Market-Effects Momentum: Are We Giving Market Effects Their Full Due?

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ABSTRACT

Energy-efficiency programs, whether they have a resource-acquisition or a market transformation goal, stimulate end users to adopt energy-efficiency measures not only during the program year in which they were exposed to program activities but also in subsequent years. The belief that this will occur justifies market-transformation programs. For resource-acquisition programs, this effect occurs when program participants decide that the promoted energy-efficiency measure was a good choice and return to make that choice again. These lagged energy-efficiency adoptions represent sales *momentum* caused by a program's activities. When we evaluate a program using regression modeling with a *program* variable, these momentum effects are captured if we have a good non-intervention baseline. But when we evaluate using a *participation* variable, or have an inadequate baseline, or when we use rebate-redemption counts and free-ridership surveys, we can expect to miss some of the momentum effects attributable to our program. When we evaluate a proposed program's cost effectiveness without using post-program momentum effects, we may reject it when it would otherwise be cost effective. This paper describes the "market-effects momentum" concept, reviews three recent evaluations that address it, and examines its implications for free-ridership, cost effectiveness, forward capacity markets, and cap and trade programs for greenhouse gas.

Introduction and Purpose

The author of this paper once listened to a senior marketing representative of one of the major national appliance retail chains claim that his chain's brand held the largest market share for appliances in the United States. He was asked, "What would happen to that market share if you were to suddenly stop promoting the brand?" After a pause he replied, "We'd probably continue to hold it for a year, then it would start to decline." He did not know how far it would drop, or how long it would take. The point of this anecdote is: professional marketers of consumer products assume that their marketing efforts will continue to generate *new* sales even *after* they stop marketing.

This assumption poses interesting questions for those who have responsibility for justifying electric- or gas-rate surcharges on the basis of a program's cost effectiveness and for those responsible for conducting a forward capacity market or cap-and-trade program. Because it poses interesting questions for them, it poses important challenges for energy-program evaluators. The purpose of this paper is to describe some of the attempts that have been made in the energy-evaluation field to address this assumption about post-marketing sales of efficient products and to describe the implications of this "market-effects momentum" for free-ridership, net-to-gross ratios, forward capacity markets, and greenhouse-gas cap-and-trade programs.

This paper will first illustrate the market-effects momentum concept and describe how it is being treated in a program-evaluation protocol. Then it will describe the concept's implications for policy makers. Finally, it will describe three recent evaluations that have used the concept. It will argue that most program planners and evaluators have not been giving market effects their full due.

[1] The opinions expressed in this paper are those of the author and do not necessarily reflect those of Lockheed Martin.

Market-Effects Momentum

Preliminaries

The *California Evaluation Framework* defines a market effect as "A change in the structure of functioning of a market or the behavior of participants in a market that result from one or more program efforts. Typically these efforts are designed to increase the adoption of energy-efficient products, services, or practices and are causally related to market interventions" (TecMarket Works 2004, 429). Examples include increases in the number of ENERGY STAR appliance models manufactured, increases in the use of air compressor system maintenance plans, and increases in the sales of any energy-efficient end-use product. The definition explicitly identifies market effects as effects net of a baseline; market effects lead, directly or indirectly, to net energy savings and demand reduction.

Figure 1 is a high-level diagram of the relationships between energy-efficiency program interventions and their goal of saving energy. It shows where market effects fit into program theory. They necessarily precede goal achievement. This paper will use sales of energy efficient end-use products as the market effect of interest and will conveniently assume that all sales are eventually "adopted" (put to use saving energy). Energy-efficient sales are indicated in the market-effects box with the heavy border in Figure 1. The concepts illustrated here with sales could just as well have been illustrated with market shares and energy-using behaviors.

