Massachusetts ENERGY STAR®
Lighting Program 2010
Annual Report

Final

June 15, 2011

Volume 3:
Appendices E - G

Submitted to:

Energy Efficiency Advisory Council Consultants
Cape Light Compact
NSTAR
National Grid
Unitil
Western Massachusetts Electric

Submitted by:

NMR Group, Inc.
Cadmus Group, Inc.
KEMA

50-2 Howard Street, Somerville, MA 02144
Phone: (617) 284-6230 Fax: (617) 284-6239
www.nmrgroupinc.com

Volume 3: Appendices E - G

Table of Contents

Appendix E: Residential Lighting Shelf Survey, Pricing Analysis, and Conjoint Results

Appendix F: CFL Revealed Preference Results

Appendix G: Estimating the Net-to-Gross Ration for the 2009-2010 Massachusetts ENERGY STAR® Lighting Program: Delphi Panelist Response Summary

Massachusetts ENERGY STAR® Lighting Program 2010 Annual Report

Appendix E:

Residential Lighting Shelf Survey, Pricing Analysis, and Conjoint Results

Residential Lighting Shelf Survey, Pricing Analysis, and Conjoint Results

Final Report

Prepared for
Energy Efficiency Advisory Council Consultants
National Grid
NSTAR Electric
Unitil
Western Massachusetts Electric Company

Prepared by
The Cadmus Group, Inc. / Energy Services
720 SW Washington Street, Suite 400
Portland, OR 97205
503-228-2992

April 15, 2011

Prepared by:
Noah Lieb
James Stewart
Ryan Cook
Jane Colby

Corporate Headquarters:
57 Water Street
Watertown, MA 02472
Tel: 617.673.7000
Fax: 617.673.7001

An Employee-Owned Company
www.cadmusgroup.com

720 SW Washington St.
Suite 400
Portland, OR 97205
Tel: 503.228.2992
Fax: 503.228.3696

Table of Contents

1. Executive Summary 1

2. Introduction 3

Shelf-Stocking Survey 3
Hedonic Pricing Regression Analysis 3
Economic Theory of Program Incentives 3
Conjoint Survey 5
Overview of Methodology 5

3. Shelf-Stocking Survey 7

Methodology 7
Key Details About the Sample 7
Shelf-Space Data 10
Results 10

4. Hedonic Pricing Regression Model 14

PA Tracking Database 14
Definition of PA-Discounted Bulbs 15
Statistical Analysis Approach 15
Summary of Average Prices 16
Regression Analysis 17
Results 19

5. Conjoint Survey 23

Methodology 23
Questionnaire 24
Survey Scenarios 26
A-Line CFLs 26
Flood CFLs 26
Weighting and Segmentation 27
Price Elasticity 27
Results 28
Price Elasticity 28
Hedonic Pricing Regression 30
Recommendation 30

Appendix A. Shelf Survey Input Form 32

Appendix B. Regression Model Outputs 38

Appendix C. Conjoint Recruiting Script 46

Appendix D. Derivation of Elasticity Curves 50

1. Executive Summary

On behalf of the Massachusetts ENERGY STAR® Lighting program administrators (PAs), The NMR Group, Inc. subcontracted with Cadmus to perform research to assess the effect of the Mass Save® residential lighting program on the following:

- The effect of the Mass Save® Upstream Lighting Program on CFL prices in the state
- The amount of shelf area dedicated to CFLs, comparing participating retailers to non-participating retailers
- The impacts of price variations and other CFL characteristics on consumer's light bulb choices.

To perform this analysis, Cadmus designed and analyzed a shelf-stocking survey, a hedonic pricing regression analysis, and a conjoint survey. KEMA performed the in-store data collection for the shelf-stocking survey. This work serves as one task being completed as a part of the broader Residential Retail Products residential lighting evaluation.

The shelf-stocking study was performed by the evaluation team between September and December 2010. During visits to a representative sample of 95 stores in Massachusetts, we collected data on 2,849 CFL packages. We also matched the shelf-stocking data to the PAs' tracking database of both CFL sales and the paid incentives, so that we could compare the advertised retailer discount amount to the incentives paid by the PAs to the manufacturer and retail partners.

The hedonic pricing regression analysis used data collected in the shelf-stocking study to create a regression model in which the price of a product is regressed on the product's characteristics. The idea behind the hedonic pricing model is that variation in the product's price can be explained by the product's observable attributes, which are not explicitly traded in the market. The shelf stocking survey and hedonic pricing regression analysis considered both standard spiral and specialty CFLs.

The conjoint survey involved 300 randomly recruited electric customers across the PAs. The survey questions contained descriptions of different specialty light bulbs that were characterized by a consistent set of six or fewer distinct attributes (the levels of which vary across questions). Respondents were asked to choose between the different options presented. The conjoint analysis used simulation modeling to (1) estimate the survey populations' willingness to pay at each price point for two types of specialty CFL bulbs, and (2) compute an elasticity of demand for specialty CFLs. Then, using the results of the hedonic pricing regression model, we estimated a specialty CFL net-to-gross (NTG) ratio.

Cadmus' key findings are these:

- After controlling for differences in wattage, sales channel, manufacturer, and other characteristics between discounted and undiscounted CFLs, the program-discounted CFLs cost on average $1.46 less than the undiscounted CFLs. The difference was 117% of the average discount paid to industry partners, for a realization rate of 1.17.

- For A-bulb, reflector, and globe CFLs, the program-discounted CFL cost less than the undiscounted CFLs by amounts ranging from $2.33 to $3.61. The realization rates for these specialty CFLs ranged from 0.71 to 0.83.
- Stores selling PA-discounted CFLs allocated an average of 18% more shelf space to CFLs than non-partner stores.
- The estimated NTG ratio for specialty bulbs using the conjoint analysis was 0.59.

2. Introduction

On behalf of the Massachusetts ENERGY STAR® Lighting program administrators (PAs), The NMR Group, Inc. subcontracted with Cadmus to perform research to assess the effect of the Mass Save® residential lighting program on the following:

- CFL prices in the state;
- The amount of shelf area dedicated to CFLs, comparing participating retailers to non-participating retailers; and
- The impact of price variations and other CFL characteristics on consumer's light bulb choices.

To perform this analysis, Cadmus designed and analyzed a shelf-stocking survey of 2,486 CFL packages at 95 retail stores. We also developed a hedonic pricing regression analysis to isolate the effects of the program on CFL prices, and we conducted a conjoint survey of 300 PA customers. KEMA performed the in-store data collection. This work serves as one task being completed as a part of the broader Residential Retail Products residential lighting evaluation.

Shelf-Stocking Survey

Our shelf-stocking survey was designed to gather price data on all CFLs in a sample of participating and non-participating retail stores, stratified by retail channel. In addition, we measured shelf space devoted to CFLs versus other types of light bulbs in each store. A copy of the shelf survey data collection form is included in Appendix A.

Our survey sample was randomly chosen; however, some stores in the sample did not allow our team to perform the shelf survey. In some of these cases, we chose a different store to inventory. In other cases, we used Lockheed Martin shelf inventory data when available. One key difference between the data we collected and those collected by Lockheed Martin is that Lockheed Martin only collects pricing data on ENERGY STAR- light bulbs. For these participants, we were unable to obtain the data desired on all CFLs available in the stores.[1]

Hedonic Pricing Regression Analysis

The main goal for using the hedonic pricing regression analysis was to estimate the impact of PA incentives on the retail price of CFLs sold in a representative sample of Massachusetts retailers.

Economic Theory of Program Incentives

The economic theory behind this analysis focuses on profit-maximizing retailers such as drug stores or home improvement stores that sell CFLs. These retailers have some ability to choose prices for CFLs because of product and store differentiation and, thus, the retailers face a downward-sloping demand curve rather than a flat, perfectly elastic one. However, while these retailers have some ability to select a price for CFLs, their ability to raise prices is limited by competition from similar retailers offering the same products.

[1] This may have an effect of lowering the price difference between discounted and non-discounted CFLs, as ENERGY STAR CFLs may be priced higher than non-ENERGY STAR CFLs.

Figure 1 shows the downward-sloping demand curve of CFLs for a typical Massachusetts retailer. The horizontal axis shows the quantity of CFLs, and the vertical axis shows the retail price. Below the demand (D) curve is the marginal revenue (MR) curve, which shows the additional revenue earned by the retailer for each CFL it sells.

The figure also shows the retailer's marginal cost of sales curve (MC^0), which is the cost of selling each additional CFL. This curve is upward sloping, indicating that the marginal cost of sales is increasing and that the retailer requires a higher price to sell more CFLs. The profit maximizing price is chosen by equating marginal revenue and marginal cost. This occurs at Q^0 and results in a price of P^0.

Figure 1. Illustration of Retail Price Impact of PA Incentives

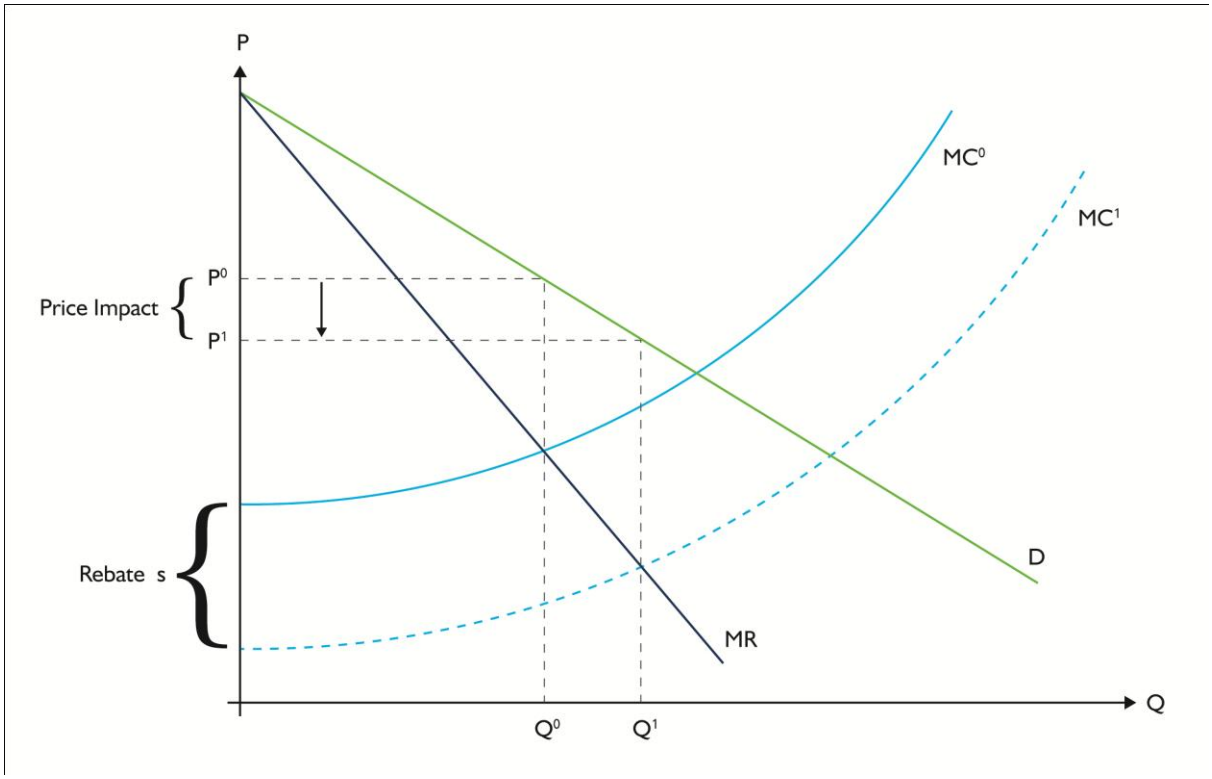


Figure 1 also shows the impact of a program incentive per CFL of *s* on the retail price of CFLs. For example, if a manufacturer passes the full amount of the subsidy to retailers, then at every quantity of output, a subsidy of *s* shifts the marginal cost curve down by the amount of the subsidy. Consequently, instead of a price of P to sell Q units of CFLs, the retailer now requires only a price of P-*s*.

The retailer selects a new price by choosing a quantity Q^1 that equates marginal revenue with the new marginal cost (MC^1). This new equilibrium price is P^1. The new subsidized price will always be below the original price if the demand curve is downward sloping. The difference in the prices before and after the subsidy will depend on the price elasticity of demand and the shape of the marginal cost curves, and it may be less than or equal to the amount of the subsidy. The impact of the subsidy on retail price will be smaller when demand is very inelastic.

Cadmus does not purport that retailers select CFL prices exactly as described in this simple economic theory model. But an economic theory model does not have to describe exactly how retailers select prices to be useful. A good theoretical model approximates actual retailer behavior and yields accurate predictions about retail prices. For instance, retailers may not explicitly compare marginal revenue with cost but follow simple heuristics such as "mark-up CFLs 50 percent above cost." This heuristic would likely result in prices similar to those predicted by the model. If it did not, profits at the retailer would lag, and adjustments would be made. The theoretical model also identifies what is being measured in the hedonic pricing analysis. This helps in the interpretation of the results.

In the context of Figure 1, the hedonic pricing regression analysis attempts to measure the difference between P_0 and P_1. This is the impact of the PA incentive on the retail price to consumers. There are, however, several reasons why the estimated impact of the PA incentive may differ from the impact predicted in the model.

- Retailers may reduce or increase the prices of discounted CFLs relative to the theoretical price, so that prices end in 9 or 99 cents.
- The actual and theoretical price effects may differ because PA subsidies may lead retailers to reduce the prices of non-discounted bulbs. In a cross-sectional analysis of CFL prices, this would have the effect of reducing the impact of the subsidy on CFL prices.

Conjoint Survey

Cadmus conducted a conjoint survey because it provided an objective methodology for assessing trade-off price and non-price attributes without directly asking consumers what they were willing to pay. Based on this survey, Cadmus expected to achieve these outcomes:

- Help the sponsors plan, design, and update incentive programs to promote energy-efficient CFLs[2], and
- Estimate the price elasticity and combine that estimation with pricing analysis to estimate the NTG ratio for specialty CFLs.

When this study was initiated, the sponsors were offering a Consumer Products Program for lighting involving both cooperative promotions with retailers and coupons for consumers to purchase spiral and specialty CFLs at a discount. The sponsors then added a markdown/buydown incentive to retailers and manufacturers in amounts ranging from $3 to $6 per specialty bulb, depending on the type of bulb.

Overview of Methodology

Conjoint analysis surveys provide descriptions of different goods, characterized by a consistent set of six or fewer distinct attributes (the levels of which vary across questions). Respondents are asked to choose between the different options presented. A fundamental benefit of this conjoint analysis approach is that the questions provide an experience similar to real-world decision

[2] Results relating to this objective were published in a separate report to the Massachusetts PAs, dated August 24, 2010.

making in which multiple attributes are considered simultaneously. Traditionally, conjoint analysis is used to determine an optimal price for a product and its varying options (e.g. new cars with sun roofs or stereos). The price points associated with the various product offerings (in this case, light bulbs) are used to determine willingness to pay based on participants "purchasing decisions" (selecting the different bulbs in the survey).

While the conjoint approach attempts to mimic real-life purchase decision making, several key differences between this study and actual purchase environments may affect the results:

- The study took place in a controlled environment without distractions. Real-life shopping experiences are often affected by product location in the store and on the shelf, the amount of time a consumer has to evaluate options, and whether other factors are competing for the shopper's attention.
- In addition to assessing the product's physical attributes, our study attempted to ascertain the importance of non-product attributes, such as how product information is best disseminated and the amount of influence of different promotional approaches. In reality, these factors may subconsciously affect decision-making, which makes the influence of an attribute difficult to predict via a written survey description.[3]
- While Cadmus designed the survey to mimic information found on actual light bulb packages, there were instances where the survey contained more detail than a customer would find in a store. This was intended to help participants understand the questionnaire. For instance, many light bulb packages state energy savings claims on a label (e.g., "saves $8 per year"). In contrast, the survey description read, "Incandescent bulbs will not save any money off your energy bills, while compact fluorescent bulbs will save about $8 per year off your energy bills."
- For purposes of the study, the light bulb questions asked about the CFL choices without the context of an installation location or current home saturation levels. While past surveys found that 88% of Massachusetts residences have chosen CFLs for at least one socket in their home, the CFL saturation rate (i.e., the percentage of sockets filled with CFLs) among homes varies considerably.[4]

The remainder of the report is organized to provide the approach and results for each research technique, as follows:

- Section 3 describes the shelf-stocking survey;
- Section 4, the hedonic pricing regression analysis; and
- Section 5, the conjoint survey.

3 For example, participants predicted that having an information label on a product was more influential to their purchasing decision than the recommendations of a sales person.

4 The Market for CFLs in Massachusetts, submitted to Cape Light Compact, National Grid, NSTAR Electric, Unitil, and Western Massachusetts Electric Company, January 28, 2010, by NMR Group.

3. Shelf-Stocking Survey

Methodology

The shelf-stocking surveys covered a geographically representative sample of stores across Massachusetts. The store sample was also designed to be representative of the retail channels through which CFL sales in the state occur. These retail channels include drug, mass merchandise, home improvement, and grocery stores. However, because most home improvement stores did not cooperate with the shelf-stocking survey, the final sample is not representative of CFLs by sales channel. CFLs sold in large home improvement stores are underrepresented in the sample.[5] Table 1 contains a summary of the statistics for the stores in the survey.[6]

Table 1. Store Allocation by Distribution Channel, Metropolitan Area and Program Administrator (n=95)

Distribution Channel	Percent	Metropolitan Area	Percent	Program Administrator	Percent
Discount	11.6%	Barnstable Town	11.6%	Cape Light	8.4%
Drug Store	11.6	Boston-Quincy	23.2	Municipality	2.1
Grocery	17.9	Cambridge-Newton-Framingham	18.9	National Grid	40.0
Large Home Improvement	13.7	Peabody	7.4	NSTAR	30.5
Mass Merchandise	25.3	Pittsfield	5.3	Unitil	7.4
Membership	2.1	Providence-New Bedford-Fall River	8.4	WMECO	11.6
Small Hardware	17.9	Springfield	11.6		
		Worcester	13.7		
Total	**100%**	**Total**	**100%**	**Total**	**100%**

Key Details About the Sample

- Mass merchandise stores (such as Wal-Mart or Target) comprised the largest single category, accounting for 25% of stores in the sample.[7]
- Small hardware and grocery stores each accounted for 18%.
- The largest number of stores was in the Boston-Quincy and Cambridge-Newton-Framingham metro areas.
- Seventy percent of stores were located in the National Grid or NSTAR service territories.

---

5 The underrepresentation of CFLs in home improvements is troublesome but would be an even greater concern if the pricing analysis was sales-weighted, as home improvement stores probably sell more of each CFL model they stock than grocery, drug, and mass merchandise stores.

6 The metropolitan statistical area is based on the U.S. Census Bureau definitions. Each metropolitan statistical area "…is a core area containing a substantial population nucleus, together with adjacent communities having a high degree of economic and social integration" and that "must have at least one urbanized area of 50,000 or more inhabitants." http://www.census.gov/population/www/metroareas/aboutmetro.html

7 Home improvement stores comprise the largest category of retailers in the program; however, most of them did not cooperate with our requests to perform shelf-surveys.

The store sample was designed to be representative of the channels through which program CFL sales occur, but because some stores refused to take part in the inventory, the final sample may not have been representative. Table 2 shows how the original shelf survey sample compares to actual completions and Table 3 shows the refusals and non responses from each area.

Table 2. Sample and Completed Shelf Survey Store Population

	Cape Light		National Grid		NSTAR		Western Mass		Unitil		Municipality		Participants		Non-Participants	
Store Type /Sponsor	Goal	Completed	Goal	Completed	Goal	Completed	Goal	Completed	Goal	Completed	Goal	Completed	Goal	Completed	Goal	Completed
Discount	1	1	2	2	2	2	1	1	1	1	0	0	7	7	4	4
Drug Store	1	1	2	2	2	2	1	1	1	1	0	0	7	7	4	4
Grocery	1	1	4	4	3	2	1	1	1	1	0	0	10	9	7	8
Large Home	1	1	7	4	5	4	2	0	0	0	0	1	15	10	5	3
Mass Merch / Membership	1	1	6	6	4	3	1	1	1	1	0	0	13	12	13	14
Small Hardware	1	1	3	3	3	3	1	1	1	2	0	0	9	10	6	7
Totals	6	6	24	21	19	16	7	5	5	6	0	1	61	55	39	40

Table 3. Refusals and Non-Responses

Store Type /Sponsor	Cape Light	National Grid	NSTAR	Western Mass	Unitil	Participants	Non-Participants
Discount	4	0	0	0	0	4	12
Drug Store	1	2	3	1	0	7	0
Grocery	0	4	3	0	0	7	13
Large Home	1	5	3	2	0	11	2
Mass Merch / Membership	1	2	5	0	0	8	0
Small Hardware	0	0	0	0	0	0	10
Totals	**7**	**13**	**14**	**3**	**0**	**37**	**37**

At each store, surveyors collected information about the product characteristics and the prices of distinct packages of bulbs on the shelves. Information on a total of 2,849 CFLs packages was collected. Note that identical CFL models in different package groupings were counted as two observations in the shelf-stocking data.

The product information collected for each package consisted of the following:

- bulb type (CFL, incandescent, specialty, etc.)
- bulb style (A-line, spiral/twister, etc.)
- base type (screw, pin, candelabra, etc.)
- wattage
- lumens
- number of bulbs in the package
- number of packs on shelf

Our survey team also recorded special features such as dimmable, three-way, and ENERGY STAR designation.

Table 4 shows the CFLs recorded by wattage, package size, manufacturer, and retail channel of the four bulb types for which the pricing analysis was conducted: (1) standard twister-spirals; (2) A-Line bulbs; (3) floods; and (4) globes. These types accounted for 76% of all CFLs in the shelf-stocking survey. The remainder, which were not included in the pricing analysis, either did not have medium screw bases (e.g., the bases may have been pin, small screw or candelabra, GU, intermediate, or mogul) or they were three-way or dimmable twister-spiral, bug/party, flame/decorative, nightlights, torpedo/bullet, or tube CFLs. Again, it should be kept in mind that CFLs in large home improvement stores are underrepresented in the sample.

Table 4. CFLs Recorded by Wattage, Package Size, Manufacturer, and Retail Channel

	Standard Twister Spiral	A-Line	Flood	Globe
Wattage (%)				
Less than 11 Watts	11.0%	23.9%	1.3%	24.6%
11 to 15 Watts	42.3	62.0	56.9	63.8
16 to 20 Watts	15.9	10.6	12.8	10.7
21 to 25 Watts	15.1	1.4	18.2	0.4
Greater than 25 Watts	15.5	2.1	10.8	0.4
Total	100.0	100.0	100.0	100.0
Number of CFLs in Package (%)				
Quantity 1	48.3%	50.0%	66.2%	60.3%
Quantity 2	26.9	46.5	22.6	32.1
Quantity 3	7.9	3.5	5.9	7.6
Quantity 4	8.6	0.0	2.8	0.0
Quantity 5+	8.3	0.0	2.6	0.0
Total	100.0	100.0	100.0	100.0
Manufacturer (%)				
Bright Effects	10.2%	14.8%	15.4%	7.6%
Feit	3.9	0.7	1.8	3.1
GE	37.3	44.4	40.3	56.3
Home Depot	3.7	16.9	5.1	5.4
Sylvania	26.9	11.3	15.1	10.7
TCP	6.5	5.6	5.6	8.0
Other	11.5	6.3	16.7	8.9
Total	100	100	100	100
Retail Channel (%)				
Discount	3.2%	2.8%	1.8%	2.2%
Drug Store	9.1	7.7	7.9	6.7
Grocery	8.9	9.9	9.0	4.0
Large Home Improvement	27.1	38.0	39.5	14.7
Mass Merchandise	33.1	30.3	24.1	42.0
Membership	1.0	0.0	2.3	0.0
Small Hardware	17.5	11.3	15.4	30.4
Total	100.0	100.0	100.0	100.0
Sample size (n)	1422	142	390	224

The survey team also noted whether the bulbs were discounted by the PAs, had another discount, or were ENERGY STAR rated. Table 5 shows the percentage of CFLs of each type with these characteristics. The percentages of PA-discounted CFLs may be larger or smaller than those in

Table 3 depending on the actual percentage of PA-discounted CFLs in home improvement stores.[8]

Table 5. Percentage of CFLs with Discounts or ENERGY STAR label

	Standard Twister Spiral	A-Line Bulbs	Flood	Globe
PA Discounted (%)	6.2	7.0	15.4	10.3
Other Discounted (%)	6.7	14.1	12.3	10.3
ENERGY STAR labeled (%)	82.2	83.8	93.6	83.9

Note: Columns do not sum to 100% because categories are not mutually exclusive.

The results of the shelf-stocking survey were as follows:

- Standard, twister-spiral CFLs accounted for 49.9%.
- Floods, the next largest share of the estimation sample, accounted for 14%.
- Six percent of standard, twister-spiral CFLs received a PA incentive.
- Another six percent of standard, twister-spiral CFLS received a non-PA discount.
- Larger percentages of other CFL types received PA discounts.

Among the CFLs in the estimation sample, there is significant variation in the wattage, the quantity of CFLs per package, the manufacturer, and the sales channel. However, the most common CFLs were:

- Rated between 11 and 15 watts
- Packaged in a single or double pack
- Manufactured by General Electric or Sylvania
- Sold in a large home improvement or mass merchandise store

Shelf-Space Data

Surveyors also collected information about the dimensions (length, width, and height) of the shelf and display areas dedicated to different light bulb types: CFL, incandescent, halogen, LED, fluorescent, krypton, metal halide, neon, and high pressure sodium. This information was used to analyze the share of store shelf space dedicated to different lighting types.

Results

Cadmus analyzed data collected by KEMA from 85 stores regarding the amount of shelf space allocated to different lighting products. The information collected encompassed store type, metropolitan statistical area, PA service territory, and whether the store was selling CFLs

[8] Three of six home improvement stores surveyed by Cadmus were designated as participating in the CFL program. But at the time of the shelf surveys, we did not find any PA-discounted CFLs in participating or nonparticipating stores.

discounted by MassSave (participation). Shelf-space is measured in three dimensions as volume (shelf length x width x height).

Table 6 shows the mean percentage of shelf space dedicated to CFLs[9], incandescent bulbs, halogen bulbs, and other bulb types. It is further organized by whether the store was a participating or non-participating store.

The largest percentage of shelf space in both participating and non-participating stores was dedicated to incandescent bulbs. Participating stores had less shelf space allocated to lighting products, but a larger percentage of that space (33%) was allocated to CFLs. However, non-participating stores had only 14% of shelf space allocated to CFLs. This difference is statistically significant based on a t-test of means ($t=4.71$, $p<0.0001$).

Table 6. Allocation of Shelf Space to Lighting Technologies

Status	Count	Average Display Space (Cu. Feet)	CFL	Incandescent	Other
Participant	54	369	33%	43%	23%
Nonparticipant	31	618	14%	38%	48%

The store sample was designed to be representative of the channels through which program CFL sales occur, but because some home improvement stores refused to take part in the inventory, the final sample may not have been representative.

Table 7 shows the percentage allocation of shelf space to lighting products by retail distribution channel for participating and nonparticipating stores. Caution should be exercised in interpreting the results because of the small sample sizes for some store types. Among participants, discount and membership stores allocated the most shelf space to CFLs, 50% and 73%, respectively. Among nonparticipants, drug stores allocated the highest share of shelf-space to CFLs, with 52%. There were, however, significant differences in the allocation of shelf space to CFLs between participants and nonparticipants for several store types, including small hardware, discount, grocery, membership, and large home improvement. For instance, among home improvement stores, which were underrepresented in the sample, participants allocated 34% of shelf-space to CFLs while nonparticipants allocated 13%. Only in drug stores did nonparticipants allocate more relative space to CFLs than participants.

[9] Results are unweighted. Because sales by store data are not available we cannot compute a weighted area-wide average.

Table 7. Allocation of Space by Retail Distribution Channel

	Participants					Nonparticipants				
Store Type	Count	Average Display Space (CuFt)	CFL	Incandescent	Other	Count	Average Display Space (CuFt)	CFL	Incandescent	Other
Small Hardware	12	378	29%	40%	30%	5	79	15%	43%	42%
Discount	8	101	50%	34%	16%	3	12	14%	80%	6%
Grocery	11	113	27%	64%	10%	5	6	14%	79%	7%
Membership	2	542	73%	20%	7%	0	-	-	-	-
Drug Store	7	20	41%	58%	1%	3	25	52%	40%	8%
Large Home Improvement	3	955	34%	40%	25%	3	5348	13%	35%	52%
Mass Merchandise	11	844	30%	46%	24%	12	215	18%	56%	26%

Table 8 reports the results of a regression analysis of the percentage of shelf space allocated to CFLs as a function of participant status, sales channel, MSA, utility service territory, and survey month.[10]

[10] The MSA and utility service territory variables are not collinear because each of the MSAs is served by at least two utilities.

Table 8. Regression Analysis of Shelf Space Allocation

Variable	Parameter	Standard Error
Intercept	0.22	(0.10)
Participant	0.18*	(0.04)
Small Hardware	-0.04	(0.06)
Discount	0.08	(0.06)
Drug Store	0.19*	(0.06)
Mass Merchandise	-0.01	(0.05)
Large Home Improvement	0.03	(0.08)
Boston	0.08	(0.08)
Barnstable	0.07	(0.12)
Cambridge	0.00	(0.08)
Peabody	-0.04	(0.09)
Pittsfield	-0.24*	(0.11)
Springfield	-0.07	(0.12)
Worcester	0.04	(0.09)
NSTAR	-0.07	(0.05)
Cape_Light	-0.15	(0.13)
Unitil	-0.04	(0.08)
WMECO	-0.05	(0.09)
Municipality	-0.03	(0.16)
September	-0.21*	(0.10)
October	-0.08	(0.08)
November	-0.03	(0.08)
F-Value	35.91	
Adjusted R-Squared	0.50	
N	384	

Notes: Model estimated by OLS. The omitted category is grocery store type, Providence MSA, NGRID service territory, and December survey month. *denoted statistically significant at the 5% level.

According to these regression results, only four variables (participating status, drug store, Pittsfield MSA, and survey month) had statistically significant impacts on the allocation of shelf space.[11]

- On average, participating stores had 18% more shelf space allocated to CFLs than non-participating stores. This relationship result should be viewed as a correlation. Without more information about how stores became participants, it is not possible to infer that participation increased the allocation of shelf space to CFLs.
- Also, the shelf space allocated to CFLs was 19 percentage points higher in drug stores than in grocery stores. (Keep in mind, however, that the total amount of shelf space allocated to CFLs in drug stores was less than in grocery stores.)
- Stores in the Pittsfield metropolitan statistical area allocated a significantly smaller percentage of their space to CFLs than stores in other MSAs.

The estimated impacts of the other explanatory variables were imprecise and statistically insignificant.

[11] We estimated another version of the model in which we omitted utility fixed effects. The statistical significance and signs of the other coefficients did not change.

4. Hedonic Pricing Regression Model

Methodology

As part of the shelf-inventory survey, KEMA surveyors collected information about bulb prices displayed on packages and/or on store shelves. Our surveyors recorded the following:

- register price (the price paid by customers at the register)
- full or original price, if the bulb was discounted and the original price was observable
- the amount of any discount for each package, again if observable
- whether there was point-of-purchase sign indicating that the CFLs were discounted by MassSave

PA Tracking Database

Although many CFLs in sampled stores were labeled as "PA discounted," the amount of the discount was not displayed. In fact, the PA discount was not known even in instances where the retailer displayed the original and discounted retail prices on the sales tag because retailers were able to discount the CFLs by a different amount from the PA incentive. Thus, to determine the incentive amount, we matched CFLs in the shelf-stocking survey to the Mass Save® tracking database, which listed per-unit subsidies provided to industry partners between July 2010 and December 2010. This tracking database contains the following information:

- PA incentive amount
- CFL model number
- Manufacturer
- Store where the discounted bulbs were sold
- Quantity of discounted bulbs sold

Table 9 contains a summary of our efforts to match CFLs in the shelf-stocking survey to the PA incentives.

Table 9. PA Incentive Data

	Twister Spiral	A-Line Bulbs	Flood	Globe
PA Labeled only	18	1	6	-
Matched to Mass Save Database only	70	9	52	23
PA Labeled and Matched to Mass Save Database	-	-	2	-
N in shelf-stocking survey	1,422	142	390	224

Cadmus successfully matched 70 CFLs from the shelf-stocking data to the PA tracking database using information about manufacturer, model number, wattage, and store location.[12] The number

[12] For a match to occur, a bulb had to satisfy all of the criteria; however, we recognized that the same CFL is sometimes listed under two model numbers. For CFLs that matched on manufacturer, wattage, and store

of matches was five percent (70/1,422) of the twister-spiral CFLs in the shelf-stocking survey. Cadmus was able to match about the same percentage of A-Line bulbs (6%) and globes (6%), but a significantly higher percentage of floods (37%).

Some CFLs in the shelf-stocking data were labeled as discounted by the PA but could not be matched to the PA tracking database. There were 18 such twister-spirals, one such A-Line bulb, and six such floods.

Definition of PA-Discounted Bulbs

Based on the data available, there were two ways of identifying PA-discounted CFLs.

- Whether the bulb was advertised in the store as having a discount sponsored by the Mass Save.
- By matching CFLs in the shelf-stocking survey to the MassSave discount database. CFLs successfully matched to the MassSave database could definitively be counted as PA-discounted.

An inclusive, conservative approach would be to designate CFLs as being PA-discounted if they satisfied either condition, while a more strict definition would require that both conditions be satisfied. After considering the potential impacts, Cadmus chose the more inclusive definition of a PA-discounted CFL: A CFL in the shelf-stocking survey data was PA-discounted if it was successfully matched to the PA incentive data or if the CFL was labeled as PA-discounted. If a CFL did not satisfy either requirement, it was considered not discounted by MassSave.

We chose the more-inclusive definition because it allows for the possibilities that (1) some PA-discounted CFLs were not labeled as such, and (2) an error occurred in the matching process between the databases.[13]

Discounted CFLs that were not labeled as PA-discounted or could not be matched to the PA incentive data were classified as "other discounted" CFLs.

Statistical Analysis Approach

The statistical analysis approach analyzes the average retail prices of CFLs in Massachusetts to identify the impact of PA incentives. The analysis takes two forms.

- The first is a series of simple averages of prices for PA-discounted, other discounted, and non-discounted CFLs. For example, the average prices of incented spiral/twister CFLs

location but not on model number, we checked the Energy Star qualified CFL list to see if the models were the same. If they were, a CFL was counted as a match. Also, some CFLs in the shelf-stocking survey satisfied the manufacturer, wattage, and store location matching criteria and the model number criteria except for a few characters at the end of the model number. Unless the characters clearly indicated the CFLs were different, we treated these CFLs as successful matches.

