ALL THESE YEARS MEASURING FREE RIDERSHIP & NOW WE MEASURE A PORTION OF THESE AS CAUSED BY MARKET TRANSFORMATION

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As this paper is going to press, the project is just being completed. As such, the results provided are preliminary and more illustrative of what may be found than definitive in the case of Consolidated Edison Company of New York's commercial and industrial rebate participants or the findings that will follow by the New York Public Service Commission. Any opinions expressed explicitly or implicitly are those of the authors and do not necessarily represent those of Consolidated Edison Company of New York.

Introduction

Participant spillover is defined as energy-conserving actions taken by program participants that fall outside the specific program(s) offered. Non-participant spillover is defined as customers who are not participants in identified programs, but are stimulated by those programs to carry out the same energy-efficient actions. This includes customers who adopt measure due to changes in stocking patterns, i.e., free drivers.

The element of time can begin to blur the lines. Participation, and spillover can help create market transformation. The market transformation created from prior program actions can itself create participants who may answer that they intended to take the actions anyway. Their stated intentions cause these participants to be designated as free riders. Yet, they may only have these intentions because of prior program efforts.

The market transformation caused by prior program actions can mean that the lines between program impact and free ridership become blurred. Today's free-riders may have been caused by yesterday's market transformation. Programs that move the market would be expected to create free riders as they are defined by self-reported stated intentions. This is the area of overlap between market transformation and gross (static one-year estimate) free riders.

This paper presents how this issue is being examined and measured as one component from a free ridership study being performed for Consolidated Edison Company of New York. The overall study is designed to develop a prospective free ridership factor for the participants of Con Edison's commercial and industrial rebate programs. Con Edison's free ridership factor is weighted by expected demand reductions and is, therefore, equivalent to the naturally occurring savings' rate (NOC) among participants. Estimating these NOC factors is being done in four

steps. These steps are:

1. Estimate a base free ridership estimate by measure from the customer survey-based method recommended by the Empire State Electric Energy Research Corporation (ESEERCO) Study, Stated Intentions with Consistency Check.(6)
2. Calculate a Step 2 Adjustment by energy efficiency measure that approximates for the self-reporting bias difference between customer survey-based methods and nested logit methods of NOC estimation. This is based upon prior comparative studies from ESEERCO and Pacific Gas & Electric Company.(1)(6)
3. Create a Step 3 Adjustment from comparisons in installation rates and plans between participants, participants in the rebate process pipeline, non-participants who have participated in other programs, non-participants aware of the program, and non-participants unaware of the program.
4. Create a Step 4 Adjustment from survey responses to estimate self-reported free riders who actually were influenced by earlier Con Edison efforts, such as audits, advertisements, earlier program participation, and participation in residential programs by the decision-maker. This adjustment is to subtract those customers classified as free riders who were influenced by earlier utility actions, i.e., market transformation.

The foundation for the Step 4 Adjustment and the preliminary analysis to estimate this adjustment is the focus of this paper.

A Variety of Perspectives on Market Transformation

Market transformation has been defined in a number of ways. However, the emerging consensus includes the following components: it represents a strategic intervention or initiative; it results in changes in the structure of the market or the behavior of market participants that increases energy efficiency (e.g., adoption of energy efficient products, services, or products); and that change is long-lasting (e.g., persists when the relevant Program or incentives are withdrawn). As Schlegel has pointed out, evaluators can readily assess the intervention that has taken place and (at least some of) its proximate effects.(19) It is obviously more difficult, expensive, and time-consuming to attempt to assess the persistence of effects. Indeed, in a series of papers, Dr. Feldman has argued that, for both logical and empirical reasons, the focus must be upon proximate effects.(7, 8) Without dealing with the merit of those arguments, we felt it was most appropriate for the purposes of this project to accept Schlegel's argument that short-term evaluations should focus on market effects, setting aside for the present the question as to whether the observed effects will persist.