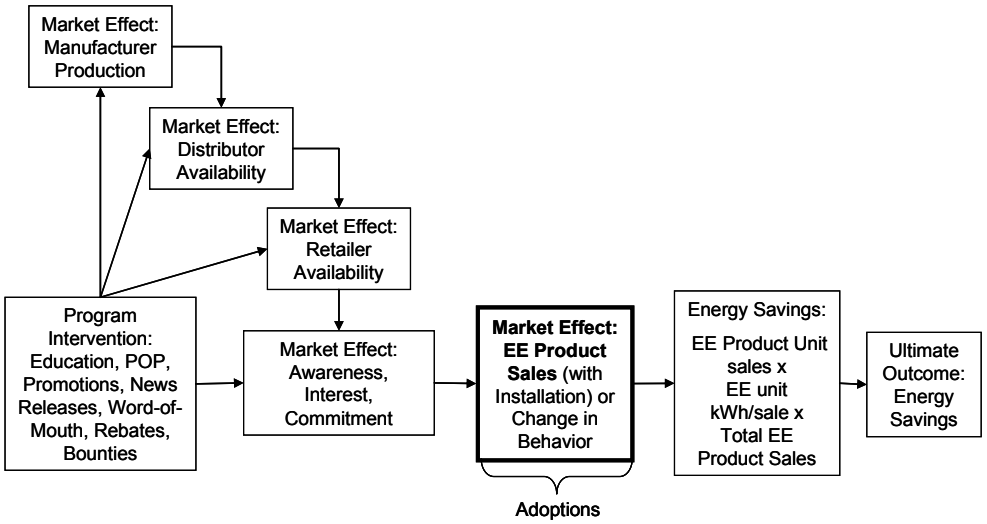

Figure 1: The Relationship of Market Effects to the Goal of Energy Savings

Market-Effects Momentum

The concept of market-effects momentum was formulated for the California energy program planning and evaluation industry in California's *A Framework for Planning and Assessing Publicly Funded Energy Efficiency* (*California Planning Framework*) (Sebold et al. 2001). The *California Planning Framework* addressed market-transformation planning and evaluation issues; therefore, it had to acknowledge that a successful energy-efficiency program will continue to generate sales of energy efficient products after its intervention ends. The framework tackled the logical implications of this, namely, *any* year of a program intervention produces new sales in subsequent years irregardless of whether the program was still active or not. "[M]arket-transformation initiatives are designed to spawn

market effects that last beyond a single program year" (Sebold et al. 2001, 7-3, 7-4). The framework illustrated this idea using graphics similar to those in Figures 2, 3, 4, and 5.[2]

Figure 2 begins the graphical illustration of market-effects momentum by showing hypothetical baseline sales of an energy-efficient end-use product over an eight-year period in the absence of any program intervention (the non-intervention baseline). As we will see, estimation of this baseline is important for the evaluation of market-effects momentum.

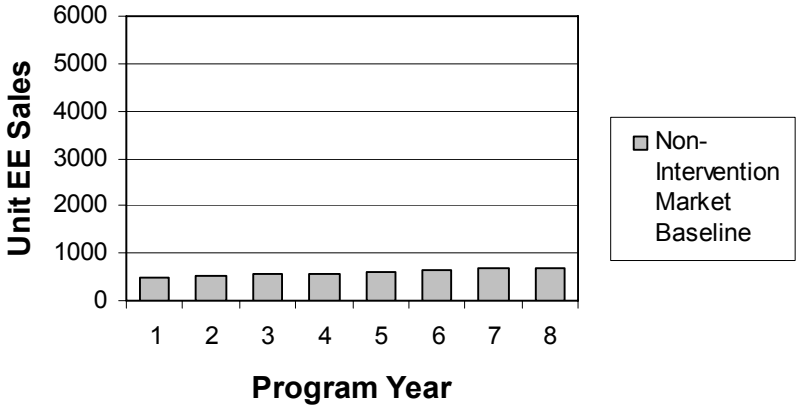

Figure 2: Non-Intervention Baseline Sales for an Energy-efficient End-use Product

Figure 3 shows a hypothetical increase in sales during the first year of a one-year program designed to promote sales of an energy-efficient product (the black segment of the first bar). The program stops after one year, but its influence continues to generate new sales for several years after the program's termination (the striped segments). The usual assumption—including that of the marketing representative in the Introduction—maintains that these momentum sales will gradually decay. The illustrations in this paper reflect this assumption, but as will be seen later, this need not be the case.

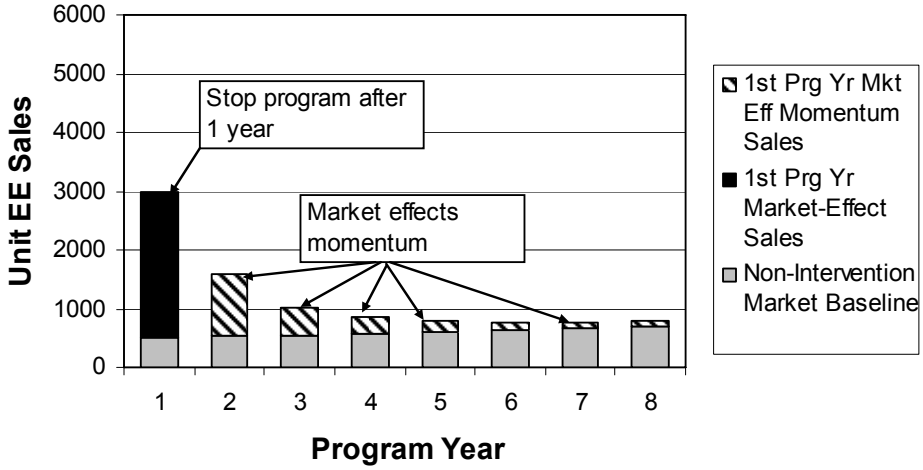

Figure 3: Baseline Sales Plus First-year Program Sales Attributable to Program plus Sales Due to Momentum Created by the First-year Program

[2] Figures 2, 3, 4, and 5 are based on the figures in Section 7 of Sebold et al. 2001 but present energy-efficient sales in bar-chart rather than line-chart format.