[13] We performed robustness tests to check the sensitivity of our results to our definition of PA discount. We estimated the models omitting PA labeled CFLs, so that only CFLs matched to the MassSave database were included in the regression. We then ran another regression omitting matched CFLs but including PA-labeled CFLs. This was done only for twister-spiral CFLs as there were not enough CFLs of other types that were PA-labeled. We obtained results similar to those reported here.

and non-discounted CFLs in Massachusetts are compared. Formal tests confirm whether any differences are statistically significant.

- The second is a series of multivariate regression analyses. The regression models quantify the relationship between CFL prices per bulb and various characteristics (e.g., wattage, the number of bulbs in the package, and retail outlet). The multivariate analysis estimates the effect of the PA incentive on the price of CFLs, after controlling for the other characteristics.

By allowing for interactions between the incentive amount and the store or the CFL characteristics, the analysis can investigate whether the impact of a PA-discount varies by sales channel, wattage, etc.

Summary of Average Prices

Table 10 and Table 11 show the final register price information for PA-discounted, other-discounted, and non-discounted CFLs in the data set. Mean prices per bulb are presented for each of the four CFL types (i.e., standard, twister-spiral; A-bulb; reflector; and globe).

To control for bulb characteristics that are correlated with price, prices are distinguished by wattage category. For example, the average price of an undiscounted 11- to 15-W standard, twister spiral CFL was $4.23. With an average PA incentive, the same type of CFL cost $2.68, for a decrease in register price of $1.54.

In the last column of each table, we report the average PA incentive, which was obtained by linking CFLs to the PA program tracking database. The average PA incentive for standard, twister-spiral 11- to15-W CFL was $0.82. The store discount was 188% of the average incentive.

Table 10. Standard CFL Prices and PA Incentives by Wattage

CFL Type	Wattage	N	Price - All CFLs	Price-PA Discounted Bulbs	Price Other Discounted Bulbs	Price Not Discounted Bulbs	Difference Between PA Discounted And Non-Discounted Bulbs	Average PA Incentive Per Bulb
Standard Twister Spiral	<11W	157	$4.22	$2.81	$3.71	$4.46	($1.65)*	$0.75
Standard Twister Spiral	11-15W	602	$4.13	$2.68	$3.72	$4.23	($1.54)*	$0.82
Standard Twister Spiral	16-20W	226	$4.55	$2.83	$3.87	$4.80	($1.97)*	$0.75
Standard Twister Spiral	21-25W	215	$4.73	$3.62	$3.63	$4.87	($1.25)*	$0.75
Standard Twister Spiral	>25W	221	$6.19	$4.52	$4.75	$6.48	($1.95)*	$1.37
Standard Twister Spiral	**Total**	**1422**	**$4.62**	**$3.13**	**$3.95**	**$4.78**	**($1.64)***	**$0.87**

Note: All prices are per bulb at the register. N represents the number of CFL packages in sample. There was one Twister Spiral bulb in the sample with an unknown wattage. PA incentives are only for CFLS matched to PA tracking database. * denotes statistically significant at the 5% level.

Table 11. Specialty CFL Prices and PA Incentives By Wattage

CFL Type	Watt Category	N	Price All CFLs	Price PA Discounted Bulbs	Price Other Discounted Bulbs	Price Not Discounted Bulbs	Difference Between PA Discounted And Non-Discounted Bulbs	Average PA Incentive Per Bulb
A-Line	<11W	34	$4.87	$1.31	$2.63	$5.73	($4.42)	$2.75
A-Line	11-15W	88	$5.16	$4.34	$2.15	$5.81	($1.47)	$3.22
A-Line	16-20W	15	$6.75	-	-	$6.75		-
A-Line	21-25W	2	$7.75	-	-	$7.75		-
A-Line	>25W	3	$6.56	-	-	$6.56		-
A-Line	**Total**	**142**	**$5.32**	**$4.03**	**$2.34**	**$5.97**	**($1.94)**	**$3.17**
Flood	<11W	5	$6.61	-	$2.99	$7.82		-
Flood	11-15W	222	$6.21	$3.91	$4.25	$6.86	($2.95)*	$4.02
Flood	16-20W	50	$6.86	$4.09	$3.73	$8.02	($3.93)*	$5.32
Flood	21-25W	71	$6.79	$3.73	$4.20	$9.34	($5.61)*	$4.49
Flood	>25W	42	$7.89	$3.49	$6.49	$8.45	($4.96)*	$6.00
Flood	**Total**	**390**	**$6.59**	**$3.85**	**$4.50**	**$7.55**	**($3.70)***	**$4.48**
Globe	<11W	55	$5.88	$5.04	$5.67	$6.02	($0.98)	$3.39
Globe	11-15W	143	$5.63	$3.52	$3.76	$6.26	($2.74)*	$2.96
Globe	16-20W	24	$7.68	-	$5.50	$7.89		-
Globe	21-25W	1	$7.49	-	-	$7.49		-
Globe	>25W	1	$5.88	-	-	$5.88		-
Globe	**Total**	**224**	**$5.92**	**$3.92**	**$4.33**	**$6.40**	**($2.49)***	**$3.07**

Note: All prices are per bulb at the register. N represents the number of CFL packages in sample. PA incentives are only for CFLS matched to PA tracking database. * denotes statistically significant at the 5% level.

Table 10 and Table 11 show that PA incentives resulted in significant decreases in the average retail prices of CFLs.

- The average difference in price between PA-discounted and undiscounted standard, twister-spiral CFLs was $1.64. This was 34% of the retail price of undiscounted CFLs and almost twice the amount of the PA incentive.
- For A-line bulbs, the average difference in retail price between PA-discounted and non-discounted CFLs was $1.94, which is equal to 32% of the original purchase price, but only 61% of the PA incentive.
- For floods and globes, the differences in price were 49% and 39%, respectively, of the undiscounted price and approximately 80% of the PA incentive.

Regression Analysis

The summary statistics show that PA-discounted CFLs were cheaper than undiscounted or other discounted CFLs. However, there are various critical questions regarding the effect of the price difference, such as these:

- How much of the price differences shown in Table 10 and Table 11 reflect the effect of PA discounts?
- How much of the differences reflect other factors that may be correlated with discount of CFLs, such as retailers discounting lower quality, cheaper CFLs?

- What fraction or multiple of incentives is passed on to consumers in the form of lower retail prices? Is there a "multiplier effect", i.e. does a dollar of PA discount result in a more than one dollar reduction in retail price?
- Does the impact of the PA incentive vary by retail sales channel?

Cadmus' strategy for answering these questions was to estimate a hedonic pricing model in which the price of a product is regressed on the product's characteristics.[14] The theory underlying the hedonic pricing model is that variation in the price of a product can be explained by the product's observable attributes, which are not explicitly traded in the market. In the model, the coefficient corresponding to an attribute represents the "implicit price" of the untraded attribute. The hedonic pricing model, therefore, allows one to recover prices or values of attributes or goods that are not observed.

The CFL pricing model used in this study followed the basic hedonic formulation:

$$\text{Register price per bulb} = \beta_0 + \beta_1 \text{DiscountPA} + \beta_2 \text{DiscountOther} + \beta_3 \text{Product Characteristics} + \beta_4 \text{Retail Channel} + \beta_5 \text{MetroArea} + \beta_6 \text{MonthYear} + \varepsilon$$

Where:

- The dependent variable was the price per bulb in the package.
- The independent variables were the characteristics of the CFL (wattage and ENERGY STAR Label, where 1=Yes, 0=No).
- The dummy variables were used for the number of bulbs in the package and the fixed effects (the manufacturer, metropolitan statistical area, and year-month).

We allowed the impact of the number of CFLs in the package on the price per bulb to vary non-parametrically (i.e., without making functional form assumptions) with the number of bulbs in the package. This was done by including separate indicator variables for the number of CFLs in the package.[15]

In addition, the right-side variables included indicator variables for whether the package was discounted by a PA (1=Yes, 0=No) or by another source, such as the retailer (1=Yes, 0=No). We expect both variables to have negative and statistically significant effects on register price, but the magnitudes of the coefficients are *a priori* unclear.

[14] See Malpezzi, Stephen (2002). " Hedonic Pricing Models: A Selective and Applied Review." In Housing Economics: Essays in Honor of Duncan Maclennan. Also, Sheppard, Stephen (1999). Hedonic Analysis of Housing Markets. In Paul C. Chesire and Edwin S. Mills (eds.), Handbook of Regional and Urban Economics, v3. Elsevier.

[15] The price per bulb is typically decreasing in the number of bulbs in the package. However, the relationship may be non-linear. We selected a functional form that allows the relationship between price per bulb and number of bulbs to vary in a general way. If we were make assumptions about the functional relationship between price per bulb and the number of bulbs that were incorrect, this would have the effect of introducing additional error in the model and reducing the statistical precision of the estimates.

Finally, to test the hypothesis about the relationship between retail channel and the impact of the PA discounts, our team needed to augment the main regression equation with interaction terms between PA incentives and the sales channel variables.

Results

In this section, we report the results of the Ordinary Least Squares (OLS) estimation of the hedonic CFL pricing model. We estimated separate models for each bulb type. We report estimates of the coefficients for only select variables, including the PA discount and Other Discount variables. (The complete regression results for each CFL type are in Appendix B.)

Table 12 shows results from the estimation of several specifications of the hedonic model for standard, twister-spiral CFLs. We began by estimating a very parsimonious specification (Model 1) that contained only the following:

- PA discount and Other discount variables
- ENERGY STAR label
- Watts
- Package quantity variables

In models 2 through 5, we progressively added dummy variables for the following[16]:

- Manufacturer (Feit Electric, General Electric, Sylvania, Bright Effects, TCP, Home Depot)
- Sales channel (Discount, Grocery, Hardware, Home Improvement, Mass Merchandise)
- Metro area
- Month

[16] In each of these dummy variable groups, the impact of the variables is measured relative to an omitted category. The omitted manufacturer is "Other". The omitted sales channel category is drug store. The omitted metro area category is a store in the Providence –New Bedford-Fall River metro area. The omitted month is December. For example, if the coefficient on Grocery is 0.54, then *ceteris paribus* the price per bulb is $0.54 greater on average in grocery stores than in drug stores.

Table 12. Regression Analysis of Standard, Twister-Spiral CFL Retail Prices

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Intercept	7.91*	6.69*	6.97*	7.42*	7.42*	7.23*
	(0.16)	(0.19)	(0.24)	(0.29)	(0.32)	(0.31)
PA Discount	-0.98*	-1.16*	-1.22*	-1.49*	-1.46*	0.59
	(0.20)	(0.19)	(0.18)	(0.19)	(0.19)	(0.54)
Other Discount	-0.88*	-1.09*	-1.24*	-1.36*	-1.37*	-1.36*
	(0.19)	(0.17)	(0.16)	(0.17)	(0.17)	(0.16)
Energy Star	-0.89*	-0.81*	-0.90*	-0.90*	-0.88*	-0.88*
	(0.13)	(0.12)	(0.11)	(0.11)	(0.11)	(0.11)
Small Hardware Store * PA Discount						-5.15*
						(0.74)
Discount Store * PA Discount						-1.70
						(1.19)
Membership Store *PA Discount						-1.19
						(1.62)
Mass Merchandise Store * PA Discount						-1.80*
						(0.60)
Wattage	Yes	Yes	Yes	Yes	Yes	Yes
Pack Quantity	Yes	Yes	Yes	Yes	Yes	Yes
Manufacturer	No	Yes	Yes	Yes	Yes	Yes
Retail Channel	No	No	Yes	Yes	Yes	Yes
MSA	No	No	No	Yes	Yes	Yes
Site Visit Month	No	No	No	No	Yes	Yes
F-Value	102.93	96.63	87.89	69.86	64.36	60.94
Adjusted R-Squared	0.44	0.54	0.59	0.60	0.60	0.61
N	1406	1406	1406	1406	1406	1406

Notes: Dependent variable in all models is price per bulb. Standard errors in parentheses. All models estimated by OLS. * denotes statistically significant at the 0.05 level.

In Model 1, the impact of the PA discount was to reduce the average retail price of a standard, twister-spiral CFL by $0.98. The addition of manufacturer dummy variables (fixed effects; inclusion denoted by a "yes" in Table 12) in Model 2 and retail channel in Model 3 increased the estimated impact to approximately $1.20. After adding controls for the Metropolitan Statistical Area and the Site Visit Month in models 4 and 5, the estimated impact of the PA discount increased significantly to $1.50. All of the estimated PA discount coefficients in models 1 through 5 are statistically significant at the 0.01 level. Model 5 is our preferred specification because it includes the large number of explanatory variables and has the greatest explanatory power (based on the adjusted R^2).

In Model 6, we tested the hypothesis that the impact of a PA discount on retail price varied by sales channel by interacting the sales channel with PA discount. The model did not include an interaction variable between home improvement store and PA discount because none of the CFLs in home improvement stores were labeled as PA-discounted or were matched to the MassSave database. The coefficients on the interaction between a PA discount and such variables as small hardware, discount, and mass merchandise are individually statistically significant or almost statistically significant at the 0.05 level. Our study revealed that PA-discounted CFLs sold for approximately $1.75 less in discount and mass merchandise stores than in grocery stores (the omitted category). Also, the PA-discounted CFLs offered in small hardware stores were significantly cheaper than CFLs sold through other channels. Based on an

F-test, we rejected the hypothesis that the interaction variables between sales channel and PA discount were jointly insignificant (F=13.44, p< 0.0001).

Table 13 reports the results of only Model 5's specification for A-Line bulbs, floods, and globes. (The results of the other model specifications are in Appendix B.)

The average impact of a PA discount was to reduce the register price of an A-line bulb by $2.67, a reflector CFL by $3.61, and a globe by $2.33. All of these price reductions are statistically significant at the 1-percent level.

Table 13. Regression Model Results of A-Line, Reflector, and Globe CFLs

Variable	A-Line Bulb	Flood	Globe
Intercept	6.65*	9.09*	8.01*
	(1.17)	(0.97)	(1.77)
PA Discount	-2.67*	-3.61*	-2.33*
	(0.51)	(0.35)	(0.43)
Other Discount	-3.48*	-2.06*	-1.39*
	(0.40)	(0.36)	(0.36)
Energy Star	-0.29	-0.28	-0.38
	(0.3)	(0.46)	(0.31)
Wattage	Yes	Yes	Yes
Pack Quantity	Yes	Yes	Yes
Manufacturer	Yes	Yes	Yes
Retail Channel	Yes	Yes	Yes
MSA	Yes	Yes	Yes
Site Visit Month	Yes	Yes	Yes
F-Value	13.89	20.04	11.24
Adjusted R-Squared	0.73	0.62	0.61
N	142	384	217

Notes: Dependent variable in all models is price per bulb. Standard errors in parentheses. All models estimated by OLS. * denotes statistically significant at the 5 percent level.

In addition to estimating the average impact of a PA discount on the retail price of CFLs, Cadmus estimated the average reduction in retail price per dollar of the PA incentive. This is a "realization rate," indicating how much of the PA incentive was passed along to the consumer in the final sales price. In Figure 1, the realization would be $(P^0-P_1)/s$.

We estimated realization rates by substituting the incentive amount for the dummy variable for PA discount in the CFL price regressions. These models were estimated only with CFLs matched to the PA incentives listed in the tracking database. Table 14 reports estimates of the realization rates for the different CFL types using our preferred Model 5 specification.

Table 14. Estimated PA Discount Realization Rates by Bulb Type

Bulb Type	Realization Rate	Standard Error
Twister-Spiral	-1.17*	-0.24
A-Line Bulb	-0.71*	-0.17
Flood	-0.83*	-0.08
Globe	-0.76*	-0.13

Notes: Dependent variable in all models is price per bulb. All models estimated by OLS. * denotes statistically significant at the 5 percent level.

The realization rate was greater than one for twister-spiral CFLs and less than one for the other CFLs. Specifically,

- For every dollar the PA's paid the industry partners for sales of standard, twister-spiral CFLs, the retail price decreased by $1.17. This amounts to a realization rate of 117%.
- The realization rates for A-line bulbs, floods, and globes ranged from 71% for A-line bulbs to 83% for floods, meaning that the discount was *less than* the incentive paid by the PAs. These CFLs may have realization rates less than one because retailers had more power to choose the prices of these specialty products than the prices of standard, twister-spirals.[17] Thus, retailers would have been able to keep a larger share of the PA incentives.[18]

[17] Specialty CFLs are differentiated products that are not as ubiquitous in the market as twister-spirals. Retailers may have faced less competition for sales of specialty CFLs, giving them the ability to keep the prices of discounted bulbs high.

[18] It is also possible that manufacturers are not passing along the full amount of the incentive to retailers.

5. Conjoint Survey

Methodology

Cadmus chose a conjoint survey for this evaluation because it provides an objective methodology to trade-off price and non-price attributes without directly asking the customer what they are willing to pay. Conjoint analysis surveys provide respondents with descriptions of different goods, characterized by a consistent set of six or less distinct attributes (the levels of which vary across questions). Respondents are asked to choose between the different options presented. A fundamental benefit of this conjoint analysis approach is that the questions provide an experience similar to real-world decision making – whereby multiple attributes are considered simultaneously. Additionally, a conjoint approach provides results that allow the importance of each attribute, including price, to be estimated.

To achieve a sample error of 95% confidence and 5% precision, and a sample size recommended for conjoint analysis, Cadmus recruited a total of 300 Massachusetts participants. These recruits were selected in accordance with specific demographic and geographic targets designed to align our survey with the state's American Community Survey. Table 15 and Table 16 show targeted and actual recruitment results for geographic diversity and demographic variables, respectively. (Appendix C contains the recruiting script.)

Table 15. Geographic Recruitment Levels

MA Counties	Target	Actual
Barnstable	19	19
Bristol; Plymouth	48	53
Essex ; Middlesex	101	108
Norfolk ; Suffolk	64	72
Worcester	36	38
Franklin; Hampden; Hampshire; Berkshire	32	32
MA Total	**300**	**322**

Table 16. Demographic Recruitment Levels

Demographic	Level	MA Target	MA Actual
Age	65 +	17%	18%
	18-64	83%	82%
Ethnicity	White	86%	88%
	Nonwhite	14%	12%
Home Ownership	Own	62%	78%
	Rent	38%	22%
Education	College	67%	56%
	No college	33%	44%
Children	No kids	70%	64%
	Kids	30%	36%
Income	Below median	50%	43%
	Above median	50%	57%

The following screening criteria were applied:

- Potential participants were limited to those involved in purchasing decisions for their households.
- Potential participants were limited to those who were customers in one of the PA territories.

Additionally, all potential participants were asked what percentage of their light sockets had CFLs and then characterized as follows, based on their response.

- from 0 to 20%, a "low user"
- from 21 to 40%, a "mid user"
- 41% or more, a "high user"

Participants were recruited by Population Research Systems (PRS), a market research company, which used listed telephone samples of households within the relevant counties. Cadmus and the sponsors desired to target at least 30% of participants to take the survey in person, so PRS used telephone samples purchased for regions within 10 to 15 miles of the six regional survey locations (Hadley, Fall River, Milton, Bedford, Worcester, and Bourne), with one designated day per site. Cell phone samples were also purchased and called, but only on weekends when cell minutes are typically free.

PRS offered the in-person survey first; however, for participants willing to participate but unable to attend at the offered site location and time, PRS provided a Website link to allow completion of the survey over the Internet.

Towards the end of the recruiting period, the recruiter advertised for survey participants on Craigslist to target demographic categories that had been under-represented through traditional recruiting methods, specifically, those between the ages of 18 and 64 who (1) rented their homes, (2) did not attend college, (3) were below the median income, and (4) were non-white. Eight online surveys were completed by customers recruited through Craigslist.

In-person respondents were supervised in groups of up to eight people, with an allotted time of 45 minutes per group. The number of groups held each day depended on the number of participants that chose the in-person option. A total of 32% took the survey in person, while 68% completed the survey from home over the Internet. As an incentive to complete the survey, the in-person participants were paid $50 and at-home participants were paid $30.

Questionnaire

Sawtooth Software, proprietary Web-based survey software, was utilized to do the following:

- generate the random choice survey questions (computer generated questions with random levels of specialty CFL attributes that vary by participant)
- compile data
- analyze results

The questionnaire was organized in two sections, each consisting of 15 random- choice questions and one fixed-choice question that was specified by Cadmus and asked twice of all participants to check response consistency. The first section compared an A-line specialty CFL bulb to a standard incandescent bulb, and the second section compared a specialty CFL flood light to an incandescent flood light. At the end of the CFL flood light section, participants were asked several direct response questions, which gathered awareness and self-reported attribute ranking information. The attributes and their associated levels for both the A-line and flood CFL segments are identified in Table 17.

Table 17. A-Line and Flood (Specialty CFL) Survey Attributes and Levels

Attribute	A-Line	Flood	Incandescent
Bulb Type	CFL bulb; Length = 4.3"; must be recycled; saves $8/year on energy bills	CFL bulb; must be recycled; saves $8/year on energy bills	Incandescent; Length = 3.75" (included only for A-Line survey); can be thrown away; No energy savings
Price	$1.00 - $8.00	$2.00 - $15.00	$0.50 - $1.50 A-Lines; $2.00 - $6.00 Floods
Lifetime	4, 6, or 8 times the lifetime of standard bulb	4, 6, or 8 times the lifetime of standard bulb	Standard life or 1.3 times standard life
Price Promotion	$4.00 discount (1 bulb); Buy 2, get 1 free; 50% off; $12 off 4 pack; coupon for 50% off; None	$4.00 discount (1 bulb); Buy 2, get 1 free; 50% off; $12 off 4 pack; coupon for 50% off; None	None
Brand	N/A	GE, Sylvania, Maxlite, Green-lite, Store	GE, Sylvania, Store
Light Color	Cool white; Daylight; Natural White; Warm White; Soft White	N/A	Soft White
Recommendation	A sign in the store says this bulb is recommended by your local EESP; You received a printed retailer mailer recommending this bulb; The bulb has an ENERGY STAR label on it.	N/A	None
Information	N/A	A salesperson assures you that this light bulb will be the right fit and color for your fixture; A printed guide in the store identified this light bulb as being appropriate for your fixture; In-store interactive display shows actual bulbs so you can see the light color and shape; A sign by this bulb highlights it as the latest technology; This bulb was in a special display right in the front of the store; None	None

To ensure reliable results, certain constraints were set that prohibited the program from displaying a choice containing unrealistic product combinations. For instance, the lowest price bulb could not compete against the highest price bulb.

Survey Scenarios

Each survey section began with the following scenario descriptions:

A-Line CFLs

"Assume that a light bulb needs to be replaced in your home. You should also assume that it is a bulb that is used frequently, it is a regular screw-in light bulb, and it is NOT intended for a dimmable or a 3-way light fixture. This survey will ask you to consider a number of different light bulbs, all having the same light output. Each survey question will ask you to look at three different bulbs with different characteristics and choose the one you'd be most likely to buy."

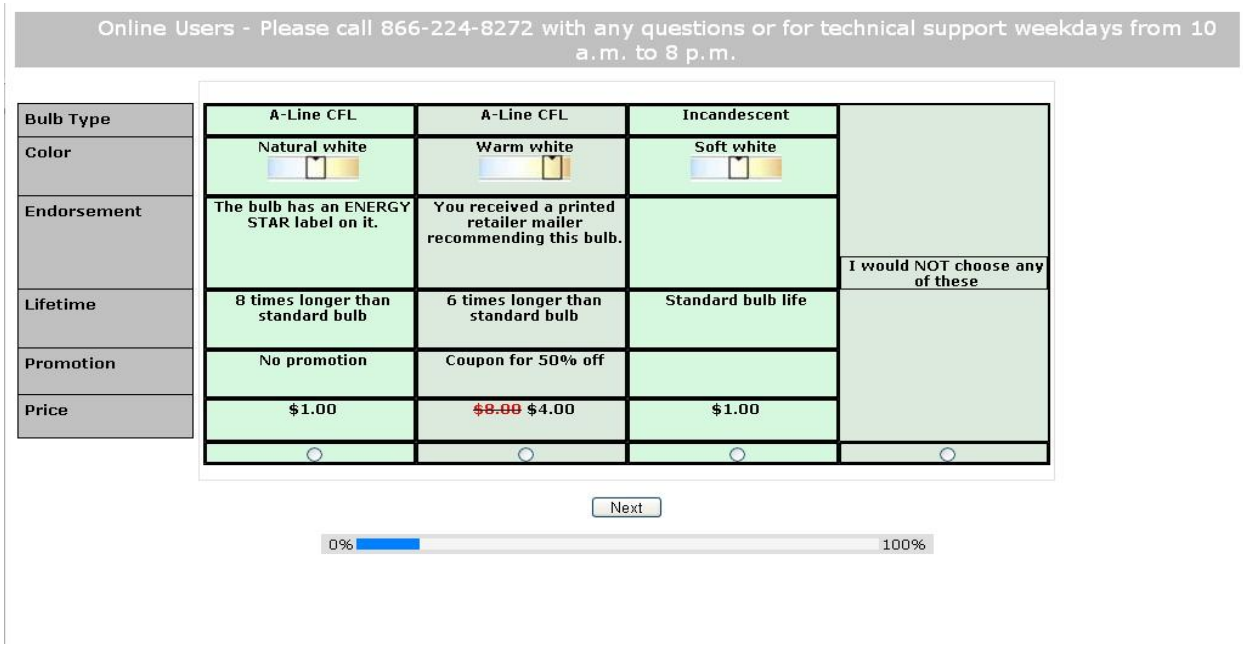
Flood CFLs

"Just like the first section, please assume you are replacing a light bulb in your home. This time, the bulb is in an overhead recessed can fixture; this type of bulb is commonly called a Flood or Reflector bulb. Also assume that the bulb is not dimmable, the bulb is not a 3-way bulb, and the bulb is in a high-use area of your home. We will ask you to consider a number of different light bulbs, all having the same light output. Each survey question will ask you to look at three different bulbs having different characteristics and choose the one you'd be most likely to buy."

Detailed explanations of each of the attributes were also provided during the on-line introduction to the survey.

Figure 2 illustrates an actual question to the conjoint, online survey participants.

Figure 2. Sample Conjoint Survey Question



Weighting and Segmentation

Cadmus weighted the data based on the targeted recruitment versus the actual recruitment for each demographic and geographic target. That is, the individual participants received a composite weight reflecting their contribution to each demographic or geographic target.

We also performed segmentation analysis by age, household income, education level, CFL usage, ownership of household, gender, the hard-to-reach (HTR) population (low income, minority, without college degrees, renters, and elderly), and based on answers to specific direct-response questions.

An incandescent bulb was included as a choice in the simulation to allow for non-CFL purchases as well, since incandescent bulbs were part of the survey design.

Price Elasticity

To compute elasticity, the Sawtooth software simulated the participants' willingness to pay (WTP) for one CFL configuration versus another at different price points. The market shares (willingness to pay for each price point) calculated for each product are based on the composite weighted survey participant results. In other words, the WTP for a particular configuration of one CFL (choosing a particular level for each attribute) is compared to the WTP of an identical CFL at each of the price levels for the CFLs.

Elasticity was computed by finding the best fit equation for the WTP market shares associated with each price point. In this case (for both A-line and flood results), an exponential equation was fit to the data points, as demonstrated in Figure 3 and Figure 4. We used an exponential equation—which has the advantage of mimicking real-world purchasing behavior—since the elasticity will effectively change based on where on the price curve the purchasing decision will be made.

According to Sawtooth documentation, the success of the simulation approach is contingent upon a number of assumptions, such as:

- The conjoint method produces accurate measures of price sensitivity.
- The relevant attributes have been included in the simulation model.
- The relevant competitive offerings are reflected in the simulation model.

This conjoint study produces accurate measures of price sensitivity similar to other CFL price sensitivity studies, and our results show that prices move in expected direction with reasonable magnitude.

All relevant attributes have been included in the simulation model:

- A-line
  - CFL: Soft white color; ENERGY STAR recommendation; 8-year life; No promotion
  - Incandescent: 1000-hour life, $0.75 price
- Flood
  - CFL: GE brand, Interactive display, 8-year life, No promotion
  - Incandescent: 1000 hour-life, $3 price

Cadmus incorporated relevant CFL competitive offerings into our simulation model: two CFLs with the exact same attributes except one had a discounted price, and a third option of an incandescent bulb.

To estimate the net-to-gross impacts of the Mass Save® residential lighting program, we calculated the elasticity associated with the two CFL surveys (flood and A-line bulbs) using the estimated market share at two key price points: the average full non-discounted price and the average fully-discounted price.

We estimated both of the price points using the hedonic pricing regression model (described in a preceding section). The ratio between the non-discounted price point market share and the discounted price point market share can be considered the free-ridership value—the market share that would have purchased a CFL bulb regardless of the program incentives. This is demonstrated by the following equation:

[market share of original non-discounted price] ÷ [market share of discounted price].

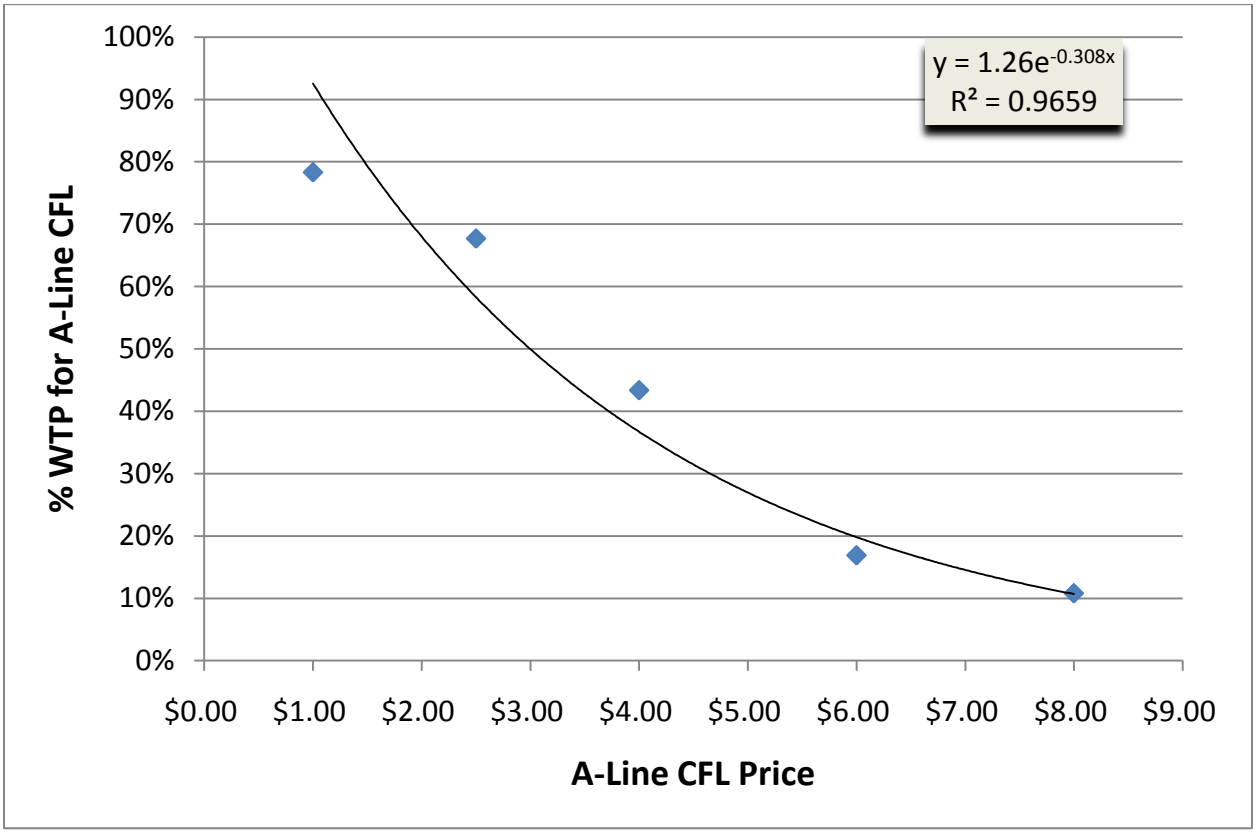
We derived the net-to-gross from the free-ridership estimate by subtracting the free-ridership ratio from 1. This methodology is illustrated in the Results section, where the actual survey results are used to generate the NTG value individually for A-line and flood CFL bulbs. The derivation of the elasticity equation is described in detail in Appendix D.

Results

Price Elasticity

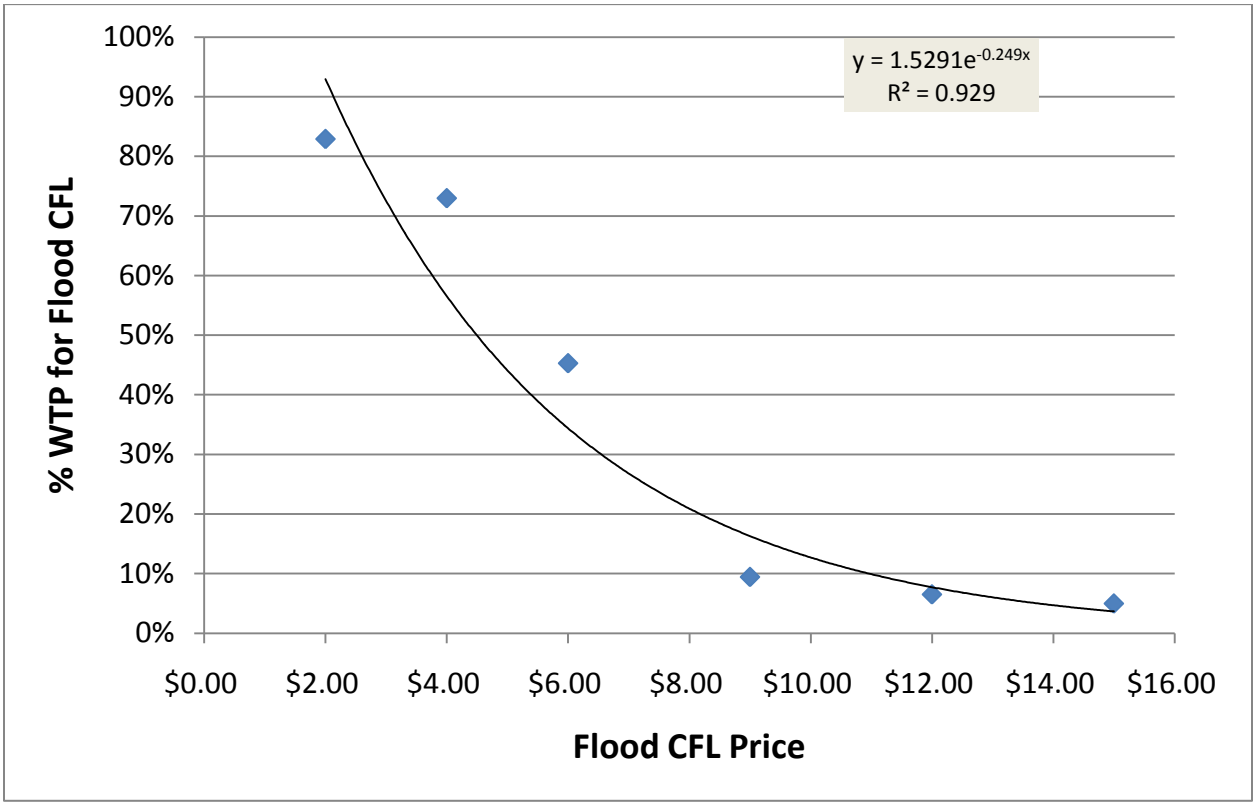
The price elasticity of an A-line CFL (with attributes of an eight-year lifetime, soft white color, ENERGY STAR labeling/recommendation, and no promotion) was -0.308x. At $3.25, demand is unitarily elastic (1÷0.308), while a $0.75 priced A-Line bulb would capture 100% of the market share. Increasing price discounts below this $3.25 threshold will not have as great an impact on market share as price discounts made above this price point. Figure 3 illustrates the price elasticity for an A-line CFL.