Schlegel also points out that many current programs were developed and implemented within a resource acquisition paradigm rather than a market transformation paradigm making their evaluation as market transformation programs problematic. He states that as the programs were not designed to address and overcome specific market barriers they may require some review and reformulation before being evaluated from that perspective.(19)

Generally, market transformation in the energy efficiency field is discussed as being measured on a top-down basis. Appliance saturation data and dealer stocking data are both examples of top-down measurement methods in that they examine totals for the overall market being investigated. This easily follows from the fact that programs that are most clearly designed as market

transformation programs also tend to concentrate on a top-down approach. These include: contests and programs aimed at manufacturers to bring new technologies to the market (e.g., the NYPA/NYCHA super refrigerator program for apartments (17), the high-efficiency clothes washer effort (4), and the Con Edison Dealer Incentive Programs.

Standard utility demand-side management (DSM) programs for the last decade have generally been rebate programs for their customers. These bottom-up efforts (customer-based to achieve a different total resource acquisition mix) have been pointed to as being different from the designed top-down market transformation (MT) programs. However, as many DSM efforts were planned to overcome market barriers and then disappear as the market began functioning "better", they too are MT programs. At a minimum, standard DSM rebate programs can have MT effects even when not specifically designed for this purpose.

Dennis Nelson of B.C. Hydro describes a Market Barriers Framework for viewing customer service programs in light of the market barriers they are designed to address. These are:

1. Customer awareness of energy efficiency options.
2. Customers' technical ability to assess the options.
3. Existence of a viable infrastructure of trade allies.
4. Vendor or trade ally awareness of the efficiency options and their understanding of the technical issues.
5. Local or national product availability.
6. Customer transaction costs to assess/implement energy efficiency options.
7. The incremental capital cost of the efficient technology.[1]

Number five, local or national product availability, is addressed by the classic MT program. Clearly, number seven is within the standard DSM rebate program, a bottom-up approach that does not include MT. However, many of the other market barriers can be addressed through bottom-up programs or top-down programs. They are also eligible to become part of market transformation. For example, number one, customer awareness, can be addressed through a top-down program in an energy awareness campaign that uses television advertising and infomercials that would meet the more classic view of a MT program. This same market barrier, nonetheless, is addressed in a more bottom-up approach from an audit program that achieves significant customer penetration.

Another view of MT is the division between whether the program is focused on the manufacturers and dealers, or on the customers. Some have argued that the first type is the only MT efforts. Yet, the first is a supply-shift strategy and the second is a demand-shift strategy. Both, as is seen if they obtain permanent shifts in either the supply curve or the demand curve, can be MT efforts. A recent statistical evaluation of the impact of energy audits at Pacific Gas & Electric (13) used nested logits to control for self-selection and found significant impacts of the audits towards technology adoption and in encouraging customers into the rebate program. This analysis was done with the perspective that the energy audit program was a demand-shift strategy.

[1] Nelson (16), p. 7.117.

A top-down measurement scheme, appliance sales data for example, still needs to account for those appliances purchased via rebates. This accounting needs to occur to insure no double-counting is occurring. But also to assess what MT efforts are occurring versus purchasing of energy decisions that will not occur again the future when rebates are not offered (i.e., a resource acquisition that is not a persistent MT effect.) Nevertheless, an MT measurement from a count of sales minus rebated net sales needs to insure that customers who are assumed that they would have made similar decisions without the program effort (free riders) are not actually part of the customer based acting in response to the MT that has occurred.

The Issue of Overlap Between Free Ridership and Market Transformation

Free riders are those participants who would have installed the efficient equipment in the absence of the program. The estimates associated with the participants are often measured for one program and program year, independent of other years or programs. This static snapshot view of free ridership is a simplistic version of the real world. Many things change and interact over time. This is also true with utility DSM and promotional programs.

Time is a part of the definition of market transformation in that its definition includes the persistence of the effect. Examining program effects over time, instead of the previously static examination of free riders and spillover, quickly provides us with a view of the potential overlap between free ridership, spillover, and market transformation as they relate to standard utility DSM program efforts.

A complete examination of market transformation was well beyond the scope of this project. Yet, there is a very small part of market transformation that is quite relevant to the determination of accurate net free ridership.

