Optimal LED Incentive Levels: Lessons Learned

Joey Barr, David Bend, Winsey Kan, and Julie Colvin, Pacific Gas and Electric

ABSTRACT

LED lighting has great potential to improve the energy efficiency of commercial and residential buildings throughout the United States. According to the DOE Energy Savings Potential of Solid State Lighting report, almost 190 TWh can be saved annually by 2030 once LEDs have fully penetrated available sockets (DOE 2003, 35). However, the 2010 DOE Market Characterization Study estimates that LEDs currently represent less than 1% of the 8.2 billion lamps installed in the U.S. building sector (DOE 2010, 22).

Utilities can play an instrumental role in this transition through support including, but not limited to, marketing, education, and incentives/rebates (throughout this presentation the terms incentives and rebates are used interchangeably). However, as utilities prepare to support LED technology in their efficiency programs, there is a great deal of uncertainty about what incentive levels make sense to deliver cost effective energy savings for specific lighting products.

Over the past year Pacific Gas and Electric Company (PG&E) has participated in pricing tests with leading LED manufacturers and retailers to determine the price elasticity of consumer demand across a range of LED bulb and fixture types (e.g. PAR30, PAR38, MR16, and Recessed Downlights). Additional pricing tests are being considered for other form factors (omnidirectional LEDs).

The development, results, and lessons learned from these pricing tests are discussed so utilities and efficiency programs from around the country can better design and deploy their support for LED technology. Furthermore, PG&E's efforts to educate consumers about the new assortment of efficient lighting through compelling marketing collateral will be discussed.

Utility Support for Energy Efficient Products

Utility rebates for energy efficient products help drive sales that increase market penetration, thereby improving the performance of the nation's building stock. If fact, over the past decade, despite increased light bulbs per home, residential lighting electricity use has decreased by over 15% (DOE 2010, 68),[1] which is at least partially attributable to market transformation efforts by the nation's utilities and other efficiency organizations.

Lighting products continue to deliver a significant portion of utilities' efficiency portfolios. For example, in 2011, residential lighting rebates comprised more than 30% of PG&E's energy efficiency portfolio. Up to, and including, 2010, PG&E did not provide financial support for LED products in the Residential Lighting Program beyond holiday lights and night lights. Beginning in 2011, the Lighting Products team at PG&E has been focused on introducing cost effective LED products into the residential portfolio.

[1] This is in part due to higher efficacies per lamp and increased migration to higher efficacy light sources.

Although bare spiral CFLs still offer the most cost effective energy savings, there are a number of reasons to introduce LEDs into the Residential Lighting Program. First, PG&E would like to help influence the market for energy efficient lighting and in many applications (though certainly not all) LEDs are the most efficacious option with the highest quality of light. Second, there are tremendous energy savings opportunities (up to 80%) with LEDs compared to incandescent lights, specifically directional applications where fluorescent technology has had limited success. Third, there is wide variation in LED quality, and PG&E, along with other efficiency programs, can play an important role in promoting products that will ensure customers have a positive experience with their first LEDs. Fourth, ENERGY STAR qualified bulbs have a minimum lifetime of 25,000 hours for non-decorative LEDs compared to only 6,000 hours for CFLs, indicating that the energy savings achieved with LEDs will last much longer than with CFLs.

However, one of the biggest barriers to the market adoption of LEDs is their high incremental costs. Consumers are reluctant to spend the upfront costs for LEDs even if they do understand the energy savings benefits. One of the primary methods utilities employ to influence market transformation is to offer rebates for efficient lighting options. However, before introducing LEDs into the Residential Lighting Program, PG&E wanted to test several incentive levels for products of interest to gauge lamp price elasticity which would enable PG&E to set an optimal incentive level.

Market Incentive Test

In the summer and early fall of 2011, PG&E initiated a market incentive test for LED PAR and MR replacement lamps. The test assessed products in two different retailers: a mass market discount retailer and a large home improvement retailer. The retailers were chosen because they provided a significant sampling of stores across the PG&E territory. Overall, the rebates provided ranged from $2-$15 and triggered sales increases ranging between 175%-560%. Because of confidentiality agreements with the retailers, PG&E is unable to share exact sales data. However, the retailers and manufacturers that participated in the test were pleased with the results and acknowledged the powerful influence the rebates had on sales levels.