Figure 3. A-Line CFL Simulation



The price elasticity of a flood CFL (with attributes of GE brand, interactive display, eight-year life, and no promotion) was -0.249x. At $4.02, demand is unitarily elastic (1÷0.249), while a $1.70 priced flood bulb would capture 100% of the market share. Increasing price discounts below this $4.02 threshold will not have as great an impact on market share as price discounts made above this price point. Figure 4 illustrates the price elasticity for a flood CFL.

Figure 4. Flood CFL Simulation



Hedonic Pricing Regression

According to our hedonic pricing regression analysis, the average full price paid for A-line bulbs was $5.42, the average estimated discount was $2.67, and the final discounted price was $2.75. Using these price points as inputs into the exponential equation from Figure 3, we derive that the proportion of the population willing to pay the non-discounted price of $5.42 was 23.7%, while the proportion willing to pay the discounted price of $2.75, was 54.0%. Therefore, we estimate free-ridership at the discounted price for A-line CFL bulbs to be 43.9%, and the corresponding NTG ratio, 56.1% (or 0.561).

According to our hedonic pricing regression analysis, the average full price paid for flood bulbs was $7.09, the average estimated discount was $3.61, and the final discounted price was $3.48. The proportion of the population willing to pay the non-discounted price of $7.09, was 26.2%, while the proportion willing to pay the discounted price of $3.48, was 64.3%. Therefore, we estimate free-ridership at the discounted price for flood CFL bulbs to be 40.7%, and the corresponding NTG ratio, 59.3% (or 0.593).

Recommendation

Cadmus recommends using a weighted average NTG across these two estimates, based on the proportion of A-line to flood CFLs sold in Massachusetts during the program years. This A-line-to-flood proportion is estimated to be 22.4% for A-line to 77.6% for floods. Therefore, Cadmus' recommended NTG value, based on the conjoint survey, for the specialty light bulbs is 58.6% or

0.586. This is the value that the evaluation team will provide to the Delphi Panel for consideration.

Appendix A. Shelf Survey Input Form

Massachusetts Shelf Stocking Study Data Collection Instrument

Field staff name:	
Store name:	Date:
Store street address:	Store city and state:
Store type:	Store zip code:
Store manager name:	Store manager actual title:

The NMR Group, along with the Cadmus Group Inc. and KEMA, is conducting a study on behalf of the energy efficiency program administrators in the State of Massachusetts regarding compact fluorescent lighting in an effort to evaluate and improve their energy efficiency programs. As part of this study, we are going to retail stores across the state to learn about their sales and stocking practices for light bulbs and lighting fixtures. Your responses are confidential and will not be linked to your particular store by name or address.

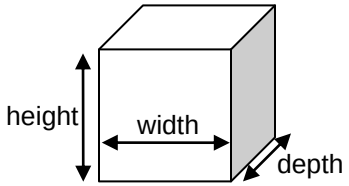
SECTION I: STORE AUDIT FORM (BULBS ONLY)

1. Measure light bulb displays.

ALL MEASUREMENTS IN INCHES

HEIGHT = top to bottom

WIDTH = left to right
DEPTH = front to back



If all displays of a certain type (e.g., all aisle displays) have the same measurements, record all as "SIZE 1" and indicate the number of similar displays in the "# displays of this size." If displays of a certain type have different measurements, record them separately (as size 1, size 2, size 3, etc.). Use additional sheets if necessary.

Display Type	# Displays (of this type and size)	Total Display Dimensions			% Display Space by Bulb Type				
							Other Types		
		Height	Width	Depth	CFL	Incan-descent	Halogen	LED	Other
Aisle, Shelf, or Shelves – SIZE 1 (Bulbs displayed on wall/shelves in aisle)									
Aisle, Shelf, or Shelves – SIZE 2									
Aisle, Shelf, or Shelves – SIZE 3									
Endcap – SIZE 1 (End of aisle display, perpendicular to aisle)									
Endcap – SIZE 2									
Endcap – SIZE 3									
Free-standing display / pallet – SIZE 1 (Not mounted/hung on a wall)									
Free-standing display / pallet – SIZE 2									
Free-standing display / pallet – SIZE 3									
Other 1 Describe:									
Other 2 Describe:									
Other 3 Describe:									

Store name/City/Date: _____

Code List Table

Auditor Note: use the following Bulb Codes for the bulb types depicted.

Bulb Style	Code	Image	Bulb Style	Code	Image
1. Spiral/twister	**TW**		7. Circline	**CI**	
2. Globe (e.g., for bathroom vanity fixtures)	**GL**		8. Tube Style	**TU**	
3. A-lamp (shaped like standard incandescent)	**AL**		9. Night Light	**NL**	
4. Torpedo/ Bullet	**TO**		10. Decorative/ Flame	**FL**	
5. Bug/Party light (colored bulbs)	**BU**		12. Linear Fluorescent	**LI**	
6. Spotlight/ reflector/flood	**SP**		11. Other (Describe to right of table)	**OT**	

Base Type Codes		Lighting Type Codes	
Screw (medium)	**S**	CFL	**CFL**
Pin	**P**	LED	**LED**
GU-type	**GU**	Incandescent	**INC**
Candelabra (small screw)	**C**	Fluorescent	**FL**

Fixture Location/Type			
Ceiling	**C**	Track Lighting	**TR**
Wall	**W**	Landscape/Walkway	**LA**
Floor Lamp	**FL**	Recessed	**R**
Desk Lamp	**D**	Chandelier	**CH**
Vanity/Bathroom	**V**	Other	**O**

Store name/City/Date: _____

SECTION II. CFL & LED INVENTORY DATA COLLECTION FORM

Manufacturer/ Brand	Bulb Type (LED or CFL)	Bulb Style Code (from Code List Table,)	Base Type[1]	Model Number	Location[2]	Qty in Pack	PA Sponsor labeled[3]	Full/ Original Price[4]	Discount Amount (if on sale/discounted)	Discounted Price (if on sale/ discounted)	Lumens	Wattage	3-way?	Dimmable?	ENERGY STAR?
								$	$	$			☐	☐	☐
								$	$	$			☐	☐	☐
								$	$	$			☐	☐	☐
								$	$	$			☐	☐	☐
								$	$	$			☐	☐	☐
								$	$	$			☐	☐	☐
								$	$	$			☐	☐	☐
								$	$	$			☐	☐	☐
								$	$	$			☐	☐	☐
								$	$	$			☐	☐	☐
								$	$	$			☐	☐	☐
								$	$	$			☐	☐	☐
								$	$	$			☐	☐	☐
								$	$	$			☐	☐	☐
								$	$	$			☐	☐	☐
								$	$	$			☐	☐	☐
								$	$	$			☐	☐	☐
								$	$	$			☐	☐	☐

1 Screw, Pin, GU, Candelabra
2 A=Aisle, E=End-cap, D=Free-standing display, O=Other
3 Yes/No
4 If discounted, record price before discount. If not discounted, record product price.

IF ONLY ONE PRICE SHOWN: Try to determine whether it's a discounted price/sale price or if it's a full-priced CFL. If sale price: record value in "Discounted price." If full price: record value in "Original Price."

SECTION III. ENERGY STAR LIGHT FIXTURE INVENTORY DATA COLLECTION FORM

Manufacturer/ Brand	Fixture Type[1]	Lighting Type[2]	Bulb Style Code[3]	Base Type[4]	Model Number	Location[5]	Sockets per Fixture	PA Sponsor labeled[6]	Full/ Original Price[7]	Discount Amount (if on sale/discounted)	Discounted Price (if on sale/ discounted)	3-way?	Dimmable?	Outdoor?	Fan Included?
									$	$	$	☐	☐	☐	☐
									$	$	$	☐	☐	☐	☐
									$	$	$	☐	☐	☐	☐
									$	$	$	☐	☐	☐	☐
									$	$	$	☐	☐	☐	☐
									$	$	$	☐	☐	☐	☐
									$	$	$	☐	☐	☐	☐
									$	$	$	☐	☐	☐	☐
									$	$	$	☐	☐	☐	☐
									$	$	$	☐	☐	☐	☐
									$	$	$	☐	☐	☐	☐
									$	$	$	☐	☐	☐	☐
									$	$	$	☐	☐	☐	☐
									$	$	$	☐	☐	☐	☐
									$	$	$	☐	☐	☐	☐
									$	$	$	☐	☐	☐	☐

1 From Code List Table
2 CFL, LED, Inc, FL If bulb included
3 From Code List Table, if bulb included
4 Screw, Pin, GU, Candelabra
5 A=Aisle, E=End-cap, D=Free-standing display, O=Other
6 Yes/No
7 If discounted, record price before discount. If not discounted, record product price.

Appendix B. Regression Model Outputs

Table B.1 Regression Outputs for Retail Price Analysis of Standard, Twister-Spiral CFLs

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Intercept	7.91	6.69	6.97	7.42	7.42	7.23
	(0.16)	(0.19)	(0.24)	(0.29)	(0.32)	(0.31)
IOU Discount	-0.98	-1.16	-1.22	-1.49	-1.46	0.59
	(0.20)	(0.19)	(0.18)	(0.19)	(0.19)	(0.54)
Other Discount	-0.88	-1.09	-1.24	-1.36	-1.37	-1.36
	(0.19)	(0.17)	(0.16)	(0.17)	(0.17)	(0.16)
Energy Star	-0.89	-0.81	-0.90	-0.90	-0.88	-0.88
	(0.13)	(0.12)	(0.11)	(0.11)	(0.11)	(0.11)
Less or Equal to 10 W	-1.97	-1.85	-1.84	-1.84	-1.87	-1.84
	(0.18)	(0.17)	(0.16)	(0.16)	(0.16)	(0.15)
11 to 15 W	-1.76	-1.72	-1.65	-1.64	-1.65	-1.63
	(0.14)	(0.13)	(0.13)	(0.12)	(0.12)	(0.12)
16 to 20 W	-1.37	-1.24	-1.26	-1.24	-1.24	-1.20
	(0.17)	(0.15)	(0.14)	(0.14)	(0.14)	(0.14)
21 to 25 W	-0.94	-0.88	-0.78	-0.75	-0.76	-0.77
	(0.17)	(0.17)	(0.17)	(0.16)	(0.16)	(0.16)
Quantity - 2-Pack	-1.42	-1.52	-1.60	-1.61	-1.61	-1.63
	(0.11)	(0.11)	(0.10)	(0.10)	(0.10)	(0.10)
Quantity - 3-Pack	-2.12	-2.44	-2.67	-2.70	-2.71	-2.75
	(0.19)	(0.17)	(0.17)	(0.17)	(0.17)	(0.17)
Quantity - 4-Pack	-3.18	-2.40	-2.40	-2.38	-2.39	-2.44
	(0.17)	(0.17)	(0.17)	(0.16)	(0.16)	(0.16)
Quantity - 5-Pack or More	-3.33	-3.18	-3.12	-3.12	-3.12	-3.17
	(0.18)	(0.17)	(0.17)	(0.17)	(0.16)	(0.16)
Manufacturer: GE		1.39	0.75	0.89	0.98	0.93
		(0.16)	(0.16)	(0.16)	(0.16)	(0.16)
Manufacturer: Sylvania		1.93	1.79	1.78	1.82	1.80
		(0.15)	(0.16)	(0.16)	(0.16)	(0.16)
Manufacturer: Bright Effects		0.12	0.52	0.52	0.59	0.61
		(0.19)	(0.21)	(0.21)	(0.22)	(0.21)
Manufacturer: TCP		0.30	-0.17	-0.22	-0.21	-0.24
		(0.22)	(0.22)	(0.23)	(0.23)	(0.23)
Manufacturer: Home Depot		-0.05	0.37	0.24	0.16	0.10
		(0.26)	(0.27)	(0.26)	(0.27)	(0.27)
Manufacturer: Feit		0.10	-0.53	-0.60	-0.51	-0.51
		(0.25)	(0.25)	(0.25)	(0.26)	(0.25)
Small Hardware Store			0.26	0.30	0.17	0.50
			(0.20)	(0.21)	(0.24)	(0.24)
Discount Store			-2.15	-1.98	-1.98	-1.87
			(0.27)	(0.27)	(0.28)	(0.28)
Drug Store			0.62	0.70	0.77	0.95
			(0.22)	(0.23)	(0.25)	(0.24)
Membership Store			-0.65	-0.36	-0.32	-0.23
			(0.45)	(0.46)	(0.47)	(0.47)
Mass Merchandise Store			0.66	0.68	0.72	0.90
			(0.17)	(0.18)	(0.20)	(0.20)
Large Home Improvement Store			-0.59	-0.34	-0.22	-0.06
			(0.18)	(0.20)	(0.21)	(0.21)

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Boston MSA				-0.78	-0.79	-0.66
				(0.18)	(0.19)	(0.20)
Barnstable MSA				-0.20	-0.10	-0.11
				(0.19)	(0.19)	(0.19)
Pittsfield MSA				-0.28	-0.06	0.21
				(0.37)	(0.40)	(0.39)
Worcester MSA				-0.62	-0.68	-0.66
				(0.19)	(0.19)	(0.19)
Cambridge MSA				-0.56	-0.55	-0.44
				(0.18)	(0.19)	(0.19)
Peabody MSA				-0.54	-0.49	-0.38
				(0.20)	(0.20)	(0.21)
Springfield MSA				-0.85	-0.72	-0.61
				(0.19)	(0.21)	(0.21)
September Survey					0.65	0.47
					(0.32)	(0.32)
October Survey					-0.09	-0.08
					(0.22)	(0.22)
November Survey					-0.26	-0.35
					(0.23)	(0.23)
Small Hardware Store * IOU Discount						-5.15
						(0.74)
Discount Store * IOU Discount						-1.70
						(1.19)
Membership Store * IOU Discount						-1.19
						(1.62)
Mass Merchandise Store * IOU Discount						-1.80
						(0.60)
F-Value	102.93	96.63	87.89	69.86	64.36	60.94
Adjusted R-Squared	0.44	0.54	0.59	0.60	0.60	0.61
N	1406	1406	1406	1406	1406	1406
Notes: Dependent variable in all models is price per bulb. Standard errors in parentheses. All models estimated by OLS.						

Table B.2 Regression Outputs for Retail Price Analysis of A-Line Bulbs

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Intercept	8.01	5.88	7.55	7.56	6.65	6.69
	(0.97)	(0.96)	(0.97)	(1.13)	(1.17)	(1.20)
IOU Discount	-2.14	-2.22	-2.75	-2.98	-2.67	-2.55
	(0.52)	(0.51)	(0.50)	(0.51)	(0.51)	(0.75)
Other Discount	-3.19	-3.34	-3.61	-3.52	-3.48	-3.48
	(0.39)	(0.43)	(0.41)	(0.41)	(0.40)	(0.41)
Energy Star	-0.28	-0.25	-0.41	-0.28	-0.29	-0.30
	(0.35)	(0.31)	(0.30)	(0.31)	(0.30)	(0.31)
Less or Equal to 10 W	-0.78	-0.86	-0.74	-0.78	-0.92	-0.92
	(0.93)	(0.82)	(0.76)	(0.79)	(0.77)	(0.78)
11 to 15 W	-1.12	-1.02	-0.89	-0.84	-0.96	-0.97
	(0.91)	(0.81)	(0.74)	(0.77)	(0.75)	(0.76)
16 to 20 W	-0.54	-0.20	-0.31	-0.28	-0.39	-0.41
	(0.98)	(0.87)	(0.80)	(0.83)	(0.81)	(0.82)
21 to 25 W	0.89	1.11	1.21	1.31	1.09	1.09
	(1.40)	(1.21)	(1.12)	(1.15)	(1.13)	(1.14)
Quantity - 2-Pack	-1.76	-1.79	-1.75	-1.80	-1.78	-1.77
	(0.28)	(0.29)	(0.29)	(0.29)	(0.28)	(0.29)
Quantity - 3-Pack	-3.08	-2.59	-2.80	-2.74	-2.74	-2.76
	(0.72)	(0.62)	(0.59)	(0.61)	(0.60)	(0.61)
Manufacturer: GE		1.90	1.17	0.95	1.43	1.33
		(0.50)	(0.54)	(0.58)	(0.61)	(0.72)
Manufacturer: Sylvania		3.79	2.69	2.79	3.26	3.19
		(0.55)	(0.60)	(0.63)	(0.65)	(0.71)
Manufacturer: Bright Effects		2.03	1.00	0.71	-0.14	-0.25
		(0.62)	(0.85)	(0.89)	(1.37)	(1.43)
Manufacturer: TCP		1.98	1.32	1.30	1.78	1.66
		(0.68)	(0.72)	(0.77)	(0.78)	(0.91)
Manufacturer: Home Depot		2.23	1.45	1.14	2.04	1.94
		(0.60)	(0.82)	(0.86)	(0.91)	(1.01)
Manufacturer: Feit		-1.88	-2.65	-2.98	-2.51	-2.62
		(1.41)	(1.33)	(1.35)	(1.33)	(1.40)
Small Hardware Store			-1.01	-1.35	-2.52	-2.43
			(0.65)	(0.77)	(0.86)	(0.92)
Discount Store			-3.90	-3.74	-3.73	-3.71
			(0.77)	(0.78)	(0.81)	(0.83)
Drug Store			-0.40	-0.39	-1.50	-1.42
			(0.72)	(0.80)	(0.87)	(0.93)
Mass Merchandise Store			-0.91	-1.09	-2.27	-2.20
			(0.63)	(0.67)	(0.77)	(0.82)
Large Home Improvement Store			-0.71	-0.65	-0.40	-0.33
			(0.77)	(0.84)	(1.39)	(1.42)
Boston MSA				0.05	-0.40	-0.38
				(0.55)	(0.56)	(0.57)
Barnstable MSA				0.26	-0.15	-0.14
				(0.56)	(0.56)	(0.57)
Pittsfield MSA				-1.90	-3.14	-3.11
				(0.90)	(0.99)	(1.01)
Worcester MSA				0.39	2.05	2.09
				(0.85)	(1.52)	(1.56)
Cambridge MSA				-0.06	-0.23	-0.22

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
				(0.56)	(0.55)	(0.55)
Peabody MSA				0.18	-0.04	-0.02
				(0.56)	(0.55)	(0.56)
Springfield MSA				0.36	0.15	0.17
				(0.48)	(0.47)	(0.48)
September Survey					1.33	1.26
					(1.52)	(1.55)
October Survey					0.22	0.22
					(1.43)	(1.47)
November Survey					1.94	1.94
					(0.69)	(0.70)
Small Hardware Store * IOU Discount						-0.35
						(1.27)
Large Home Improvement Store * IOU Discount						-0.08
						(1.25)
F-Value	18.04	19.21	18.65	14.31	13.89	12.80
Adjusted R-Squared	0.52	0.66	0.71	0.72	0.73	0.73
N	142	142	142	142	142	142
Notes: Dependent variable in all models is price per bulb. Standard errors in parentheses. All models estimated by OLS.						

Table B.3 Regression Outputs for Retail Price Analysis of Reflector CFLs

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Intercept	9.86	9.86	7.96	8.62	9.09	9.28
	(0.58)	(0.62)	(0.77)	(0.95)	(0.97)	(0.97)
IOU Discount	-3.84	-4.04	-3.36	-3.51	-3.61	-5.23
	(0.32)	(0.34)	(0.34)	(0.35)	(0.35)	(0.71)
Other Discount	-2.43	-2.57	-2.18	-2.18	-2.06	-1.99
	(0.34)	(0.37)	(0.35)	(0.36)	(0.36)	(0.35)
Energy Star	-0.32	-0.12	-0.69	-0.54	-0.28	-0.19
	(0.48)	(0.48)	(0.45)	(0.45)	(0.46)	(0.44)
Less or Equal to 10 W	-0.89	-1.04	-1.17	-1.19	-1.65	-1.80
	(1.11)	(1.12)	(1.04)	(1.04)	(1.03)	(0.99)
11 to 15 W	-1.63	-1.58	-1.63	-1.53	-1.49	-1.57
	(0.37)	(0.37)	(0.34)	(0.34)	(0.34)	(0.32)
16 to 20 W	-1.19	-0.98	-0.74	-0.59	-0.52	-0.56
	(0.46)	(0.49)	(0.46)	(0.45)	(0.45)	(0.44)
21 to 25 W	-0.05	-0.19	-0.31	-0.12	0.00	0.00
	(0.42)	(0.46)	(0.43)	(0.42)	(0.42)	(0.41)
Quantity - 2-Pack	-2.84	-2.27	-1.91	-2.05	-2.02	-2.02
	(0.27)	(0.31)	(0.29)	(0.29)	(0.29)	(0.28)
Quantity - 3-Pack	-2.73	-2.80	-2.16	-2.12	-1.96	-1.80
	(0.48)	(0.48)	(0.54)	(0.53)	(0.52)	(0.52)
Quantity - 4-Pack	-1.99	-2.19	-1.62	-1.44	-1.28	-1.08
	(0.66)	(0.65)	(0.67)	(0.67)	(0.66)	(0.64)
Quantity - 5-Pack or More	-3.67	-3.04	-2.93	-2.97	-2.95	-3.09
	(0.69)	(0.72)	(0.67)	(0.66)	(0.65)	(0.63)
Manufacturer: GE		0.01	-0.11	-0.16	0.11	-0.01
		(0.36)	(0.36)	(0.37)	(0.39)	(0.39)
Manufacturer: Sylvania		0.08	1.45	0.82	0.88	1.21
		(0.39)	(0.48)	(0.53)	(0.52)	(0.52)
Manufacturer: Bright Effects		-1.42	-1.26	-1.21	-0.82	-0.76
		(0.42)	(0.51)	(0.52)	(0.55)	(0.55)
Manufacturer: TCP		-0.51	-0.70	-0.93	-1.11	-1.15
		(0.57)	(0.56)	(0.56)	(0.56)	(0.54)
Manufacturer: Home Depot		-1.14	-1.47	-1.61	-2.04	-2.03
		(0.60)	(0.63)	(0.62)	(0.63)	(0.61)
Manufacturer: Feit		-1.09	-0.14	-0.04	0.31	-0.59
		(0.86)	(0.87)	(0.88)	(0.88)	(0.97)
Small Hardware Store			2.19	1.72	2.05	1.95
			(0.56)	(0.63)	(0.69)	(0.81)
Discount Store			-1.15	-1.75	-1.39	-2.05
			(0.88)	(0.93)	(0.92)	(0.95)
Drug Store			4.16	3.35	3.93	3.23
			(0.63)	(0.70)	(0.71)	(0.78)
Membership Store			-0.95	-0.72	-0.40	0.36
			(0.86)	(0.87)	(0.88)	(1.70)
Mass Merchandise Store			2.22	1.74	2.35	1.49
			(0.48)	(0.54)	(0.57)	(0.66)
Large Home Improvement Store			2.12	1.35	1.96	1.09
			(0.57)	(0.62)	(0.65)	(0.75)
Boston MSA				-0.41	-0.03	0.40
				(0.51)	(0.53)	(0.52)
Barnstable MSA				0.17	0.54	0.57

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
				(0.56)	(0.56)	(0.55)
Pittsfield MSA				-2.71	-1.37	-2.03
				(1.13)	(1.17)	(1.17)
Worcester MSA				-0.82	-0.92	-0.36
				(0.53)	(0.53)	(0.52)
Cambridge MSA				0.27	0.63	0.93
				(0.52)	(0.52)	(0.51)
Peabody MSA				0.34	0.73	0.97
				(0.54)	(0.55)	(0.53)
Springfield MSA				-0.37	0.20	0.45
				(0.51)	(0.53)	(0.52)
September Survey					-1.11	-1.57
					(0.87)	(0.87)
October Survey					-1.41	-1.28
					(0.57)	(0.56)
November Survey					-2.23	-1.93
					(0.61)	(0.59)
Small Hardware Store * IOU Discount						-0.08
						(0.96)
Membership Store * IOU Discount						-0.70
						(1.89)
Large Home Improvement Store * IOU Discount						2.48
						(0.87)
Mass Merchandise Store * IOU Discount						4.88
						(1.12)
F-Value	35.91	25.43	25.34	20.84	20.04	20.01
Adjusted R-Squared	0.50	0.52	0.59	0.61	0.62	0.65
N	384	384	384	384	384	384

Notes: Dependent variable in all models is price per bulb. Standard errors in parentheses. All models estimated by OLS.

Table B.4 Regression Outputs for Retail Price Analysis of Globe CFLs

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Intercept	6.00	4.05	5.16	7.74	8.01	7.50
	(1.73)	(1.68)	(1.63)	(1.79)	(1.77)	(1.86)
IOU Discount	-1.97	-1.51	-1.99	-2.41	-2.33	-1.68
	(0.38)	(0.40)	(0.41)	(0.42)	(0.43)	(1.29)
Other Discount	-2.02	-1.85	-1.62	-1.52	-1.39	-1.45
	(0.38)	(0.38)	(0.36)	(0.36)	(0.36)	(0.35)
Energy Star	-0.12	-0.06	-0.35	-0.27	-0.38	-0.47
	(0.35)	(0.34)	(0.32)	(0.31)	(0.31)	(0.30)
Less or Equal to 10 W	1.12	1.52	0.85	0.48	0.68	0.74
	(1.72)	(1.62)	(1.49)	(1.49)	(1.46)	(1.42)
11 to 15 W	1.00	1.24	0.58	0.22	0.38	0.51
	(1.71)	(1.60)	(1.47)	(1.47)	(1.44)	(1.40)
16 to 20 W	2.22	2.33	1.41	0.97	1.10	1.17
	(1.74)	(1.63)	(1.50)	(1.51)	(1.47)	(1.43)
21 to 25 W	1.49	3.44	2.33	1.66	1.89	1.55
	(2.43)	(2.31)	(2.13)	(2.12)	(2.07)	(2.02)
Quantity - 2-Pack	-1.58	-1.25	-0.80	-0.92	-0.99	-0.95
	(0.26)	(0.36)	(0.35)	(0.35)	(0.34)	(0.34)
Quantity - 3-Pack	-2.41	-2.66	-1.97	-2.09	-2.28	-2.56
	(0.45)	(0.43)	(0.43)	(0.43)	(0.43)	(0.44)
Manufacturer: GE		1.89	1.75	1.63	1.77	1.46
		(0.41)	(0.39)	(0.41)	(0.40)	(0.41)
Manufacturer: Sylvania		1.91	2.30	1.74	1.71	1.53
		(0.50)	(0.51)	(0.55)	(0.56)	(0.55)
Manufacturer: Bright Effects		1.62	-0.18	-0.98	-0.63	-0.35
		(0.68)	(1.14)	(1.22)	(1.23)	(1.63)
Manufacturer: TCP		0.16	0.19	-0.33	-0.25	-0.48
		(0.62)	(0.63)	(0.65)	(0.64)	(0.63)
Manufacturer: Home Depot		0.60	-1.22	-2.27	-2.30	-1.93
		(0.71)	(1.16)	(1.25)	(1.22)	(1.59)
Manufacturer: Feit		1.00	1.33	1.38	1.36	-0.14
		(0.81)	(0.76)	(0.77)	(0.76)	(0.87)
Small Hardware Store			0.00	-1.31	-1.52	-1.08
			(0.61)	(0.79)	(0.82)	(1.01)
Discount Store			-2.97	-3.86	-3.80	-3.57
			(0.86)	(0.96)	(0.94)	(1.11)
Drug Store			1.63	0.41	0.71	0.98
			(0.71)	(0.88)	(0.88)	(1.06)
Mass Merchandise Store			-0.67	-1.98	-1.73	-1.46
			(0.58)	(0.75)	(0.74)	(0.96)
Large Home Improvement Store			1.10	0.86	1.09	0.63
			(1.06)	(1.19)	(1.19)	(1.31)
Boston MSA				-0.89	-0.95	-0.72
				(0.44)	(0.47)	(0.48)
Barnstable MSA				-0.60	-0.30	-0.27
				(0.45)	(0.46)	(0.45)
Pittsfield MSA				-3.21	-2.57	-2.35
				(1.20)	(1.22)	(1.38)
Worcester MSA				-0.66	-0.87	-0.77
				(0.41)	(0.42)	(0.41)
Cambridge MSA				-1.00	-1.06	-0.94

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
				(0.57)	(0.57)	(0.56)
Peabody MSA				-1.39	-1.23	-1.03
				(0.51)	(0.52)	(0.54)
Springfield MSA				-1.24	-0.78	-0.50
				(0.47)	(0.56)	(0.56)
September Survey					0.68	0.80
					(0.65)	(0.64)
October Survey					-0.59	-0.21
					(0.48)	(0.50)
November Survey					-1.00	-0.66
					(0.53)	(0.53)
Small Hardware Store * IOU Discount						-1.98
						(1.44)
Mass Merchandise Store * IOU Discount						1.10
						(1.42)
F-Value	15.84	13.26	14.22	11.38	11.24	11.40
Adjusted R-Squared	0.38	0.46	0.55	0.56	0.59	0.61
N	217	217	217	217	217	217

Notes: Dependent variable in all models is price per bulb. Standard errors in parentheses. All models estimated by OLS.

Appendix C. Conjoint Recruiting Script

Massachusetts and Rhode Island Conjoint Survey

Hello, this is _____ calling on behalf of

If state = MA, SHOW "the electricity providers in Massachusetts"

If state = RI, SHOW "National Grid"

This is not a sales call. May I please speak with the person who makes the purchasing decisions for this household?

Set callback if Head of Household not available

We are calling our customers to see if you will be interested in taking a paid survey about energy usage and electronics. Please be assured that no one will try to sell you anything and no one will contact you as a result of your participation in this study. We are only interested in your opinions. We are offering $50 for person who makes most of the household purchasing decisions to participate in this research. Is this something you will be interested in?

May I ask a few questions to see if the study is suitable for you?

Q1. First, who is your electricity services provider? (DO NOT READ).

1. National Grid
2. NSTAR
3. WMECO
4. Unitil
5. Cape Light Compact
6. Other **(TERMINATE)**

Q2. Have you, yourself, participated in paid marketing research study in the past year?

1. Yes **(TERMINATE)**
2. No

Q4. To participate in this study, we are inviting you to take the survey at one of our nearby locations. The survey should only take about 30 to 40 minutes, and we will pay you $50 for your time. You can take the survey at (either ____ or ____ locations nearby). Or, if you prefer to take the survey from home, we are offering you $30. Would you rather take the survey…?

1. At home **(CONTINUE TO Q4a)**
2. In person **(SKIP TO Q5)**

Q4a. Do you have a computer and internet service at home?

1. Yes **(CONTINUE TO Q5)**
2. No **(TRY TO CONVERT TO IN-PERSON, SUGGEST USING A LIBRARY, A FRIEND'S COMPUTER, OR TERMINATE)**

Q5. May I have your age, please? (If respondent hesitates – read list)

1. 18 years old or younger **(TERMINATE)**
2. 19 – 29 **(CONTINUE AS 18-64)**
3. 30 – 39 **(CONTINUE AS 18-64)**
4. 40 – 49 **(CONTINUE AS 18-64)**
5. 50 – 59 **(CONTINUE AS 18-64)**
6. 60 – 64 **(CONTINUE AS 18-64)**
7. 65 or older(CONTINUE AS OVER 65)

Q6. Please tell me to what degree you, yourself, participate in the decision making process regarding your household electronics devices, such as TVs, stereo and computers. Would you say …?

1. You are the primary decision maker for electronics devices **(CONTINUE)**
2. You share in the decision making for electronics devices **(CONTINUE)**
3. You are rarely or never involved in making electronics devices purchases **(TERMINATE)**

Q7. Thinking about all the light bulb purchases that your household makes, would you say you …

1. Almost always make light bulb purchases for the household**(CONTINUE)**
2. Share in the responsibility for purchasing light bulbs for the household **(CONTINUE)**
3.
4. Rarely or never purchase light bulbs for the household **(TERMINATE)**

Q8. Which of the following statements best describes your awareness of compact fluorescent light bulbs, or CFLs? (READ LIST AND RECORD RESPONSE)

1. I am very familiar with CFLs **(SKIP TO Q10)**
2. I am somewhat familiar with CFLs **(SKIP TO Q10)**
3. I've heard of CFLs, but don't know too much about them **(CONTINUE TO Q9)**
4. I've never heard of CFLs **(CONTINUE TO Q9)**

Q9. Let me explain a little bit more to you about CFLs. These bulbs usually do not look like regular incandescent bulbs. The most common type of CFL is made with a glass tube bent into a spiral, resembling soft-serve ice cream, and it fits into a regular light bulb socket. Before today, were you familiar with this type of light bulb?

1. Yes **(CONTINUE)**
2. No **(TERMINATE)**
3. Don't know **(TERMINATE)**

Q10. Approximately what percentage of the light sockets in your home have CFLs? Your best guess is fine. (READ AND RECORD RESPONSE)

1. 0% to 20% **(CONTINUE AS LOW USER)**
2. 21% to 40% **(CONTINUE AS MID USER)**
3. More than 40% **(CONTINUE AS HIGH USER)**
4. Don't know **(CONTINUE AS DK)**

Q11. Do you own or rent your home?

1. Rent **(CONTINUE AS RENTER)**
2. Own **(CONTINUE AS OWNER)**
3. Don't know **(TERMINATE)**
4. Refused **(TERMINATE)**

Recruiter: Please code respondent's answer into 1 or 2 based on description unless they say DK or Refused.

