Measurable Spillover (Free Drivers): The Search Continues

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DSM practitioners and utility planners will not be making the appropriate investment decisions unless estimates of non-incented program effects are an integral component of DSM planning. The industry accepted term, free drivers, has been superseded by a new term, spillover. While the new term is more descriptive of what is being measured, this new terminology is still not descriptive enough for the DSM industry. Four forms of non-incented program effects, including spillover are defined along with their relationship to market transformation. Tighter bounds on the definition of spillover are proposed, along with a broader view of program participation. The definitions are clarified through a new version of B.C. Hydro's technology tree, and appropriate measurement methodologies are outlined.

Introduction

For many utilities the objective of DSM program investment is to reduce the market barriers which impede the adoption of cost effective energy efficiency technologies by their customers. Market barriers are situations which impede natural conservation proceeding "as it should"; resulting in the utility customers not making rational economic decisions regarding the adoption of energy efficiency technologies. Market barriers which can be addressed by DSM programs are customer awareness of energy efficiency options, customer's technical ability to assess the options, existence of a viable infrastructure of trade allies, vendor or trade ally awareness of the efficiency options and their understanding of the technical issues, local or national product availability, customer transaction costs to assess technologies, and the most important one; the significant difference between the investment discount rates which a customer desires and those which a utility accepts.

This difference in discount rates can be dealt with through utility assistance which reduces the customers' cost for the investment. Utility efforts can be leveraged through incentives, rebates or direct install program approaches. If one defines program participation as receiving an incentive, then efforts to affect the other barriers could be classified as leading to spillover rather than program savings. Many DSM programs are designed to affect more than one barrier, and the current accounting approaches do not adequately reflect this.

The terminology in this area of DSM is growing and evolving. Key terms such as free drivers and free riders have been defined in industry guides (EPRI 1991, Saxonis 1992). Newer terms such as market transformation and spillover have grown in usage and have been recently defined in Prahl & Schlegal 1993, and California Public Utilities Commission 1993. This paper will endeavour to explain the old and new terms and how they relate to one another. The concept of spillover (previously referred to as free drivers), plays an important role in the acceptance of market transformation as a DSM objective. If the industry cannot become comfortable with estimating or measuring spillover it becomes increasingly difficult to take advantage of market transformation activities in DSM programs. Industry interest in spillover, market transformation, and reduced investment in incentives leads to a requirement for a somewhat narrower definition of spillover, and a broader definition of program participants. This paper will attempt to illustrate the need for these definitional adjustments, explain the measurement approaches which are available, and will conclude with the revised definitions.

While free riders have received a lot of attention from the DSM community, spillover, or free drivers, has been almost ignored. Spillover effects involve non-participants who acquired a specific technology or an energy conservation measure (ECM), and who did not receive an incentive, but were influenced by the operation of the utility DSM program. The focus has tended to be a financial one, dependent upon whether the customer who acquired the energy conservation measure (ECM) received a financial inducement from the utility. As DSM programs mature and utilities provide better customer service, many

utilities are making investments which lead to ECMs being installed, with no specific incentives being paid. Audits might be conducted, seminars given, advice relating to energy efficiency from utility marketing representatives accepted or other actions might occur which influence the customer's decision to install the ECM. If these types of actions lead to ECM installations and the utilities are not credited with the savings, the question might arise as to whether it is really in the best interests of the utility to invest in these types of customer service efforts.

Kushler et al. (1992) offered their opinion on the future issues in DSM evaluation "clearer definitions of what is included in "net savings" or "net benefits" will be needed. In particular, the question of how (or whether) to account for the benefits due to market transformation resulting from utility DSM programs needs to be addressed. "(pp. 7. 14). B.C. Hydro has conducted evaluations of market transformation programs, such as the High-Efficiency Motors Program (Nelson & Terries, 1992). This evaluation determined the program influence level through a framework referred to as the technology tree. The technology tree is a decision tree approach which has been used at B.C. Hydro for almost three years to explain the market options, and to help in the measurement of them. This analytical approach has been described at length in Nelson 1993, and the motors study was described in Nelson & Terries 1993. Subsequent evaluations of programs in the industrial sector have necessitated the addition of two new branches on the technology tree, and the relocation of some old ones. The new and improved technology tree is a little more complicated, but is more relevant for current evaluations, for addressing market transformation measurement issues, and for dealing with non-incented DSM activities.