Mass Market Test - Mass Market Discount Retailer

In the mass market discount chain, PG&E provided rebates for LED PAR38 replacement lamps. The original retail price for these lamps was $39.99 (as of July 2011). The test started in July and ran for three 4 week periods until October, in dozens of stores across PG&E's service territory. PG&E chose four week periods in order to smooth findings that might be affected by an anomaly week (e.g. particularly high or low sales because of factors outside the market test like a long holiday weekend).

Table 1. Rebate Amounts in Large Discount Store Market Test

	Phase 1	Phase 2	Phase 3
Rebate Amount	$15	$10	$5

The test was designed to provide rebates in descending order, rather than randomly or in ascending order, to mitigate any customer satisfaction issues if a customer bought a replacement lamp one week only to find that the price had dropped in the next phase of the test. We used this same rebate strategy for all the market incentive tests.

Analysis

Using weekly sales data, PG&E was able to compare the sales lift driven by each rebate level to baseline sales data. The baseline was comprised of sales data collected the month before the incentive test from the same set of stores. Anomalies and stocking issues were removed from the analysis (detailed later), and the results are in the table below.

Table 2. Sales Increases in Large Discount Store Market Test

Period	Baseline	Phase 1	Phase 2	Phase 3
Retail Price	$39.99	$24.99	$29.99	$34.99
Rebate	$0	$15	$10	$5
Sales Uplift	**0%**	**557%**	**447%**	**177%**

Note: The uplift percentages in Phases 1 and 2 are extrapolations based on trend. The anomalies and stocking issues affecting the actual sales numbers are detailed below.

One of the key takeaways is that market uplift occurs with relatively small rebate amounts relative to retail prices. For example, the $5 rebate resulted in a 12.5% percent price discount, but yielded a nearly 200% increase in sales. The primary takeaway, from a program planning perspective, is that although the highest rebate amount ($15) resulted in the largest sales increase, the middle rebate amount ($10) had only a slightly lower sales increase. Thus, with constrained budgets, the middle rebate level will drive almost as many sales, but for 66% of the cost. In fact, the manufacturer that participated in this test with PG&E also supports the strategy to maintain a rebate of $10 or less for these products, so as not to significantly decrease consumers' perceived value of the product. It is important not to create an impression of lower value to consumers, so utilities need to monitor the manufacturing price floor for LED lamps and ensure their incentives do not push beneath those values.

Results: Challenges and Issues

There were several challenges with the discount chain market test. In the second week of the test, because the rebate influence exceeded expectations, stores ran out of inventory, and the final sales tally was artificially low (or so we presume). Thus, when planning programs, utilities should have detailed conversations with manufacturers about their stocking and shipment plans to ensure that stock-outs do not occur. An additional issue was that Phase 1 was only three weeks instead of four weeks. Thus the comparison is not truly "apples to apples". Another challenge occurred when there was a drop in sales in the first week of the second phase of the test. The manufacturer theorizes that the discount store's everyday repeat shoppers may have been waiting for the incentive to increase again, leading to a decrease in sales for that week. However, after a week of the incentive holding at $10, these customers resumed their normal purchasing behavior (i.e. sales did increase in the next three weeks).

Interestingly, this same phenomenon did not occur when the rebate dropped from $10 to $5 in Phase 3. A final challenge with this market test involved accounting for seasonality factors. In future tests, PG&E would mitigate this issue by using comparison data from similar non-participating stores or by comparing sales of incentivized and non-incentivized products within the same retailer.

Large Home Improvement Retailer Test

The large home improvement retailer incentive test differed from the discount store test because three different products, LED MR16, PAR30, and PAR38 were tested as opposed to the single product (PAR38) tested in the large discount store trial. The test included over 70 stores in PG&E's service territory and lasted for three months, starting in late August.

Table 3. Rebate Amounts in Large Home Improvement Retailer Market Test

Product	Rebate Amount		
	Phase 1	Phase 2	Phase 3
MR16	$10	$5	$2
PAR30	$15	$10	$5
PAR38	$15	$10	$5

Analysis

Sales results from the month preceding the test were used as a baseline to compare data. Using this baseline, the percentage sales increases for each of the specific products are found in Tables 4, 5, and 6. The results from the MR16 test (Table 4) demonstrate that the $7 rebate, with a corresponding price of $12.97, yielded the same sales uplift as a $10 rebate. This reinforces that sales do not necessarily have a linear relationship with utility incentive level.