The bold striped segments of the bars in Figure 3 illustrate the sales momentum generated by program activities during the first program year. They appear in the second through eighth years. These additional new future sales generated by a program's activities in a prior year are what this paper calls "market-effects momentum," "momentum sales," and "momentum effects."[3]

Several points need to be stressed here. (1) The market-effects-momentum sales in the second through eighth years are *new* sales in those years. (2) They are in excess of the non-intervention baseline sales. (3) They are attributable to the one-year program by virtue of the belief that marketers have in the efficacy of their work and, surely, by the belief market-transformation sponsors have in the value of their programs. (4) Because they are attributable to the first-year program, *they are not free rider* sales. Rather, they might be thought of as "lagged spillover" sales.[4] (5) Finally, the first-year program could have been either a resource-acquisition program or a market-transformation program; it makes no difference. These points are basic to the purpose of this paper. Their implications for evaluation and program-planning practices will be reviewed later.

Instead of discontinuing the program after one year, continue it for a second year. Figure 4 shows the hypothetical sales attributable to the second year of program activities, C:D. (A colon between two letters refers to a range of sales delineated by letters in the figures.) They add to the baseline sales, A:B, and momentum sales attributable to the first year that occur in the second year, B:C. One of the evaluations reviewed for this paper refers to the C:D effects as "contemporaneous" program effects to distinguish them from the B:C momentum effects (Nexus Market Research 2005, 18). The momentum sales from the second year begin in the third year, G:H, and continue. In Figure 4, the first two years of the program continue to produce new sales out to the eighth year.

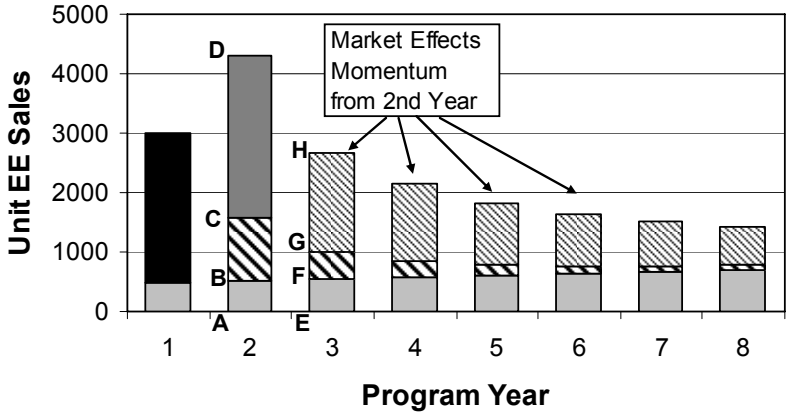

Figure 4. Sales from a Two-year Program Including Momentum-effect Sales plus Baseline Sales

The concept can be extended indefinitely. Figure 5 on the next page extends Figures 3 and 4 to a program that runs for five years and shows how momentum sales will build up and continue after the program is over.

[3] These momentum effects are not the same as the delayed outcomes that are characteristic of commercial and industrial programs where a decision made as a result of the program in year *t* is not implemented until year *t+1* or later.

[4] However, unlike the definition of spillover in the *California Evaluation Framework*, this use of "spillover" includes activity by program participants as well as non-participants (TecMarket Works 2006, 441).