Definitional Issues

DSM evaluation is best described as "an attempt to measure the unmeasurable" (Kushler et al. 1992 pp. 7.2). After installing an energy conservation measure, the gross energy savings can often be determined through end-use metering, and the net energy savings have been thought to be estimable through billing analysis, using a comparison group. Evaluators have learned that the net program effect is necessary to determine the cost-effectiveness of DSM programs. This involves attempting to *create* what the participants would have done in the absence of the program, and determining that hypothetical situation is what makes this field so challenging. With perfect pre- and post -measurements for participants and a comparison group, using a quasi-experimental design, a simulation of what would have happened should be possible. The issue is that the search for the perfect comparison group is generally unsuccessful. As DSM programs become more mature, or as a utility offers the programs to all of its customers, who is in the non-participant group?

The participant group can also be questioned (Train 1993). The traditional definition of participants may not be appropriate, and may lead to understating some of the program's achievements. The issues of the appropriateness of the comparison group and the participant group are definitely inter-related.

This paper attempts to remove some of the mystery surrounding the sometimes perplexing concept of free riders and provide definitions and measurement approaches for spillover, and other non-incented savings. A free rider is a DSM program participant who acquired the technology and/or received an incentive, but who would have adopted the basic technology in the absence of the program. Within the spectrum of free ridership there are a variety of levels including: (1) those who were persuaded to acquire the technology earlier than they otherwise would have (deferred free riders); (2) those who were encouraged to move up to a higher efficiency category through the incentive (incremental free riders); (3) and the "pure" free riders - those who would have purchased the same item without the program (Saxonis 1992).

Free drivers, or what is now called spillover, has not received the same level of attention as free riders. "The opposite of a free rider is a free driver. A free driver contributes to the goals of the program (e.g., reduce energy consumption) but is not formally a program participant. A free driver is affected by the program either through a conscious awareness of the program or because of program-related changes in the marketplace." (Saxonis 1992, pp. 132) In a decision of the California Public Utilities Commission (93-05-063) a collaborative definition of spillover was detailed as: "Reductions in energy consumption and/or demand in a utility's service area caused by the presence of the DSM program, beyond program-related gross savings of participants. These effects could result from: (a) additional energy efficiency actions that program participants take outside the program as a result of having participated; (b) changes in the array of energy-using equipment that manufacturers, dealers, and contractors offer all customers as a result of program availability: and (c) changes in the energy use of non-participants as a result of utility programs, whether direct (e.g., utility program advertising) or indirect (e.g., stocking practices such as (b) above, or changes in consumer buying habits)." (pp. A-8 CPUC 1993). This spillover definition covers almost everything which had been considered as free drivers. The loose definition of free drivers, and the difficulty with the determination of whether a person was influenced by the program has made measurement in this area hard to defend - an issue complicated even further by the difficulty in locating these

customers. And now, with an expanding emphasis on customer service, other non-incented benefits of the DSM programs are being realized.

In addition to free riders, program participants, and program spillover, another group of interest to evaluators is referred to as "on-going adopters". A member of this group is a non-participant who acquired the technology and did not receive an incentive, but would have adopted the technology in the absence of the program, thus being a component of what one could call natural change.

With DSM being meant to forestall or postpone the acquisition of new generation capacity, through the reduction of the market barriers, it is very important for evaluators to understand natural change, free riders, and spillover to determine how the world after the program is different from what the world would have been like without the program. To justify the launch of DSM programs and to evaluate their impact, estimates must be made of the expected penetration of the technology in question, by year, into the marketplace. Prior to the launch of a program the plans would detail what the expected natural adoption rate would be for the technology if there was no program. That natural adoption rate becomes free riders and on-going adopters when the program operates. The utility needs to understand how the program has changed its customers' energy requirements in comparison to the base load forecast in order to cleanly add DSM into the integrated resource plan, as well as to conduct proper cost effectiveness assessments.

