

**The Impact of Dynamic Pricing on Low Income Consumers:
Evaluation of the IEE Low Income Whitepaper**

A Policy Report Prepared by

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Author's Note

Work on this report began during the summer of 2010, in response to the June 2010 version of the IEE Whitepaper. Due to competing time commitments, work on the project did not resume until the fall of 2010, and the paper was updated to reflect the September 2010 revision of the IEE Whitepaper. It has come to the author's attention that another report on the IEE Whitepaper was sponsored by the Maryland Office of People's Counsel (MOPC) and released on November 10, 2010. ("The Impact of Dynamic Pricing on Low-Income Customers: An Analysis of the IEE Whitepaper," Nancy Brockway and Rick Hornby.) While there is overlap between this report and the MOPC report, both the MOPC report and this report provide unique insights into the problems with the IEE Whitepaper.

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I. Introduction and Summary

The purpose of this report is to evaluate a September 2010 whitepaper released by the Edison Foundation's Institute for Energy Efficiency—"The Impact of Dynamic Pricing on Low Income Customers"¹ (hereinafter IEE Whitepaper). A shortened version of the IEE Whitepaper also appears in the November 2010 issue of *Public Utilities Fortnightly*.² The IEE Whitepaper concludes that low income consumers are responsive to dynamic rates and that most low income consumers can benefit from dynamic pricing.³ However, the IEE Whitepaper suffers from significant methodological and factual weaknesses.

Major problems with the IEE Whitepaper include the following:

- The IEE Whitepaper defines "low income" in an inconsistent and inappropriate manner. The IEE Whitepaper first describes its analysis as focused on a poverty-related measure of low income.⁴ However, rather than using this (or any) standardized definition of low income, the IEE Whitepaper arbitrarily defines income classifications with incomes as high as \$50,000 per year as "low income" and reports results as if these categories are representative of low income customers.⁵ The IEE Whitepaper's "low income" classification does not adjust for household size—a key factor when evaluating poverty or financial hardship. By classifying higher income customers as "low income," the IEE Whitepaper produces distorted results and is more likely to find that the differences between "high" and "low" income customers' demand response is not that great.⁶
- The IEE Whitepaper presents an evaluation of four pricing pilots and one dynamic rate tariff. The IEE Whitepaper claims that results regarding the behavior of low income consumers associated with these pilots are statistically significant. However, the statistical validity of the studies related to income is doubtful. The statistical weakness of the income-related data from pilots has been acknowledged by the IEE Whitepaper's authors' in previously published work, but is ignored in the IEE Whitepaper.
- The IEE Whitepaper presents the results of simulation models that purport to show large numbers of low income customers benefitting from dynamic pricing—even if those customers exhibit no demand response. However, the IEE Whitepaper's analysis excludes all costs of implementing dynamic pricing, such as the costs of smart meters. These costs will have an impact on customer bills. Because it ignores the costs of

¹ Faruqi, A., Sergici, S, and Palmer, J. "The Impact of Dynamic Pricing on Low Income Customers," IEE Whitepaper, revised September 2010.

http://www.edisonfoundation.net/iee/reports/IEE_LowIncomeDynamicPricing_0910.pdf

² Wood, Lisa and Ahmad Faruqi, "Dynamic Pricing and Low-Income Customers," *Public Utilities Fortnightly*, November 2010, pp. 60-64. Because the *Public Utilities Fortnightly* article contains a subset of the content appearing in the IEE Whitepaper, this report will reference only the IEE Whitepaper.

³ IEE Whitepaper, p.1, p. 10.

⁴ IEE Whitepaper, p. 12.

⁵ Both the CL&P and CSPP separately report information on customers that are designated as qualified low income customers due to observed low income characteristics, such as the qualification for an energy subsidy program.

⁶ As shown in the Appendix, below at page 12, households with poverty status exhibit different load characteristics than both lower income and higher income households that do not have poverty status.

implementing dynamic pricing, the IEE Whitepaper’s simulations do not support the authors’ conclusion that most low income customers will benefit from dynamic pricing.

The IEE Whitepaper concludes “low income customers are responsive to dynamic rates and that many such customers can benefit even without shifting load.”⁷ As will be discussed further below, the analysis presented in the IEE Whitepaper to buttress this conclusion is not reasonable. Policy makers evaluating dynamic pricing proposals need solid information regarding the impact of dynamic pricing on low income customers so that appropriate protections can be put in place—such information is lacking in the IEE Whitepaper.

II. Problems with the IEE Whitepaper

The IEE Whitepaper divides its analysis into two parts—a review of four dynamic pricing pilots and one current dynamic pricing tariff, and simulation models associated with critical peak pricing and peak-time rebates. In both cases the IEE Whitepaper bases its conclusions on flawed methodology. As a result, the IEE Whitepaper’s conclusions are not reasonably supported.