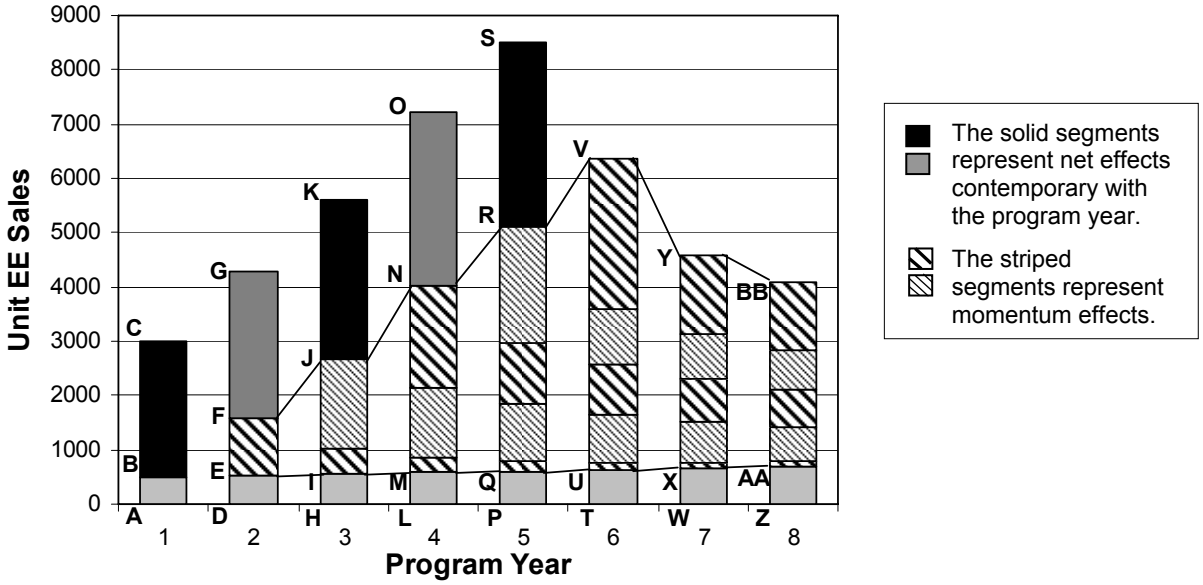

Figure 5. Sales from a Five-year Program Including Momentum-effect Sales

In these figures, the bold and not-bold striped portions of the bars represent market-effects momentum from alternative program years. In Figure 5, this momentum is responsible for the sales represented by the E:F, I:J, M:N, and Q:R portions of the bars during the program years and for all of the non-baseline sales after the program ends, i.e., during the sixth through eighth years.

Market-Effects Momentum and Dynamic Baselines

This paper has developed the market-effects momentum concept from the ideas put forth in the *California Planning Framework*. However, it asserts that momentum sales are attributable to prior-year program-intervention activities and, therefore, are attributable to the program. This is not the interpretation used by the *California Planning Framework*. Rather, the framework states that these lagged-spillover outcomes cumulate to create a *new* baseline for each subsequent program year's contemporaneous sales. For example, the framework's interpretation would classify the sales in Figure 5 represented by the portion of the bar P:R as baseline sales for the 5th program year.

When interpreted this way, baselines become "dynamic" (Sebold et al. 2001, 7-2 – 7-4). They include not only a non-intervention market baseline (P:Q) but also the market effects from preceding years' program interventions (Q:R). The author does not agree with this interpretation; neither, he believes, did the later California evaluation protocols.

Market-Effects Momentum and the California Evaluation Protocols

As the *California Planning Framework* was being published, the electricity price crisis in California turned the state's energy-efficiency policy away from market transformation to a frontal assault on reducing the demand for electricity. This resulted in the development of the *California Evaluation Framework* and its companion evaluation protocol document, the *California Energy Efficiency Evaluation Protocols* (*California Evaluation Protocols*) (TecMarket Works 2006). Both are grounded in the original *California Planning Framework*, but their main concern is with providing guidance on how to plan and evaluate resource-acquisition programs.

The *California Evaluation Protocols* explicitly acknowledges the effects of a program intervention that occur after the year in which the intervention occurs, i.e., it acknowledges the market-transformation momentum effects of a resource-acquisition program and calls them "long-term effects" (TecMarket Works 2006, 144). It recognizes that these long-term effects (resulting from previous program years) can occur in current program years and in future years whether the program exists in these future years or not. The protocol then explicitly *excludes* the addition of *future-year* effects to the impacts of the program year being evaluated, but it *allows* the momentum effects from *previous years'* interventions to be included in the current program year's evaluation. Perhaps this recognizes the methodological challenges in developing defensible forecasts of market-effects momentum in future years.

In any case, the *California Evaluation Protocols* advises using either a "preponderance of evidence" or "net market effects modeling" approach to measure momentum effects (TecMarket Works 2006, 156). This guidance appears to abandon the "dynamic baseline" interpretation of the earlier *California Planning Framework* and allows momentum effects from prior program years to be attributed to the program and added to its contemporaneous effects.

Implications of Market-Effects Momentum for Planners and Evaluators[5]

Market-effects momentum has implications for several fundamental decision-making topics in the energy-efficiency planning and evaluation industry. These include measurement of free riders, estimation of cost-effectiveness, the amount of demand reduction eligible for forward capacity market auctions, and the value of energy savings certificates for cap-and-trade programs.