Q12. Which of the following best describes your total yearly household income? (READ LIST AND RECORD RESPONSE)

1. Less than $24,999 **(CONTINUE AS BELOW MEDIAN)**

2. $25,000 - 49,999 **(CONTINUE AS BELOW MEDIAN)**

If state = MA SHOW 3. $50,000 - $64,999 **(CONTINUE AS BELOW MEDIAN)**

If state = RI SHOW 3. $50,000 - $54,999 **(CONTINUE AS BELOW MEDIAN)**

If state = MA SHOW 4. $65,000 - $99,999 **(CONTINUE AS ABOVE MEDIAN)**

If state = RI SHOW 4. $55,000 - $99,999 **(CONTINUE AS ABOVE MEDIAN)**

5. $100,000 - 124,999 **(CONTINUE AS ABOVE MEDIAN)**

6. $125,000 or more **(CONTINUE AS ABOVE MEDIAN)**

9. Refused **(TERMINATE)**

Q13. What level of education have you, yourself, completed? (READ LIST AND RECORD RESPONSE)

1. Attended high school but did not graduate **(CONTINUE AS NOT COMPLETING HS)**
2. High school graduate or G.E.D. associates degree or some college **(CONTINUE AS HS GRADUATE OR GED)**
3. Completed bachelor degree or higher **(CONTINUE AS COMPLETED BA or MORE)**

Q14. Which of the following best describes your ethnicity?

1. Caucasian or White **(CONTINUE AS WHITE)**
2. African American or Black **(CONTINUE AS NON-WHITE)**
3. Asian or Pacific Islander **(CONTINUE AS NON-WHITE)**
4. Other Specify _____**(CONTINUE AS NON-WHITE)**
5. Refused **(CONTINUE AS NON-WHITE)**

Q15. Do you have children under the age of 18 living at home?

1. Yes **(CONTINUE AS HAVE UNDER 18)**
2. No **(CONTINUE AS NO UNDER 18)**
3. Refused **(TERMINATE)**

IF Q2 = 2 (In Person), ASK Q16

IF Q2 = 1 (At home), SKIP TO Q17

Q16. We will have computers set up for you to complete the survey in (INSERT CITY) on (INSERT DATE) at (INSERT TIMES). Would any of these dates and times work for you?

1. Yes, in-person **(SCHEDULE)** – SKIP TO In-Person Thank you
2. Will complete survey off-site **(TRY TO CONVERT TO COMPLETING SURVEY OFF-SITE. SUGGEST USING A LIBRARY, A FRIEND'S COMPUTER, ETC.)** – GO TO Q17
3. Neither in-person nor off-site **(TERMINATE)**

Q17. We will send you the link by email on (insert date link will be available). The email will be from (insert email address), so please watch for it. What email address would you like me to send it to?

Enter e-mail: _____

NEXT SCREEN

Re-enter e-mail: _____

GO TO OFF-SITE THANK YOU

In-Person Thank you

We will call you 2 days before your scheduled date to remind you. Once you complete the survey, our staff member will hand you your $50 incentive. Thank you.

Off-site Thank you

Please note that we will have a phone help line during the hours of 10 a.m. and 8 p.m. during the period from April 6 through April 28 if you have any difficulty with the survey and need to ask questions. Once you submit the completed survey on-line, we will be notified and will mail you a check for $30 within 2 weeks. Thank you.

Appendix D. Derivation of Elasticity Curves

The exponential model says that y is a function of x: y=y(x), where y(x) = 1.26*exp(-0.308*x) (for A-Line bulbs).

Delta_y is the change in y when its argument changes by Delta_x – ie, when the argument goes from x to x + Delta_x.

In other words, Delta_y = y(x + Delta_x) – y(x). Plugging in the expression in the model, this is…

Delta_y = [y(x + Delta_x)] – [y(x)]

= [1.26*exp(-0.308*(x + Delta_x))] – [1.26*exp(-0.308*x)]

= [1.26*exp(-0.308*x) * (1-0.308 * Delta_x)] – [1.26*exp(-0.308*x)]

= [1.26*exp(-0.308*x) *1] + [(1.26*exp(-0.308*x) * -0.308*Delta_x)] – [1.26*exp(-0.308*x)]

= [(1.26*exp(-0.308*x) * -0.308*Delta_x)]

Delta_y/Delta_x = [(1.26*exp(-0.308*x) * -0.308*Delta_x)] ÷ Delta_x

Delta_y/Delta_x = [(1.26*exp(-0.308*x) * -0.308]

Delta_y/Delta_x * [x/y] = [(1.26*exp(-0.308*x) * -0.308] * [x/y]

Delta_y/y ÷ Delta_x/x = [(1.26*exp(-0.308*x) * -0.308] * [x/1.26*exp(-0.308*x)]

Delta_y/y ÷ Delta_x/x = -0.308*x

Where Delta_y/y ÷ Delta_x/x = Equation for Elasticity

Therefore Elasticity = -0.308*x

Massachusetts ENERGY STAR® Lighting Program 2010 Annual Report

Appendix F:

CFL Revealed Preference Results

Final Report

CFL Revealed Preference Results

Prepared for:

Bay State Gas (NiSource)
Berkshire Gas
Cape Light Compact
National Grid USA
New England Gas
NSTAR
Unitil/Fitchburg Gas and Electric
Western Massachusetts Electric

Middletown, Connecticut, May 6, 2011

Copyright © 2011, KEMA, Inc.

The information contained in this document is the exclusive, confidential and proprietary property of KEMA, Inc. and is protected under the trade secret and copyright laws of the U.S. and other international laws, treaties and conventions. No part of this work may be disclosed to any third party or used, reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying and recording, or by any information storage or retrieval system, without first receiving the express written permission of KEMA, Inc. Except as otherwise noted, all trademarks appearing herein are proprietary to KEMA, Inc.

Table of Contents

Executive Summary 1
1. Introduction 4
2. Results 5
   2.1 Willingness to Purchase Any CFLs at Price Multiples 5
   2.2 How Many Customers Would Purchase… 7
   2.3 Results by Bulb Type 9
   2.4 Results by Channel 12
   2.5 Results by Education Level 17
   2.6 Results by Income Level 20
   2.7 Results by the Order in Which Hypothetical Price Multiples Were Asked 24
3. Summaries for Final Estimates 28

Table of Contents

List of Exhibits:

Table 1: Respondents by Retail Channel 4
Table 2: Impact of the Discount and Free-Ridership 12
Table 3: Impact of the Discount on Number of CFLs Purchased by Channel 17
Table 4: Impact of the Discount and Free-Ridership by Education Level 20
Table 5: Respondent Income and Census Household Income 20
Table 6: Impact of the Discount and Free-Ridership by Income Level 24
Table 7: Impact of the Discount and Free-Ridership by Order Asked 27
Table 8: Summary of Free Ridership Estimates 28
Table 9: Summary of Elasticity Estimates 29

Figure 1: Willingness to Buy CFLs vs. Relative Price by Income and Education 6
Figure 2: Willingness to Buy CFLs by Retail Channel 7
Figure 3: Modeled # CFLs for Standard and Specialty 10
Figure 4: Reported and Modeled Number of CFLs vs. Dollar Price 11
Figure 5: Number of CFLs Purchased at Relative Price by Channel 13
Figure 6: Modeled # CFLs for Standard and Specialty by Channel 15
Figure 7: Reported and Modeled Number of CFLs vs. Dollar Price 16
Figure 8: Modeled # CFLs for Standard and Specialty by Education Level 18
Figure 9: Demand for CFLs by Education (Specialty and Standard) 19
Figure 10: # CFLs vs. Relative Prices by Household Income 22
Figure 11: Demand for CFLs by Income (Specialty and Standard) 23
Figure 12: # CFLs vs. Relative Prices by Order Asked 25
Figure 13: Demand for CFLs by Order of Hypothetical Prices 27

Executive Summary

As part of the evaluation of the Massachusetts ENERGY STAR® Lighting Program, KEMA, under subcontract to the NMR Group, Inc. (NMR), performed in-store intercept surveys with customers purchasing light bulbs at the time of purchase. This effort was undertaken to perform an elasticity analysis with resulting estimates of free ridership rates and net to gross factors. This approach to estimating free ridership is one of six evaluation tasks that have estimated net-to-gross ratios for standard and/or specialty compact fluorescent lamps (CFLs). A Delphi panel approach will be utilized to take the net to gross results from this memo, along with those quantified in the other tasks, and develop an overall estimate.

For this task in particular, KEMA asked customers questions to elicit both their rationale for their choice of lighting product that day and for their hypothetical choice had the CFLs been priced higher and lower. One hundred five customers were intercepted at 25 stores. The respondents are comprised of 43 consumers that bought at least one CFL, 52 that bought an incandescent and 12 that purchased at least one bulb of a non-CFL technology, with some buying more than one type. Table ES 1 lists intercept completions by retail channel. The mass merchandise and home improvement channels had the most intercepts completed.

Table ES 1: Respondents by Retail Channel

Channel	Intercepts
Grocery	9
Hardware	12
Discount	17
Mass Merchandise	37
Home Improvement	30
Total	105

The survey asked customers if they would buy a CFL under various price points, then specifically how many they would buy at each price point. KEMA then conducted an elasticity analysis on the data. The models used the relationship between price and quantity as determined through the related retailer pricing effort (results delivered in a separate report on March 11, 2011) to gauge the increased number of CFLs sold at the discounted price compared to the regular price. This memo describes the results, including an investigation of the extent to which the elasticities vary by customer, channel or bulb type. This information is then used with

program-wide information about number of discounted CFLs sold to compute net-to-gross estimates.

While we do not provide hard to reach free ridership analysis, we do provide results by education and income level for purposes of informing any effort to quantify hard to reach net to gross factors that might be undertaken as part of the overall Delphi effort. Table ES 2 presents a summary of all free ridership estimates from this work. Free-ridership estimates for specialty and standard CFLs are very consistent across the breakout groups, the lone exception being respondents who would not give their income (with higher free-ridership estimates). The result for an overall CFL estimate is 64 percent free-ridership, given the distribution of program CFLs between specialty and standard models. This was not changed when the estimate was analyzed by education level and income level and weighted to match the demographics of the state population. Therefore, we believe a free ridership estimate of 64% is appropriate to consider a final estimate from the intercept work.

In considering discrete estimates for standard versus specialty CFLs, standard CFLs are reliably around the 63% free ridership estimate. Indeed, the estimate flowing from the overall standard CFL analysis (bulb type only) was 63% with a very good error of +/- 5%. The specialty CFL estimates have slightly more diversity than the standard CFL estimates but still only range from 66% to 69%. Given the consistency in results between the various breakouts analyzed and the small error bound around the overall specialty bulb type only analysis, we recommend the specialty free ridership estimate from this effort be the overall estimate produced by bulb type (69%). While exclusive of spillover, the net to gross ratio for each result is the complement of each free ridership presented. For example, the net-to-gross estimate (NTG = 1 – free ridership) for standard CFLs estimated from the channel analysis is 0.39 (1 – 0.61).

Table ES 2: Summary of Free Ridership Estimates

Analysis Method (*with Standard Error*)	Standard CFL Estimate	Specialty CFL Estimate	Overall CFL Estimate
By Channel	61% (*13%*)	66% (*10%*)	62% (*11%*)
By Education Level	63% (*5%*)	68% (*8%*)	64% (*5%*)
By Income	63% (*7%*)	69% (*8%*)	64% (*6%*)
By Order Asked	63% (6*%*)	69% (6*%*)	66% (*5%*)
By Bulb Type Only	63% (*5%*)	69% (*6%*)	64% (*4%*)

Table ES 3 presents a summary of the elasticity findings. Standard CFLs are consistently found to be more elastic than specialty CFLs. This finding is consistent with the WTP analysis results provided earlier in this study under separate cover.

Table ES 3: Summary of Elasticity Estimates

Analysis Method	Standard CFL Estimate		Specialty CFL Estimate	
By Channel	Discount/ Grocery	Hardware/ HI/MM	Discount/ Grocery	Hardware/ HI/MM
	1.222	1.501	0.680	0.870
By Education Level	Up to Associate's Degree	Bachelor's and Beyond	Up to Associate's Degree	Bachelor's and Beyond
	1.392	1.349	0.733	0.829
By Income	Up to $49,999	$50,000 and Up	Up to $49,999	$50,000 and Up
	1.299	1.384	0.863	0.665
By Order Asked	Low to High	High to Low	Low to High	High to Low
	1.217	1.422	0.703	0.890
By Bulb Type Only	1.358		0.754	

1. Introduction

As part of the impact evaluation of the Massachusetts ENERGY STAR® Lighting Program, KEMA, under subcontract to the NMR Group, Inc. (NMR), performed in-store intercept surveys with customers purchasing light bulbs at the time of purchase. This effort was undertaken to perform an elasticity analysis with resulting estimates of free ridership rates and net to gross factors. This approach to estimating free ridership is one of six evaluation tasks that have estimated net-to-gross ratios for standard and/or specialty compact fluorescent lamps (CFLs). Estimating an overall net to gross for this technology can be complex. Therefore, a multitude of approaches were undertaken with the understanding that while each have their own strengths and weaknesses, when taken in total, the results of each discrete effort can provide adequate information to discern an overall factor. A Delphi panel approach will be utilized to take the net to gross results from this memo, along with those quantified in the other tasks, and develop an overall estimate.

For this task in particular, KEMA asked customers questions to elicit both their rationale for their choice of lighting product that day and for their hypothetical choice had the CFLs been priced higher and lower. One hundred five customers were intercepted at 25 stores. The respondents are comprised of 43 consumers that bought at least one CFL, 52 that bought an incandescent and 12 that purchased at least one bulb of a non-CFL technology, with some buying more than one type. Table 1 lists intercept completions by retail channel. The mass merchandise and home improvement channels had the most intercepts completed. Note that while we do not provide hard to reach free ridership analysis, we do provide results by education and income level for purposes of informing any effort to quantify hard to reach net to gross factors that might be undertaken as part of the overall Delphi effort.

Table 1: Respondents by Retail Channel

Channel	Intercepts
Grocery	9
Hardware	12
Discount	17
Mass Merchandise	37
Home Improvement	30
Total	105

The survey asked customers if they would buy a CFL under various price points, then specifically how many they would buy at each price point. KEMA then conducted an elasticity analysis on the data. The models used the relationship between price and quantity as determined through the related retailer pricing effort (results delivered in a separate report on March 11, 2011) to gauge the increased number of CFLs sold at the discounted price compared to the regular price. This memo describes the results, including an investigation of the extent to which the elasticities vary by customer, channel or bulb type. This information is then used with program-wide information about number of discounted CFLs sold to compute net-to-gross estimates.

2. Results

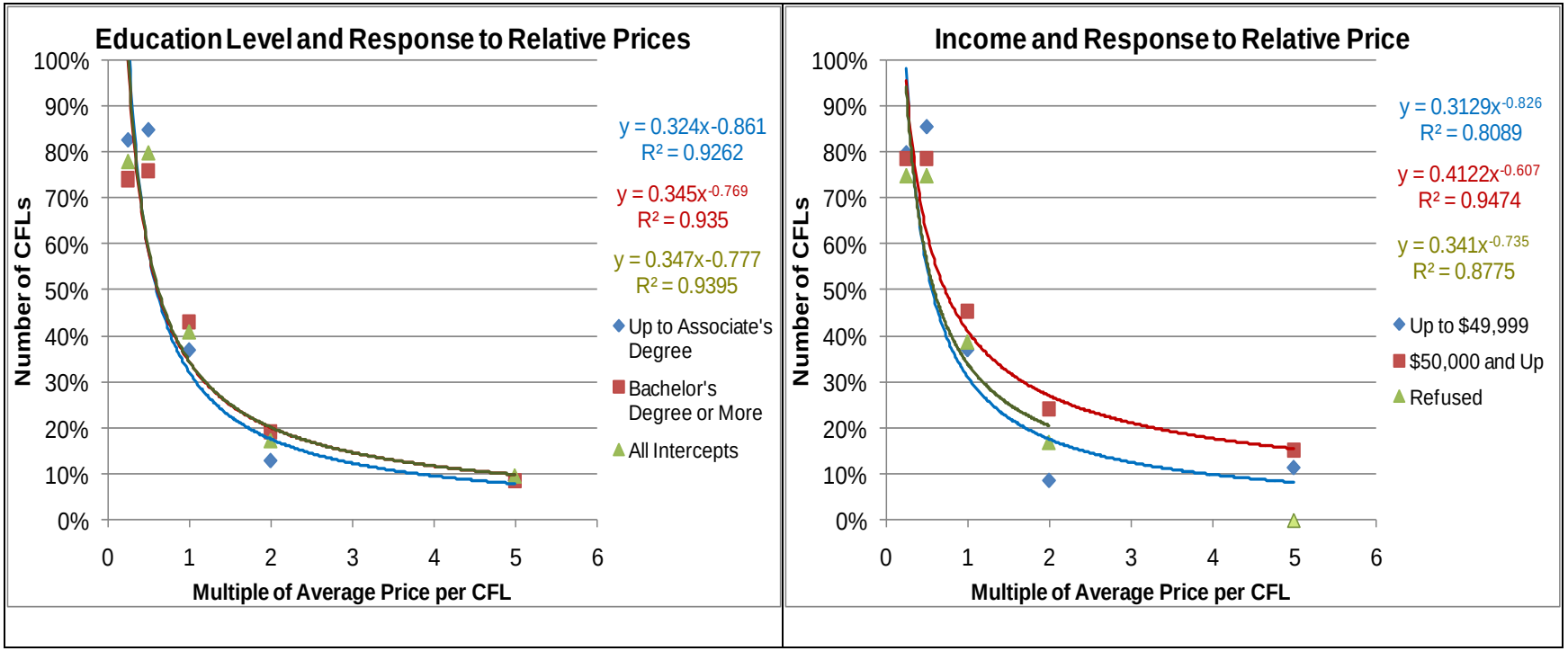
2.1 Willingness to Purchase Any CFLs at Price Multiples

CFL purchasers were asked how many CFLs they would buy at three multiples of the price they actually paid: five times the price, double the price and half of the price. Based upon what they had in their cart at the time of the intercept, we also acquired how many they did buy at the actual price. Purchasers of only incandescent or other bulb types were asked whether or not they would have bought a CFL at half the shelf price and at one quarter of the shelf price. Because they purchased no CFLs, we know they bought none at the actual shelf price during this particular visit to the store. We combined both sets of customer responses into a single series in order to assess willingness to purchase any CFLs at the five price multiples.[1]

The analyses indicate that willingness to purchase any CFLs was similar for respondents across educational categories and income groupings, as illustrated in Figure 1.

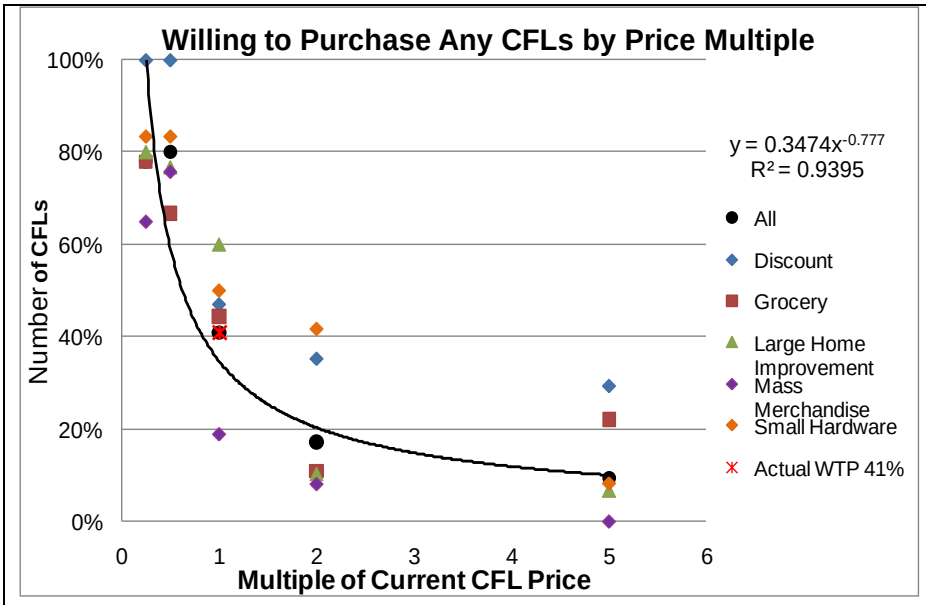
[1] That is 1) quarter of the actual price, 2) half of the actual price, 3) the actual price, 4) double the actual price, and 5) five times the actual price.

Figure 1: Willingness to Buy CFLs vs. Relative Price by Income and Education



Grouped by retail channel, the results point to some differences, but the overall trends are similar across channel: at less than the current shelf price, about 80% of customers would buy CFLs (Figure 2). At higher than the current price, behavior diverges by channel. At five times the current price, discount and grocery store customers would buy CFLs in larger proportions than customers of hardware, home improvement and mass merchandise stores.

Figure 2: Willingness to Buy CFLs by Retail Channel



Channel	N	Mean CFL Price
Grocery	9	$1.78
Discount	17	$3.03
Mass Merchandise	37	$3.30
Small Hardware	12	$4.00
Large Home Improvement	30	$4.02

The overall average willingness to purchase at the current price was about 41% overall, varying by channel. Willingness to pay five times the price has a weak to low correlation with average shelf price of a CFL on that day (r = 0.26).

2.2 How Many Customers Would Purchase…

The fraction of CFL sales that are program-attributable is compiled from the more detailed responses of CFL and incandescent purchasers to the questions “How many CFLs would you purchase today if the price were…”; halogen, LED and traditional fluorescent purchasers were

dropped from this analysis.[2] We asked CFL purchasers about three hypothetical price points: five times, two times, and half price and noted the actual quantity purchased at the shelf price. Incandescent purchasers were asked about one-half and one-quarter of the current CFL price; they implicitly responded that they would purchase zero at the current price and higher multiples. These are the reported quantities and prices Q_R and P_R. The responses from both the CFL and incandescent price batteries were used to estimate a pricing function (the model). We then used statewide shelf average prices from the pricing study to predict quantities that would have been purchased at the non-discounted and discounted prices.

Free-ridership is calculated from the demand models, separately for standard and specialty lamps, and by other variables, including: channel (business type), education level and income. These models are evaluated at the full price and program discounted price per bulb. The impact of the discount is the difference in quantity that would be purchased between the modeled full price (MFP) and the quantity at the modeled discount price (MDP). In effect, this quantity represents how many more lamps they purchased as a result of the sponsor discount. The formula below provides the percent of program bulbs that are theorized to be program induced.

$$\frac{Q_{MDP} - Q_{MFP}}{Q_{MDP}} = Program\ Induced$$

The free-ridership is the complement of that and represents the percent of sales that would have occurred even at the full (non-program) price level. Net-to-gross estimates from this exercise, therefore, does not include any accounting of spillover.

$$\frac{Q_{MFP}}{Q_{MDP}} = FR$$

It should be noted that the study achieved 49 usable intercepts from purchasers of standard lamp (A-line and spiral/twist) styles purchasers and 44 from purchasers of specialty style lamps (all other shapes).

[2] These lamp types are not always interchangeable with CFL or incandescent, and may require dedicated fixtures. In addition, the pricing profiles are different, and we felt that grouping e.g. halogen with either incandescent or CFL would raise a needless threat to the validity of the study. There were too few other types to analyze separately.

2.3 Results by Bulb Type

The actual and modeled purchases for all respondents for specialty and standard CFLs are graphed against the hypothetical price ratio in Figure 3. The red bars show the average value of the reported number of CFLs the respondent would purchase at the price ratio on the horizontal axis.[3] Those responses are modeled with a demand function, and the model predictions at each price ratio are indicated with the blue bars. Standard and specialty CFLs are modeled separately in this memo.

Actual specialty CFL mean purchases were larger than mean standard CFL purchases, but the standard lamp model is more sensitive to price, with an elasticity of 1.36, nearly twice that of the specialty model (0.75). The average CFL count at one-fourth of the shelf price is lower than at half of the shelf price. As only incandescent purchasers were asked about the hypothetical quarter-price, this indicates that incandescent purchasers are more sensitive to price.

[3] Actual average purchases are the red bars at ratio = 1, the other red bars are average values of the customer's assertion.

Figure 3: Modeled # CFLs for Standard and Specialty

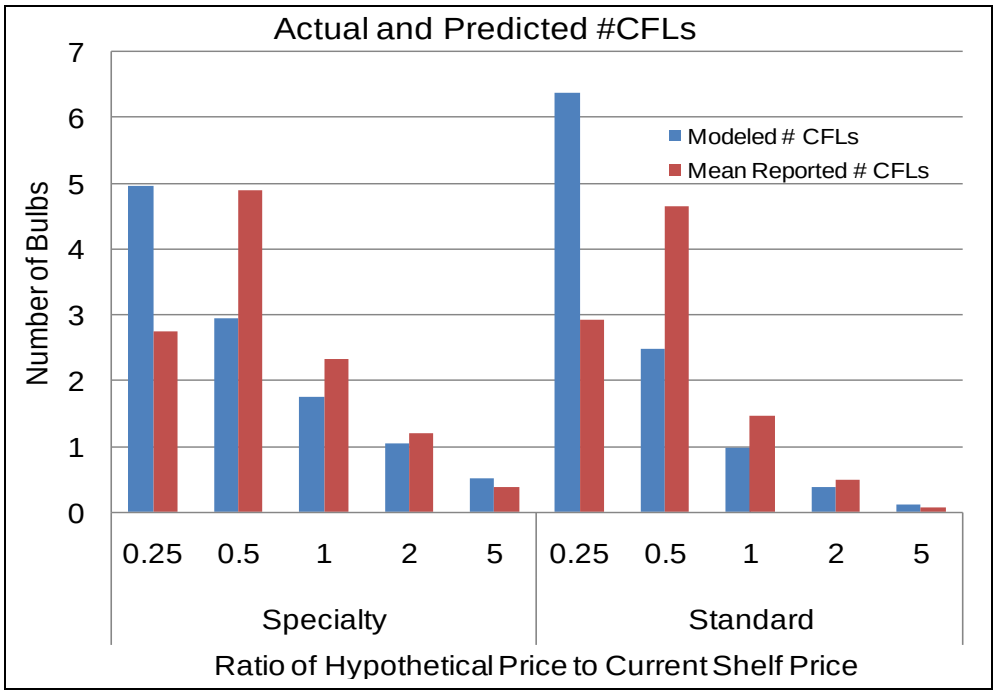
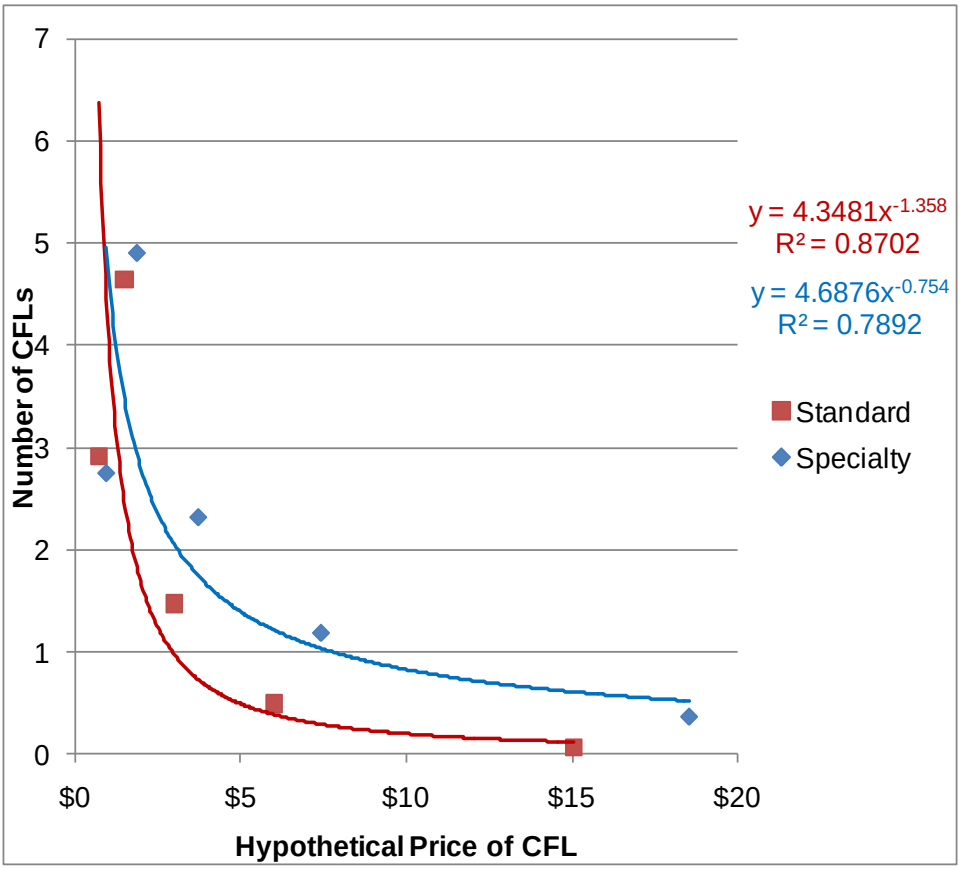


Figure 4 shows the same quantities (reported number of CFLs and the modeled number of CFLs) graphed against the average price in dollars for each of those price points. Reported quantities are plotted as data points, and the modeled purchases are the best-fit trend lines. Purchasers of standard CFLs have a steeper curve, indicating that they are more sensitive to prices, than purchasers of specialty bulbs. Standard CFLs are more uniform, and consumers have more experience with them than with the great variety of specialty CFL designs. Based upon these findings, one might hypothesize that standard-lamp customers would have fixed expectations of what constitutes a bargain, fair and excessive price and that purchasers of specialty lamps might be expected to have more individual or tentative expectations of price or availability. Further, among specialty purchasers, expectations for some shapes might be more fixed than for others. This possibility might help explain the smaller-magnitude for the exponent in the specialty models observed in the findings.

Figure 4: Reported and Modeled Number of CFLs vs. Dollar Price



The impact of the discount on respondents' purchase decisions is shown in Table 3 for specialty and standard purchasers overall, without attention to any other factors, discussed below, such as retail channel, demographic groups, or question order. When we look at the data at this high level, free-ridership is statistically different at 63% for standard purchases, and 69% for specialty purchases. Weighting by program sales gives an average free-ridership of 64%, same as when calculated by education level (later in memo). Please note that these are free ridership estimates and not NTG estimates, which we present later in the report.

Table 2: Impact of the Discount and Free-Ridership

	Standard Bulb	Specialty Bulb
Modeled Full Price (MFP)	0.7	1.2
Modeled Discount Price (MDP)	1.1	1.7
Discount Impact (DI)	0.4	0.5
DI/MDP=	37%	31%
Free-ridership (*standard error*)	63% (*5%*)	69% (*6%*)
Program Average Free-ridership	64% (*4.2%)*	

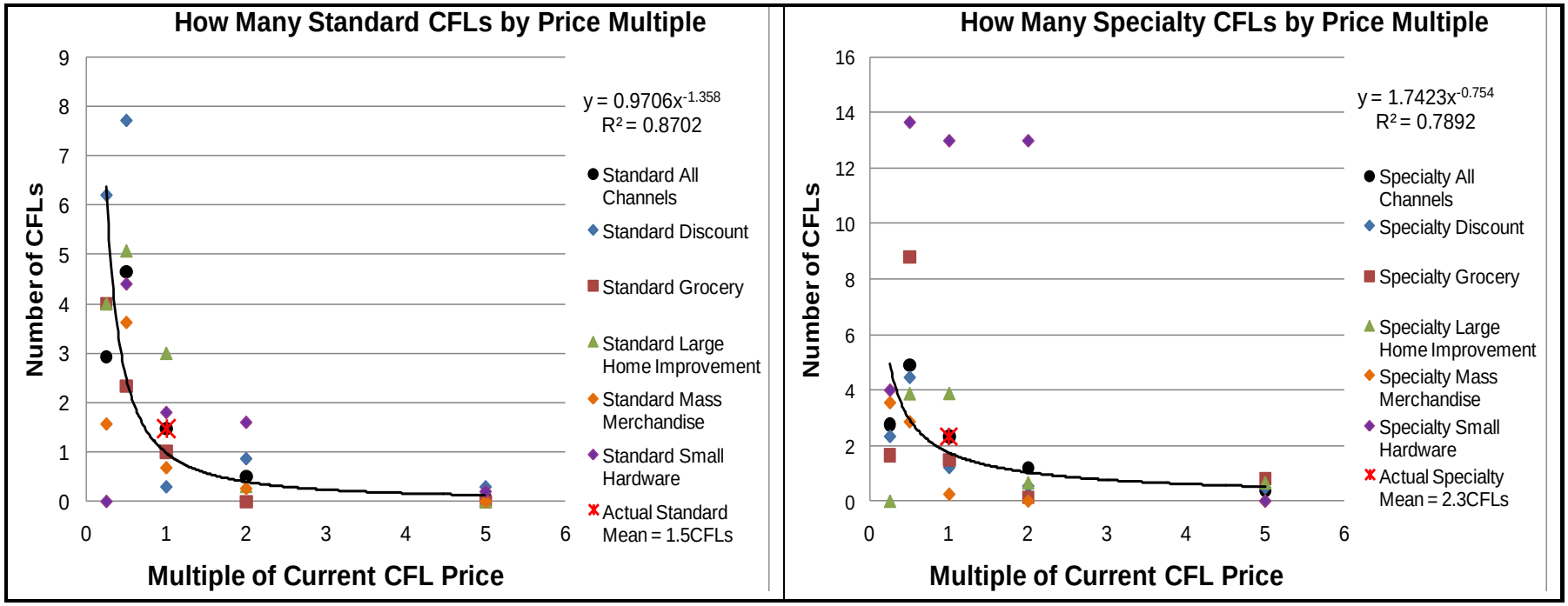
2.4 Results by Channel

Customers in all channels who purchased standard lamps purchased an average of 1.5 CFLs, as in Figure 3. This average includes respondents who purchased incandescents and zero CFLs. Standard CFL purchases behave as expected: the quantities demanded increase steadily as the relative price decreases, and vice versa, in all channels. The overall best-fit curve is one where the log of the quantity is a constant multiple of the log of the relative price—a power series—and it fits very closely.

For specialty CFL styles (also in Figure 5), the mean number of CFLs purchased was 2.3 CFLs. Specialty CFL purchases exhibit more variation by retail channel, with some channels hardly showing a change in quantity with a change in price. Some of this reflects the small sample sizes in each channel. The overall average series (black dots) is complicated by the fact that enough incandescent purchasers would not buy a CFL even at a quarter of the shelf price, and that the mean quantity of CFLs at half-price (which includes both incandescent and CFL purchasers) is higher than the mean quantity at one-quarter the price.[4] This makes the curve flatter overall than for standard lamps. For this reason, we model standard and specialty bulbs separately in this memo.

[4] One possible explanation is that some stores did not have the right specialty lamp available in CFL, so the hypothetical purchase option is less plausible than if both incandescent and CFL were on the shelf. Another possible explanation is that for specialty lamps, price is not as decisive a factor.