Table 1: Summary of Income-Based Analysis from Dynamic Pricing Programs	
Dynamic Pricing Program	Reported Low Income Results
BGE Smart Energy Pricing (SEP) Pilot—Baltimore Gas & Electric	Large numbers of pilot participants did not provide information on income. As a result, demographic results, including those based on income, should be interpreted with caution. ⁸
CL&P Plan-IT Wise Energy Program—Connecticut Light & Power	Verified hardship customers exhibit lower response compared to higher income customers. Response difference between customers with self-reported incomes above and below \$50,000 is not clear. Demographic results, including those based on income, should be interpreted with caution. ⁹
PEPCO PowerCentsDC Program—District of Columbia	Low-income customers exited the pilot, resulting in a smaller low-income sample. Remaining low-income consumers exhibit response similar to, but lower than, the higher income response. ¹⁰
California Statewide Pricing Pilot	Verified low income customers are much less price responsive. The elasticity of substitution for verified low income households is essentially zero and the daily price elasticity is less than half the magnitude of the price elasticity for non-low income households. ¹¹
California SmartRate™ Tariff—Pacific Gas & Electric	Verified low income customers reduced load much less than higher income customers, and the demand response of low income customers declined from year-to-year. ¹²

⁷ IEE Whitepaper, p. 1.

⁸ Ahmad Faruqui, Ph.D. and Sanem Sergici, Ph.D. "BGE’s Smart Energy Pricing Pilot, Summer 2008 Impact Evaluation," Brattle Group. Prepared for Baltimore Gas & Electric. April 28, 2009, p. 18.

⁹ Docket No. 05-10-03RE01 Compliance Order No. 4. “Appendix C Plan-IT Wise Results—Supplemental Analysis by the Brattle Group,” Ahmad Faruqui, Ph.D. and Sanem Sergici, Ph.D. February 19, 2010, pp. 9-10. [http://nuwnotes1.nu.com/apps/clp/clpwebcontent.nsf/AR/appendices/\\$File/appendices.pdf](http://nuwnotes1.nu.com/apps/clp/clpwebcontent.nsf/AR/appendices/$File/appendices.pdf)

¹⁰ PowerCentsDC™ Program Final Report, September 2010, p. 33. http://www.dcpsc.org/pdf_files/hottopics/PowerCentsDC_Final_Report.pdf

¹¹ *Impact Evaluation of the California Statewide Pricing Pilot*, Charles River Associates, March 16, 2005, p. 75.

¹² “2008 Ex Post Load Impact Evaluation for Pacific Gas and Electric Company’s SmartRate™ Tariff,” Final Report, December 30, 2008, pp. 34-35. “2009 Load Impact Evaluation for Pacific Gas and Electric Company’s Residential SmartRate™ —Peak Day Pricing and TOU Tariffs and SmartAC Program,” Volume 1: Ex Post Load Impacts, April 1, 2010, p. 35.

A. IEE Whitepaper’s Review of Pricing Pilots

The IEE Whitepaper reviews information from four dynamic pricing pilot programs and one dynamic pricing tariff. Table 1, above, summarizes the income-related results of these studies as previously described in reports to state public utility commissions. As summarized in Table 1, the results of these programs indicate that the low income dynamic pricing response is either not clear or shows a more limited response than higher income consumers. The IEE Whitepaper reaches a different conclusion. As will be discussed in detail below, the IEE Whitepaper’s interpretation is based on a flawed evaluation of the studies.

An underlying issue associated with the IEE Whitepaper’s evaluation of this empirical data relates to the fact that the data is from pilot programs. Data is based on pilot studies may not be appropriate to generalize results from a pilot to a larger population. The pilots examined in the IEE Whitepaper generally involve the participants receiving some type of compensation or being held harmless from the risk associated with dynamic pricing.¹³ As a result, those consumers who participated in the pilots may have characteristics that are not reflective of either the general population or low income consumers.

The second issue, and a critical flaw in the IEE Whitepaper’s methodology, is its arbitrary definition of “low income.” Initially the IEE Whitepaper indicates that an income evaluation based on poverty is desirable.¹⁴ However, the IEE Whitepaper later states that it relies on the “low income” concept associated with each program.¹⁵ This is not the case. While the authors do report information for verified¹⁶ low income categorizations associated with the studies, they also arbitrarily designate income categories associated with some pilots as “low income” even if the pilot has another qualified low income component. Income levels alone are not sufficient to identify households with financial hardship or poverty—family size and composition contribute to a proper definition of “low income.”

As will be discussed in more detail below, the IEE Whitepaper’s arbitrary designation of customers who may not be low income consumers as “low income” distorts the IEE Whitepaper’s results. By labeling higher income customers as low income, the IEE Whitepaper is more likely to find that the differences between “high” and “low” income customers demand response is not that great. The problem with the IEE Whitepaper is even more pronounced as results associated with qualified low income customers are commingled with results from higher income customers who are incorrectly described as “low income.”