Market-Effects Momentum and Free-Ridership

Measurement of all energy-efficient sales in any given year will capture momentum effects as well as contemporaneous and non-intervention baseline effects in that year. If evaluators then account for the non-intervention baseline sales, the remaining sales should all be attributable to the program. However, cost or policy considerations often force evaluators to measure sales attributable to a program year by counting program participants in that year and then surveying them to estimate free-ridership (participants who claim they would have take the desired action in the current year even without the program). The free riders are then subtracted from the total participants to obtain the market effects attributable to that year's program. Some of these free riders will truly belong in the non-intervention baseline, but if we accept the market-effects momentum concept, some will be participants who opted for the energy efficient action because of a prior year's program activities. *These are not free riders*. If we fail to accept this, the resulting free-ridership will be too high and the evaluation will underestimate the program's impact.

It will be difficult to estimate what proportion of the free riders are really momentum-effect buyers and what portion belong to the non-intervention baseline. Market-effects momentum requires

[5] The author believes that the concepts described in this paper and their resulting implications apply to all sectors; however, the commercial and industrial (C&I) sectors—and in particular the *large* C&I subsectors—may not experience as strong momentum effects as are implied in this paper. In this context, it has been suggested that the practical significance of market-effects momentum may apply more to market-transformation (MT) programs than to resource-acquisition (RA) programs. This comment may have *some* validity for C&I programs; however, the author believes that the distinction between MT and RA programs hides the fact that energy-efficiency programs, whatever their *goals*, are *marketing* programs—whether policy makers understand them this way or not. Marketing programs will have lingering momentum effects. However, this discussion requires a separate paper.

that evaluators reconsider their batteries of free-rider questions and add questions that probe for lagged spillover to avoid underestimating net program impacts.

Market-Effects Momentum and Cost Effectiveness

Failure to include valid momentum effects will reduce cost effectiveness. Such a failure might result in termination of a program that is still effective. Of greater import, however, is the consideration of *post-program* momentum effects when assessing the cost-effectiveness of a *proposed* program. Post-program momentum effects add to program benefits at no additional program cost. The sponsor of one of the evaluation examples described in this paper uses momentum effects in this way to help justify proposed programs.

Market-Effects Momentum in Forward Capacity Markets and Cap-and-Trade Programs

Forward capacity markets (FCMs) offer to buy verified peak demand reduction that is bid at a competitive price. Energy-efficiency programs may be eligible for these markets because their impact on energy usage also reduces peak demand. If an FCM that accepts only net impacts also allows momentum effects, they will increase the demand reduction that can be bid at a given price. This will increase the competitiveness and value of energy-efficiency programs to their sponsors.

Similarly, momentum effects can add to the value of (net) energy savings certificates (ESC) that are used to stimulate energy efficiency in the context of greenhouse gas cap-and-trade programs (Hamrin, Vine & Sharick 2007).

To illustrate how momentum effects can add to the value of contemporaneous effects, Figure 6 shows how net energy savings from market effects can accumulate when market-effects momentum is considered.[6]

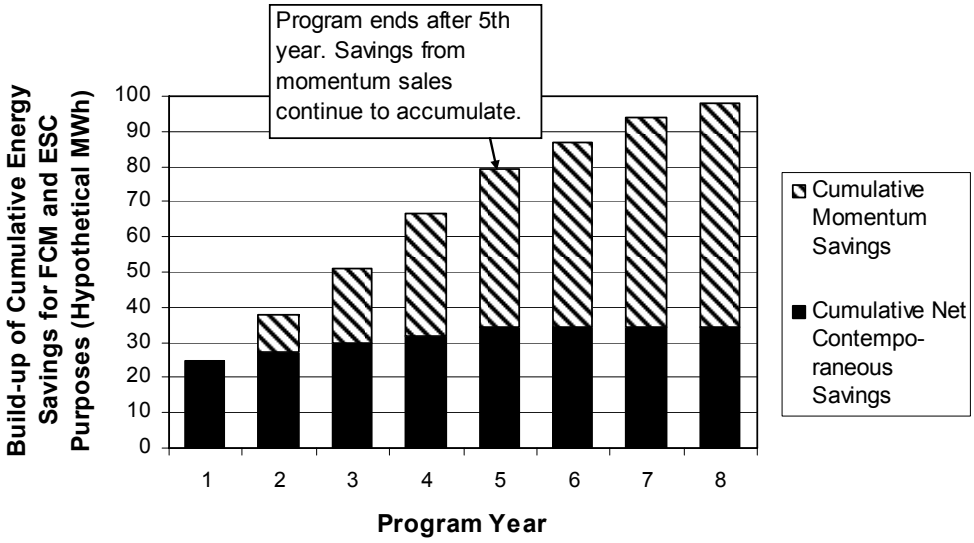

Figure 6. The Build-up of Cumulative Energy Savings from Contemporaneous and Momentum Effects for FCM or ESC Credits

[6] Figure 6 and all figures in this paper ignore the deterioration of an efficient end-use product's savings during its lifetime due to age and removal.