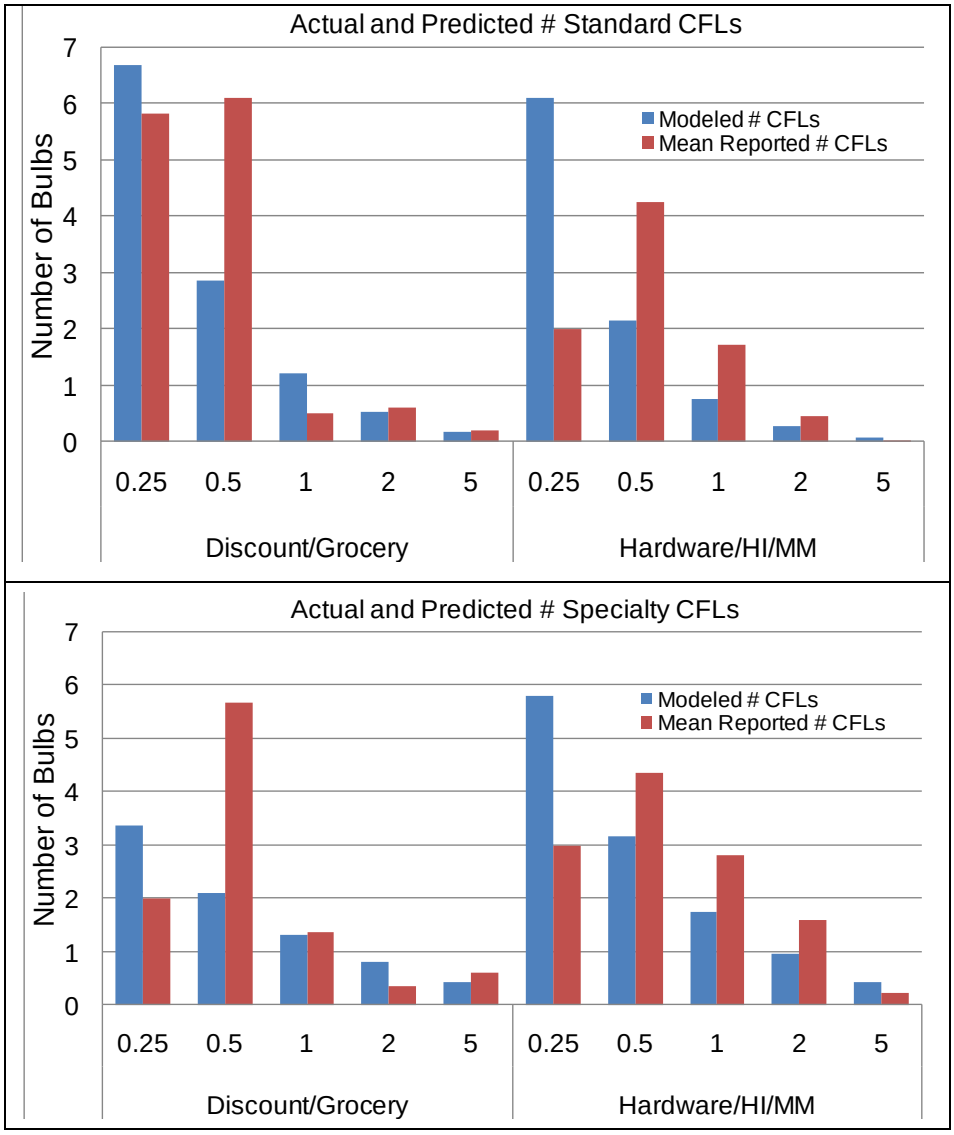
Figure 5: Number of CFLs Purchased at Relative Price by Channel



Two adjustments clarify matters. First, when channels are grouped based on the similarity of their individual best-fit models, there are more customers per channel, and more consistent price-dependence; this can be seen in Figure 6. These groupings are discount/grocery stores and hardware/home improvement/mass merchandise. Second, when average prices are denominated in dollars rather than multiples, then the varying price is no longer a hidden variable; this can be seen in Figure 7. These results are discussed in turn.

Discount and grocery store purchasers of standard bulbs (upper chart of Figure 6) are more responsive to halving the price of CFLs than their counterparts in hardware, home improvement (HI) and mass merchandise stores (MM). Both of the standard CFL series are smooth and monotonic, though the reported data (red bars) are less smooth than the modeled (blue bars). For example, discount and grocery purchasers report that at half the price, they would buy more than six times as many bulbs—the model predicts a more modest tripling of the number. In the hardware/HI/MM channel grouping, the reported response to doubling and halving the price is more modest because the mean number purchased is actually larger. For specialty CFL purchases (lower chart of Figure 6), again the discount/grocery customers report a very large increase in quantity demanded to halving the price, and a big decrease in response to doubling the price. The hardware/HI/MM customers seem to respond more moderately in their reported quantities (red bars) than do the discount/grocery customers.

Figure 6: Modeled # CFLs for Standard and Specialty by Channel

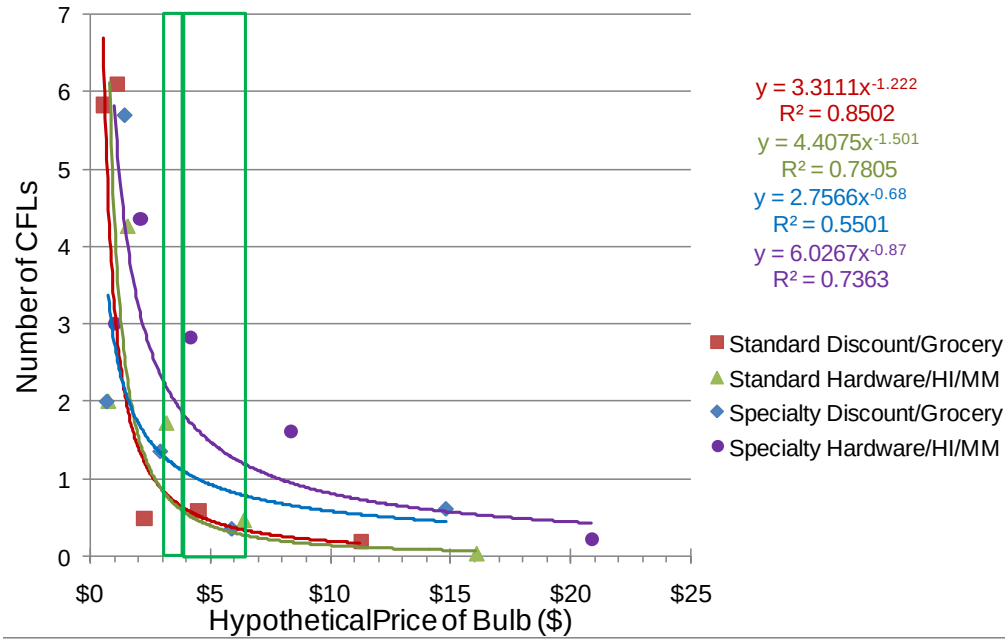


Hypothetical price as multiple of current shelf price from 0.25 to 5

Figure 7 shows the reported and modeled number of CFLs as a function of dollar-denominated prices. It is even clearer that hardware, home improvement and mass merchandise customers have a flatter response to changes in prices, while the discount and grocery store purchaser curves are steeper. Even though the discount and grocery store prices are generally lower, their customers purchase fewer CFLs at all hypothetical prices except for half-price. The green rectangles indicate the discounted and non-discounted prices of standard ($2.83 and $3.98,

respectively) and specialty ($3.96 and $6.48, respectively) CFLs, according to the shelf pricing data collection effort.

Figure 7: Reported and Modeled Number of CFLs vs. Dollar Price



The impact of the discount is calculated separately for specialty CFLs and for standard CFLs for each of the grouped channels,. The discount seems to have induced each participant to buy one extra CFL on that day. Table 3 presents free ridership estimates for each channel grouping and bulb type. In the final row, we weight each bulb type/channel group result by program sales. Overall, this approach provides free ridership estimates of 61% for standard bulbs and 66% among specialty bulbs. Using program sales data from January 9, 2009 through June 11, 2010, we estimate an overall weighted estimate of free ridership of 62%.

Table 3: Impact of the Discount on Number of CFLs Purchased by Channel

Parameter	Standard Bulb		Specialty Bulb	
	Discount/ Grocery	Hardware/ HI/MM	Discount/ Grocery	Hardware/ HI/MM
Modeled Full Price (MFP)	0.6	0.6	0.8	1.2
Modeled Discount Price (MDP)	0.9	0.9	1.1	1.8
Discount Impact (DI)	0.3	0.4	0.3	0.6
DI/MDP=	34%	40%	28%	34%
Bulb and Channel Free-ridership	66%	60%	72%	66%
Sales Weighted FR Estimate by Bulb Type (SE)	61% (*13%*)		66% (*10%*)	
Overall Free-ridership Estimate	62% (*10.5%*)			

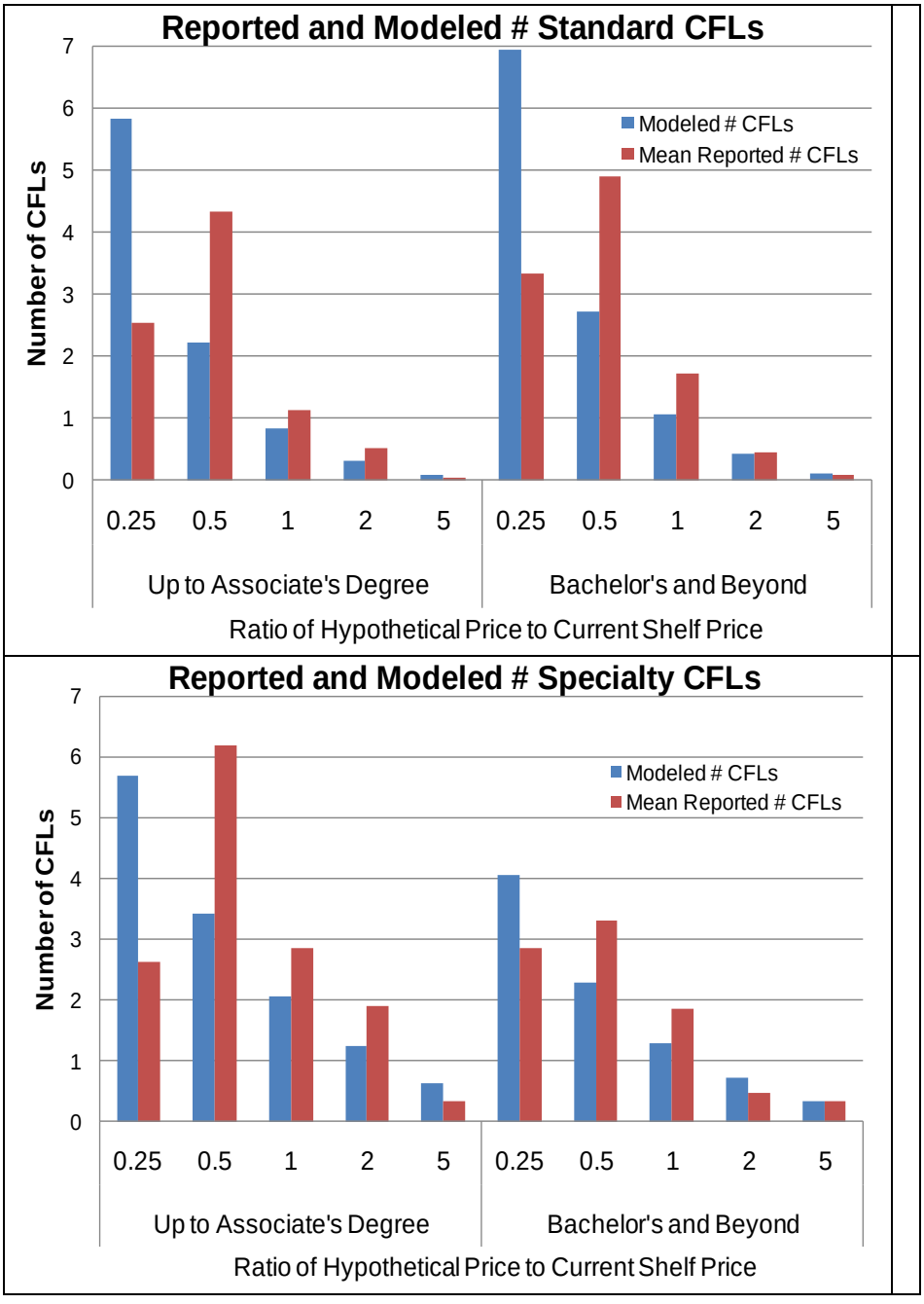
2.5 Results by Education Level

The sample is relatively well-educated compared to the adult population of the state as a whole. Of the 102 respondents who answered the question, 46 (45%) had at most a two-year college degree, while 56 (55%) had at least a bachelor's degree; of the 56, 25 (24%) had achieved graduate degrees as well. In Massachusetts, only 35% of residents over 18 have at least a bachelor's degree, while 37% of adults over 25 do.[5] Based on our sample, CFL purchasers are even more likely than the respondents overall to have a college degree: only 17 (40% of CFL purchasers) had not completed a 4-year degree, while 25 (60% of CFL purchases) had a bachelor's degree.

Denominated in multiples of the shelf price that day, there was little difference in standard CFL price sensitivity between the group receiving up-to-an-Associate's degree and the Bachelor's-and-beyond group. This is visible in Figure 8 for – the reported series (red bars) are similar for standard CFLs in both education groups. For specialty bulbs, there is more sensitivity to relative price for respondents with less than a four-year college degree than for ones with at least a bachelor's degree. All respondents claim that at half of the shelf price, they would purchase more CFLs than they actually did.

[5] Source: U.S. Census Bureau, 2005-2009 American Community Survey. TableS1501. Educational Attainments

Figure 8: Modeled # CFLs for Standard and Specialty by Education Level



When prices are denominated in dollars, however, education level matters less than whether the respondent purchased specialty or standard lamps. As can be gleaned from Figure 9, the elasticity of demand for specialty bulbs is 0.83 for customers with up to a 2-year college degree, and 0.73 for those with at least a four-year degree. Within the price range for full-price and

discount-price specialty lamps, both curves are similarly steep (sensitive to price). For standard CFLs all education levels see elasticities of 1.35 and 1.39, which are steeper (more sensitive to price) than for specialty CFLs especially within in the range between full-price and discounted-price during the study period.

Figure 9: Demand for CFLs by Education (Specialty and Standard)

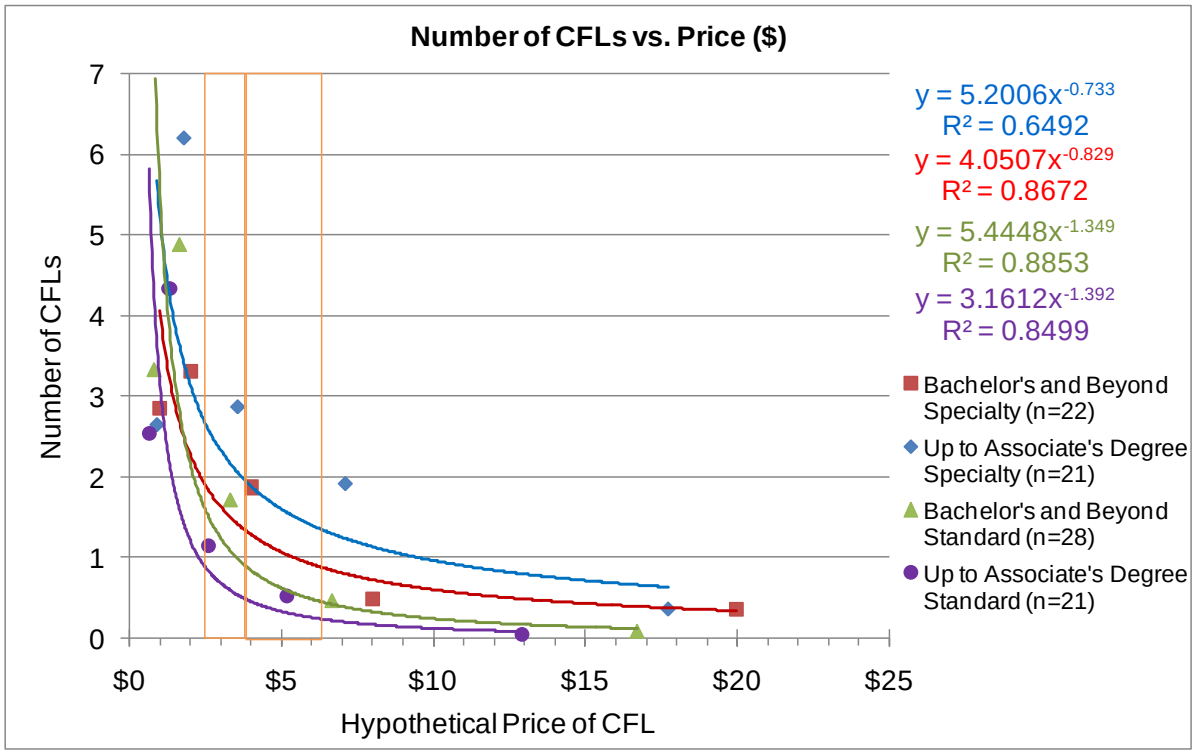


Table 4 presents a predicted impact of the Massachusetts discount that is less than half a standard CFL for respondents with less than a bachelor's degree who bought standard bulbs, and just half of a CFL for those with more schooling. Free-ridership is 62% for the lower education group, and 63% for the higher. For specialty bulbs, the impact of a discount is slightly higher for both groups, but the quantities are also slightly larger, making for free-ridership estimates of 67% for specialty purchasers with less than a bachelor's degree, and 70% for those with at least a bachelor's degree. Weighting the free-ridership estimates by the census data on population proportions we get a program average free-ridership of 63% for standard CFLs and 68% for specialty CFLs.

Table 4: Impact of the Discount and Free-Ridership by Education Level

	Standard		Specialty	
	Up to Associate's Degree (n=21)	Bachelor's and Beyond (n=22)	Up to Associate's Degree (n=21)	Bachelor's and Beyond (n=28)
Modeled Full Price (MFP)	0.5	0.8	0.9	1.3
Modeled Discount Price (MDP)	0.7	1.3	1.3	1.9
Discount Impact (DI)	0.3	0.5	0.4	0.6
DI/MDP=	38%	37%	33%	30%
Bulb and Education Level Free-ridership	62%	63%	67%	70%
Census-weighted Fr Estimate by Bulb Type (SE)	63% (*5%*)		68% (*8%*)	
Overall CFL Free-ridership Estimate	64% (*6%*)			

2.6 Results by Income Level

CFL purchasers were distributed rather evenly across income levels in the sample, for both specialty and standard CFLs. Approximately one third of each group refused to report their household income, another third earned less than $50,000 and the remainder earned $50,000 or more. These counts are compared with census data in Table 5; the census does not report refusals to respond. Although we do not know for sure, it may be that many of those respondents who refused to provide their income range likely fall into the $50,000 or more group, given their greater representation in the population than in our sample.

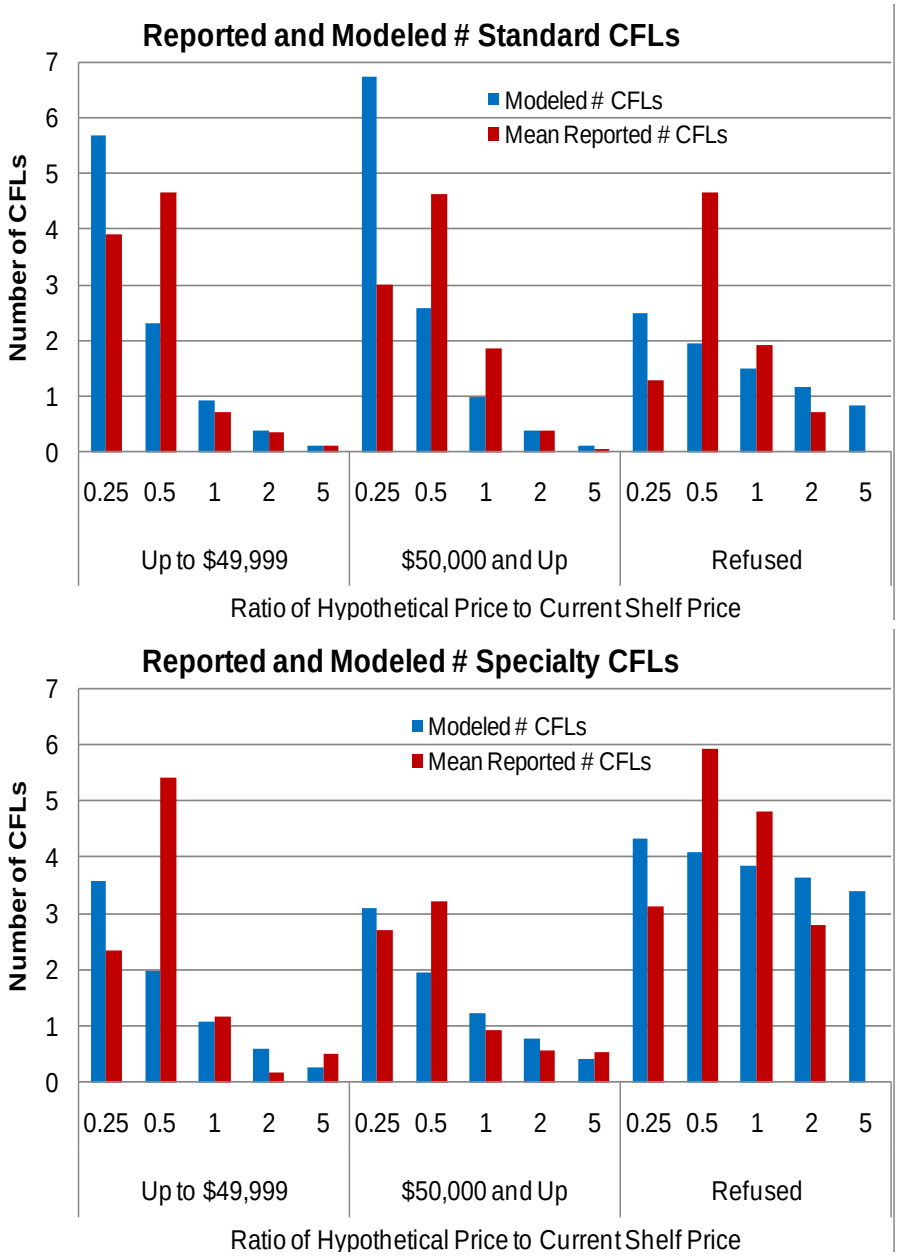
Table 5: Respondent Income and Census Household Income

Income Level	Standard	Specialty	Census	Census%
Up to $49,999	18	12	973,933	39.5%
$50,000 and Up	16	16	1,491,721	60.5%
Refused	15	15	N/A	N/A

Figure 10 shows the response to prices denominated in multiples of the shelf price that day. For standard CFLs, the lower-income groups bought less than a single CFL, while the higher-income group and those who refused to report their income actually bought almost two CFLs per respondent. At twice and five times the shelf price, both groups reporting income would buy similar numbers—less than a single CFL each—while the group that would not say their income reported willingness to purchase more CFLs at higher prices. All three groups would purchase similar numbers of standard CFLs at lower prices. The modeled response to price is much flatter in the group refusing to report household income than in the other two.

For specialty purchasers, those who refused to give their income actually bought almost five CFLs per respondent, while both other groups purchased about one CFL each. The lower-income group reports greater sensitivity to price changes than the higher-income group. Even more than among standard bulb purchasers, the group refusing to report household income shows a very flat response to increases and decreases in hypothetical price: at one quarter of the current price, they would purchase about half a bulb more than they did, and at five times the current price, they would buy half a bulb less. All three income groups are more responsive to price changes for standard CFLs than for specialty CFLs.

Figure 10: # CFLs vs. Relative Prices by Household Income



When prices are denominated in dollars, the three groups show different levels of responsiveness to price (Figure 11). Respondents who refuse to report income respond much less to price changes, purchasing zero bulbs at five times the price, and less at one-quarter the price than at one-half the price; this is consistent with different stated preferences between incandescent purchasers and CFL purchasers. Standard bulb purchasers who report income

behave similarly in the two income classes; they are relatively sensitive to price, with an elasticity of demand of 1.3 for lower-income respondents and 1.4 for higher-income respondents. Both curves are fairly shallow between $3 and $4 per bulb where the discount is measured. For specialty purchasers, respondents reporting incomes under $50,000/yr are slightly more sensitive to price than respondents earning $50,000 or more/yr, elasticities are 0.86 for the former and 0.67 for the latter.

Figure 11: Demand for CFLs by Income (Specialty and Standard)

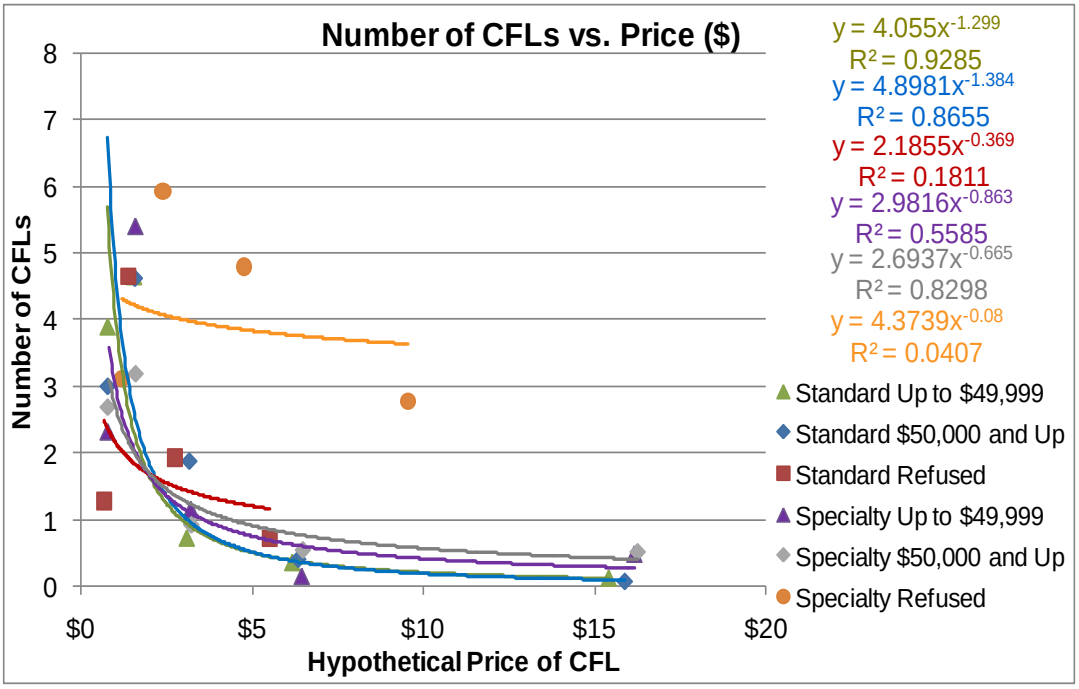


Table 6 shows a predicted impact of the discount of about 0.4 CFLs for standard lamp purchasers who report income, and about 0.3 CFLs for specialty purchasers who report an income. Those who refuse to report income would buy nearly the same number at the modeled full and discount prices, their calculated free-ridership is 88% for standard and 96% for specialty lamps. Those models fit very poorly, however. When only respondents who report their household income are considered, and weighted by the census data on household income for adults in Massachusetts, free-ridership is about 63% for standard purchases, and 69% for specialty purchases. Weighting by program sales gives an average free-ridership of 64%, same as when calculated by education level.

Table 6: Impact of the Discount and Free-Ridership by Income Level

Parameter	Standard Bulb			Specialty Bulb		
	Up to $49,999 (n= 18)	$50,000 and Up (n= 16)	Refused (n= 15)	Up to $49,999 (n= 12)	$50,000 and Up (n= 16)	Refused (n= 15)
Modeled Full Price (MFP)	0.7	0.7	1.3	0.6	0.8	3.8
Modeled Discount Price (MDP)	1.0	1.2	1.5	0.9	1.1	3.9
Discount Impact (DI)	0.4	0.4	0.2	0.3	0.3	0.1
DI/MDP=	36%	38%	12%	34%	28%	4%
Bulb and Income Level Free-ridership	64%	62%	88*%	66%	72%	96*%
Census-weighted FR Estimate by Bulb Type (*SE*)	63% (*5%*)		N/A	69% (*8%*)		N/A
Overall CFL Free-ridership Estimate	64% (*5%*)					

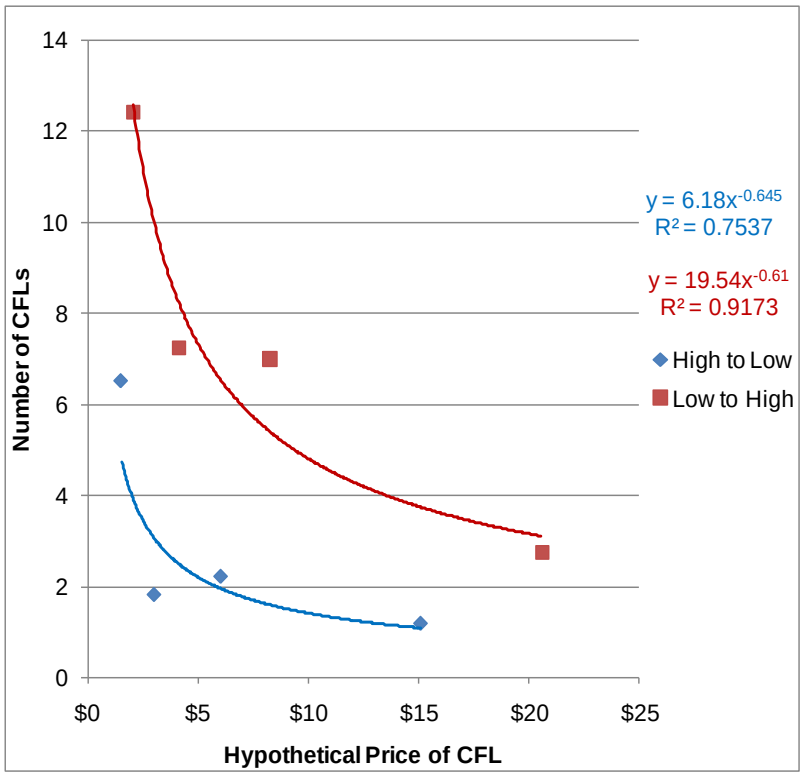
* Disregarded because of Poor Fit Models

2.7 Results by the Order in Which Hypothetical Price Multiples Were Asked

When asked what they would do at a range of prices, customers report differently when they are asked about prices in ascending or descending order. In this survey, about one-half of all customers (45) were asked in ascending and the remaining one-half (48) in descending order. CFL purchasers in both groups were asked about the two higher prices (in either order), and asked about half-price bulbs last.

Figure 12 shows that customers asked in descending order actually purchased more standard CFLs on that day—an average of 1.8 bulbs, compared to 0.8 for customers asked in ascending order. For specialty purchasers, the ascending customers bought 3.5 CFLs compared to 0.5 when asked high-to-low. As they had made their purchase decisions before being asked the survey, these tendencies for actual purchase behavior are coincidental to question order.

Figure 12: # CFLs vs. Relative Prices by Order Asked



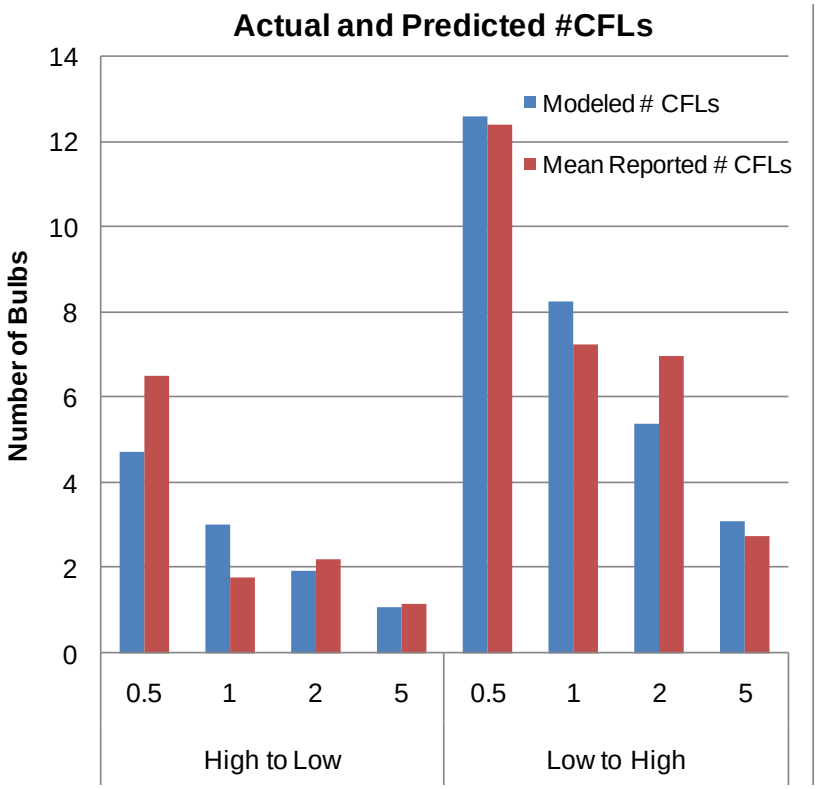
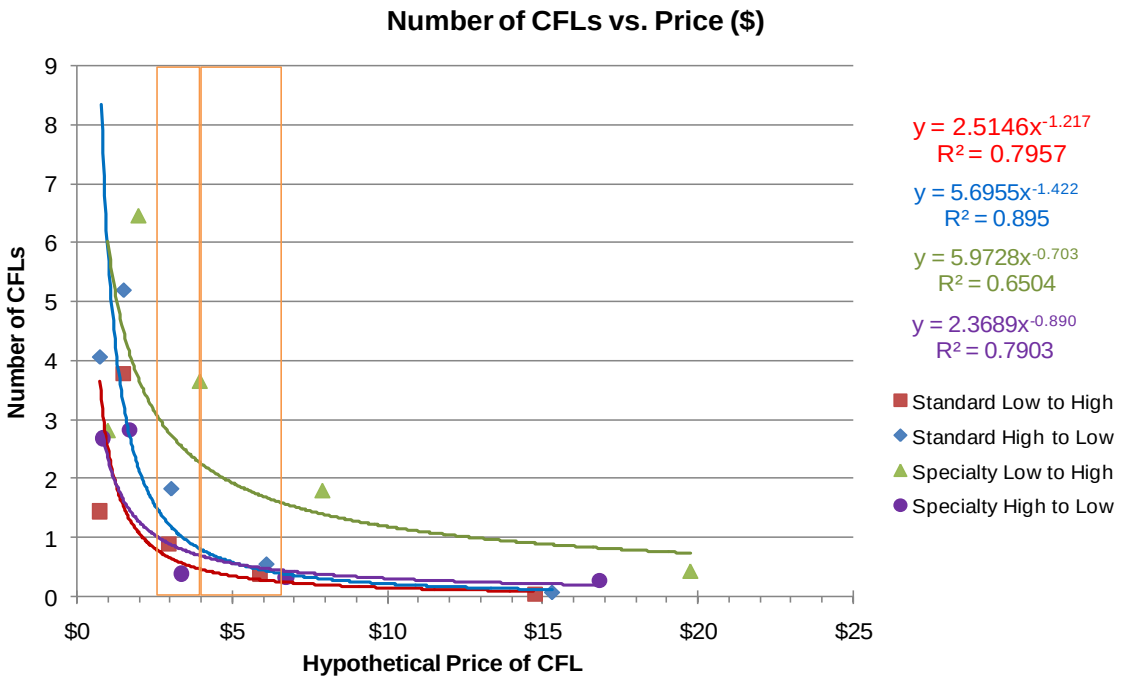


Figure 13 shows the modeled demand for CFLs for dollar-denominated prices comparing standard and specialty bulb modeled separately by the order in which the questions were posed. Specialty and standard CFLs follow the same pattern already seen in the analyses above: Standard CFLs show a noticeable power-curve relationship, with an elasticity of 1.2 to 1.4, while the elasticities for specialty CFLs are lower at 0.70 and 0.89. This specific analysis, however, demonstrates that, within the range of the standard-bulb full- and discount-prices, the high-to-low model is more sensitive to price (steeper) than the low-to-high model. For specialty CFLs, however, in the range of the modeled full and discount prices, both curves are fairly flat.