There comes a time, however, when it cannot be ascertained if the traditional comparison groups are representative, and whether the proxy for free riders that the "natural" change in the comparison group can provide is really a measure of free riders, a measure of free drivers, or a measure of many other factors (Saxonis 1992). If the selected comparison group for a billing analysis contains program spillover which would reduce that group's energy consumption, there is room for significant understatement of the program impact. This is one effect of spillover; i.e. the effects of the DSM program contaminating the selected comparison group, and resulting in the subtraction of an effect (through the assumption that it was indicative of free riders) which should actually have been added (because it was from program spillover). This issue was likely a reason for the acceptance of the term spillover as being a better descriptor than free drivers.

The DSM Technology Tree

The resolution of these challenges is not easy, but a "market-based" approach to this area has helped in defining the issues. In the B. C. Hydro - Power Smart programs attempts are made to forecast both free riders and spillover. The task of explaining these terms to program staff (and to ourselves) has been quite challenging. Long before the terms "market transformation" and "spillover" came into common usage, a tool was developed to explain the market options, and to help to plan the measurement of them. This tool is the "technology tree". The original perspective on the tree, the "financial" approach, is illustrated in Figure 1. This approach was adequate to explain the shortfalls of the usual billing analysis, but as the need arose to better define and measure spillover and other non-incented program effects, an attribution approach, more applicable to non-incentive programs and a market transformation perspective, was developed. In this paper both technology tree perspectives,

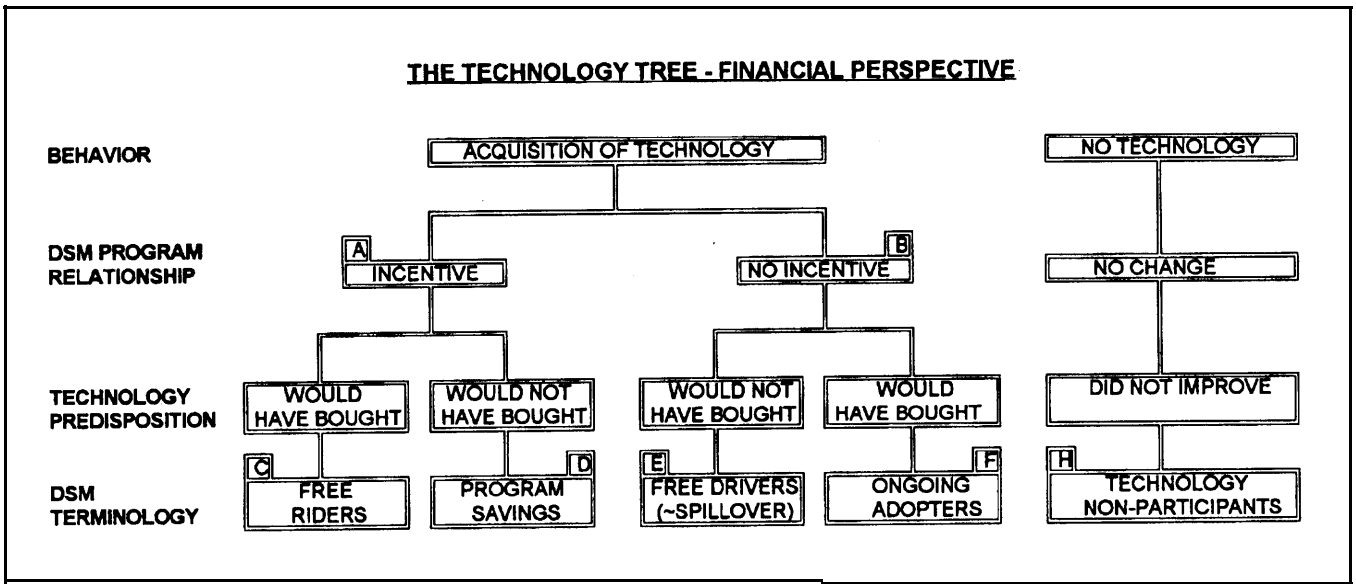


Figure 1. The Original Technology Tree

financial and attribution, will be described, with an additional figure explaining many of the sources and categories of non-incented savings.