1. IEE Whitepaper on the Baltimore Gas & Electric (BGE) SEP Pilot

The IEE Whitepaper notes that the BGE SEP Pilot included 1,375 participants. Demographic data, including that on household income, was derived from a survey of pilot participants. However, 368 of the 1,375 participants did not report income data when surveyed (i.e., 26.8% of

¹³ For example, the BGE SEP Pilot offered participants incentive payments of either \$150 or \$100 for successful completion of the program; the PEPCO PowerCentsDC Program offered consumers payments of \$100, with \$50 up front and \$50 on completion; the California Statewide Pricing Pilot offered residential customers up to \$175 for completing the project; low income customers in the PEPCO study were only allowed to participate in the rebate-based portion of the plan.

¹⁴ IEE Whitepaper, p. 12.

¹⁵ IEE Whitepaper, p. 12.

¹⁶ “Verified” in the sense that pilot participants were associated with a low income energy assistance program, thus verifying their income status.

the participants). This missing data weakens the potential for statistically valid results. Furthermore, the IEE Whitepaper's authors note that the subset of participants for whom income information was known exhibited a different elasticity of substitution than the full sample—*those responding to the survey question on income tended to be more responsive to dynamic rates.*¹⁷ This difference raises a red flag regarding the ability to interpret the results of the pilot with regard to customer income characteristics—the IEE Whitepaper's analysis reveals that the subset of data from the pilot that they rely on has a different characteristic than the overall pilot data set. The authors, however, ignore this problem and state their conclusions:

Within the subset of customers with known income status, we defined two groups – low income was defined as self reported income under \$25,000 and high income was defined as self reported income over \$75,000. The results show that a customer's income status did not have a measurable effect on their elasticity of substitution. *More explicitly, these results show that the elasticity of substitution of low income customers is not statistically different from that of other higher income customers whose income data is known.*¹⁸

The authors claim that the elasticity of substitution of low income customers is *not statistically different* from that of higher income customers. However, because the data set is an admittedly biased subset of data from a customer survey—with both missing data and different demand response characteristics than the sample population—claims of statistical significance are highly tenuous. This fact was recognized by none other than Ahmad Faruqi and Sanem Sergici (the IEE Whitepaper's primary authors) when they prepared an assessment of the BGE SEP Pilot for Baltimore Gas & Electric:

Using the information collected through this survey, we investigated the impacts of several socio-demographic characteristics on the elasticities estimated from the demand equations. . . . *However, these results should be interpreted with some caution since not all customers responded to the surveys, and as a result we lost 20 percent of the analysis sample when estimating the demand equations with customer characteristics. For this reason, our impact evaluation is based on the demand equations without the socio-demographic variables.*¹⁹

Thus, when performing the analysis of the pilot for BG&E, the authors did not consider results based on socio-demographic factors to be reliable, and the authors did not use the socio-demographic variables (including income) in their demand equations. Similar words of caution are absent from the IEE Whitepaper. Instead, the authors describe the elasticity measures associated with the “low income” and “high income” customers as if they were on a sound foundation.²⁰ Because of the substantial missing data and sample bias problems associated with the survey-based income analysis, the IEE Whitepaper's statements regarding the BGE SEP Pilot do not have a reasonable foundation.

¹⁷ IEE Whitepaper, p. 16.

¹⁸ IEE Whitepaper, p. 16, emphasis in original.

¹⁹ Ahmad Faruqi, Ph.D. and Sanem Sergici, Ph.D. "BGE's Smart Energy Pricing Pilot, Summer 2008 Impact Evaluation," Brattle Group. Prepared for Baltimore Gas & Electric. April 28, 2009, p. 18, emphasis added.

²⁰ The IEE Whitepaper does add the opaque statement that “we do not know how customers who did not respond to the survey question would have responded to the dynamic rates.” (IEE Whitepaper, p. 16.) This caveat is misplaced from the standpoint that the problem of the statistical validity of the authors' comparison between low and high income customers continues to exist.

2. IEE Whitepaper on the CL&P Plan-IT Wise Energy Pilot

For this pilot CL&P separately identified a portion of the pilot population as low income/hardship customers. These customers accounted for 154 members of the sample, which CL&P indicates is “consistent with the overall representation within CL&P.”²¹ In addition, CL&P conducted enrollment surveys of pilot participants, and as part of the survey attempted to determine the income status of the participants. The enrollment survey divided participants into one of four income categories, with “less than \$50,000” being the lowest.²² The IEE Whitepaper treats this income classification as “low income.” This is a significant methodological error. As shown in the Appendix, below, low income households with poverty status have load characteristics different from both lower and higher income households that do not have poverty characteristics. The IEE Whitepaper misclassifies the “less than \$50,000” households as “low income” without any consideration of poverty—thus distorting the reported pricing response.