Figure 13: Demand for CFLs by Order of Hypothetical Prices



The impact of the discount on respondents' purchase decisions is shown in Table 7 for both specialty and standard purchasers. Despite the possibility of sensitivity in the results from question ordering, the weighted results by bulb type from both orders are consistent with the findings from the previous analyses. The overall free ridership estimate from this approach is 66%, comprised of an estimate of 63% for standard bulbs and 69% for specialty bulbs.

Table 7: Impact of the Discount and Free-Ridership by Order Asked

Parameter	Standard Bulb		Specialty Bulb	
	Low to High (n=19)	High to Low (n=30)	Low to High (n=26)	High to Low (n=18)
Modeled Full Price (MFP)	0.5	0.8	1.6	0.5
Modeled Discount Price (MDP)	0.7	1.3	2.3	0.7
Discount Impact (DI)	0.2	0.5	0.7	0.2
DI/MDP=	34%	38%	29%	35%
Free-ridership Estimate	66%	62%	71%	65%
Weighted Free-Ridership by Bulb Type (SE)	63% (*6%*)		69% (*6%*)	
Overall CFL Free-ridership Estimate	66% (*5%*)			

3. Summaries for Final Estimates

Table 8 presents a summary of all free ridership estimates from this work. Free-ridership estimates for specialty and standard CFLs are very consistent across the breakout groups, the lone exception being respondents who would not give their income (with higher free-ridership estimates). The result for an overall CFL estimate is 64 percent free-ridership, given the distribution of program CFLs between specialty and standard models. This was not changed when the estimate was analyzed by education level and income level and weighted to match the demographics of the state population. Therefore, we believe a free ridership estimate of 64% is appropriate to consider a final estimate from the intercept work.

In considering discrete estimates for standard versus specialty CFLs, standard CFLs are reliably around the 63% free ridership estimate. Indeed, the estimate flowing from the overall standard CFL analysis (bulb type only) was 63% with a very good error of +/- 5%. The specialty CFL estimates have more slightly diversity than the standard CFL estimates but still only range from 66% to 69%. Given the consistency in results between the various breakouts analyzed and the small error bound around the overall specialty bulb type only analysis, we recommend the specialty free ridership estimate from this effort be the overall estimate produced by bulb type (69%). While exclusive of spillover, the net to gross ratio for each result is the complement of each free ridership presented. For example, the net-to-gross estimate (NTG = 1 – free ridership) for standard CFLs estimated from the channel analysis is 0.39 (1 – 0.61).

Table 8: Summary of Free Ridership Estimates

Analysis Method (*with Standard Error*)	Standard CFL Estimate	Specialty CFL Estimate	Overall CFL Estimate
By Channel	61% (*13%*)	66% (*10%*)	62% (*11%*)
By Education Level	63% (*5%*)	68% (*8%*)	64% (*5%*)
By Income	63% (*7%*)	69% (*8%*)	64% (*6%*)
By Order Asked	63% (6*%*)	69% (6*%*)	66% (*5%*)
By Bulb Type Only	63% (*5%*)	69% (*6%*)	64% (*4%*)

Table 9 presents a summary of the elasticity findings. Standard CFLs are consistently found to be more elastic than specialty CFLs. This finding is consistent with the WTP analysis results provided earlier in this study under separate cover.

Table 9: Summary of Elasticity Estimates

Analysis Method	Standard CFL Estimate		Specialty CFL Estimate	
By Channel	Discount/ Grocery	Hardware/ HI/MM	Discount/ Grocery	Hardware/ HI/MM
	1.222	1.501	0.680	0.870
By Education Level	Up to Associate's Degree	Bachelor's and Beyond	Up to Associate's Degree	Bachelor's and Beyond
	1.392	1.349	0.733	0.829
By Income	Up to $49,999	$50,000 and Up	Up to $49,999	$50,000 and Up
	1.299	1.384	0.863	0.665
By Order Asked	Low to High	High to Low	Low to High	High to Low
	1.217	1.422	0.703	0.890
By Bulb Type Only	1.358		0.754	

Massachusetts ENERGY STAR® Lighting Program 2010 Annual Report

Appendix G:

Estimating the Net-to-Gross Ratio for the 2009-2010 Massachusetts ENERGY STAR® Lighting Program: Delphi Panelist Response Summary

Estimating the Net-to-Gross Ratio for the 2009-2010 Massachusetts ENERGY STAR® Lighting Program:

Delphi Panelist Response Summary

Final

5/30/2011

Submitted to:

Energy Efficiency Advisory Council Consultants

Cape Light Compact

NSTAR

National Grid

Unitil

Western Massachusetts Electric

Submitted by:

NMR Group, Inc.

50-2 Howard Street, Somerville, MA 02144
Phone: (617) 284-6230 Fax: (617) 284-6239
www.nmrgroupinc.com

Table of Contents

EXECUTIVE SUMMARY I

DEVELOPING A SINGLE 2009-2010 NTG ESTIMATE FOR ALL CFLS II

NTG ESTIMATES FOR SPIRAL CFLS ONLY III

NTG ESTIMATES FOR SPECIALTY CFLS ONLY IV

DISCUSSION OF OUTLIERS VI

1 REVIEW OF DELPHI STUDY OBJECTIVES AND PROCESS 1

1.1 OBJECTIVE 1

1.2 PROCESS 1

1.2.1 Panel of Experts 2

1.2.2 Delphi Survey – Round One 3

1.2.3 Delphi Survey – Round Two 4

2 DATA SUMMARY: ASSESSING THE 2009-2010 NTG ESTIMATES FOR SPIRAL CFLS 5

2.1 MA WILLINGNESS TO PAY ASSESSMENT: ESTIMATED NTG OF 0.49 (SPIRAL CFLS ONLY) 7

2.2 MA SUPPLIER SELF-REPORTS: ESTIMATED NTG OF 0.39 (SPIRAL CFLS ONLY) 9

2.3 MA ACTIVE PURCHASER REVEALED PREFERENCE: ESTIMATED NTG OF 0.37 (SPIRAL CFLS ONLY) 11

2.4 MA MULTISTATE REGRESSION MODEL: ESTIMATED NTG OF 0.45 (ALL CFLS) 12

2.5 WEIGHTING THE 2009-2010 ESTIMATES FOR SPIRAL CFLS 14

2.6 DEVELOPING A SINGLE 2009-2010 NTG ESTIMATE FOR SPIRAL CFLS 16

2.6.1 NTG Estimates for Spiral CFLs – Round One Comments 16

2.6.2 NTG Estimates for Spiral CFLs – Round Two Comments 17

2.6.3 Final NTG Estimates for Spiral CFLs 22

3 DATA SUMMARY: ASSESSING THE 2009-2010 NTG ESTIMATES FOR SPECIALTY CFLS 26

3.1 MA WILLINGNESS TO PAY ASSESSMENT: ESTIMATED NTG OF 0.31 (SPECIALTY CFLS ONLY) 28

3.2 MA Supplier Self-Reports: Estimated NTG of 0.49 (Specialty CFLs only) 29
3.3 MA Conjoint/Pricing Elasticity Analysis: Estimated NTG of 0.59 (Specialty CFLs only) 30
3.4 MA Active Purchaser Revealed Preference: Estimated NTG of 0.31 (Specialty CFLs only) 32
3.5 MA Multistate Regression Model: Estimated NTG of 0.45 (All CFLs) 33
3.6 Weighting the 2009-2010 NTG Estimates for Specialty CFLs 34
3.7 Developing a Single 2009-2010 NTG Estimate for Specialty CFLs 37
3.7.1 NTG Estimates for Specialty CFLs – Round One Comments 37
3.7.2 NTG Estimates for Specialty CFLs – Round Two Comments 37
3.7.3 Final NTG Estimates for Specialty CFLs 42
4 Developing a Single 2009-2010 NTG Estimate for All CFLs 46
4.1 NTG Estimates for All CFLs – Round One Comments 46
4.2 NTG Estimates for All CFLs – Round Two Comments 46
4.3 Final NTG Estimates for All CFLs 50
5 Final Net-to-Gross Estimates 53
Appendix A First-round survey Instrument A1
Appendix B Second-round survey Instrument B1

Tables

Table E-1: Weighted or Re-estimated NTG Ratios after Removing Outliers III
Table 2-1: Accuracy of Estimates – Spiral CFLs 6
Table 2-2: Assigned Weights for NTG Estimates – Spiral CFLS 14
Table 2-3: Confidence in Responses – Spiral CFLs 20
Table 2-4: Whether Panelists Modified Initial Responses or Not – Spiral CFLs 20
Table 2-5: Weighted or Re-Estimated NTG – Spiral CFLs 22
Table 3-1: Accuracy of Estimates – Specialty CFLs 27
Table 3-2: Assigned Weights for NTG Estimates – Specialty CFLs 35

TABLE 3-3: CONFIDENCE IN RESPONSES – SPECIALTY CFLS 39
TABLE 3-4: WHETHER PANELISTS MODIFIED INITIAL RESPONSES OR NOT – SPECIALTY CFLS 40
TABLE 3-5: WEIGHTED OR RE-ESTIMATED NTG – SPECIALTY CFLS 42
TABLE 4-1: CONFIDENCE IN RESPONSES – ALL CFLS 48
TABLE 4-2: WHETHER PANELISTS MODIFIED INITIAL RESPONSES OR NOT – ALL CFLS 48
TABLE 4-3: WEIGHTED OR RE-ESTIMATED NTG – ALL CFLS 50
TABLE 5-1: ACCURACY OF ESTIMATES – SPIRAL CFLS 53

Figures

FIGURE 1-1: NET-TO-GROSS METHODS AND ESTIMATES 3
FIGURE 2-1: AVERAGE ESTIMATED ACCURACY OF NTG ESTIMATES FOR SPIRAL CFLS ONLY, 2009-2010 IN MASSACHUSETTS 7
FIGURE 2-2: SCORES OF 2009-2010 SPIRAL CFL NTG ESTIMATES FOR MASSACHUSETTS 15
FIGURE 2-3: WEIGHTING THE SPIRAL CFL NTG ESTIMATES 15
FIGURE 2-4: WEIGHED OR RE-ESTIMATED NTG RATIOS FOR SPIRAL CFLS 23
FIGURE 2-5: WEIGHTED OR RE-ESTIMATED NTG ESTIMATE: SPIRAL CFLS ONLY 23
FIGURE 3-1: AVERAGE ESTIMATED ACCURACY OF NTG ESTIMATES FOR SPECIALTY CFLS ONLY, 2009-2010 IN MASSACHUSETTS 28
FIGURE 3-2: MEAN SCORES OF 2009-2010 SPECIALTY CFL NTG ESTIMATES FOR MASSACHUSETTS 36
FIGURE 3-3: WEIGHTING THE SPECIALTY CFL NTG ESTIMATES 36
FIGURE 3-4: WEIGHTED OR RE-ESTIMATED NTG RATIOS FOR SPECIALTY CFLS 42
FIGURE 3-5: MASSACHUSETTS CFL NTG ESTIMATES – SPECIALTY CFLS ONLY 43
FIGURE 4-1: WEIGHTED OR RE-ESTIMATED NTG RATIOS FOR ALL CFLS 50
FIGURE 4-2: WEIGHTED OR RE-ESTIMATED NTG ESTIMATE – ALL CFLS 51

Executive Summary

The goal of this study was to assess the net impact of the 2009 and 2010 Massachusetts ENERGY STAR® Lighting Program on the sales of Compact Fluorescent Lights in Massachusetts. The Massachusetts ENERGY STAR Lighting Program is an ongoing effort to encourage the use of ENERGY STAR-qualified lighting among residential customers. The Massachusetts Program Administrators (PAs) also work with other regional programs through the Northeast Energy Efficiency Partnerships (NEEP) to leverage program effectiveness by aggregating markets and coordinating consumer messaging. Additionally, all PA lighting initiatives are coordinated with and designed to support the national ENERGY STAR program.

This report discusses the results from a Delphi panel of experts asked to help determine which, if any, of the net-to-gross (NTG) estimates developed for the program is most accurate. The Delphi panel was composed of lighting and energy efficiency experts from across the country and Canada. Twenty experts were able to take part in the first round of the Delphi and 19 provided responses in a second round. In the first round, panelists were provided with an instrument that included a detailed description of the NTG estimates and methodologies being reviewed, along with the strengths and weaknesses associated with each. Delphi panelists were asked to assess the Massachusetts NTG estimates for 2009-2010 only, not for any other states or years.

The second Delphi instrument summarized the estimates and comments made by the panel members in round one. In round two, panel members were provided an opportunity to modify their initial projections and assumptions, based on the estimates and comments provided by their fellow panelists. The second instrument also asked the experts to state any reasons for changing or not changing their projections, along with any comments on the appropriateness of the other assumptions and comments listed.

Panelists are grouped into three categories for purposes of presenting the information while protecting their identities: 1) CFL manufactures and program implementation contractors (five panelists); 2) employees of entities that implement programs (six panelists); and 3) regulators, evaluators, and efficiency experts (eight panelists). The efficiency experts may work for efficiency advocacy groups, think tanks, or firms that provide program design support.

Many panelists expressed doubt about the methods used and the final NTG estimates, and some said that the low NTG estimates were counterintuitive. Additionally, many remarked that specialty CFLs having a lower NTG than spiral CFLs was illogical. One member of the CFL manufacturers/program implementation contractors group stated this was surprising considering that, "historic sales volumes for specialty CFLs in the absence of incentives are negligible." One member of the regulator/evaluator/efficiency expert group said that "some of the approaches to estimating specialty product NTGs are inherently biased to the low end of a range (e.g. not examining all types of specialty products, focusing on just price, or not separately looking specialty products at all)." Another member of the same group said "it is hard to deny that specialty models have sold far less well than bare spirals and in far fewer outlets. Therefore,

those sales increases that have occurred are more readily attributable to utility program activity. I am persuaded that the NTG ratio for specialty products should be slightly higher."

Ultimately, no single method emerged as the clear favorite of the Delphi panel. The final adjusted NTG estimates fell within a narrow range—the same range, in fact, as the estimates produced by the NMR team for spiral CFLs and CFLs overall, although panelists ended up recommending a slightly higher NTG for specialty CFLs. None of the methods received an average accuracy rating over 4.0 on a scale of 1 to 5, where 1 is "very inaccurate," 2 is "somewhat inaccurate," 3 is "neither accurate nor inaccurate," 4 is "somewhat accurate," and 5 is "very accurate." For spiral CFLs, the MA Multistate Modeling method received the highest average accuracy rating (3.5). For specialty CFLs, the Conjoint/Pricing Elasticity Analysis received the highest average accuracy rating (3.4).

Below we present a summary of the findings from the Delphi regarding NTG estimates for spiral CFLs only, specialty CFLs only, and all CFLs.

Developing a Single 2009-2010 NTG Estimate for all CFLs

- The range of estimates provided by the Delphi panel was fairly narrow and within the range of the unadjusted estimates provided by the various NTG ratios developed for the program. Some experts said that this narrow range boosted their confidence in the final ratio, especially due to the diversity of the group giving input. Table E-1 shows the final NTG ratio estimates provided by the Delphi panel alongside the range of estimates provided by the various NTG methods.
- The Delphi panel, with three outliers eliminated, provided a median NTG ratio estimate of 0.43 for spiral CFLs with a mean of 0.45. NMR recommends that the PAs use the median NTG ratio of 0.43 for spiral CFLs.
- The Delphi panel felt strongly that there should be a separate NTG ratio for spiral CFLs and specialty CFLs, with a general consensus that specialty CFLs would have a higher NTG ratio. The final median weighted NTG ratio for specialty CFLs provided by the Delphi panel with two outliers eliminated was 0.60 and the mean NTG ratio was also 0.60. NMR recommends that the PAs use the median NTG ratio of 0.60 for specialty CFLs.
- Finally, to determine an overall NTG ratio for the program for all CFLs, NMR eliminated the outliers (three for spirals and two for specialty CFLs), and weighted the remaining panelists' NTG estimates for spiral CFLs and specialty CFLs based on the proportions of program-supported sales in 2009 and 2010. This resulted in a combined NTG estimate of 0.47 for all CFLs.
- Panelists rated their confidence in their own and the three groups' estimates (that is, CFL manufactures and program implementation contractors, employees of entities that implement programs, and regulators/evaluators/efficiency experts. While many panelists expressed an overall lack of confidence in the results, several panelists said

that the close clustering of responses to the round one survey, with the exception of two or three outliers, increased their confidence in the results. In particular, one member of the regulator/evaluator/efficiency expert group said the following:

> *One question I wish you had asked is my confidence in the group as a whole to come up with an accurate NTG. I have very high confidence in this … since the group is diverse, represents multiple perspectives and knowledge bases, and the majority of the individual overall NTG values are very closely clustered.*

Table E-1: Weighted or Re-estimated NTG Ratios after Removing Outliers

	All Respondents	Original Estimates
Spiral CFLs only		
Sample Size	*16*	
Median	0.43	0.36- 0.49
Mean	0.45	
Specialty CFLs only		
Sample Size	*17*	
Median	0.60	0.31 - 0.59
Mean	0.60	
All CFLs		
Sample Size	*17*	
Proportional average of spiral and specialty	0.47	

NTG Estimates for Spiral CFLs Only

- After reviewing the results from round one, many panelists expressed a lack of confidence in any of the methods. They commented that NTG should be used as an indicator as opposed to a definite ratio and suggested alternative methods to increase the validity of the estimate. However, as mentioned earlier, the final NTG estimates provided by the panel fell within a fairly narrow range, and generally within the range of the estimates produced though the various methods used by the NMR team.
- Asked to rate their confidence in their own and their fellow panelists' ratings, the panel expressed the lowest average level of confidence in the CFL manufacturer/ program implementation contractor group's estimates. Many observed that this group may have a conflict of interest when calculating a NTG for this program, as they may have something to gain from the final estimate.

Willingness to Pay Assessment

- The Delphi panel largely did not support the Willingness to Pay Assessment, highlighting this method's reliance on consumer self-reporting as a major weakness and giving it an average accuracy rating of 2.8.

- Weaknesses identified include the reliance on consumer self-reported data, issues with sample size, and the absence of spillover, past program, or market transformation effects in calculations.

Supplier Self-Reports

- The Supplier Self-Reports method was given an accuracy rating of 3.1 overall; the regulators/evaluators/efficiency experts group, however, gave this method an average accuracy rating of 4.0.
- Strengths identified included the ability to account for non-residential sales to control for any upward bias, the advantage in simplicity and face validity, and the hypothesis that retailers and suppliers may have a better idea of the market at the macro level.
- Weaknesses identified included the absence of both spillover and past program or market transformation effects in the calculations, and the fact that manufacturers and retailers may have a bias when answering questions.

Active Purchaser Revealed Preference

- Active Purchaser Revealed Preference was given an accuracy rating of 2.9 by the experts. Panelists did not mention any strengths of this method, but rather focused on the weaknesses.
- Weaknesses identified included the absence of spillover, reliance on self-reporting and hypothetical questions, and the fact that it focused only on price as a driver of decision-making. Some members of the group again found the resulting NTG estimate to be unrealistically low.

Multistate Regression Model

- The MA Multistate Regression Model was rated an accuracy of 3.5, the highest average rating given by the panel as a whole.
- Strengths identified included a larger and more random sample, attempts to account for many variables that affect the program, including past program activity, and the avoidance of the social desirability bias.
- Weaknesses identified included uncertainty with the accuracy of the date of purchase, the fact that it erroneously treats non-program states as a baseline, and that, since the estimate includes specialty CFLs, it should have a higher NTG than spiral CFLs alone.

NTG Estimates for Specialty CFLs Only

- Asked to rate their confidence in their own and their fellow panelists' ratings, the panel as a whole again expressed the lowest average level of confidence in the CFL manufacturers/program implementation contractors group, again because of a possible conflict of interest. Again, some panelists were reassured by the close

clustering of specialty CFL NTG estimates from their fellow panelists, except for a couple of outliers.

- After reviewing the results from round one, some panelists reemphasized the lack of confidence in any of the methods, commenting that none of the methods are perfect and that overall uncertainty was high with the specialty CFLs.

Willingness to Pay Assessment

- Experts did not support the Willingness to Pay Assessment for specialty CFLs, again highlighting this method's reliance on consumer self-reporting as the major weakness and giving it an average confidence rating of 2.1 on a scale of 1 to 5.
- Weaknesses identified included reliance on consumer self-reported data, issues with the sample size, and the absence of spillover. Also, several panelists said the low NTG estimate was counterintuitive.

Suppler Self-Reports

- The Supplier Self-Reports method was given an accuracy rating of 2.8 overall.
- Weaknesses identified included the absence of spillover, and the potential bias of retailers and manufacturers, as well as their lack of understanding of the market. Many members of the group also found the low NTG estimate to be counterintuitive.

Conjoint/Pricing Elasticity Analysis

- The Conjoint/Pricing Elasticity Analysis was only done for specialty CFLs. It was given an average rating of 3.4, the highest average rating of the respondents as a whole.
- Strengths identified included the large sample size, the hedonic pricing analysis, the view that it was based on sound economics, and the more realistic and expected NTG estimate that resulted from this calculation.
- Weaknesses identified included the limitations of self-reported data, the limited number of types of specialty bulbs included, and the opinion that it was not built on a strong understanding of the market.

Active Purchaser Revealed Preference

- Active Purchaser Revealed Preference was given an accuracy rating of 2.3 by the experts.
- Weaknesses identified included the small sample size, problems with self-reporting, and the focus on price as the only driver of decision-making. The group also found the resulting NTG estimate to be low.

Multistate Regression Model

- The Multistate Regression Model was given an accuracy of rating 3.2. With this method, experts supported the attempt to account for many variables that affect the

program, including past program activity, the avoidance of the social desirability bias and small sample issues, and the potentially accurate NTG estimate resulting from this calculation.

- Weaknesses identified included the inclusion of both specialty and spiral CFLs in one NTG ratio, the use of non-program states as a baseline, and the opinion of some panelists that the low NTG estimate was counterintuitive.

Discussion of Outliers

The NMR team, along with the PAs and the Energy Efficiency Advisory Council consultants, agreed to nominate and recruit experts to serve on the Delphi panel without consideration of possible conflict of interest (e.g., the incentive to sell more CFLs possibly influencing responses), but rather based on expertise and familiarity with the market. While we did not make *a priori* judgments about panelists' ability to be objective, we did decide beforehand that we would screen out responses that substantially differed from those of other respondents, irrespective of panelists' backgrounds.

Of the 19 panelists responding in round two, 16 provided NTG estimates for spiral CFLs ranging from 0.39 to 0.65; these 16 responses are included in the mean and median estimates (0.45 and 0.43, respectively). Fourteen of these 16 panelists gave estimates for the spiral CFL NTG within an even narrower range of 0.39 to 0.50. In addition, there were three outliers,[1] with ratings of 0.70, 0.75, and 1.15; these estimates were excluded from the mean and median NTG estimates for the panel as a whole.

For the specialty CFL NTG, 17 panelists gave NTG estimates ranging from 0.42 to 0.90; these 17 responses are included in the mean and median estimates (both of which are 0.60). Twelve of these 17 gave estimates in the narrower range of 0.59 to 0.70, with four giving lower estimates and one giving a higher estimate. In addition, there were two outliers, with ratings of 1.15 and 1.25; these estimates were excluded from the mean and median NTG estimates for the panel as a whole.

The NTG estimate of 0.47 for all CFLs provided by the NMR team is based on the median estimates of 0.43 for spiral CFLs and 0.60 for specialty CFLs provided by the panel, excluding outliers, weighted to the number of spiral and specialty CFLs supported by the program in 2009 and 2010. However, panelists also provided their own estimates of the overall CFL NTG. Fourteen panelists gave estimates ranging from 0.42 to 0.55; three panelists—all from the CFL manufacturers/program implementers group—gave estimates ranging from 0.66 to 0.7; one panelist (from the employees of entities that implement programs group) gave an estimate of 0.88; and one panelist (from the regulators, evaluators, and efficiency experts group), gave an estimate of 1.50.

[1] Defined as 1.5 times the interquartile range or greater

The panelist giving the estimate of 1.50 said that estimate "accounts for the missing causes that were not studied, such as market effects, spillover, repeat purchases caused by the program, and increased demand over the long term." However, in the round one instrument, we had said that "all methods estimate the NTG for a given program year or a few years, and do not attempt to calculate possible spillover from program activity to CFL sales in non-program states," and "we are asking for your assessment of the Massachusetts NTG estimates for 2009-2010 only, not for any other states or years." As we explained in the second round instrument, we were looking for the marginal impact of this year's program, and past program impacts are irrelevant. In addition, we said the following in the round two instrument:

> *It is true that past activities in Massachusetts and other active states very likely did have an effect on current CFL sales in non-program states, and have thereby affected the baseline. To some extent, this may be reflected in some of the earlier NTG estimates for Massachusetts—i.e., 2.77 in 2006 and 2.15 in 2007 (see the "background data" tab in the round one instrument). These earlier NTG estimates, computed for single program years, already account for much of the cumulative savings from market effects and spillover in non-program states.*

The panelist giving the highest NTG estimates appears to be including the effects that we had deliberately sought to exclude since they had to some extent been accounted for in past estimates. This exercise is not an attempt to estimate the net effects of historical Massachusetts CFL program since its inception, but, more narrowly, to estimate the effects of the 2009-2010 program only.

The panelist who gave a rating of 0.88 had given a 0.75 NTG for spiral CFLs and a 1.25 NTG for specialty CFLs—both of them also eliminated as outliers—justifying these estimates as follows:

> *Given my own recent experience managing a CFL lighting program, I feel that PAs are still having a significant impact in the promotion of Standard Spiral CFLs. After reviewing the other responses it was obvious to me that as a program implementer, I am biased about the effectiveness of CFL lighting programs. However, I also believe that the other respondents are either unaware or ignoring the impact that CFL programs are having in reducing the price of Specialty CFLs, which is a large component of overcoming a barrier to consumers purchase of these products, and participating in CFL programs such as those Sponsored by the MA PAs.*

This panelist seems to be relying on gut feeling for spiral CFLs, and for specialty CFLs does not address the fact that several of the methods actually took the effect of pricing into account.

1 Review of Delphi Study Objectives and Process

1.1 Objective

The objective of this study was to assess the net impact of the 2009 and 2010 Massachusetts ENERGY STAR® Lighting Program on the sales of Compact Fluorescent Lights in Massachusetts. Specifically, the input from a Delphi panel of experts was intended to aid in deciding which, if any, of several net-to-gross (NTG) estimates developed for the program was most accurate, and help develop final Massachusetts-specific NTG numbers for 2009 and 2010. The Massachusetts ENERGY STAR Lighting Program is an ongoing effort to encourage the use of ENERGY STAR-qualified lighting among residential customers. The Massachusetts Program Administrators (PAs) also work with other regional programs through the Northeast Energy Efficiency Partnerships (NEEP) to leverage program effectiveness by aggregating markets and coordinating consumer messaging. Additionally, all PA lighting initiatives are coordinated with and designed to support the national ENERGY STAR program.

1.2 Process

The Delphi method is often characterized as a group communication process or forecasting method that relies upon panels of experts to develop an estimate or group judgment on a topic or issue. It is an interactive process that involves at least two rounds of questions or interviews with panels. The Delphi technique is based on the principle that structured responses from experts will be more accurate than unstructured response from individuals.

Data collection using the Delphi technique uses the following steps. First, panelists who are experts in the field or topic of interest are recruited to participate in the Delphi panel. Next, the panelists are presented with a topic or scenario, supporting data, and a questionnaire. The questionnaire typically includes both structured, or close-ended, questions and open-ended questions. The open-ended questions are used to solicit respondents' assumptions or reasoning they made in their responses to the close-ended questions of the survey. Next, the data are summarized and a second questionnaire is sent to the panelists. Data summaries generally include measures of central tendency, such as a median or mean, and measures summarizing the dispersion of the data, such as inter-quartile ranges and outlier responses, and assumptions and reasoning offered by fellow panelists from their first-round responses. In the second questionnaire, respondents are asked to review the data summary and their own original responses, provide revisions to their original responses (if necessary), and provide their

reasoning for revising (or retaining) their original responses. Subsequent rounds of data collection follow the pattern of the second-round survey.[2]

1.2.1 Panel of Experts

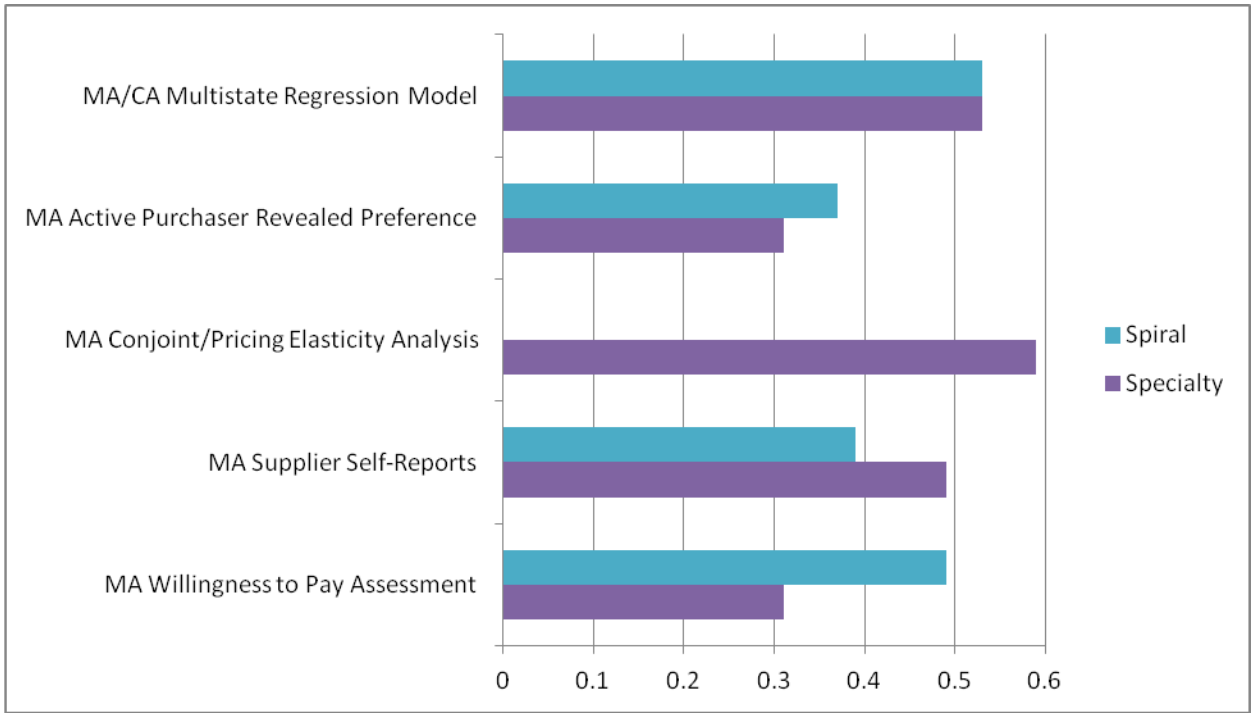
In this study, the Delphi process sought input from lighting and energy efficiency experts from across the U.S. and Canada to assess the net impact of the Massachusetts ENERGY STAR® Lighting Program on the sales of CFLs in Massachusetts. Participants who partook in both rounds of the survey were offered compensation for themselves or a charity of their choice. The first-round panel consisted of 20 members from the following categories: CFL manufacturers, program implementation contractors, employees of entities that implement programs (utilities or government agencies), regulators, evaluation contractors and efficiency experts. Nineteen experts were able to take part in the second round as well, with one member from the CFL manufacturers group being unable to participate. This panelist's input was included in the first round results, however.

[2] See: (A) Hsu, C. and B.A. Sandford. (2007). "The Delphi technique: making sense of consensus." *Practical Assessment, Research & Evaluation*. 12(10): 1-8; (B) Linstone, H. A., & Turoff, M. (1975). *The Delphi Method: Techniques and Applications*. Reading, MA: Addison-Wesley Publishing Company; (C) Ludwig, B. (1997). "Predicting the future: Have you considered using the Delphi methodology?" *Journal of Extension*, 35 (5), 1-4. Retrieved August 25, 2010 from http://www.joe.org/joe/1997october/tt2.html.

1.2.2 Delphi Survey – Round One

The first round of the Delphi panel asked the panel of experts to individually assess the Massachusetts NTG estimates for 2009-2010 only, not for any other states or years. The instrument included a detailed description of the NTG estimates and methodologies being reviewed along with the strengths and weaknesses associated with each. A basic explanation of how NTG estimates can be interpreted in this study was also provided; these explanations can be found in the 'Net-to-Gross Methods' tab of the first-round survey located in Appendix A. The methods and resulting NTG estimates are provided in Figure 1-1.

Figure 1-1: Net-to-Gross Methods and Estimates



The experts were asked to assess the accuracy of the 2009 and 2010 estimates together since some of the estimates were for 2010 only and others were for 2009-2010 together; there were no 2009-only estimates. They were also asked to explain the reasoning for a given response, keeping in mind that these reasons would be shared with other panel members in the second round of the survey and could affect their assessments.

In addition to the NTG estimates and methods, the survey also included a program description and history, and background data. The full round one instrument can be found in Appendix A.

The results of the first round were summarized in the second round of the Delphi survey, which was sent out to panel members one week after the deadline for the first survey. The full second Delphi instrument can be found in Appendix B.