The technology tree defines potential paths for the utility's customers, enabling each to declassified as a free rider, a program participant (incensed savings), a free driver (now spillover), an ongoing adopter, or anon-participant. Each of these five categories of customers have a different propensity for measurement, but all can be estimated in a macro sense. At the time of a study, either a customer has adopted a specific technology or they have not. If the customer has adopted the technology the utility will want to understand why. Was this behavior related to the DSM program, and if so, how was it related? Figure 1 shows the five possible paths the customer could have followed; and how one would classify the customer in DSM terms. First the technology adoption is reviewed, then the financial relationship to the program is assessed, and finally the propensity to adopt the technology in lieu of the program is estimated, leading to the classification of customers into the five groups. One cannot distinguish individual customers affected by spillover from individual on-going adopters, but with an estimate of natural conservation through the relevant period (the technology adoption rate), one can estimate the number of customers in each group.

The technology tree approach provides a structure for program forecasts, evaluation plans and the reporting of results. The basic requirement for using the technology tree is the estimation of an adoption curve for the technology or ECM under study. This adoption curve is equivalent to the status quo, or what would have happened in the marketplace over the relevant years in the absence of the program. If one can also determine the annual penetration rate of the technology over the program period, then integration of this information with program records and the status quo estimate enables measurement of free riders, spillover, and ongoing adopters, as has been shown in a high-efficiency motors evaluation (Nelson and Terries 1993). If the ongoing penetration level of the technology is not available through industry sales data, then it is possible to estimate free riders, but spillover would require a different approach.

The initial information requirements involve nothing more than would be required by program planning prior to launch. A DSM program presumably would not be launched today without a solid measure of the relevant technology's acceptance in the marketplace and its expected future, and a forecast of what the program was attempting to accomplish in the marketplace. Program design staff need to understand the baseline or status quo, and show how their program approach will alter this baseline to the benefit of consumers and the utility. These are the inputs to the technology tree described in Figure 1.

Recent work in the area of spillover, growing out of the evaluation of industrial and commercial programs at B.C. Hydro, has led to further definition of the forms of non-incented program effects. If a utility has the objective of transforming a market, to fit any definition of market transformation the incentives must eventually stop. Therefore, the evaluators must find a means by which the quantification of non-incented program effects, including spillover, can be understood and accepted.

Spillover and Market Transformation

Spillover, defined earlier in this paper, is a rather broad concept encompassing an array of program effects including market transformation. "Market transformation occurs when utility DSM programs induce a lasting, beneficial change in the behavior of some actors within a market system." (Prahl & Schlegel 1993, pp. 470). Beneficial in this definition is to mean "conducive to energy efficiency" (Prahl, Nelson & Peach 1993, pp. 6). The concept of market transformation is dependent on the effects lasting, and their ability to continue *without* ongoing utility support. Market transformation can come through standards/legislation/code changes, through industry development of new products such as the Golden Carrot project (which furthered the development of energy efficiency in refrigerators), and through lasting change in the behavior of either the manufacturers, the distributors, or the customers which leads to the energy efficient options being selected in the future.

How does market transformation differ from spillover? Figure 2 shows that market transformation can result from legislation *or* program spillover. If the effects on the marketplace last beyond the program life, then they are regarded as market transformation effects (if they are significantly different from what one had anticipated as the market's adoption rate for the particular technology). Program effects resulting from non-participants changing behavior related to the purchase of energy efficient products as a result of: shelf space changes, increased retailer selling experience, regional inventory shifts, increased product awareness and trade ally competition—which is concurrent with the program—is referred to as spillover. For these terms, time is the determinant-if it is a lasting benefit - then it is market transformation. If the benefits from non-participants are not expected to last beyond the program, then they are spillover, and not market transformation.

The credibility issue for spillover and market transformation is the first concern. For utility staff and regulators to understand why and how these effects can occur, spillover and other non-incented program effects must be properly defined and described. In Figure 2, two categories and four types of non-incented program effects are identified.