Net-to-Gross analyses began years ago as an examination of free ridership. More recently, the distinction has been made between those participants who would have installed without the program (free riders), the savings that would have occurred anyway from these participants (participant's naturally occurring conservation--NOC), and the total NOC (from participants and non-participants). Net impacts are often discussed as including all program impacts on net (i.e., with participant and non-participant spillover). This can be seen in the graphic used in the CADMAC Spillover Review Study (2) and is displayed as Figure 1.

Participant spillover is defined as energy-conserving actions taken by program participants that fall outside the specific program(s) offered. Non-participant spillover is defined as customers who are not participants in identified programs, but are stimulated by those programs to carry out the same energy-efficient actions.

The element of time can begin to blur the lines. Participation, and spillover can help create market transformation. The market transformation created from prior program actions can itself create participants who may answer that they intended to take the actions anyway. Their stated intentions cause these participants to be designated as free riders. Yet, they may only have these intentions because of prior program efforts. Figure 2 attempts to show the time component involved in market transformation.

The market transformation caused by prior program actions can mean that the lines between program impact and free ridership become blurred. Today's free-riders may have been caused by yesterday's market transformation, as shown in Figure 2 as the white semi-circle portion of free riders. This is the area of overlap between market transformation and gross (static one-year estimate) free riders.

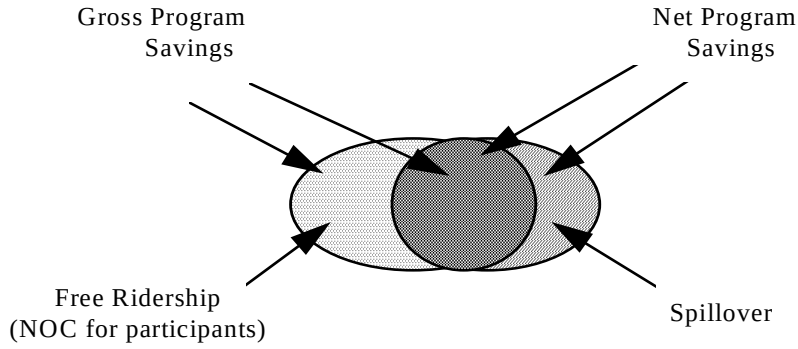

Figure 1 Free Ridership (NOC), Spillover, and Net Program Impacts

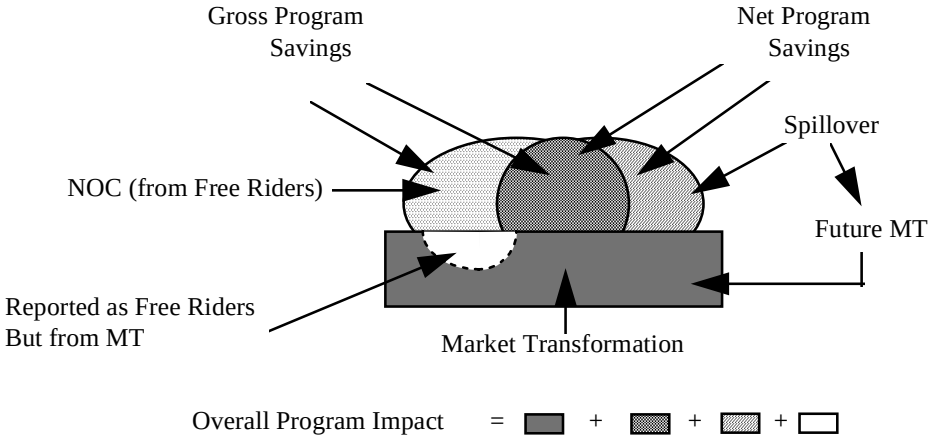

Figure 2 Free Ridership, Spillover, and Market Transformation

This occurrence is similar to the measurement issue presented by Saxonis (22) in 1992 of misidentifying free drivers' actions as free riders.

Prior studies indicate that this is more than a theoretical proposition. In the review study by Mast and Ignelzi (14), they cite strong evidence for significant occurrences of this phenomenon.