In Figure 6, savings due to momentum effects from prior years (the savings represented by the striped bars) add to new contemporaneous savings plus the cumulative savings from prior years' contemporaneous effects (the black segment of the bars) through the fifth program year. After the program terminates, the momentum-effects savings resulting from the program's active years will continue to accumulate and grow until the momentum is exhausted.

Of course, carry this to extremes and a program sponsor can claim that all new sales (net of baseline) from a successfully transformed market should count as credits until sales reach equilibrium with product end-of-lifetime replacements. A policy decision would be required to manage the level of momentum sales that can be bid into an FCM auction or claimed for an ESC.

Net demand reductions for FCMs and net energy savings for ESCs will require verification, and verifying claimed momentum effects (1) during a program year or (2) for a year's anticipated future effects poses major challenges to evaluators and policy makers. The following section reviews three evaluations that have addressed this issue.

Market-Effects Momentum in Actual Evaluations

The California guidance documents acknowledge that market-effects momentum is not simple to measure. Has anyone tried? This section summarizes three evaluations that have addressed the challenges. One of the evaluations hypothesizes that it has identified the existence of market-effects momentum in the evidence of a program year's impact. Two of the evaluations have quantified it. The summaries describe these evaluations without attempting to judge the validity of their results. They serve to illustrate methods that can be used to evaluate market-effects.

An Evaluation that *Identifies* Market-Effects Momentum in Program Impacts

Vermont's Energy Efficient Products Program (EPP). In 2002, KEMA-XENERGY evaluated the appliance component of Vermont's 2000-2001 residential EPP (Rosenberg 2003). This component consisted of refrigerators, clothes washers, dishwashers, and room air conditioners. The program offered rebates only for clothes washers. The EPP is a Vermont-wide successor program to several individual utility incentive programs in Vermont that had operated since 1997.

- **Indicator of Market-Effects Momentum:** Changes in ENERGY STAR market share and sales, 1999 to 2001.
- **Data Source for Indicators:** (1) U.S. Department of Energy annual market share and sales data for each state as reported by participants in the national ENERGY STAR Program;[7] (2) sales data developed from the Association of Home Appliance Manufacturers (AHAM) shipment data; and (3) sales data from the program's own collection efforts.
- **Methodology:** Multivariate regression modeling of market share for each appliance for each of the three program years. The model included a variable for active state or regional ENERGY STAR incentive program and demographic variables for educational attainment and median household income.

[7] The U.S. DOE program refers to the proportion of all sales that are ENERGY STAR sales as "market penetration." The author uses the term "market share" for this proportion.

- **Momentum Findings**: The model produced its strongest findings for clothes washers, the only appliance with a cash incentive. Figure 7 shows the impact of the ENERGY STAR market share attributable to the program in each of the three program years that were evaluated.

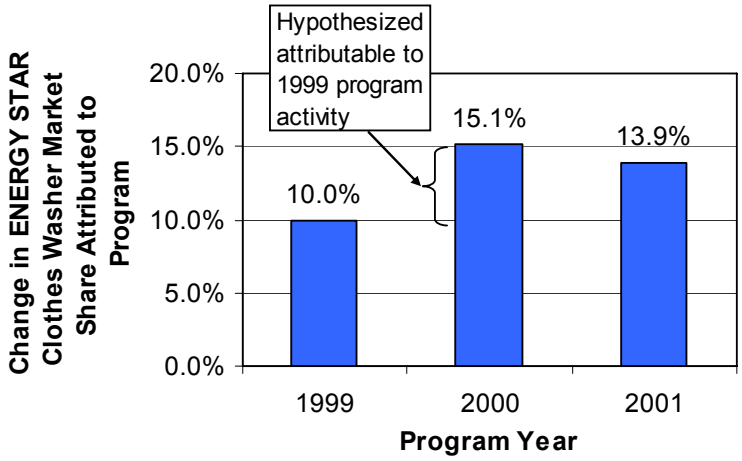

Figure 7. Vermont EPP Program Impact on ENERGY STAR Market Share for Clothes Washers

KEMA-XENERGY hypothesized that the 1999 (and earlier) program activities had an impact on the sales of ENERGY STAR clothes washers in 2000 and 2001 "in that their market share was considerable higher than it would have been in the absence of the program. In both 2000 and 2001, the actual market share for ENERGY STAR clothes washers among Vermont chains exceeded the model prediction—in 2000 by a considerable margin" (Rosenberg 2003, 263).