However, the problems with the IEE Whitepaper’s treatment of the low income customers in the CL&P pilot are even more substantial. Like the BG&E pilot discussed above, income status was determined by a survey of participants, and 44.1% of the CL&P pilot participants declined to state their income levels—an even higher percentage than with the BG&E pilot.²³ However, the IEE Whitepaper ignores this missing data problem and states:

...the elasticities of substitution for low income customers were essentially the same as those for the average customer with known income data.”²⁴

Given the missing data problem, this is not a reasonable statement, even if one ignores the misclassification of higher income customers as “low income.” In fact, the negative impact of missing data on interpreting income-related responsiveness in the CL&P pilot is elsewhere acknowledged by the IEE Whitepaper’s authors. In a document filed with the Connecticut Department of Public Utility Control, dated February 19, 2010, Drs. Faruqui and Sergici describe a regression evaluation of the socio-demographic factors associated with the CL&P Plan-IT Wise pilot:

On average half of the customers dropped from the regressions with survey variables, as they did not respond to a particular survey question. Therefore, the results should be interpreted with caution.²⁵

This observation is missing from the IEE Whitepaper. Furthermore, in the February 19, 2010 report, Drs. Faruqui and Sergici conclude that the price response of customers with incomes

²¹ *Id.*

²² Docket No. 05-10-03RE01, Compliance Order No. 4, Appendix C – Plan-it Wise Customer Experience, pp. 3-4.

²³ There is a discrepancy between the IEE Whitepaper and the CL&P reports on the pilot regarding the number of participants who declined to state income. The IEE Whitepaper indicates the number is 44.1%, the CL&P report on the pilot indicates that the number is 23%. In either case, the impact is the same—the income status of a substantial portion of the sample is unknown, thus affecting the statistical validity of the results.

²⁴ IEE Whitepaper, p. 18.

²⁵ Docket No. 05-10-03RE01 Compliance Order No. 4. “Appendix C Plan-IT Wise Results—Supplemental Analysis by the Brattle Group,” Ahmad Faruqui, Ph.D. and Sanem Sergici, Ph.D. February 19, 2010. [http://nuwnotes1.nu.com/apps/clp/clpwebcontent.nsf/AR/appendices/\\$File/appendices.pdf](http://nuwnotes1.nu.com/apps/clp/clpwebcontent.nsf/AR/appendices/$File/appendices.pdf)

above and below \$50,000 was “not clear.”²⁶ This conclusion contradicts the authors’ statements in the IEE Whitepaper.

With regard to the hardship customers in the CL&P pilot, the IEE whitepaper states:

*[R]esults indicated that hardship customers responded slightly less than the average treatment customer to the PTR rate, although they did still respond. The incremental effect of the PTR rate was similar for hardship and non-hardship customers.*²⁷

The February 19, 2010 report prepared by Drs. Faruqui and Sergici provides a different perspective on the responsiveness of the hardship customers in the CL&P pilot. The February 19, 2010 report states that hardship customers were “non-responsive” for time-of-use (TOU) rates,²⁸ a fact that is missing from the IEE Whitepaper. The evaluation of the CL&P hardship cases in the February 19, 2010 report led the authors to conclude that “hardship reduces responsiveness.”²⁹

The IEE Whitepaper’s claims with regard to the CL&P pilot are based on flawed methodology and are unreliable. The IEE Whitepaper contradicts the authors’ previous statements and misclassifies higher income customers as “low income.” Furthermore, the problem introduced by the lack of data from a large number of survey respondents does not, by the IEE Whitepaper’s authors’ previous admission, generate results on which one can place much confidence.

3. IEE Whitepaper on the PEPCO PowerCentsDC Pilot

The final report on the PEPCO PowerCentsDC Program states:

...there was a delay of about a year between customer recruitment and the program start-up due to the timing of receipt of necessary regulatory approvals. During this delay, many customers with limited income changed premises, thereby dropping out of the program, or no longer qualified for RAD rates. Therefore, customers with limited income appear to have a higher exit rate than other customers, and the available sample for analysis was smaller.³⁰

Thus, the inclusion of low-income consumers in the PEPCO pilot ran into problems, and low-income representation was less than planned. While the IEE Whitepaper correctly notes that the observed response of low-income customers is lower than high-income customers, the underlying data appears to be less than ideal.

²⁶ Docket No. 05-10-03RE01 Compliance Order No. 4. “Appendix C Plan-IT Wise Results—Supplemental Analysis by the Brattle Group,” Ahmad Faruqui, Ph.D. and Sanem Sergici, Ph.D. February 19, 2010, p. 10. [http://nuwnotes1.nu.com/apps/clp/clpwebcontent.nsf/AR/appendices/\\$File/appendices.pdf](http://nuwnotes1.nu.com/apps/clp/clpwebcontent.nsf/AR/appendices/$File/appendices.pdf)

²⁷ IEE Whitepaper, p. 18, emphasis in the original.