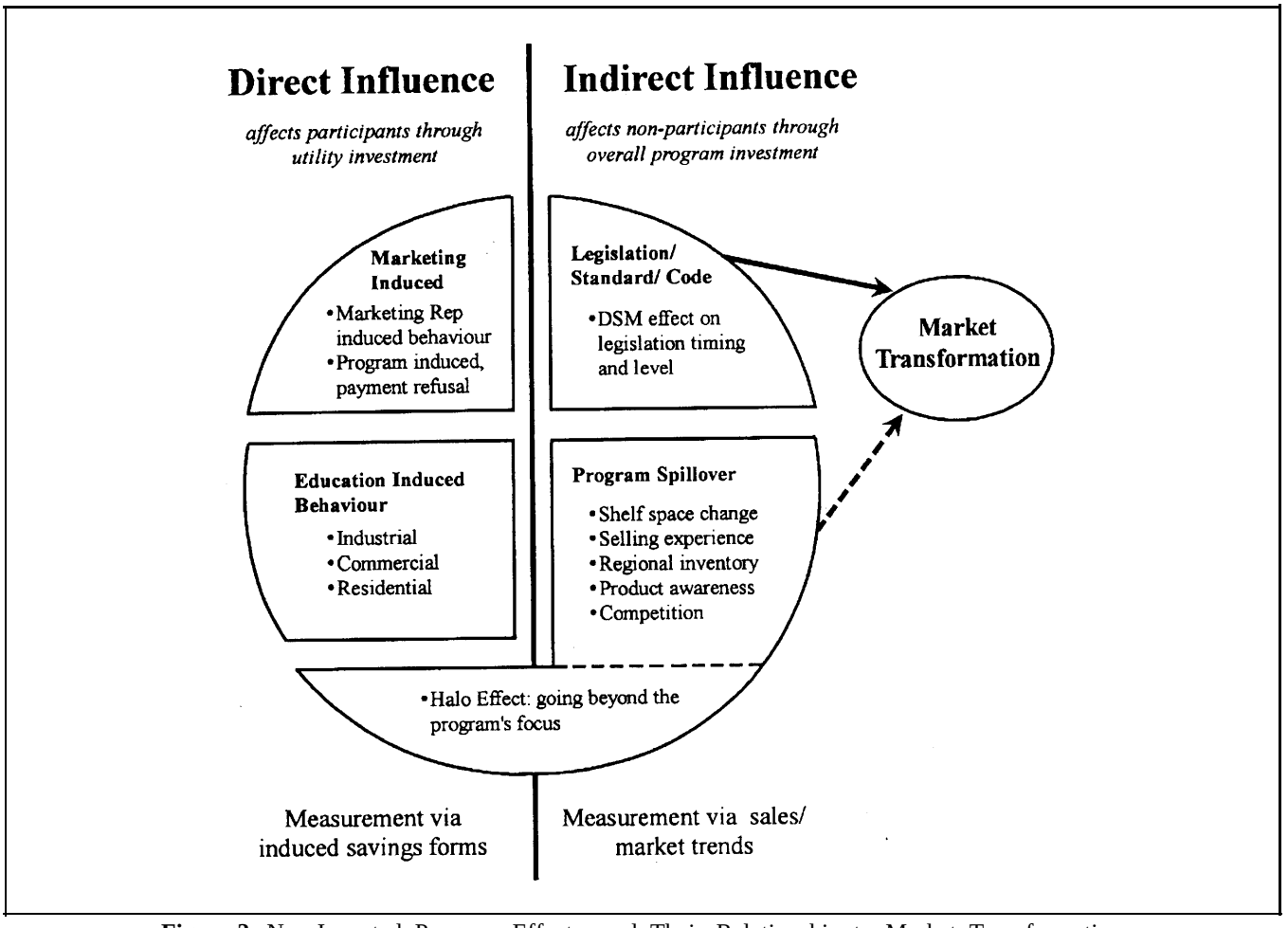


Figure 2. Non-Incented Program Effects; and Their Relationship to Market Transformation

The two categories, direct and indirect influence, are based on the availability of different *measurement?* approaches. The measurement drives the categorization, not the program objectives or direction. As an example, a program designed to cause market transformation without legislation, would categorize its savings as spillover, even though it was a direct objective of the program.