- **How Momentum Findings Were Used:** Not determined.
- **Implications:** The method demonstrates that using net market effects regression modeling to quantify the net impacts for multiple years may be a feasible method for quantifying effects that include momentum sales. The study stopped short of separating out these effects because that was not its purpose and the method included them in the reported impacts anyway.

Evaluations that *Quantified* Market Effects Momentum

Northwest Energy Efficiency Alliance (NEEA) 2004 ENERGY STAR Windows Program. In 2005, Summit Blue began an ongoing effort to quantify long-term energy impacts of market-transformation initiatives for the Pacific Northwest states (Washington, Oregon, Montana, and Idaho) after program funding had been terminated. Its first study examined NEEA's ENERGY STAR Windows Program. This program targeted window manufacturers from 1998 to 2001 with the objective of building product image and brand association that ultimately would lead consumers to demand more energy-efficient windows for their homes (Cooney et al. 2006).]

- **Indicator of Market Effects Momentum:** ENERGY STAR market share. The study also quantified sales and per-unit energy savings.
- **Data sources for Indicators:** (1) Interviews with staff, implementers and project evaluators; (2) secondary sources: Ducker Research Report 2004, DOE ENERGY STAR Web site, California DEER database, windows market research reports, Census reports; (3) survey of a sample of regional and national windows manufacturers.

- **Methodology:** Averaged ENERGY STAR windows market-penetration estimates obtained from interviews and secondary sources to develop a "gross" market share. Subtracted NEEA-provided baseline obtained from Delphi study to obtain market share attributable to program (Degens 2007).
- **Momentum Findings:** Figure 8 shows the growth in ENERGY STAR windows market share *after* the program was terminated, i.e., the market-effects momentum, that NEEA deemed was attributable to its program. The chart shows that net market share continued to grow after the program ended. Summit Blue judged that the continued growth occurred because the program had successfully transformed its market.

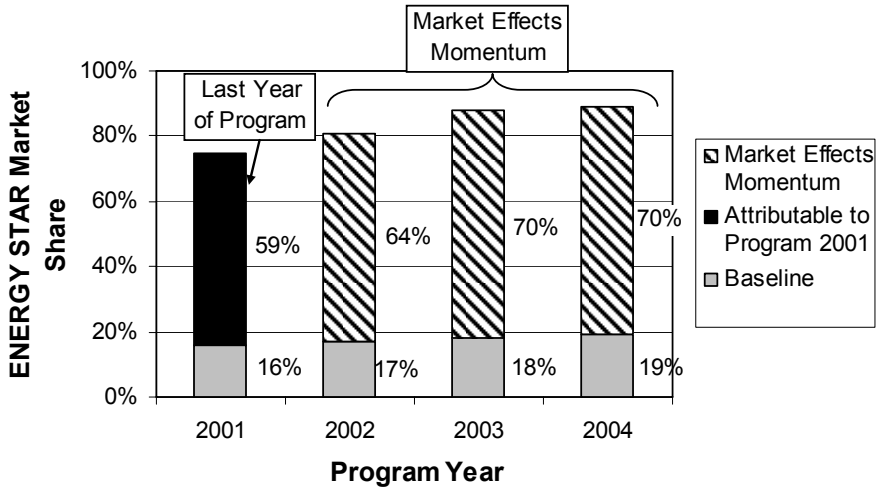

Figure 8. Continued Growth in Net ENERGY STAR Windows Market Share after the NEEA Windows Program Ended

- **How Momentum Findings Were Used:** NEEA uses estimates of momentum sales in its cost-effectiveness calculations to justify proposed programs. NEEA's tracking studies such as this one help to justify its use of post-program sales in cost-effectiveness calculations for proposed programs. The results are also used to develop better forecasts of such post-program sales (Harris 2007).
- **Implications:** The method used by Summit Blue demonstrates that preponderance-of-evidence methods can be a feasible method for post-hoc quantification of momentum sales. They can also be used to reconcile projected momentum sales with actual sales.

Massachusetts 2004 Appliance Program. In 2004, Nexus Market Research (NMR) evaluated the Massachusetts utilities' 2003 ENERGY STAR appliance initiative (Nexus Market Research 2005). The evaluation looked at clothes washers, refrigerators, dishwashers, and room air conditioners. This evaluation explicitly acknowledged momentum sales, calling them "cumulative effects" on market penetration (market share), and had a goal of quantifying their contribution to program energy savings.