During the test for PAR30 and PAR38 lamps (results in Tables 5 and 6) the retailer lowered the prices of the products, which was not a planned condition. Thus, during Phase 2 there were actually two different retail prices for customers. Although unplanned, this alteration provided a natural experiment for the impact of price versus the impact of utility incentive level. PG&E learned that when a product has the same price but a different rebate amount (Phases 2 and 3) the higher rebate amount still drives increased sales (244% vs. 215% and 329% vs. 194%). The second lesson is that when the rebate amount is the same (Phases 2 and 2a) the lower final price was a strong indicator for increased sales (315% vs. 244% and 518% vs. 329%).

Thus, the PAR30 and PAR38 tests provide mixed results on whether it is more important to consumers to feel like they are getting a substantial discount or the actual final sales price. Future incentive tests should be designed to better gauge the impact of these varying effects.

Table 4. Sales Increases – Large Home Improvement Retailer – MR16

Period	Baseline	Phase 1	Phase 2	Phase 2a	Phase 3
Retail Price	$19.97	$9.97	$12.97	$14.97	$17.97
Rebate	$0	$10	$7	$5	$2
Sales Uplift	**0%**	**416%**	**416%**	**331%**	**176%**

Note: For a few weeks during Phase 2 the retailer provided a $7 rebate instead of $5.

Table 5. Sales Increases – Large Home Improvement Retailer – PAR30

Period	Baseline	Phase 1	Phase 2	Phase 2a	Phase 3
Retail Price	$39.97	$24.97	$29.97	$24.97	$29.97
Rebate	$0	$15	$10	$10	$5
Sales Uplift	**0%**	**328%**	**244%**	**315%**	**215%**

Note: In Phase 2 the retailer changed the price of the PAR lamps in a separate move from the market incentive test. Thus for the first 3 weeks of Phase 2 the final discounted price is the same as in Phase 3.

Table 6. Sales Increases – Large Home Improvement Retailer – PAR38

Period	Baseline	Phase 1	Phase 2	Phase 2a	Phase 3
Retail Price	$44.97	$29.97	$34.97	$24.97	$34.97
Rebate	$0	$15	$10	$10	$5
Sales Uplift	**0%**	**462%**	**329%**	**518%**	**194%**

Note: In Phase 2 the retailer changed the price of the PAR lamps in a separate move from the market incentive test. Thus for the first 3 weeks of Phase 2 the final discounted price is the same as in Phase 3.

Results: Challenges and Issues

Pricing and signage were the main challenges during the large home improvement test. Due to communication errors between the manufacturer and retailer, for two phases of the test (Phase 2 of MR16 and Phase 3 of PAR38), some of the products received different rebates than initially contracted. Although this added to the complexity of the analysis, it provided some interesting lessons. As shown in Tables 5 and 6, in the instances where the final discounted price was the same but the rebate level (or perceived discount) changed, the higher rebate amount still caused an increase in sales, although there is a range in the magnitude of that effect.

The team also learned about the importance (and challenges) of effective signage. Updated rebate signs had to be refreshed before each new test phase, which presented logistical challenges for retailers and manufacturers, resulting in a lag of a few days before every store had the same updated signage. Additionally, one of the key lessons is that rebate stickers/signs need to clearly indicate that the price at the register already includes the discounted price. Although the stickers created for the market incentive test indicated a rebate (and the price tag showed the initial retail price as well as the post-rebate price), there were a few customers and sales staff that did not understand how to obtain the rebate, resulting in one customer tearing off the signage and presenting it to a cashier for the rebate.

Example of Sign used in Large Home Improvement Retailer Test

Mass Market Test for Recessed Fixtures

Subsequent to the market incentive tests for PAR and MR lamps, PG&E initiated a market test for LED recessed retrofit downlight fixtures in a large home improvement retailer. The test is still in progress and the results are anticipated before August.

The experience from the first tests helped influence the planning and implementation of this most recent test. For example, in the recent test, the marketing stickers indicate a rebate, but do not specify the exact amount. Thus, PG&E can use the same stickers throughout the test (mitigating the need to replace signs every four weeks) resulting in less consumer confusion if there is a mismatch between advertised rebate and actual deduction at the cash register.

Also, this test involves two different manufacturers, but in the same retail location- a large home improvement retailer. This will enable PG&E to have a more direct comparison to see if there are additional factors which influence sales (i.e. location within the store, end caps and other promotions, perceived attributes of manufacturer's products, etc.). Lastly, in this test PG&E utilized a Three Party Agreement, including both the manufacturer and the retailer. This agreement was used to ensure that proper signage can be installed in the retail locations and that sales data can readily be obtained from either the retailer or the manufacturer.

Lessons Learned

PG&E learned a number of lessons from these market incentive tests, and will use these experiences to help guide future tests and implementation in the Residential Lighting Program.