Direct Influence Non-Incented Savings

There are three types of "direct influence" savings. The first is through the traditional utility leveraging with rebates, incentives, or direct install efforts. The other two types involve customers influenced by the program or those influenced by utility DSM education. Marketing induced behavior can result from the installation of ECMs at the recommendation of utility marketing representatives or contractors, for which no incentives were claimed (Brian Gard William Lesh Inc. 1986; Nelson & Terries 1993). Incentives may have not been claimed due to a variety of reasons including; payback was too short to qualify, company would not accept subsidies, or company transaction costs for the claim were perceived to be too high to be worth the trouble. Some customers could have installed ECMs but had payment refused by the utility due to a late application, or some other lack of compliance. In all of the above cases the utility representatives directly influenced the decision to install the ECM and the utility DSM initiative should be credited with energy and/or demand savings. These customers are program participants, and the utility made a direct investment of resources in these specific customers.

The second type of direct influence non-incented savings comes from specific utility DSM educational programs. Industrial programs often have seminars to promote proper pumping systems design and operation, but if the changes that the participants made after the seminar had a short payback, the utility would not have provided a cash incentive. Commercial training on building commissioning may have led to a number of behavioral and mechanical changes for the customers which would not result in entries in utility records. Education in the residential area could take the form of building audits which might not lead to full retrofits, but the customers may have selectively used the information from the audit to do some

work themselves. Again, specific customers have had direct investment of utility resources.

Measurement will be a challenge, but is possible if the utility is outward looking. Many utilities have customer representatives calling on their customers, looking after the customers' needs and promoting the DSM programs. When training seminars or audits have been conducted, it should be expected that the utility would conduct customer surveys to enquire as to how they perceived the service, and to see if they have made any changes as a result of their contact with the utility. If a commercial or industrial customer said they made significant changes, a marketing representative could obtain details on a subsequent customer site visit. When these representatives determine that ECMs have been installed which they or a utility seminar originally promoted, details can be recorded on what B.C. Hydro refers to as induced savings forms. Information which clarifies the savings level and attributes the cause of the changes to the utility efforts are recorded on this form. The savings are reported by the program as induced savings, and this customer is viewed as a program participant. At the point in time where a formal impact evaluation is carried out, the direct program savings are of two types, leveraged (with incentives) and induced (through marketing/education). The evaluation assesses each type separately so the findings can be extrapolated to the appropriate part of the program.

Indirect Influence Non-Incented Savings

There are two categories of indirect influence non-incented savings; legislation/standards and program spillover. Legislation ultimately results in the installation of ECMs which exceed specified minimum levels of efficiency. If a utility or a group of utilities demonstrably altered the timing of efficiency legislation or *increased* the level of efficiency which was mandated, then they should claim credit for the time and/or level affected. If legislation was not an original objective of the program, those savings would be classified as spillover.

Program spillover can take many forms. For example, if a short retail promotion was run for compact fluorescent bulbs, retailers would likely change their shelf space to accommodate these "new" products. Once the promotion ends, many stores would continue the shelf space arrangement to see if the product would be sold on its own merits. The sales staff would also have a different approach to the product, as they would now be aware of compact fluorescent bulbs and fixtures, and they would have had success in selling the products. After a promotion they should have a higher probability to sell the product than if the promotion had not been held.

Experience has shown that in products where the inventory cost is relatively low and the turnover is high, such as efficient water heaters, the distribution channels can shift their inventories back to the original product quickly. For products which do not turn over quickly or have high inventory costs, such as high-efficiency motors, the termination of the incentive phase of the DSM program may not result in the return of inefficient products due to the cost of shifting inventories. In some types of products, when regional inventory and sales approaches have been influenced enough, even without legislation, one can say the market has been transformed.

Utility promotions of DSM programs often affect customer awareness of efficient products. Although the customer may not have the need to or the opportunity to replace the ECM during the promotional period they may still acquire the efficient technology in the future as a result of heightened awareness of their options. Another type of program spillover shown on Figure 2 is competition. One example of competition being noted as a cause of spillover is when a utility noticed that only a few builders were constructing new homes to their standards and claiming incentives from a new home program; while other builders built very close to the standards, avoided the perceived hassle of certification and complete compliance, and informed their customers that the homes are equivalent (Violette, Ozog, and Wear 1991).

The last form of spillover involves the propensity of some customers to follow the successful installation of utility supported measures with other efficiency measure installations, and is sometimes referred to as the halo effect. If these customers were ones who had been directly contacted by the utility on the original program, then reports of these additional behaviors could be recorded on the induced savings forms. If, on the other hand, these customers were impacted indirectly by the utility program, then these savings might only be accounted for through market assessment.