²⁸ Docket No. 05-10-03RE01 Compliance Order No. 4. “Appendix C Plan-IT Wise Results—Supplemental Analysis by the Brattle Group,” Ahmad Faruqui, Ph.D. and Sanem Sergici, Ph.D. February 19, 2010, p. 10. [http://nuwnotes1.nu.com/apps/clp/clpwebcontent.nsf/AR/appendices/\\$File/appendices.pdf](http://nuwnotes1.nu.com/apps/clp/clpwebcontent.nsf/AR/appendices/$File/appendices.pdf)

²⁹ *Id.*

³⁰ PowerCentsDC™ Program Final Report, September 2010, p. 18.

Thus, the representation of low income consumers in the PEPCO pilot may be less than optimal.

4. IEE Whitepaper on the California Statewide Pricing Pilot

As the authors of the IEE Whitepaper note, the California Statewide Pricing Pilot (CSPP) was conducted in 2003. The results of this study, as summarized in a 2005 report prepared by Charles River Associates, are still widely cited.³¹ With regard to the income characteristics of customers in the CSPP, the authors of the IEE Whitepaper claim:

*High income households were somewhat more price-responsive than low income households. However, the difference was not substantial and low income customers also exhibited demand response.*³²

For the reasons discussed below, the IEE Whitepaper's characterization of the CSPP results is incorrect.

The CSPP had three "tracks." The CSPP's "Track A" included an analysis based on customer income. However, according to the Charles River Associates report on the CSPP, the Track A component of the CSPP took a selective approach to developing its sample population and reflected the following customer characteristics:

Track A customers were drawn from a population of customers with average summer energy use exceeding 600 kWh per month. The saturation of central air conditioning among the Track A treatment group was roughly 80 percent, much higher than among the general population, and average income was also much higher.³³

As a result, the Track A pilot suffers from sample bias, and does not provide a reasonable platform for making generalizations. Unfortunately, the authors of the IEE Whitepaper ignore this sample bias. Generalizing to a larger population from information generated from a biased sample will not result in reasonable projections.

But this is not the only problem in the IEE Whitepaper's treatment of the CSPP's Track A. As was the case with the CL&P pilot discussed above, the IEE Whitepaper arbitrarily treats a lower income classification associated with the CSPP as "low income." In the Charles River report, the results of the CSPP were evaluated, in part, by grouping participants into two income classifications—those with "average annual income equal to \$100,000" and those with "average annual income equal to \$40,000."³⁴ Here too, the IEE Whitepaper defines the lower income category as "low income," and reports its conclusions as if all customers in the lower income classification are verified low income customers. As discussed above, juxtaposing results from verified low income customers with customers who fall into an arbitrarily defined lower income category is not a reasonable research approach.³⁵

³¹ *Impact Evaluation of the California Statewide Pricing Pilot*, Charles River Associates, March 16, 2005.

Available at: http://sites.energetics.com/MADRI/toolbox/pdfs/pricing/cra_2005_impact_eval_ca_pricing_pilot.pdf

³² IEE Whitepaper, p. 25, emphasis in original.

³³ *Impact Evaluation of the California Statewide Pricing Pilot*, Charles River Associates, March 16, 2005, p. 9.

³⁴ *Impact Evaluation of the California Statewide Pricing Pilot*, Charles River Associates, March 16, 2005, p. 75.

³⁵ As discussed earlier, qualification of "low income" consumers based on a poverty measure is superior because it provides a better gauge of economic hardship. E.g., a \$40,000 annual income household with a one-person family is likely to face significantly different budgetary constraints than a four-person family with the same \$40,000 income level.

The CSPP also had two additional aspects that addressed “qualified” low income customers. “Track B” of the CSPP targeted low income customers residing in San Francisco neighborhoods in the vicinity of a power plant. Track B did not include a control group, which made the evaluation of results more difficult.³⁶ Given the narrow focus of the Track B program, generalizing its results is not reasonable.

In addition, the CSPP also studied customers that were enrolled in the state’s CARE program. The CARE program provides energy assistance to qualified low income customers. Given the income qualification of the CARE customers, the results relating to the CARE program are important to consider.

The Charles River report on the CARE component of the CSPP shows that qualified low income customers exhibited very different behavior than non-CARE customers. The Charles River report on the CSPP summarizes as follows regarding the CARE program participants:

Customers who receive the CARE discount are much less price responsive than those who don’t. Indeed, the elasticity of substitution for CARE households is essentially zero and the daily price elasticity is less than half the magnitude of the price elasticity for non-CARE households.³⁷

The IEE Whitepaper characterization of the CSPP results, cited above, does not reasonably correspond with the results reported in the Charles River report on the CSPP. According to the Charles River report, the true low income customers studied in the CSPP are much less price responsive. The IEE Whitepaper’s conclusion that the CSPP shows that high and low income customers do not exhibit a “substantial” difference is incorrect.