- **Indicators of Market Effects Momentum:** ENERGY STAR market share and sales, 1998 to 2003, for the appliance initiative.
- **Data sources for Indicators:** (1) U.S. Department of Energy estimates of annual market share for all states as reported by retailers participating in the national ENERGY STAR Program, (2) appliance shipment data from AHAM, and (3) a random-digit-dial consumer survey conducted for this study.
- **Methodology:** Multivariate regression modeling of market share for each of the appliance categories for the 2003 program year. The models' parameters were quantified using data for the 2001-2003 program years. The model included demographic variables, several current-program-related

variables that represented the total effect of the program, and a change-in-penetration variable for prior-years program activity that NMR used to represent cumulative (momentum) effects. NMR used ANOVA to pre-determine that this change-in-penetration variable might contribute to the regression models' explanatory power by comparing the rate of change in market penetration for Massachusetts the four appliance categories from 1998 to 2002 to their national averages.[8]

The total program impact was determined by subtracting the output of the "no-program"/"no-momentum" model (without the change-in-penetration variable) from the "with program" model output. To evaluate the momentum-effect contribution to the 2003 impact for each appliance, NMR quantified the change-in-penetration variable with the appliance's national average change in penetration and included it in the model. This reflected the fact that Massachusetts should have seen some increase in penetration even without a program (baseline penetration). It then compared the "no program"/"no momentum" model output to the "with program" and "with-momentum" model output to estimate the penetration increases due both to 2003 contemporaneous program activity and to the momentum effect of prior Massachusetts appliance program activity (Nexus Market Research 2005, Appendix G, Section 6.2. Wilson-Wright 2007)

- **Momentum Findings:** The energy savings due to momentum-effect sales constituted 53% of the estimated total program impact for 2003.
- **How Momentum Findings Were Used:** The Massachusetts sponsors of the appliance initiative used these findings, with other evidence, to reason that their programs were successfully transforming the market for ENERGY STAR clothes washers, room air conditioners, and refrigerators (Wilson-Wright 2007). They revised their programs to offer cash incentives only for higher efficiency (higher than ENERGY STAR) clothes washers.
- **Implications:** This methodology offers a potential regression method for quantifying market-effects momentum and demonstrates the need for baseline market-share data.

Concluding Thoughts

The author's search of the principal on-line evaluation libraries revealed only four evaluations that explicitly considered market-effects momentum. This paper summarizes three of them. Probably others exist or are in the works, but the individuals who were interviewed for this paper suggested that the number is small. Finding a reliable methodology that will be acceptable to regulators is a challenge.

A reliable non-intervention baseline is critical to estimating net program impacts that include momentum effects. Creating such a baseline is difficult. Evaluations with access to energy-efficient end-use sales data in states that have never had programs promoting such sales can use these data to account for the non-intervention baseline sales in net-effects regression modeling. The resulting estimated net sales will represent contemporaneous program and market-effects momentum sales.[9] This approach was used by the reviewed KEMA-XENRGY and NMR evaluations. In the author's opinion it offers the most promise for reliably capturing market-effects momentum in impact evaluations.

The use of non-regression methods, including the preponderance-of-evidence approach, offers more challenges. If an evaluator is forced to rely on rebate redemptions or other measures of participation, it will need to conduct a survey to estimate the non-intervention baseline. This method will inevitably misclassify some of the market-effects momentum as free ridership, and its use to quantify momentum effects will remain suspect.

[8] The Massachusetts ENERGY STAR market-penetration rate of change was significantly higher than the national average for refrigerators, clothes washers and room air conditioners. It was not significantly different for dishwashers; they were ultimately excluded from the analysis.

[9] This will not be the case, however, when the impact variable is a participation variable rather than a program variable.

Each of the evaluations reviewed acknowledged assumptions and weaknesses in their estimation of program momentum effects. The author believes that current regression methodologies are defensible for this purpose, but valid data for estimating a non-intervention baseline do not exist for most energy-efficient end-use products and behaviors. As a result, many jurisdictions will conclude that estimation of momentum is too unreliable and disallow it. This is especially likely to be the judgment for impacts in the commercial and industrial sectors. Until we have better baseline data, many programs will not receive all of the credit they deserve, and some proposed programs that would otherwise be cost effective may not survive the screening process. In order to measure the benefits of market-effects momentum, the energy-efficiency industry badly needs baseline surveys of specific energy-efficient end-use product sales and practices for all sectors.

Acknowledgements

I want to thank Lisa Wilson-Wright of Nexus Market Research, for reviewing the section on the 2004 Massachusetts MPER; Terence Conaty of Lockheed Martin for assistance on the requirements of forward capacity markets; and Bill Steigelmann of Lockheed Martin and Ralph Prahl for their very useful comments on earlier drafts. I am entirely responsible for any errors that remain.

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