Measurement of the indirect influence non-incented savings is somewhat more complex than standard utility DSM tracking. Knowledge must be obtained in the program planning process concerning the current state of customer acceptance of the ECM and an estimate made of the adoption curve for the technology or behavior. Program planners will then have to forecast the effect they expect their program to have on the marketplace. The challenge for evaluation is to find a means by which to estimate the level of change which has occurred in the marketplace, and ascribe energy savings levels to it. Rather than looking at traditional participant and non-participant groups' billing histories on a computer screen,

the DSM staff will be looking outward at their customers and the marketplace to measure and gauge the DSM program's real impact.

As evaluators look at the variety of forms and origins of non-incented program savings, it will become clear that this is not as nebulous an area as the original term "free drivers" implied. In fact some utilities set as their prime objective the achievement of savings that one might classify as "induced" or spillover. The discussions above on the categories of savings will hopefully clarify the issues in this area, and illustrate that much of what might have been called spillover has really been a result of direct utility efforts, which could actually be quantified on a customer by customer basis. This requires a broadening of the definition of program participation to include customers who were directly influenced by the utility program, both through leveraged and induced effects. Other effects, such as legislation and program spillover require market based assessments using original program market data and follow up research. These assessments are used to determine the change in technology adoption and how this differs from the original adoption curve (natural conservation) forecast. These program effects can often be quite significant in comparison to the leveraged savings achieved through direct install or rebates.

Changes to the Technology Tree

The original technology tree had a financial perspective. With a more complete understanding of the sources and types of non-incented savings, the financial approach is clearly inadequate. An attribution approach is required. Terms on the tree have been changed, and the changes are indicated by shading in Figure 3. The term "incentive" has been changed to "investment" to reflect the changing focus of some DSM programs adding customer information services in parallel with the incentives. Instead of "no incentive" the chart now reads "no contact", illustrating that for these customers, no specific customer contact or investment was made by the utility. "Program savings" now reads "leveraged savings", covering direct installs, rebates and incentives. Under the financial perspective the direct influence (induced) savings would have come under the term spillover. This paper has attempted to show why direct influence savings should be viewed as normal energy savings achieved through participants, rather than being classified as spillover or free drivers. And lastly, the term free drivers (spillover) has been replaced with more specific terminology, legislation and spillover, both of which may lead to market transformation.

The attribution perspective is designed to clarify the point that the utility should focus on savings which have been *directly* influenced, whether they were financially leveraged through incentives, or were a result of other ongoing utility investments in the DSM area. The term spillover (or free drivers) should *only* refer to the area of non-incented savings which is categorized as indirect influence. The program evaluation would then look at two clusters of savings documents, the rebate/incentive records, and the induced savings forms covering the non-incented savings. The savings which cannot be documented on a customer specific basis would still be referred to as spillover, and would require market transformation approaches to assess. And in reality, if the direct influence savings could not be documented they would still show up as spillover through market studies, but would likely carry a inherent higher level of uncertainty.