Lesson 1: The market incentive test demonstrated that demand improves significantly for energy efficient lighting, in this case LEDs, with financial support from utilities in the form of rebates and marketing materials.

Lesson 2: Although the largest rebate caused the highest sales increase, there were diminishing returns per dollar spent, thus programs should carefully consider incentive levels. Across the board, the middle rebate level in these specific market tests triggered similar sales increases as the highest rebate level. However, this effect was driven by the Manufacturers

Suggested Retail Price of the product as well as the rebate levels chosen by PG&E's product managers—the same will not necessarily hold true for all products.

Lesson 3: If two of the exact same products (i.e. same make, model, and manufacturer) have the same rebate, the one with the lower final price will have higher sales levels. This comparison does not necessarily apply for differing products because there might be divergent perceived brand value or quality. However, it reinforces the point that final sales price is an important factor for influencing purchasing behavior.

Lesson 4: Rebates and price levels were the most important drivers of increased sales, but appropriate marketing and signage are also imperative in an effective test or program launch. Signage must be simple, easy to understand, and located in close proximity to the product. Additionally, because there is so much consumer confusion with available products, marketing materials should also help educate consumers on appropriate options. However, because PG&E was trying to isolate the pricing variable, the team did not employ extensive marketing strategies throughout the test.

Lesson 5: The actual rebate amount is one of the primary elements in a purchase decision. However, the perceived discount (i.e. the consumer thinks they are getting a great deal) also increased sales of the test products, though the magnitude of this effect is still unclear because of mixed results. More research is necessary to conclusively answer which factor, actual rebate or perceived discount, is more effective in driving sales.

Lesson 6: In many cases consumers and retail sales staff do not understand or appreciate the benefits of energy efficient lighting. Thus, it is important to educate both groups on the costs and benefits of different lighting products and options.

Lesson 7: It is important to check that the contracted rebate amount matches the actual discount. Although this seems self-evident, it is not always the case.

Lesson 8: Retail store associates do not always know that a market incentive test or a rebate program is in place. Thus, staff needs to be trained on the existence of the test or program and understand how the rebate process works (instant discount at the register).

Lesson 9: Utility rebates and/or signage, for LEDs at current price levels, will surely increase sales. Thus, it is imperative to augment inventory accordingly so as not to run out of stock (particularly in a short-lived market incentive test).

Lesson 10: It is important to review the sales data on a weekly basis to ensure that there are no anomalies and that whoever is providing the information (manufacturer or retailer) understands what data needs to be provided. This will also aid in timely payment of invoices to vendors.

Lesson 11: It is important to use a baseline from more than just one week (preferably a month or more) to smooth out any anomalies.

Lesson 12: There should be a limit to an individual's purchase of a particular product. Because the rebates are so enticing, there is an incentive for an individual to purchase more than their specific needs (and possibly sell the others). In our market incentive tests, PG&E capped a purchase at 10 units.

Summary

The multiple market tests provided invaluable information regarding appropriate rebate amounts, necessary signage, and the collection of sales data for analysis. Particularly

for expensive products, like LEDs, utility rebates can be a key factor in transforming the market. These market tests have provided PG&E with greater confidence about what the most impactful rebate amount is for a variety of products as it begins including LEDs at scale into its Residential Lighting Program.

Although the specific rebate amounts and final retail prices are only applicable to lighting products within the PG&E territory, the lessons learned from these tests are pertinent to other market tests and general program implementation. Using these lessons, each utility should initiate its own research to determine optimal rebate levels. Additionally, due to the rapidly changing LED market, utilities will not be able to set one rebate level for an extended period of time. Furthermore, although utilities deal in terms of rebate amounts, it is also the final retail price that will drive mass adoption of these efficient lighting products. Thus, as the retail prices for energy efficient lighting products continue to drop through normal market forces, utilities should monitor their rebate amounts and initiate additional incentive tests to ensure that optimal incentive levels are maintained.

References

[DOE] Department of Energy. 2003. *Energy Savings Potential of Solid State Lighting in General Illumination Applications 2010 to 2030*. Washington D.C.: U.S. Department of Energy, Building Technologies Program.

[DOE] Department of Energy. 2010. *2010 U.S. Lighting Market Characterization*. Washington D.C.: U.S. Department of Energy, Solid State Lighting Program Building Technologies Program.

[DOE] Department of Energy. *Solid State Lighting Research and Development Plan: Multi Year Program Plan*. Washington D.C.: U.S. Department of Energy, Lighting Research and Development Building Technologies Program.