E. IEE Whitepaper on the PG&E SmartRate™ Tariff

The PG&E SmartRate™ tariff is the nation’s first large scale implementation of critical peak pricing. On up to 15 “SmartDays” during cooling season months (May 1 to October 31) customers on the SmartRate™ tariff face peak prices that are significantly higher, and which vary by time of day.³⁸ The program has been evaluated for the years 2008 and 2009.

Evaluation of this program has found the participating low income customers in the CARE program to be much less demand responsive than non-CARE customers. The 2009 report on the SmartRate™ tariff, prepared by Freeman, Sullivan & Co., concludes:

CARE customers reduced load much less than did non-CARE customers. Indeed, the average load reduction across the five-hour event period for the nine SmartDays was 11.0 percent for CARE customers and 22.6 percent for non-CARE customers. This finding is consistent with what was seen in California’s Statewide Pricing Pilot, which showed that

³⁶ “Statewide Pricing Pilot – Track B Evaluation of Community-Based Enhanced Information Treatment,” Final Report. Prepared by San Francisco Community Power in cooperation with M.Cubed September 2005, p. 2.

³⁷ *Impact Evaluation of the California Statewide Pricing Pilot*, Charles River Associates, March 16, 2005, p. 75.

³⁸ “2008 Ex Post Load Impact Evaluation for Pacific Gas and Electric Company’s SmartRate™ Tariff,” Final Report, December 30, 2008, p. 2.

the average load reduction for CARE customers was only 3 percent compared with a load reduction of roughly 15.6 percent for non-CARE customers.³⁹

The 2010 Freeman, Sullivan & Co. report states:

The average load reduction for CARE customers is roughly one third of the magnitude of non-CARE customers. Across the 15 event days in 2009, CARE customers reduced their peak period load on average by 0.15 kW, or 7.5%. Non-CARE customers, on the other hand, reduced load on average by 0.49 kW, or 22.7%.⁴⁰

The IEE Whitepaper also misreports these results. Rather than focusing on the CARE/Non-CARE comparison, the IEE Whitepaper compares CARE customers to the overall average customer response.⁴¹ As the overall average customer response also includes low income CARE customers, the overall average response is lower than the response displayed by non-CARE customers. The IEE Whitepaper concludes that “CARE customers demonstrated a 7.5 percent peak reduction while the average customer demonstrated a 15.0 percent peak reduction, meaning that the CARE response was 50 percent of the average response.”⁴² However, non-CARE customers displayed a 22.5% reduction, resulting in a CARE customer response that was one-third as much.

B. IEE Whitepaper Simulation Models

The IEE Whitepaper states that it simulates the impact on the average monthly bill from the implementation of critical peak pricing (CPP) and peak-time rebate (PTR) rates. The authors state that their approach is based on representative samples of residential and residential low income customers at a large urban utility, with the rates designed to be revenue neutral relative to the existing rate of \$0.13 per kWh.⁴³

The IEE Whitepaper provides no detail regarding the nature of the “samples” of residential and residential low income customers used in the simulations. For example, it is not clear whether the data is drawn from a pilot or general billing records; how the “low income” classification was developed; or the number of residential accounts sampled. Furthermore, the dynamic pricing models used in the IEE Whitepaper appear to exclude any of the costs of implementing dynamic pricing. Finally, the IEE Whitepaper ignores the fact that becoming a “loser” in the dynamic pricing transition may have a much more severe impact on a low income consumer. These flaws undermine the reasonableness of the simulations.

1. CPP Simulations

The authors model two CPP plans. The first assumes a critical peak price of \$1.25 per kWh during a four-hour peak period from 2 p.m. to 6 p.m. on fifteen critical summer days, for a total of 60 hours. During the balance of the year, the rate was assumed to be \$0.11 per kWh.⁴⁴ An

³⁹ “2008 Ex Post Load Impact Evaluation for Pacific Gas and Electric Company’s SmartRate™ Tariff,” Final Report, December 30, 2008, pp. 34-35.

⁴⁰ “2009 Load Impact Evaluation for Pacific Gas and Electric Company’s Residential SmartRate™ —Peak Day Pricing and TOU Tariffs and SmartAC Program,” Volume 1: Ex Post Load Impacts, April 1, 2010, p. 35.

⁴¹ IEE Whitepaper, pp. 2 & 29.

⁴² IEE Whitepaper, p. 26.

⁴³ IEE Whitepaper, p. 7.

⁴⁴ IEE Whitepaper, p. 7.

alternative simulation is based on a CPP rate assumed to be in effect from June to September, with a critical peak rate of \$0.90 per kWh in effect during a five-hour period during fifteen summer days. The off-peak rate was assumed to be \$0.10 per kWh during the summer months, and for the balance of the year the rate was assumed to be \$0.13 per kWh.

The authors find that among their low income sample, approximately 65% of low income customers are better off on the first CPP rate even without demand response. The authors indicate that this result is due to the flatter load curves associated with low income demand.⁴⁵ With the alternative CPP simulation, the IEE Whitepaper reports an even higher number of projected low income “winners.”