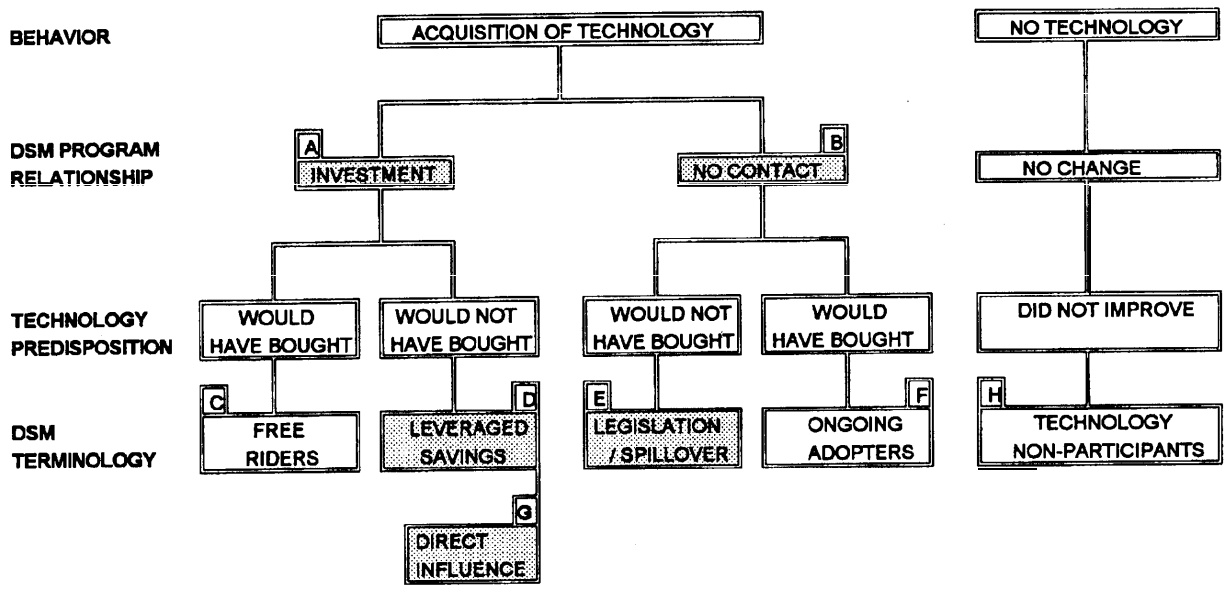
Summary

This paper has attempted to firm up the definitions of spillover, market transformation, free riders and a variety of additional terms which are required to clarify this evolving area of investigation. Utilities should estimate non-incented savings whenever they occur, or the load forecast feeding the integrated resource plans will be overstating the future system requirements.

The methods for tracking and estimating the non-incented savings are not mysterious, and can be in some cases be almost as easy to explain as the claiming of incented savings. The difficulties for utilities dealing with some regulatory commissions comes in the acceptance of the methods used and evaluation results in determining what incentives should be received. In this way it is certainly not as simple as traditional evaluation procedures.

The market based studies, while they might look like a new level of complexity for the evaluation area, are really only natural follow ups to the investigation any program design group needs to conduct before launching a program. Prior to investing significant resources in DSM programs, utilities must conduct substantial market research to establish forecasts of where natural conservation or technology trends are going, or the DSM investment may not be justified. Evaluation of non-incented savings through market based studies is simply a follow up on the earlier research, to determine what effects were actually accomplished.

Discussions regarding the difference between rebate and program savings can be better addressed through the framework outlined in this paper. Understanding non-incented savings and the related concepts is the key to justifying, operating, and evaluating both market transformation and resource acquisition programs. As the resource acquisition programs mature and grow, they will have spillover and potentially achieve some level of market transformation, and will need to be measured



Branch Definitions:

A. Specific customers where the utility has made a financial or time investment: can be measured by rebate forms, or induced savings forms.

B. Customers who acquired the technology but who received no direct utility influence: can be measured by broad based market surveys.

C. Customers who would have bought the technology without an incentive in a relevant timespan, given program duration and savings life, but who received a utility incentive: can be measured by market survey, and if possible it is best to determine from adoption rate information. Equal to or less than the adoption rate (natural conservation).

D. Customers who were influenced by the program, and received a utility incentive: measured from program records.

E. Customers who acquired the technology without an incentive, but as a result of program influence, via legislation or program spillover effects: can be measured through broad market surveys. These customers were indirectly influenced by the program, and there is a potential for market transformation.

F. Customers who would have acquired the technology without the program, and who did not receive an incentive: can be measured by broad market surveys.

G. Direct influence savings are gained through marketing representative or contactor specific education programs: measurement can be by marketing representatives on induced savings forms.

H. Customers who did not upgrade their technology [the sum of all customers in the applicable class minus those those who acquired the technology of concern]: can be determined with broad market surveys.

Some Useful Equations:

C + F = "Natural Conservation" or the forecasted technology adoption level in lieu of a program.
D+G+E-C = Total program savings .
C + D = Total rebate activity.
D + G = Direct influence in the broader sense.

Figure 5. The Current Technology Tree

through more than the tabulation of the rebates paid and their associated energy claims. Utilities invest a great deal of resources in both DSM programs and load forecasts. If non-incented savings are not measured and claimed for the DSM programs, the investments will not be based on the appropriate information, and utilities will not be operating least cost integrated resource plans.

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