1.2.3 Delphi Survey – Round Two

The second Delphi instrument summarized the estimates and comments made by the panel members in round one. The summary estimates were organized by three categories of panelists:

1) CFL manufacturers and program implementation contractors (n=6)
2) Employees of entities that implement programs (n=6); these entities could be utilities or government agencies
3) Regulators, evaluation contractors and efficiency experts (n=8); the efficiency experts may work for efficiency advocacy groups, think tanks, or firms that provide program design support

The second instrument was sent to panel members in order for each to review the summary of estimates provided by the other panel members and the reasoning associated with those estimates, which were presented next to an individual's initial estimates. Panel members were then allowed to modify their initial projections and assumptions following this review. The second instrument also asked the experts to state any reasons for changing or not changing their projections, along with any comments on the appropriateness of the other assumptions and comments listed.

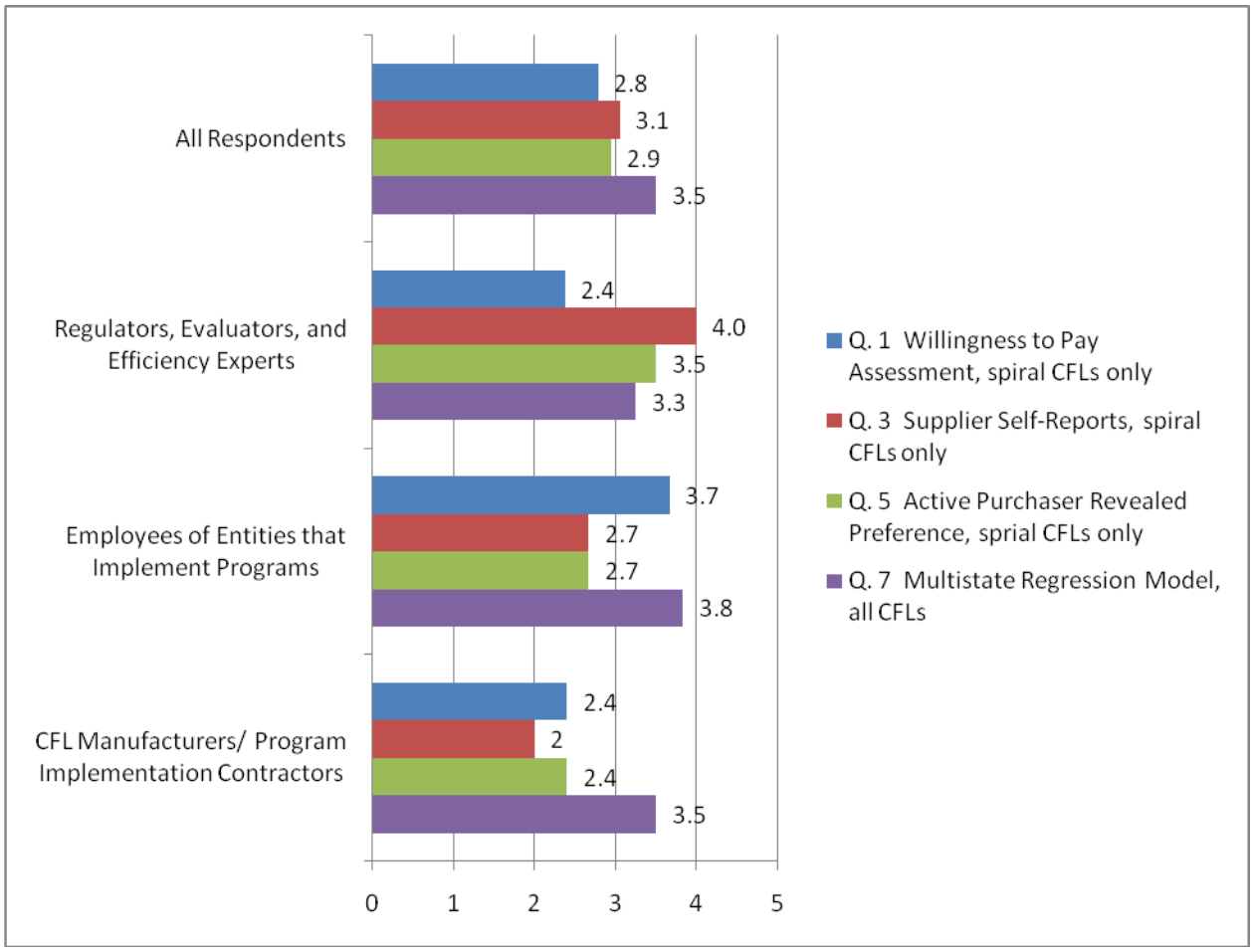
2 Data Summary: Assessing the 2009-2010 NTG Estimates for Spiral CFLs

In this section, we present a summary of responses to questions pertaining to Massachusetts NTG estimates for spiral CFLs only. Table 2-1 and Figure 2-1 summarize these responses, after which we summarize respondents' reasoning for their ratings of each of the methods on a scale from 1 to 5, where 1 is "very inaccurate," 2 is "somewhat inaccurate," 3 is "neither accurate nor inaccurate," 4 is "somewhat accurate," and 5 is "very accurate." Both the CFL manufacturers/program implementation contractors and employees of entities that implement programs groups rated the Multistate Regression Model (3.5 and 3.8, respectively) as the most accurate, followed by the Willingness to Pay Assessment (2.4 and 3.7, respectively). In contrast, the regulator/evaluator/efficiency expert group rated the supplier self-reports the highest, followed by active purchaser revealed preference. Overall, the Multistate Regression Model received the highest average rating (3.5). However, it should be noted that on average none of the methods received what would be considered high ratings. Only two of the estimates were rated as at least somewhat accurate (a four or a five) by more than half of the panelists: Supplier Self-Reports (11 out of 19) and Multistate Regression Model (12 out of 19). Supplier Self-Reports received the most support from a single group (regulator/evaluator/efficiency expert group) with seven out of eight regulator/evaluator/efficiency expert group rating it as at least somewhat accurate.

Table 2-1: Accuracy of Estimates – Spiral CFLs

How accurate do you think these estimate are --that is, how well do you think they reflect the actual, underlying net-to-gross ratio in 2009-2010 in Massachusetts for spiral CFLs?				
SCALE: 1=Very inaccurate, 2=Somewhat inaccurate, 3=Neither accurate nor inaccurate, 4=Somewhat accurate, 5=Very accurate				
	CFL Manufacturers/ Program Implementation Contractors	**Employees of Entities that Implement Programs**	**Regulators, Evaluators, and Efficiency Experts**	**All Respondents**
Sample Size	*5*	*6*	*8*	*19*
Willingness to Pay Assessment, *spiral CFLs only (NMR NTG estimate=0.49)*				
Mean	2.4	3.7	2.4	2.8
% Rated 4 or 5	20% (1 out of 5)	83% (5 out of 6)	25% (2 out of 8)	42% (8 out of 19)
Individual values	2, 2, 2, 2, 4	2, 4, 4, 4, 4, 4	1, 1, 2, 2, 2, 3, 4, 4,	1-4
Supplier Self-Reports, *spiral CFLs only (NMR NTG estimate=0.39)*				
Mean	2.0	2.7	4.0	3.1
% Rated 4 or 5	20% (1 out of 5)	50% (3 out of 6)	88% (7 out of 8)	55% (11 out of 19)
Individual values	1, 1, 2, 2, 4	1, 1, 2, 4, 4,4	3, 4, 4, 4, 4, 4, 4, 5	1-5
Active Purchaser Revealed Preference, *spiral CFLs only (NMR NTG estimate=0.37)*				
Mean	2.4	2.7	3.5	2.9
% Rated 4 or 5	20% (1 out of 5)	33% (2 out of 6)	50% (4 out of 8)	42% (8 out of 19)
Individual values	1, 2, 2, 3, 4	1, 2, 2, 3, 4, 4	2, 2, 3, 3, 4, 4, 5, 5	1-5
Multistate Regression Model, *spiral CFLs only (NMR NTG estimate=0.53)*				
Mean	3.5	3.8	3.3	3.5
% Rated 4 or 5	60% (3 out of 5)	66% (4 out of 6)	63% (5 out of 8)	63% (12 out of 19)
Individual values	2, 3, 4, 4, 4	3, 3, 4, 4, 4, 5	2, 2, 2, 4, 4, 4, 4, 4	2-5

Figure 2-1: Average Estimated Accuracy of NTG Estimates for Spiral CFLs Only, 2009-2010 in Massachusetts



2.1 MA Willingness to Pay Assessment: Estimated NTG of 0.49 (Spiral CFLs only)

Ratings of the accuracy of the willingness to pay method for spiral CFLs were mostly either somewhat accurate (8 out of 19 respondents) or somewhat inaccurate (8 out of 19). Across all categories, respondents cited the following issues with this method:

- Small sample size
- Absence of spillover
- No accounting for past program or market transformation effects
- Weakness of self-reporting

The most common concern with this method was the weakness of self-reporting and its dependence on consumers' responses to hypothetical situations. Respondents reasoned that, due to a social desirability bias, consumers will report what they think the interviewer wants to hear,

but their behavior may not follow expressed attitudes or intentions. As one panel member (from the regulator, evaluators and efficiency experts group) stated:

> *A social desirability bias, especially with in-home, face-to-face inquiry, is likely to result in an inflated willingness to purchase spiral CFL bulbs at higher prices.*

CFL manufacturers and program implementation contractors were most likely to rate this method as somewhat inaccurate (4 out of 5 respondents), with one emphasizing the fact that the Massachusetts program is well established and, therefore, promotions and rebates are not likely to have a large impact on consumers' spiral CFL purchase decisions.

In contrast, employees of entities that implement programs were most likely to rate the method as somewhat accurate (5 out of 6 respondents). Respondents in this group said the willingness to pay estimate is a reasonable indicator for how well the program is doing in reaching its market and expressed a preference for the use of multiple methods. One of them said:

> *The effect of the program may be to increase the total number of lamps purchased, not just whether any lamp would be purchased or increase in quantity demanded per unit price versus increase in the CFL demand due to factors other than the price; So asking for willingness to pay for one lamp does not represent the program accurately. Additionally, asking the question in the absence of any true decision-making and not asking questions of people who had not purchased CFLs recently decrease the validity and perhaps underestimates the effect of the program. Also the NTG based on willingness to pay estimates for bare spiral is expected to e higher than for the specialty CFLs, yet the data methods produce lower estimates for specialty bulb, which is counter intuitive.*

The regulator/evaluator/efficiency expert group gave a wide range of accuracy ratings to this method. Some members from this group said that the hedonic pricing element was positive, while others said focusing only on price while omitting other key factors, such as advertizing, was a weakness. One of them said the following:

> *Willingness to pay estimation methods address one of many factors that affect net to gross estimates for CFL programs, price customer willing to pay for perceived value of lighting product and features. I prefer this method over some of the others because the primary objective for many of these programs is to reduce CFL prices, thus it makes sense to infer that if prices have dropped and customers report being more likely to buy CFLs at these lower price points, then the program has had a significant effect in increasing sales of this product. It is important to at least list all of the other factors that may affect net CFL purchases before reaching a decision on the relative contribution that price discounts or drops in CFL prices may have had on customer decisions. The other key factors in determining the likelihood of customers purchasing CFLS in the current year are likely to be: impact of mass media and advertizing practices, channel specific*

> *promotion policies, social norms about how and when to purchase light bulbs, and impact of word of mouth "advertizing" thru family members and influential neighbors. As a result I am only somewhat certain that these NTG estimates are accurate without an examination of the relative role of the other factors listed above.*

In contrast, another member of the regulator/evaluator/efficiency expert group said this:

> *The approach uses a very unreliable willingness to pay approach and assumes that the rest is driven by econometric relationship between price and demand. We already know both of these approaches are exceptionally poor predictors. Willingness to pay approaches have already been largely rejected in our field as reliable and market and product barriers have more of an impact than price.*

2.2 MA Supplier Self-Reports: Estimated NTG of 0.39 (Spiral CFLs only)

Over one-half of the respondents (11 out of 19) rated the self-report method for spiral CFLs as somewhat or very accurate. Panel members mentioned the following strengths of this method:

- Accounting for non-residential sales controls for any upward bias
- Advantage in simplicity and face validity
- Retailers/Suppliers have a better idea of the market at the macro level

The following issues with this method were also cited:

- Absence of spillover
- No accounting for past program and non-program influence
- Manufacturer/Retailer bias when answering questions that may determine the fate of the program
- Low NTG

The most common concern with this method was that manufacturers' and retailers' responses will be inaccurate; trade allies may not have informed judgments about sales in the absence of the program, and could either exaggerate or underestimate effects, which could lead either to a higher or a lower NTG. One panel member (an employee of an entity that implements programs) put it this way:

> *Respondents may perceive an incentive to overstate the effect of the program to keep the program running. But an equally plausible scenario is that they perceive an incentive to understate the effect of the program to increase the perceived influence of the retailers themselves on the market.*

However, others said that relying on manufacturer and retailer responses constitutes a strength of this method. Respondents reasoned that retailers have a better idea of market behavior at the

macro level and that asking people who have market experience provides a distinct advantage over other methods.

CFL manufacturers/program implementation contractors and employees of entities that implement programs assigned this method a wide range of accuracy ratings. The majority of regulator/evaluator/efficiency experts identified the program as somewhat or very accurate (7 out of 8 respondents). The respondent who rated this method as very accurate found it encouraging that a consensus had been attempted for manufacturers and high-level buyers and that the stocking and purchasing decisions of supply-side market actors are critical to bulb availability for consumers.

Several panelists did not think suppliers were fully capable of understanding what consumers would have done in the absence of the program:

> *Given the low Net to Gross number that was derived from this evaluation method, I believe that manufacturers and chain retailers were overly optimistic in their estimations of consumers' willingness to purchase CFLs absent MA CFL programs. The economic downturn, and the resulting reduction in CFL sales and increase in incandescent sales in 2010 makes one think that perhaps the good economic times prior to 2009 created a false sense of awareness of consumer behaviors.* [Employees of entities that implement programs group]

> *I think it is almost impossible to get an unbiased estimate from suppliers about what the market would have done in the absence of the program. As a result I place more weight on customer responses, even given their biases.* [Regulator/evaluator/efficiency expert group]

> *By taking the consumer entirely out of the picture, this approach seems flawed. Retailers can make assumptions based on past sales, but without consumer input it may be hard to determine the future of the market.* [Manufacturer/program implementation contractor group]

Others expressed more confidence in suppliers' estimates, based on their role in deciding which products are available, the inclusion of upstream and downstream market actors, their access to sales data, and the inclusion of non-residential sales:

> *While supply-side market actors are not the end-users of the product, their stocking and purchasing decisions are critical to bulb availability for consumers. Purchasing decisions around lighting are ultimately a result of both individual customer preferences and availability.* [Regulator/evaluator/efficiency expert group]

> *I do not think self-report bias is a major concern here. Your sample frame and range of cohort interviews mitigate any potential bias by weighting upstream and downstream players. Any survey research that relies on human response is*

> *vulnerable to threats to validity. This particular method has additional protection against that risk by robust sales tracking in both participant and non-participant markets. Accounting for non-residential sales also controls for any bias upwards. Overall, this is a strong study methodologically, and could be used alone, or in concert with other studies. Perhaps the only major weakness is the lack of a baseline comparison.* [Employees of entities that implement programs group]
>
> *It is important that this estimate includes commercial sales, since DIY stores now offer product variety and pricing sufficient to induce many small commercial buyers to purchase there instead of through electrical contractor/wholesale channels.* [Regulator/evaluator/efficiency expert group]

A member of the manufacturer/program implementation contractor group, however, discounted the accuracy of the sales data that suppliers were relying on in answering the questions:

> *These are phone interviews with individuals who don't have the actual data in front of them and don't have the time to compile the data even if they were inclined. Depending on who is being interviewed, that particular person often may not know or understand all of the dynamics of the program. The value based on this type of survey research is highly speculative.*

2.3 MA Active Purchaser Revealed Preference: Estimated NTG of 0.37 (Spiral CFLs only)

Respondents gave a range of accuracy ratings to the active purchaser revealed preference method, with approximately one-quarter choosing somewhat accurate (5 out of 19 respondents), one-quarter choosing neither accurate nor inaccurate (4 out of 19), and one-quarter choosing somewhat inaccurate (5 out of 19). Across all categories, respondents cited the following issues with this method:

- Absence of spillover
- Small sample size
- Weakness of self-reporting and hypothetical questions
- Low NTG is counterintuitive
- Focuses only on price as a driver of decision-making

The most common concerns with this method were the small sample size and the inaccuracy of self-reporting. However, four out of eight regulator/evaluator/efficiency experts indicated that the method was either somewhat or very accurate. These respondents suggested that this method was not as hypothetical as the willingness to pay method and responses are more accurate when the customer has just made a purchase. As one member from this group stated:

> *The active purchaser method involves less speculation on the part of respondents because they are interviewed within minutes to hours of the act of making a purchase. At this time customers are able to make what is probably a more realistic assessment of what motivated the purchase and if price changes would have caused a different outcome. This is the preferable method to me because we are asking customers within minutes of when they made a decision as opposed to months afterward and, as a result, is the best way of understanding what motivated customer purchase decisions and if the program directly or indirectly caused the purchase.*

CFL manufacturers/program implementation contractors and employees of entities that implement programs assigned a range of accuracy ratings to this method. Two respondents from the CFL manufacturers and program implementation contractors group suggested that this estimate should be used as an additional indicator or a guide for program design, but not as a stand-alone NTG ratio.

The following comments from members of the regulator/evaluator/efficiency expert group show doubts about the method because of its assumption that price is the most important factor, and because of past experience with related methods:

> *This method assumes that CFL purchase behavior is driven entirely by price point.*
>
> *Econometric price models have not been shown to be reliable for CFLs.*

2.4 MA Multistate Regression Model: Estimated NTG of 0.45 (All CFLs)

The majority of respondents rated the multistate regression model as somewhat accurate (12 out of 19 respondents). Respondents who preferred this method of the four options given reasoned that it was the most defensible model during the time period, and had the most robust methodology. Strengths citied for the multistate regression model included:

- A larger and more random sample
- Tries to account for many variables that affect the program, including past program activity
- Avoids social desirability bias

Across all categories, respondents cited the following issues with this method:

- Date of purchase accuracy is uncertain
- Erroneously treats non-program states as a baseline
- NTG estimate includes specialty CFLs, which should have a higher NTG than spiral CFLs

The most common concern with this method is that using non-program states as a control may no longer be reliable. As one member (from the employee of entities that implement programs group) stated:

> *I question the comparison of "program states" to "non-program" states for the purpose of controlling for the presence and strength of existing CFL programs, as I believe that program states have had such a profound effect on the national CFL market that spillover from program states is now benefiting consumers in "non-program" states, essentially eliminating "non-program" states.*

Three out of five respondents from the CFL manufacturer/program implementation contractor group, four out of six respondents from the employees of entities that implement programs group, and five out of eight respondents from the regulator/evaluator/efficiency expert group rated the multistate regression model as somewhat or very accurate.

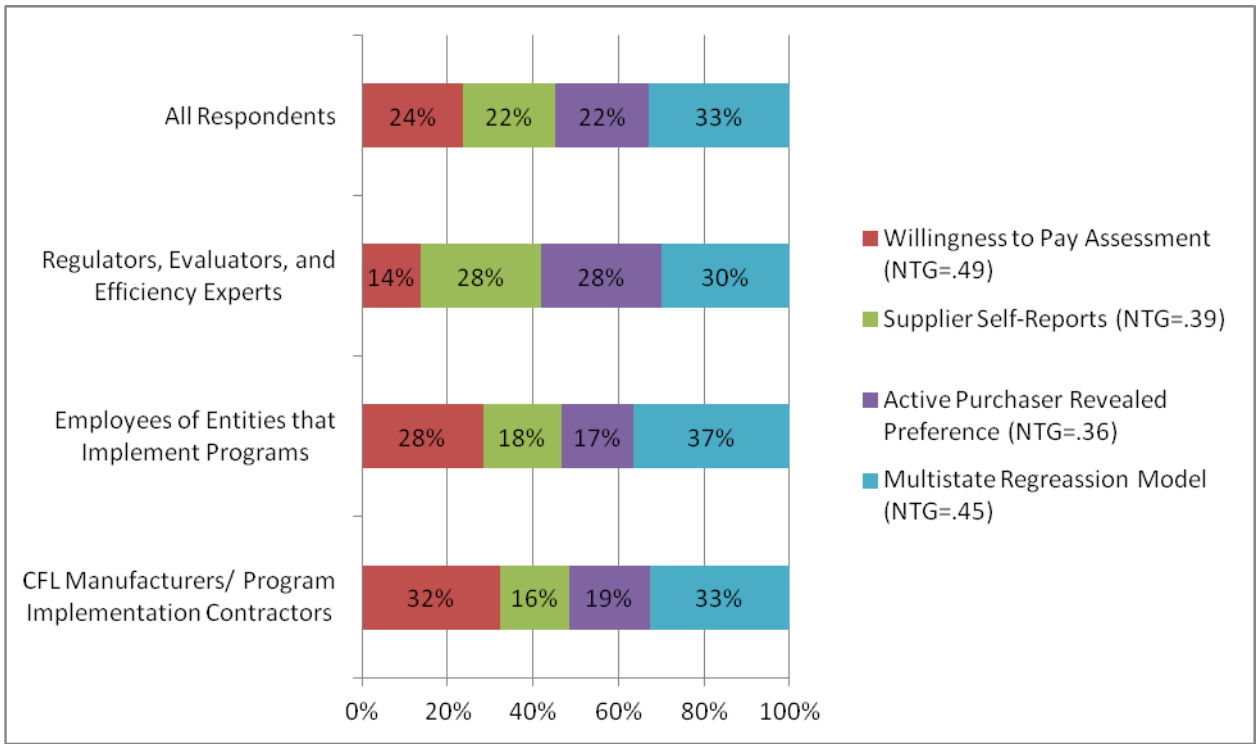
2.5 Weighting the 2009-2010 Estimates for Spiral CFLs

In this section, we present a summary of responses to questions pertaining to the weighting of the 2009-2010 Massachusetts NTG estimates for spiral CFLs. Table 2-2 and Figure 2-2 summarize these responses, after which we present respondents' reasoning for their weightings of each of the methods. On average, panelists indicated that the Willingness to Pay Assessment, Supplier Self-Reports, and Active Purchaser Revealed Preference NTG estimates should receive about the same weighting (22-24%) and that the Multistate Regression Model estimate should receive a relatively higher weighting of 33%.

Table 2-2: Assigned Weights for NTG Estimates – Spiral CFLS

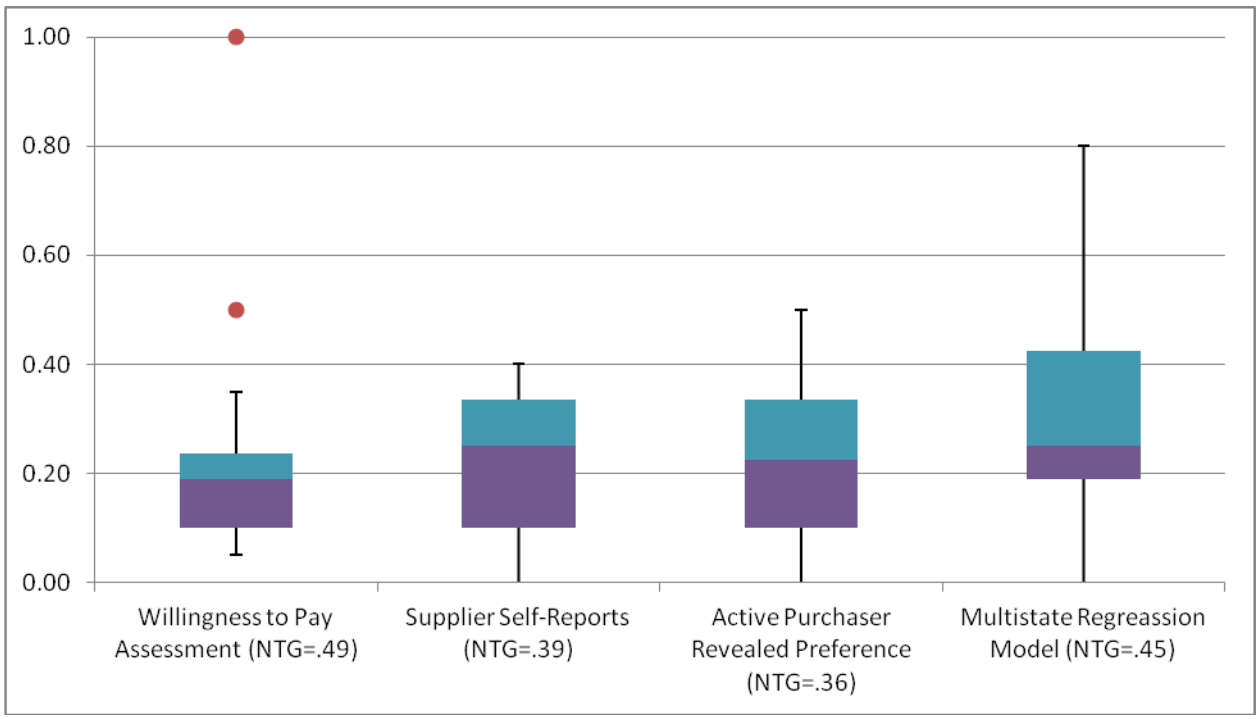
Please provide a score or weight of 0% to 100% for each of the 2009-2010 NTG estimates for Massachusetts, thinking about spiral CFLs only. The weight represents the relative importance you think each NTG estimate deserves compared to the others, for spiral CFLs only. The weights should sum to 100%.					
	CFL Manufacturers/ Program Implementation Contractors	**Employees of Entities that Implement Programs**	**Regulators, Evaluators, and Efficiency Experts**	**All Respondents**	**Net-to-gross estimate (point estimates produced by the NMR studies)**
Willingness to Pay Assessment, *spiral CFLs only*					0.49
Mean	32%	28%	14%	24%	
Median	22%	23%	10%	20%	
Individual values	10, 15, 18, 25, 25, 100%	20, 20, 20, 25, 35, 50%	5, 10, 10, 10, 10, 15, 20, 30%	0-100%	
Supplier Self-Reports, *spiral CFLs only*					0.39
Mean	16%	18%	28%	22%	
Median	18%	18%	28%	25%	
Individual values	0, 0, 10, 25, 30, 33%	0, 0, 10, 25, 35, 40%	10, 20, 25, 25, 30, 35, 40, 40%	0-40%	
Active Purchaser Revealed Preference, *spiral CFLs only*					0.37
Mean	19%	17%	28%	22%	
Median	23%	10%	33%	23%	
Individual values	0, 10, 20, 25, 25, 33%	0, 5, 10, 10, 25, 50%	10, 10, 20, 30, 35, 40, 40, 40%	0-50%	
Multistate Regression Model, *all CFLs*					0.45
Mean	33%	37%	30%	33%	
Median	25%	33%	23%	25%	
Individual values	0, 16, 25, 25, 50, 80%	0, 15, 25, 40, 60, 80%	10, 20, 20, 20, 25, 40, 40, 65%	0-80%	

Figure 2-2: Scores of 2009-2010 Spiral CFL NTG Estimates for Massachusetts



The box-and-whisker plots in Figure 2-3 represent 50% of all responses within the boxes as well as the smallest and largest weights given. Weights that were significantly larger than nearly all other responses are presented here as outliers.

Figure 2-3: Weighting the Spiral CFL NTG Estimates



Those panel members who explained the rationale behind their weighted values said they based percentages on perceived accuracy, validity and/or the robustness of the results. One panel member (from the employees of entities that implement programs group), however, felt that all of the methods could be seen as providing valid estimates and, therefore, had no specific reason to weight the methods differently from each other.

Respondents expressed a general belief that no one methodology is perfect as well as a general lack of confidence in the methods presented for spiral CFLs. Respondents noted that these methodologies allowed for neither the consideration of past program impacts nor the inclusion of other important motivators that influence the market.

Many suggested that it would be beneficial to rely on more than one method to give a better picture of overall NTG (which, of course, was the original intent of using five NTG methods followed by an expert panel approach to weight them). One panel member (from the employees of entities that implement programs group) had the following recommendation:

> *A meta-analysis, with appropriate weighting, would enhance the results and provide better guidance on the future effectiveness of continuing with the current program design.*

2.6 Developing a Single 2009-2010 NTG Estimate for Spiral CFLs

This section presents the weighted NTG estimates for respondents who accepted the results of the weighting, or the re-estimated NTG estimates for respondents who did not accept the results and provided estimates that they thought were more accurate.

2.6.1 NTG Estimates for Spiral CFLs – Round One Comments

Following the first round of the survey, one panel member from the CFL manufacturers/program implementation contractors group emphasized that the NTG estimates were all too low:

> *In my opinion, CFLs have a NTG of .90 in the first 5 years that incentivized CFLs are available in almost every retail channel; for years 5 - 10 of the program, the NTG will drop to .75; and for years 10 – 15, it will drop to .50. An NTG of approximately .38 is, therefore, inaccurately low. Why? When you blend all types of retailers along with the reality that many of the new retailers in the program fit into the low income/discount retail channel, the NTG should be closer to .70 for spiral CFLs during this time period.*

Others focused on the fact that their confidence was reduced by the fact that spillover, the effects of prior programs, and other non-program influences were not included, which led to these respondents altering their NTG estimates. One outlier, a panel member from the regulator/evaluator/efficiency expert group recommended a NTG to 1.20, suggesting that the program was responsible for market-level sales 20% greater than the sales supported by the program in 2009 and 2010. The respondent justified the estimate as follows:

> *Interviews with key market actors and with manufactures have indicated that the vast majority of market push efforts have been from utility programs, which have led to the diffusion of the innovation; a much better approach is a diffusion of innovation approach because of the lateness and the large gaps in our market tracking and market push approaches.*

2.6.2 NTG Estimates for Spiral CFLs – Round Two Comments

After reviewing the summarized responses and comments from other experts, panelists rated their confidence in their own responses as well as those from their own group and the other two categories on a scale of 0 to 10, where 0 is "not at all confident" and 10 is "extremely confident." Overall, panelists expressed the highest average level of confidence in their own responses (7.0).

Aside from their own individual responses, the CFL manufacturers/program implementation contractors group showed the highest average level of confidence in the estimates of employees of entities that implement programs. Two members of this group explained this high level of confidence as follows:

> *Employees of entities that implement programs have more direct information about the relative impact of different program tactics and the emphasis of some on the importance of merchandizing is consistent with the broader literature on consumer purchasing.*
>
> *Coming originally from the implementer side of the house, I understand that the implementers are very close to the market and have a good understanding of where the market is, where it is headed, and how consumers and retailers are responding. I am fairly sure of their responses.*

Another expressed confidence in the regulators/evaluators/efficiency experts' estimates:

> *Regulators and efficiency program experts have more familiarity with the evaluation tools themselves, exposure to large numbers of program evaluations, and a more synthetic and national perspective.*

Aside from their own individual responses, the employees of entities that implement programs group showed the highest average level of confidence in the regulator/evaluator/efficiency expert group's estimates. One member of this group explained this high level of confidence with the following:

> *I believe the regulators/evaluators/efficiency experts group has a wider range of experience reviewing net to gross issues and a better understanding of the nuances and implications of different approaches.*

Aside from their own individual responses, the regulator/evaluator/efficiency expert group showed the highest average level of confidence in the estimates of their own group, with many commenting that the experts in this group want to get at the truth and are likely to be slightly more neutral in their views.

On the whole, the lowest level of confidence was in the responses of the CFL manufacturers/program implementation contractors group. Panelists explained this lack of confidence as follows:

> *Manufacturers have complicated and substantial conflicts of interest, especially given investments in EISA (Energy Independence and Security Act) compliant halogen lamps, which will be much more profitable for them.*
>
> *With the caveat that all respondents to this survey have their own set of biases, respondents that have a financial incentive to appear more effective in markets, or a corporate incentive to appear successful, add more risk of overestimating program influence than regulators, experts, etc. This can affect their willingness to accept unexpected results.*
>
> *It's natural that the entities that manufacture, sell, or implement programs associated with CFLs would want to see high net to gross ratios that justify significant continued investment by utilities.*
>
> *I trust the program implementers and manufacturers who have something to gain from the NTG decision last.*

Additionally, experts expressed a lack of confidence in responses overall. As two members of the regulators/evaluators/efficiency experts groups stated:

> *I don't have terrific confidence in anyone's estimates at this point. This is an issue that is really hard to pin down. While they certainly have good insights, my general inclination would be to have lower confidence in the responses from program implementers because they have a vested interest in the outcomes. However, their answers, on average, were almost the same as everyone else's.*
>
> *Overall, I don't have extreme confidence in any of these methods, or in the specific ratings of any of the three groups. I give a slight edge to the regulators/evaluators/efficiency experts group as we are more likely to be closely*

> *familiar with the various methodologies, and perhaps less likely to have a vested interest in the specific NTG numbers selected.*

Another member of the CFL manufacturers/program implementation contractors group agreed:

> *After reviewing the results of Round One, I stopped believing anyone has the real answer. It is indeterminate. What we're after is an estimate that is, given the various estimates, reasonable. For bare spiral CFLs, we're all giving educated (hopefully) guesses of a reasonable estimate. I'm not confident than any of us are more accurate than others. We all have a different piece of the spiral CFL elephant. Therefore, all groups deserve the same weighting.*

Table 2-3 summarizes the panelists' confidence in the responses.