The most significant problem with these CPP rate examples is that the authors assume that the CPP plans can be implemented at no cost. This is a critical oversight given that the authors’ claim to be estimating the number of “winners and losers” associated with the implementation of the CPP plan. Before CPP can be implemented, smart meters must be in place. The costs of smart meters must be recovered, and these costs will be reflected in customer bills. Thus, the authors’ claims regarding the impact of the CPP plan are not well supported due to the overly narrow focus of the analysis. A more reasonable interpretation of “winners and losers” arising from CPP must include the impact of the costs of enabling the CPP plan on customer bills, including the cost of smart meters. In addition, the harm to the low income “losers” is likely to be more severe due to the more tenuous financial position of these consumers.

2. PTR Simulation

The IEE Whitepaper also models a PTR with a rebate of \$1.10 per kWh during the critical peak for low income customers, with the existing \$0.13 per kWh rate otherwise unchanged. The authors note that the PTR model has no impact on customer bills unless there is an opportunity for demand response (i.e., “no losers”). In order to model the impact of the PTR plan on low income customers, the authors apply the Price Impact Simulation Model (PRISM). The authors indicate that they assume a “moderate level of demand response” from low income customers.⁴⁶ As a result, their modeling shows that virtually all low income consumers are “winners” as a result of the program.⁴⁷

The PTR modeling suffers from the same defect as was discussed in the previous examples. In order for the PTR to be implemented, smart meters must be in place, and smart meters have a cost. This cost is not factored into the IEE Whitepaper analysis. As a result, the prediction that there will be “no losers” as a result of the PTR is not well supported.

In addition, it is also not clear why the authors believe that “moderate level” of demand response is reasonable for low income consumers. The authors elsewhere acknowledge the flat load curves that characterize low income consumers’ usage.⁴⁸ The authors do not make clear the magnitude of their assumption, but a “low” rather than “moderate” response from low income customers might be more realistic.

⁴⁵ IEE Whitepaper, p. 7.

⁴⁶ IEE Whitepaper, p. 8.

⁴⁷ IEE Whitepaper, p. 9.

⁴⁸ IEE Whitepaper, p. 1.

In summary, the IEE Whitepaper’s simulations present a myopic view of the impact of dynamic pricing on low income customers. Unless countervailing measures are taken, rate increases associated with infrastructure improvements needed to implement dynamic pricing (e.g., smart meters) will impact low income customers more severely than higher income customers. In addition, the low income “losers” that the IEE Whitepaper predicts may require additional policy response—the inability of some low-income customers to shift load will result in higher bills for those with limited ability to pay. The impact on customer bills of upgrading infrastructure so that a CPP or PTR program can be pursued must be considered when evaluating the potential benefits from these programs.

III. Conclusion

A key component of the “smart grid transformation” is the response that policy makers can expect from price signals sent to consumers. It is reasonable to expect that consumers with higher incomes will have load to shed during peak periods—higher income households are more likely to have central air conditioning, pool and/or spa pumps, dishwashers, washers and dryers, etc. than are low-income households.⁴⁹ The ability to shed load opens the possibility for both customer savings and social benefits from peak demand reduction. However, the level of benefits available for low income consumers is another matter. As discussed above, empirical data for the impact of dynamic pricing pilots is not of high quality, but generally points to a lower demand response potential for low income consumers. A lower potential demand response may provide fewer benefits to offset the costs of implementing dynamic pricing.

The IEE Whitepaper does not provide a reasonable assessment of the impact of demand response on low income consumers. The limited information that is available from the programs discussed above in this report shows that low income customers exhibit a reduced ability to benefit from demand response. Because of the more limited potential for low income consumers to gain benefits from shifting load, unless countervailing measures are taken, the costs associated with implementing dynamic pricing will weigh more heavily on low income consumers.

Policy makers require sound information to make decisions regarding the implementation of dynamic pricing programs. Unfortunately, the IEE Whitepaper does not contribute reasonable information. Policy makers should be sensitive to the position in which low income consumers are likely to find themselves when confronting the transition to the smart grid—a limited ability to respond to market incentives, which will also limit the benefits available to low income customers. Safeguards should be built into dynamic pricing programs to counter low income customers’ more limited ability to capture benefits from dynamic pricing.

⁴⁹ See the Appendix, below, for a summary of household data classified by income and poverty status from the Residential Energy Consumption Survey.