> "Rathbun et al. found that estimates based on self-reports from participants and non-participants indicated free-ridership on the order of 55-75% for a Wisconsin Public Service air conditioner incentive program (Rathbun et al. 1990 (20)). Yet

> prior to the program, efficient air conditioners made up only 17% of purchased stock. Rathbun explained the discrepancy by noting results from a trade ally survey indicating that the direct rebate program had a strong impact on dealer stocking and promotion practices. If such was indeed the case, then both participant and non-participant self-reporting would systematically overestimate the proportion of free-riders and underestimate the proportion of free-drivers." (14, pp. 10.150)

Programs that move the market would be expected to create free riders as they are defined by self-reported stated intentions. This phenomenon can be estimated from Gallaher and Wiecek (9) concerning a study of Niagara Mohawk Power Corporation's High Efficiency Motors program. They estimated market movement from a model predicting the probability of installing high-efficiency motors. From this model, they estimate that market movement had gone from a probability of installing high-efficiency motors of 33% to 43%, and that without incentives the probability after the program would be 40% (9, p. 845). That is, an additional seven percent of customers would install the high-efficiency motors without an incentive after the program than before. This equates to almost 18 percentage points as a free ridership estimate after the program (7%/40% who install). These customers would be truthfully answering their intentions to make the installation without the program. Yet, the installations would never have occurred without the earlier program.

The nested logit introduced by Dr. Train is not designed to account for the phenomena of market transformation over time (24, and 25, pp. 26). In fact, his original theoretical analysis assumes no market transformation or non-participant spillover is occurring. These models can, however, be used in a research design created to estimate spillover. This was done using a comparison group from outside Pacific Gas & Electric's electric service territory in the PG&E study. This study found varying amounts of market spillover, with some of these amounts being quite significant. These are summarized in Table 1.

Table 1. PG&E's Net-to-Gross Ratios

Measure Category	Net-to-Gross Ratio accounting for Free Riders Only[2]	Net-to-Gross Ratio including Free Riders and Market Spillover[1]	Difference (Spillover est.)
Lighting Upgrades	.84	.85	.01
Lighting Conversions	.55	.52	-.03
Lighting Controls	.80	1.10	.30
HVAC Adjustments	.84	---	---
HVAC Maintenance	---	.85	---
HVAC Controls	.75	.63	-.12
HVAC Installations	.43	.73	.30
Weighted Average[3]	0.75	0.78	.03

[2] Buller et al. 1994 (1), p. 1.16.
[3] Train 1995 (26), p. 5-44.

The ESEERCO study also found significant levels of free drivership due to the advertising associated with the New York utilities' lighting programs for the installation of compact fluorescents. This econometric model found a net savings increase of 29%, equivalent to a free ridership factor of -29% (6, pp. 5-15.). That is, free drivership (or non-participant spillover) was much greater than free ridership, creating a net impact greater than the original gross impact based on participants alone.

Measurement Concept

At this time, we are only attempting to measure the much smaller impacts of market transformation, those that create participants classified as free riders by the Stated Intentions methodology. (This is the white semi-circle in Figure 2, where free riders overlap with the customers impacted by market transformation.) A much larger study would need to be undertaken to measure the greater spillover and market transformation effects created by Con Edison's program(s) on the larger customer population.

An important element to this investigation has been to ask participants questions concerning when they received information on the rebated technologies and the importance of information from Con Edison in their decision to install. How long have they been aware of these technologies? Have they participated in Con Edison sponsored programs in the past (including receiving an energy audit)? Has the respondent (energy facility manager) personally participated in one of Con Edison's residential DSM programs?

Few of these areas being examined are new. The main difference in this study is in examining the outcomes alongside what we also learn about those participants who are self-reported free riders, i.e., they say they would have made the technology adoption if the program had not existed. For example, consider the following two participants.

Participant One's survey responses indicate they:

- Definitely would have installed the equipment in the absence of the program (a free rider by Stated Intentions);
- Received an energy audit from Con Edison at least a year prior to program participation;
- Received information on the rebated technology from Con Edison prior to their installation of this technology in their facility; and
- Has not made other possible energy efficiency investments.

