/9 = 0/9 = 0%; a rating of 2 becomes (2-1)/9 = 1/9 = 11%; and so forth.

recommended heat pumps sold to estimate the total number of heat pumps that represent spillover savings (9).

**Results and Discussion: Residential Heat Pumps**

The above process produced an estimate of 56 heat pumps sold that potentially resulted from spillover. The mean program influence on contractors' recommendations was 81% and the mean influence of contractors' recommendations was 83%, producing a program indirect influence of 67% on customer decisions. This resulted in an estimate of 41 spillover heat pumps (Table 1). Multiplying this by the total of about 105,400 kWh savings produced by the un-rebated, un-requested heat pumps sold produced a total of about 70,800 kWh in spillover savings, which was the equivalent of 18.3% of the program's total rebated heat pump savings for that program year. By contrast, the assessment of participant spillover via participant self-reports of program-influenced un-rebated efficient purchases, yielded savings equal to 2% of the program total savings.

Table 1. Calculation of the number of spillover heat pumps

| Qualifying Heat Pumps Sold by the 15 Contractors | Count | Source |
|---|---|---|
| Number that received rebate or loan | 208 | Program tracking data. |
| Mean reported percentage of all sales that received rebate or loan | 35.6% | Contractor survey. |
| Total qualifying units number sold | 585 | Number that received rebate or loan divided by percentage of all sales that received rebate or loan. |
| Number that did not receive rebate or loan | 377 | Estimated number of qualifying units (585) minus the number of installations in program data (208) |
| Mean reported percentage of time customer requested a heat pump | 85.1% | Contractor survey. |
| Number of contractor-recommended units sold without rebate or loan | 56 | Number qualifying units that did not receive rebate or loan (377) times the contractor's estimate of the proportion of customers who *did not* request a heat pump prior to contractor recommendation (14.9%). |
| Estimated mean program indirect influence | 67% | Mean program influence on contractor (83%) times mean contractor influence on customers (81%), from contractor survey. |
| Program-attributable number of qualifying heat pumps sold without rebate or loan | 41 | Number sold without rebate, loan, or customer request (56) times mean program indirect influence (83%). |

## General Discussion and Conclusions

This research reported in this paper supports an approach in which program indirect influence on un-incented sales is assessed by assessing program influence on trade ally recommendations and the influence of those recommendations on customer decisions. As reported previously (Bliss et al. 2017b), this approach reveals differing amounts of program influence on equipment sales in various equipment sales scenarios. We believe this produces a more accurate estimate of program-influenced savings than one that relies on single average rating of program influence on sales of efficient equipment.

This research confirms that the approach, first developed to assess lighting spillover in a nonresidential program, can be adapted for use in other program types, such as the residential heat pump program described in this paper. The results again demonstrate that efficiency programs may have exert strong *indirect* influence on end-users via trade allies. We did not, in this evaluation, assess direct program influence on program nonparticipants, and so we cannot conclude that the program had greater direct than indirect influence (as we were able to demonstrate in the nonresidential lighting analysis). However, the spillover we identified as resulting from indirect program influence far exceeded the rates typically estimated by using nonparticipant surveys to assess direct program influence on equipment purchases (usually 5% or less; PWP, Inc. and Evergreen Economics 2017). These results thus underscore the value of maintaining strong trade ally networks to support that indirect influence.

Might the contractors have over-estimated their influence on their customers' decisions? The free-ridership battery in the participant survey asked participants to rate their contractors' influence on their decision to purchase the heat pump. Responses to this question indicated that contractors had an average influence of 63% on participants' decisions. This is considerably lower than the mean 81% influence that contractors reported they had on their nonparticipant customers (Table 2). Should we have used the participant rating of contractor influence as a proxy for contractor influence on nonparticipants, rather than using the contractors' own rating of their influence on nonparticipants?

Table 2. Contractor influence ratings, by source

| Source of Contractor Influence Rating | Mean Influence Rating |
|---|---|
| Contractor self-reported rating of influence of recommendations made to nonparticipants | 81% |
| Participant rating of influence on the decision to purchase the incented heat pump | |
| All participants | 63% |
| Requested a heating system other than heat pump or a contractor recommendation | 81% |

We should not assume that contractor influence on participants is necessarily a good proxy for influence on nonparticipants. Participants also were influenced by the rebate, which was not a factor for nonparticipants, and it is conceivable that the participants rated their contractors' influence lower than they would have if the rebate had not also influenced them. Further, recall that our assessment of spillover savings excluded cases where customers specifically requested a heat pump from their contractor. Contractors' assessments of the influence of their recommendations would apply *only* to customers they recommended equipment to – that is, only to those who had not already requested a heat pump from them. It is reasonable to suspect that contractors had greater influence on those purchases than they had, on average, on the participants' heat pump purchases.

Further analysis of the participant survey results provides additional support for the above suggestion. The participant survey asked respondents what their initial request was when they contacted their contractor. Some reported they contacted the contractor explicitly to request a heat pump, while others reported they contacted the contractor to request another type of heating system or to ask for the contractor recommendation. Among those latter two groups combined – those who reported some request other than a heat pump (and who, therefore, were most like the nonparticipants counted in the spillover estimate) – the rated contractor influence was 81% – the same contractor influence percentage reported by nonparticipants.

One potential concern with our methodology is the equation of rated influence with program attribution. We converted influence ratings to 0%-100% scales and equated the results with the share of savings attributable to the program – in this case, 83%. Is that reasonable in absence of assessing other influences – such as word of mouth, desire to reduce energy consumption or save money, desire for the combined benefit of heating and cooling that heat pumps provide – and determining the program's influence *relative* to those other influences? For example, suppose we found ratings that varied from, say, 25% to 50% for other factors. Would program attribution be 83% divided by the sum of all the rated influences? This is an important question, which we will consider in future iterations of this method.

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