Appendix: Residential Energy Consumption Survey Data and Low Income Customers

Microdata from the Department of Energy's most recent Residential Energy Consumption Survey (RECS) was used to analyze household characteristics by income and poverty status. The data set was released in 2009 and is based on detailed surveys that were conducted in 2005. The RECS data includes both data on household energy use, and data on other household characteristics that may have an impact on household energy use. The survey collected data from 4,382 households sampled at random using a complex multistage, area-probability design to represent 111.1 million U.S. households, the Census Bureau's statistical estimate for all occupied housing units in 2005. Data were obtained from residential energy suppliers for each unit in the sample to produce the consumption and expenditure data.⁵⁰

To conduct the analysis reported below, households were classified with reference to their poverty status, and then ranked by income.⁵¹ Poverty households were divided into two groups—those below 100% of the poverty line, and those between 100% and 150% of the poverty line. Because poverty reflects both income and household size, the lower poverty classification had households with incomes ranging up to \$37,500. The higher poverty classification had households with incomes between \$12,500 and \$47,500. In addition, four income classifications were created for non-poverty households. These classifications and corresponding income levels are shown in Table A1, below on the following page.

Table A1 reports the presence of electric load sources and other factors, such as indicators of the level of weatherization in the dwelling. The percentage values show each characteristic expressed as the percent of households within an income classification. For example, Table A1 shows that 38.56% of households in the lowest poverty classification have central air conditioning. It is notable that the lowest non-poverty income classification (with incomes ranging between \$17,500 and \$27,500) report central air conditioning at a much higher rate (53.54%).⁵² Other non-poverty higher income groups report still higher levels of central air conditioning. Table A1 illustrates the IEE Whitepaper's problem of claiming that a lower income classification without a poverty identifier represents "low income" consumers. Table A1 shows that households associated with poverty characteristics have less load to shed than both lower- and higher- income households without poverty status. It is also notable that the poverty households also have poor weatherization characteristics. This suggests that programs targeting low income weatherization still have work to do, and may contribute to energy efficiency. Low income poverty households are much more likely to be renters than are low income non-poverty households. In addition, the fact that a higher percentage of poverty-related households report having someone at home throughout the day suggests that load shifting may be more difficult, thus contributing to the more limited responsiveness observed in the qualified low income customers in the pilots discussed above.

⁵⁰ <http://www.eia.doe.gov/emeu/recs/recspubuse05/pubuse05.html>

⁵¹ The RECS data identifies households by both income level and the household's relationship to the poverty line.

⁵² Responsiveness to electricity price changes has been shown to be related to the presence of major load sources like central air conditioning. See, e.g., Reis, P. and White, M. "Household Electricity Demand, Revisited," *Review of Economic Studies*, (2005) Vol. 72, pp. 853-883.

Table A1: Presence of Electric Load Sources and Other Energy-Related Factors by Poverty and Income (Poverty Households in Shaded Rows)

Income Range and Household Poverty Classification	Percent of all Households	Average Annual KWH	Mobile Home	Central Air	Dishwasher	Number of Refrigerators	Refrigerator with Automatic Ice/Water	Clothes Washer
Up to \$37,500 (HH Below 100% of Poverty)	14.99%	9,038	11.70%	38.56%	24.97%	1.09	9.58%	62.01%
\$12,500-\$47,500 (HH Between 100% and 150% of Poverty)	11.62%	10,342	10.17%	48.02%	36.65%	1.13	13.68%	73.58%
\$17,500-\$27,500 (Non-Poverty Households)	12.22%	8,900	10.87%	53.54%	44.72%	1.14	14.67%	74.77%
\$32,500-\$47,500 (Non-Poverty Households)	21.04%	11,224	5.93%	64.15%	61.80%	1.21	26.57%	87.16%
\$52,500-\$77,500 (Non-Poverty Households)	20.37%	12,605	2.50%	65.56%	72.59%	1.29	36.36%	90.34%
Above \$82,500 (Non-Poverty Households)	19.77%	14,708	1.16%	73.54%	86.08%	1.45	45.74%	95.67%
Overall Average		11,480	6.25%	59.29%	58.27%	1.24	26.86%	82.63%
Income Range and Household Poverty Classification	Electric Dryer	Pool	Spa	Single Pane Windows	Poor Insulation	Drafty Some or All of the Time	Someone at Home on Weekdays	Renter
Up to \$37,500 (HH Below 100% of Poverty)	45.78%	1.21%	0.61%	62.23%	29.74%	17.21%	65.22%	52.69%
\$12,500-\$47,500 (HH Between 100% and 150% of Poverty)	51.87%	3.25%	0.36%	56.12%	22.06%	13.46%	59.52%	44.47%
\$17,500-\$27,500 (Non-Poverty Households)	56.48%	1.78%	2.46%	51.50%	18.50%	9.70%	51.88%	34.00%
\$32,500-\$47,500 (Non-Poverty Households)	65.56%	5.27%	4.50%	44.33%	17.85%	10.18%	49.12%	25.06%
\$52,500-\$77,500 (Non-Poverty Households)	66.53%	9.38%	7.55%	39.06%	14.72%	7.84%	46.51%	20.01%
Above \$82,500 (Non-Poverty Households)	67.69%	18.60%	15.70%	31.34%	11.41%	7.51%	40.11%	10.56%
Overall Average	60.51%	7.47%	6.02%	45.62%	18.29%	10.55%	50.77%	28.65%