Participant Two's survey responses have the same response to the self-reported stated intentions' question, but very different responses to the other questions. These responses are:

- Definitely would have installed the equipment in the absence of the program (a free rider by Stated Intentions);
- Has not received an energy audit from Con Edison;
- Purposefully gathers information on energy efficiency; and
- Has made all other possible energy efficiency investments.

Both of these participants would initially be classified as free riders. Yet, the first would be removed from the calculation of the free ridership factor by this step as being induced by Con

Edison's programs to take these intended actions. The second participant described here is a net free rider due to market transformation effects.

Preliminary Results

There are skeptics that think that standard DSM programs can not create market transformation because their total market penetration is too small. The annual market penetration of a DSM program can be small and still the long-term penetration from that program can be quite significant.

Our first data examination is to look at the extent of penetration of Con Edison's programs as seen through survey responses from participants and non-participants. The non-participant sample was taken from billing records and firms that showed up as participants from January 1, 1995 through April, 1996 were deleted from the sampling frame. A stratified random sampling was performed for the non-participant survey sampling frame to assure representation of large customers (with demand equal to or greater than 1.5 megawatts), and all industry categories. The obtained survey sample is then weighted to represent Con Edison's total non-participant pool. The penetration rates for participants and non-participants are presented in Table 2.

Penetration rate differences between participants and non-participants are not as great as would be expected. This is because the penetration rate of Con Edison's energy efficiency (EE) efforts is quite high. Non-participants were defined by not being found in the participant pool of January 1995 through April 1996. Yet, 43% of non-participants still participated in one of Con Edison's rebate programs in the last two years. This number then jumps to 61% when examined over the last five years. More than half of the participants have had an energy audit by the utility and/or have been in more than one rebate program in the last five years.

These levels of penetration could easily be expected to create spillover and market transformation. Participants who have received utility energy audits, energy efficiency advertisements, and earlier program participation could truthfully say that they would have made the efficiency investment without the utility's 1995-1996 incentive. Yet, it would be misleading to denote all these participants as free riders when many may have been influenced by Con Edison's programs and their market transformation (i.e., the earlier efforts may have shifted the energy efficiency demand curves for these customers). It is these customers we are identifying and adjusting our free ridership factors to account for in the Step 4 Adjustment.

The preliminary estimate of the number of affected participants from the Step 4 Adjustment is provided within Table 3[4]. Table 3 examines the percentage of self-reported free riders who have participated in earlier utility energy efficiency efforts, i.e., the percentage of self-reported free riders subject to a market transformation effect.

[4] Given space limitations, only a few of the prior program questions are presented here.

Table 2 Penetration Rates for Con Edison's Commercial and Industrial Energy Efficiency (EE) Programs as Given by Telephone Survey Responses from 1995-1996 Participants and Non-Participants

	Participants	Non-Participants
Received audit by electric utility	54%	21%
In rebate program in last 2 years	NA[5]	43%
In rebate program in last 5 years	NA[4]	61%
More than 1 rebate program in last 5 years	51%	22%
Decision-maker in residential EE program	7%	11%
Seen Con Edison's Ads on EE lighting	74%	41%
Seen Con Edison's Ads on EE AC	33%	13%
Seen Con Edison's Ads on EE or VSD Motors	24%	8%
50% or More of EE info received is from Con Edison	42%	48%

[5] By definition 100%.

Table 3 Proportion of Free Riders* That Are Subject to a MT Effect

	Received Audit	More than 1 program	Seen utility's EE Ads	Any of these Three
Lamps	17%	14%	26%	31%
Customized lighting	25	22	32	37
CFLs	17	17	17	24
Fixtures	21	13	27	33
Ballasts	19	13	27	35
Lighting controls	29	30	57	58
AC & Chillers	31	38	14	52
VSD	7	36	21	36
EE Motors	25	31	37	50

* Defined as those participants with a 60% or greater probability and/or partial NOC measurement.

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