Table 2-3: Confidence in Responses – Spiral CFLs

How much confidence do you have in your own responses as well as the responses of the other panel members? In the table below, please use an "X" to indicate your level of confidence in the various groups' NTG estimates by using a scale from 0 to 10, where 0 means "not at all confident" and 10 means "extremely confident."				
Category	**Own Responses**	**CFL Manufacturers/ Program Implementation Contractors**	**Employees of Entities that Implement Programs**	**Regulators/Evaluators /Efficiency Experts**
CFL Manufacturers/ Program Implementation Contractors				
Mean	7.6	5.0	5.6	5.4
Individual Responses	5, 6, 8, 9, 10	3, 3, 5, 7, 7	3, 4, 5, 7, 9	3, 5, 5, 7, 7
Employees of Entities that Implement Programs				
Mean	6.5	4.8	5.5	6.0
Individual Responses	3, 6, 7, 7, 7, 9	3, 4, 5, 7*	3, 6, 6, 7*	3, 6, 7, 8*
Regulators, Evaluators, and Efficiency Experts				
Mean	7.0	4.9	4.9	6.4
Individual Responses	6, 6, 6, 7, 7, 7, 8, 9	3, 4, 4, 5, 5, 6, 6, 6	3, 6, 6, 6, 7, 7, 7, 7	5, 6, 6, 6, 7, 7, 7, 7
All Respondents				
Mean	7.0	4.9	5.2	6.0
Individual Responses	3-10	3-7	3-9	3-8

* "Don't Know" responses were omitted

Overall, only four out of 19 respondents modified their original NTG estimate for spiral CFLs. Two out of five members from the CFL manufacturers/program implementation contractors made changes while only one from each of the remaining groups changed their original estimates. (Table 2-4)

Table 2-4: Whether Panelists Modified Initial Responses or Not – Spiral CFLs

Category	**Modified Estimate**	**Did Not Modify Estimate**	**Total**
CFL Manufacturers/ Program Implementation Contractors	2	3	5
Employees of Entities that Implement Programs	1	5	6
Regulators, Evaluators, and Efficiency Experts	1	7	8
All Respondents	4	15	19

Three out of the four panelists who changed their responses indicated that they had added more weight to the multistate regression model. One panelist from the CFL manufacturers/program implementation contractors group who added more weight to the multistate modeling explained:

> *I now believe the only method that has a chance of taking into account all of the potential influences on a consumer's purchasing decision is some form of discrete choice modeling.*

And another from the same group essentially agreed:

> *I was persuaded that the multi-state regression analysis has obtained reasonably accurate estimates of consumer purchasing behavior, based on the small deviation between the 2009 and 2010 inventories of the same homes and the close correlation between the number of products identified by residents as new purchases and those of the inspectors based on actual empirical measurement.*

The remaining expert whose estimate changed was an outlier. While still a much higher value than the mean and median estimates, the NTG estimate was lowered from the original. The expert explained:

> *Interviews with key market actors and manufactures have indicated that the vast majority of market push efforts have been from utility programs and that these programs have lead to the diffusion of the innovation. A much better approach is a diffusion of innovation approach because of the lateness and the large gaps in our market tracking and market push approaches. Using market based analysis approaches should put the NTG above 1.0 for CFLs. The above approaches provide a false confidence in the result. In view that net is defined at total market net, an 0.40 is unreliable at the market change over time level. However, looking at the program and time period, I adjust my estimate down a few points so that it is still over 1.0 but not much over. The other approaches do not take into account how market changes spread in the population as a result of the program. If your neighbor buys a new Honda, because of a rebate and sales promotion, and he/she likes it a lot, he/she networks that satisfaction in the market and that influences sales. This side of the analysis is missing from these studies, so that whole impact needs to be added. Go to the literature of how products move into and through a market, and the causes for those movements at the segment level, and you see our approaches just do not measure up to the need.*

The 15 panelists who did not change their original estimates reiterated issues with the methods that had been expressed in the first round, including the weakness of asking consumers or retailers about hypothetical situations and the omission of the effect of spillover. As one expert from the employees of entities that implement programs group reflected:

> *I did not feel that I had sufficient information about the individual studies to determine that they were invalid. I have used or am familiar with all of the*

> *methods and, if implemented correctly, all will provide valid results. I should note that, while I view the results as somewhat accurate, they will provide one estimate of NTG that has a large error band around it. The NTG is viewed more as an indicator than a highly accurate estimate.*

Some did decide to change the weighting of different methodologies by a small amount, but found it had no impact on the overall NTG estimate. Another member from the employees of entities that implement programs group stated:

> *While some of the approaches now seem less reliable given the additional information provided in the second round, changing the relative weights for the approaches does not appreciably change the final NTG.*

2.6.3 Final NTG Estimates for Spiral CFLs

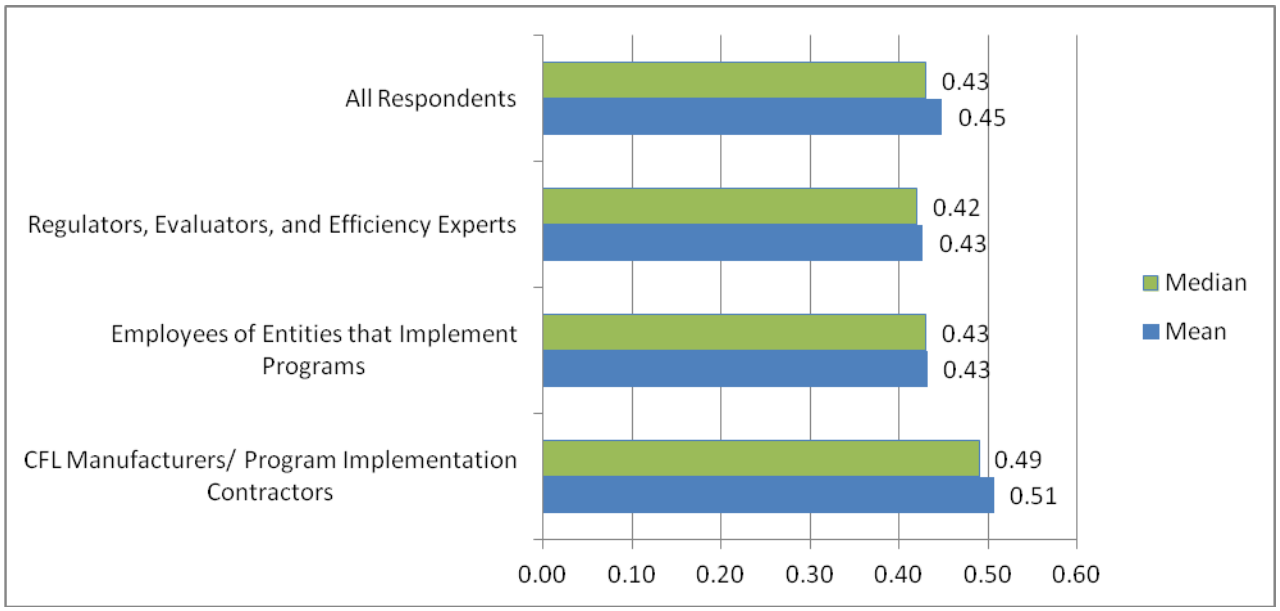
Table 2-5 and Figure 2-4 show the mean and median NTG estimates after panel members weighted or re-estimated the spiral CFLs NTG ratio in either round one or round two of the survey. (Table 2-5)

These estimates were calculated without the three outliers, 0.70, 0.75 and 1.15. Each category had one outlier, resulting in a reduced sample size after the outliers were eliminated.

Table 2-5: Weighted or Re-Estimated NTG – Spiral CFLs

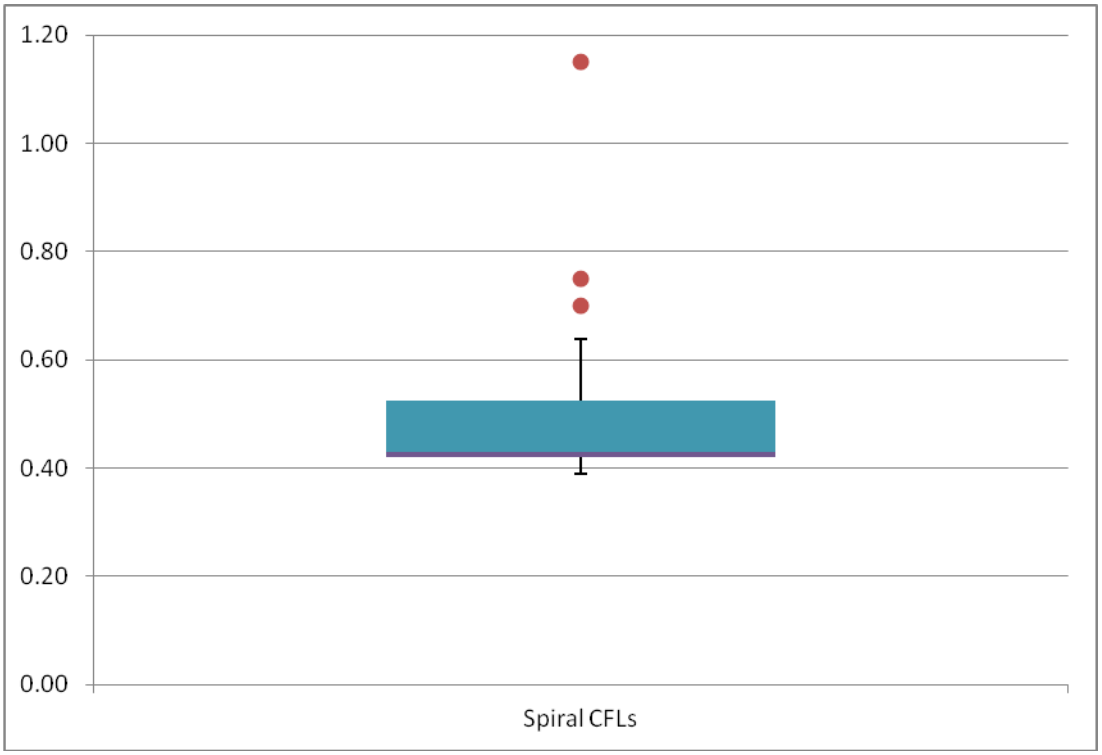
	CFL Manufacturers/ Program Implementation Contractors	Employees of Entities that Implement Programs	Regulators, Evaluators, and Efficiency Experts	All Respondents
Sample Size	*4*	*5*	*7*	*16*
Median	0.49	0.43	0.42	0.43
Mean	0.51	0.43	0.43	0.45

Figure 2-4: Weighed or Re-Estimated NTG Ratios for Spiral CFLs



The box-and-whisker plots in Figure 2-5 represent 50% of all responses within the boxes as well as the smallest and largest weights given. Other than the three outliers, the estimates (16 out of 19) all fell within a fairly narrow range.

Figure 2-5: Weighted or Re-Estimated NTG Estimate: Spiral CFLs Only



Many of the experts made additional comments on the NTG for spiral CFLs as a whole and offered recommendations for future estimates. As one member of the employees of entities that implement programs group reflected:

> *I see the NTG as an indicator, not an estimate that is accurate to 10 decimal points. It is important to see how it changes and assume that any estimate that one is getting is not super accurate and that multiple methods will probably define the range in which the true estimate is.*

Another panelist from the CFL manufacturer/program implementation contractors group commented:

> *The idea of focusing on gross sales or market share alone is no better than trying to come up with a reasonable estimate of NTG. It's probably less credible.*

Other members from the employees of entities that implement programs group offered the following suggestions:

> *I continue to recommend that a meta-analysis, with reference to other state and national program experiences and results, could be a valuable benchmark for future program design, and allocation of limited financial resources where they can have the most long-term influence.*
>
> *With the current state of socket saturation there are still ample opportunities to promote standard spirals CFLs, and to obtain a significant increment of savings prior to the EISA standards taking effect.*

And another recommendation from the CFL manufactures/program implementation contractors group:

> *The evaluation of net to gross in Massachusetts should incorporate data on the rapid and dramatic declines in sales associated with temporary or on-going suspensions of incentive programs.*

Finally, a member of the regulators/evaluators/efficiency experts group offered the following insight:

> *Methods for NTG need to be matched to primary and secondary strategies used by the program to induce purchases of CFLs. If primary program strategy is to reduce CFL prices, then methods that focus on predicting price trends and changes induced by program should be heavily weighted. The dilemma is that no one state level program has sole influence on market prices of CFLs; all of the programs influence a national market. Hence, attributing price effects solely to Massachusetts or California programs is not really possible. If primary program strategy is to increase customer awareness and knowledge of CFL product qualities and where to purchase them, then other methods that focus on changes in customer awareness and knowledge are more appropriate. I am not sure which*

objective, either reducing prices or increasing awareness, was primary or secondary in Massachusetts, hence my uncertainty.

3 Data Summary: Assessing the 2009-2010 NTG Estimates for Specialty CFLs

In this section, we present a summary of responses pertaining to Massachusetts NTG estimates for specialty CFLs only. Table 3-1 and Figure 3-1 summarize these responses, after which we present respondents' reasoning for their ratings of each of the methods.

Mostly, panel members expected higher NTG for specialty CFLs, and many thought all the estimates were too low. Most comments in the section regarding spiral CFLs also apply here.

This is from a member of the regulator/evaluator/efficiency expert group:

> *I believe the net to gross for specialty CFLs is significantly higher, given the short period of time utilities have been promoting them, the lower average availability in retail stores, and the much higher list price for which these products typically sell. Utility rebate amounts tend to be higher for these products as well, increasing the percentage effect the rebate can have on the purchase price. These products are also generally less likely to perform ideally in specialty applications than spiral CFLs do in general purpose applications, so it's reasonable to assume that utilities caused the majority of product sales in this category to occur.*

And from another:

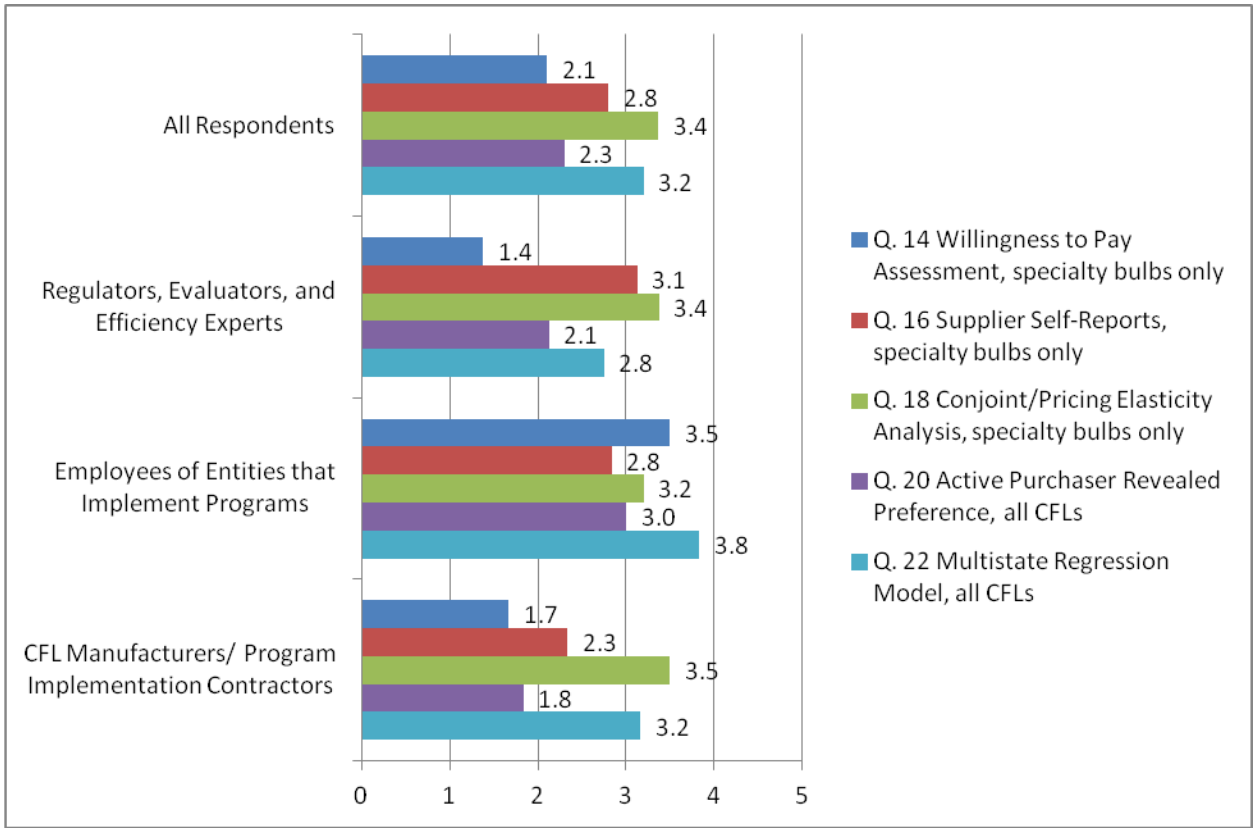
> *I feel much less comfortable with the NTG for specialty vs. basics because specialty is made up of so many different products.*

In line with these comments, only ten out of 20 panelists rated any one of the NTG methodologies as at least somewhat accurate. The majority of panelists rated the accuracy of each of the methodologies a three or less on a five-point scale, where 1 is "very inaccurate," 2 is "somewhat inaccurate," 3 is "neither accurate nor inaccurate," 4 is "somewhat accurate," and 5 is "very accurate." On average, they rated only two of the estimates higher than a three: Conjoint/Pricing Elasticity Analysis (3.4 out of 5) and Multistate Regression Model (3.2 out of 5); all other estimates received an average score of less than three. It is important to note that even though these two estimates received relatively higher average ratings, only eight out of 20 panelists rated the Conjoint/Pricing Elasticity Analysis as at least somewhat accurate and only one-half of the panelists rated the Multistate Regression Model as at least somewhat accurate. This indicates that panel members do not place much confidence in the accuracy in any of the NTG estimates.

Table 3-1: Accuracy of Estimates – Specialty CFLs

How accurate do you think these estimate are --that is, how well do you think they reflect the actual, underlying net-to-gross ratio in 2009-2010 in Massachusetts for specialty CFLs?				
SCALE: 1=Very inaccurate, 2=Somewhat inaccurate, 3=Neither accurate nor inaccurate, 4=Somewhat accurate, 5=Very accurate				
	CFL Manufacturers/ Program Implementation Contractors	**Employees of Entities that Implement Programs**	**Regulators, Evaluators, and Efficiency Experts**	**All Respondents**
Sample Size	*6*	*6*	*8*	*20*
Q. 14 Willingness to Pay Assessment, *specialty CFLs only (NMR NTG estimate=0.31)*				
Mean	1.7	3.5	1.4	2.1
% Rated 4 or 5	17% (1 out of 6)	83% (5 out of 6)	0% (0 out of 8)	30% (6 out of 20)
Individual values	1,1,1,1,2,4	1, 4, 4, 4, 4, 4	1, 1, 1, 1, 1, 2, 2, 2	1-4
Q. 16 Supplier Self-Reports, *specialty CFLs only (NMR NTG estimate=0.49)*				
Mean	2.3	2.8	3.1	2.8
% Rated 4 or 5	33% (2 out of 6)	50% (3 out of 6)	38% (3 out of 8)	40% (8 out of 20)
Individual values	1, 1, 2, 2, 4, 4	1, 2, 2, 4, 4, 4	1, 3, 3, 3, 3, 4, 4, 4	1-4
Q. 18 Conjoint/Pricing Elasticity Analysis, *specialty CFLs only (NMR NTG estimate=0.59)*				
Mean	3.5	3.2	3.4	3.4
% Rated 4 or 5	67% (4 out of 6)	33% (2 out of 6)	25% (2 out of 8)	40% (8 out of 20)
Individual values	2, 3, 4, 4, 4, 4	2, 3, 3, 4, 4	3, 3, 3, 3, 3, 3, 4, 5	1-5
Q. 20 Active Purchaser Revealed Preference, *specialty CFLs only (NMR NTG estimate=0.36)*				
Mean	1.8	3.0	2.1	2.3
% Rated 4 or 5	0% (0 out of 6)	33% (2 out of 6)	25% (2 out of 8)	20% (4 out of 20)
Individual values	1, 1, 2, 2, 2, 3	2, 2, 3, 3, 4, 4	1, 1, 1, 2, 2, 2, 4, 4	1-4
Q. 22 Multistate Regression Model, *all CFLs (NMR NTG estimate=0.45)*				
Mean	3.2	3.8	2.8	3.2
% Rated 4 or 5	50% (3 out of 6)	67% (5 out of 6)	25% (2 out of 8)	50% (10 out of 20)
Individual values	1, 3, 3, 4, 4, 4	3, 3, 4, 4, 4, 5	1, 2, 2, 3, 3, 3, 4, 4	1-5

Figure 3-1: Average Estimated Accuracy of NTG Estimates for Specialty CFLs Only, 2009-2010 in Massachusetts



3.1 MA Willingness to Pay Assessment: Estimated NTG of 0.31 (Specialty CFLs only)

One-half of the respondents rated the accuracy of the Willingness to Pay method for specialty CFLs as very inaccurate (10 out of 20 respondents), while six out of twenty respondents rated this method as somewhat accurate. The following issues with this method were reported:

- Small sample size
- Absence of spillover
- Weakness of self-reporting
- Low NTG is counterintuitive

The most common concern with this method was the fact that this NTG estimate was too low, especially that it was lower than any of the NTG estimates for spiral CFLs. Respondents reasoned that, for expensive, premium products like specialty CFLs, consumers are extremely sensitive to price. Consumers tend to avoid purchasing specialty CFLs for numerous reasons, including the fact that there are many substitutes, resulting in an inelastic demand curve.

Therefore, program price support plays a major role in purchases of these bulbs and drives capacity development, which would result in a higher NTG estimate. Additionally, panel members emphasized the fact that the market for specialty CFLs is less mature that for spiral CFLs. As one panel member (from the CFL manufacturers/program implementation contractors group) stated:

> *There are many reasons why consumers resist specialty CFLs. The 50-100-159 3-ways are too bulky to fit in most floor and table lamp shade harps; candelabras don't provide the sparkle that homeowners like in chandeliers and suspended fixtures; some dimmable [CFLs] don't work with incandescent rheostats and they're not as "responsive" as incandescents in ordinary dimming switches. Floods are limited by size. Most are more expensive than standard spirals. Therefore, I believe program price supports play a major role in purchases of specialty CFLs. I'd give specialties alone a high NTG.*

The majority of panel members from the CFL manufacturer/program implementation contractor group (5 out of 6 respondents) and the regulator/evaluator/efficiency expert group (8 out of 8) were most likely to rate this method as either somewhat or very inaccurate. However, the majority of panel members from the employees of entities that implement programs (5 out of 6) rated this method as somewhat accurate. These respondents emphasized the strengths of this method, including that it was based on sound economics, surveying recent purchasers of specialty CFLs, and bolstering the consumer survey with a shelf-stocking survey and hedonic pricing analysis. Others suggested that the willingness to pay method has the potential to provide insight into the effects of the program and could be used as an indicator of how well the program is doing.

3.2 MA Supplier Self-Reports: Estimated NTG of 0.49 (Specialty CFLs only)

Two-fifths of respondents rated the supplier self-report method as somewhat accurate (8 out of 20 respondents), while two-fifths rated it as somewhat or very inaccurate (8 out of 20), and the remaining fifth rate it as neither accurate nor inaccurate (4 out of 20).

Respondents from the CFL manufacturer/program implementation contractor group and the employees of entities that implement programs group gave varied ratings for this method, while seven out of eight respondents from the regulator/evaluator/efficiency expert group rated the suppliers self-report method as neither accurate nor inaccurate or somewhat accurate. One-half of this group expressed the belief that suppliers are likely to have a better understanding of the market than consumers and would have a better idea of what would have been sold in the absence of the program. Others felt that this method was more reasonable than willingness to pay and more appropriate to use for specialty bulbs than for spirals.

Even so, panelists across all categories reported the following issues with this method:

- Absence of spillover
- Low NTG is counterintuitive
- Weakness of retailers/manufacturer self-reporting
- Weakness of retailers/manufacturer understanding of market

The most common concern with this method was the uncertainty of the results due to its dependence upon responses from retailers and manufacturers. While some respondents felt that these people would be more familiar with the market, others felt that retailers and suppliers could misinterpret consumer behavior and perceptions. As one panel member (from the regulator/evaluator/efficiency expert group) stated:

> *Customer preferences for new specialty products are really beyond the experience of most suppliers to accurately predict what would have happened in the market, suggesting that this [NTG] result is highly uncertain.*

Additionally, as respondents pointed out with this method for spiral CFLs, suppliers may perceive an incentive to either overstate or understate program effects. Panel members again found it counterintuitive that this NTG estimate was lower than any of the spiral CFL NTG estimates; many reiterated the difficulty that specialty CFLs have had breaking into the market and that program price support plays an important role in consumers' purchasing decisions. As one panel member (from the CFL manufacturer/program implementation contractor group) asserted:

> *Historic sales volumes for specialty CFLs in the absence of incentives are negligible; therefore, any significant sales volume should be attributed to the program and the aggregate impact of all North American efficiency program incentives for the products.*

3.3 MA Conjoint/Pricing Elasticity Analysis: Estimated NTG of 0.59 (Specialty CFLs only)

The majority of respondents rated the conjoint/pricing elasticity analysis model as neither accurate nor inaccurate (9 out of 20 respondents) or somewhat accurate (7 out of 20), in addition to one who rated it as very accurate. The majority of respondents from the CFL manufacturer/program implementation contractor group rated this method as somewhat accurate (4 out of 6 respondents). Respondents from the employees of entities that implement programs group gave a range of ratings and six out of eight respondents from the regulator/evaluator/efficiency expert group rated the conjoint/pricing elasticity analysis NTG as neither accurate nor inaccurate.

Strengths citied for this model include the following:

- Large sample size
- Hedonic pricing analysis
- Based on sound economics
- More realistic/expected NTG estimate

Respondents across all categories expressed the belief that this NTG estimate is closer to what was expected and the method itself is more akin to real-world decision making. As one panel member (from the regulator/evaluator/efficiency expert group) said:

> *The value this methodology yields is more typical of those seen with spiral CFLs earlier in their program promotion cycle - an analogue for where specialty products are now.*

Some respondents support this estimate because of the methodology:

> *Conjoint combined with pricing results is a robust method for estimating program-induced sales. Also, by asking respondents to choose among different products with varying characteristics, conjoint avoids directly asking the question, "What are you willing to pay?" and is closer to real-world decision making. Avoiding the willingness to pay questions makes the responses more credible - at least for the bulbs covered.* [Regulator/evaluator/efficiency expert group]

> *The conjoint / pricing elasticity is based on sound economics. The hedonic price equations for both spiral and the two types of specialty CFLs work well. The conjoint part of the analysis has a sample size of 300, so this is a plus.* [Employee of an entity that implements programs group]

Additionally, respondents felt that this method could be a useful tool to obtain speculative answers and to forecast next year's NTG if consumers have never purchased a CFL. One said it was useful for assessing the effect of incentives:

> *I did think this analysis was very useful in determining the efficiency of the program design in actually reducing prices to customers after rebates. I particularly support the following finding from the report, which suggest rebates alone might not be the best strategy for specialty bulbs. Conjoint study page 22. "These (specialty) CFLs may have realization rates less than one because retailers had more power to choose the prices of these specialty products than the prices of standard, twister-spirals. Thus, retailers would have been able to keep a larger share of the PA incentives."* [Regulator/evaluator/efficiency expert group]

Respondents also cited the following issues with this method:

- Weakness of self-reporting
- Limited number of types of specialty bulbs included
- Not built on a strong understanding of the market

A common concern with this method, expressed mostly by panel members from the regulator/ evaluator/efficiency expert group was the fact that only a few types of specialty CFLs were addressed, and that NTGs may be different for different products. Other respondents said this estimation focused solely on price and did not address some key barriers and market conditions that affect adoption:

> *I remain concerned that this approach ultimately focuses exclusively on price, whereas (as noted above) the program impacts consumers in ways other than price.* [Regulator/evaluator/efficiency expert group]
>
> *The controlled study environment does not reflect the typical consumer's actual purchase decision.* [Regulator/evaluator/efficiency expert group]

In addition, one panel member (from the employees of entities that implement programs group) was concerned that the conjoint/pricing elasticity analysis result was out of line with other estimates:

> *Although the final composite NTG seems more realistic from an intuitive perspective, I am concerned that it is not supported by the other studies. NTGs for specialty CFLs would probably benefit from further analysis of the current studies.*

3.4 MA Active Purchaser Revealed Preference: Estimated NTG of 0.31 (Specialty CFLs only)

More than one-half of respondents rated the active purchaser revealed preference model as somewhat or very inaccurate (13 out of 20 respondents). Within each category, panel members gave a range of ratings. Issues cited for this model included the following:

- Small sample size
- Weakness of self-reporting
- Low NTG is counterintuitive
- Focus on price only

Respondents expressed issues with this method similar to those that arose with other methods, including the fact that the NTG estimate does not support program theory or intuitive reasoning. One panel member (from the regulator/evaluator/efficiency expert group) summed up the concerns as follows:

> *This method relies on very hypothetical responses in a situation laden with potential social desirability bias, ignores the effects of prior program years, which could be considerable, assumes that CFL purchase behavior is driven entirely by price point and the sample size is very small.*

However, other respondents felt that the fact that the survey was given at the time of sale, that all specialty CFLs were targeted, and that it was based on revealed preferences of purchasers added value to this methodology. Some panel members suggested using this method as a qualitative reference source or an additional indicator.

A member of the regulator/evaluator/efficiency expert group had this to say:

> *I have much less confidence in this method regarding specialty bulbs, because of the reduced familiarity. If the customers were in the act of purchasing specialty fluorescents as well as specialty incandescents, I would be somewhat less concerned.*

And a manufacturer/implementation contractor said this:

> *The method of using the difference in two model-predicted outcomes with an actual outcome without adjusting the predicted outcomes based on the one predicted-to-actual ratio available is a (minor) problem. Two-thirds of the gross sales predictions of this model under-predicted the actual count. This suggests the actual NTGs should be a bit higher.*

3.5 MA Multistate Regression Model: Estimated NTG of 0.45 (All CFLs)

The majority of respondents rated the multistate regression model as neither accurate nor inaccurate (7 out of 20 respondents) or somewhat accurate (8 out of 20). Respondents who preferred this method of the four options given reasoned that it included more information than other methods, had a smaller error associated with it than the willingness to pay survey, and was a reasonably sophisticated model. Strengths citied for the multistate regression model included:

- Potentially accurate NTG estimate
- Tries to account for many variables that affect the CFL market, including past program activity
- Avoids social desirability bias and small sample issues

Panel members expressed a desire for more detail about this methodology, stating that this NTG estimate had the potential to be accurate if all appropriate explanatory variables were included,

but more information would be necessary to be able to determine this. Across all categories, respondents mentioned the following issues:

- Erroneously treats non-program states as a baseline
- Low NTG was counterintuitive
- Including specialty and spiral CFLs in one NTG

One respondent said that this estimate, by balancing a low NTG ratio for spirals with a higher one for specialty CFLs, would make it the in the ballpark of the actual NTG. Others, however, felt differently about including both types in a single estimation. As one panel member (from the regulator/evaluator/efficiency expert group) explained:

> *By definition, the multistate model tries to estimate NTG for all bulbs, not specialty CFLs alone. As such this analysis cannot take into account differences in marketing and customer decision making for specialty bulbs. Specialty bulbs are closer to being perceived by customers as a service than a commodity like spiral CFLs.*

One-half of respondents from the CFL manufacturer/program implementation contractor group (3 out of 6 respondents) rated the multistate regression model as somewhat accurate; four out of six respondents from the employees of entities that implement programs group rated this method as either somewhat or very accurate. Three out of eight respondents from the regulator/evaluator/ efficiency expert group rated the multistate regression model as very or somewhat inaccurate, three rated it as neither accurate nor inaccurate, and two rated it as somewhat accurate.

3.6 Weighting the 2009-2010 NTG Estimates for Specialty CFLs

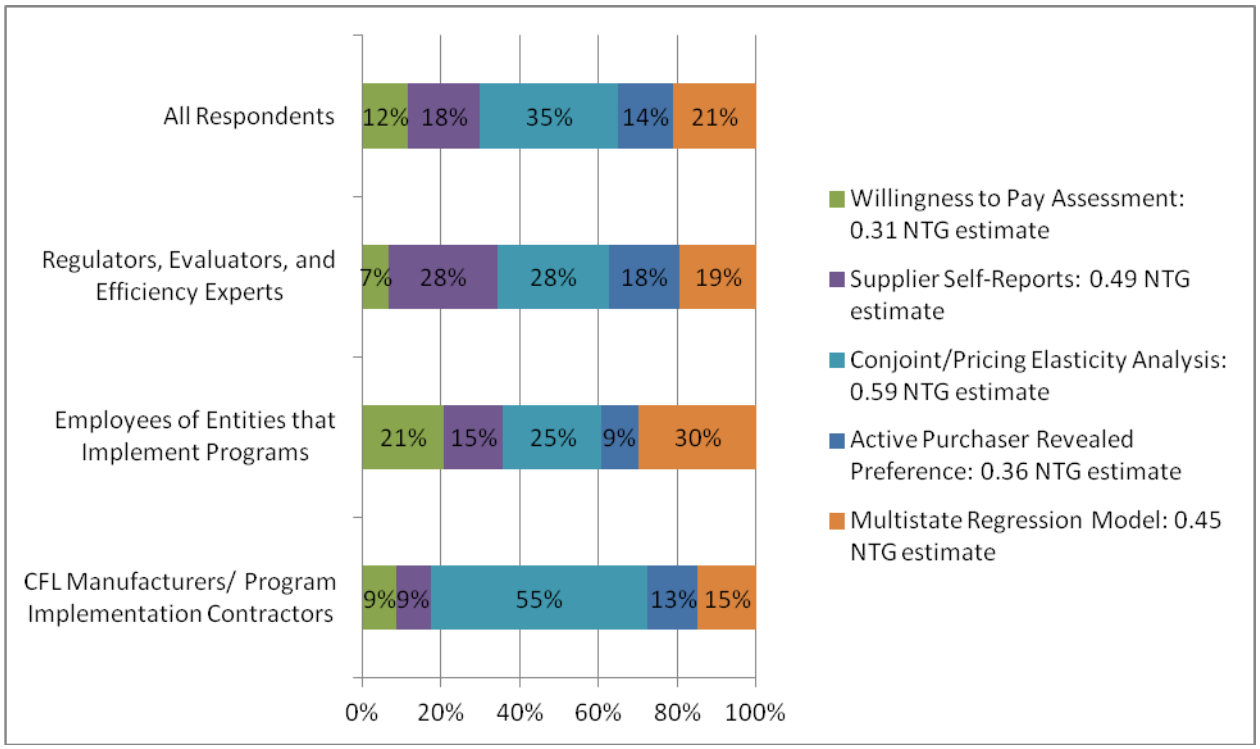
In this section, we present a summary of responses to survey questions pertaining to the weighting of the 2009-2010 Massachusetts NTG estimates for specialty CFLs. Table 3-2 and Figure 3-2 summarize these responses, after which we present respondents' reasoning for their weighting of each method. On average, panelists indicated that the Conjoint/Pricing Elasticity Analysis should receive the highest weight of 35% followed by the Multistate Regression Model with a weight of 21%, the Supplier Self-Reports with a weight of 18%. The Active Purchaser Revealed Preference and Willingness to Pay Assessment estimates received the lowest average weights (14% and 12%, respectively).

Table 3-2: Assigned Weights for NTG Estimates – Specialty CFLs

Please provide a score or weight of 0% to 100% for each of the 2009-2010 NTG estimates for Massachusetts, thinking about specialty CFLs only. The weight represents the relative importance you think each NTG estimate deserves compared to the others, for specialty CFLs only. The weights should sum to 100%. *Note that some of these estimates are only for specialty CFLs while some are for all CFLs, and we are asking you to assess how well each of the estimates represents the NTG for specialty CFLs only.*

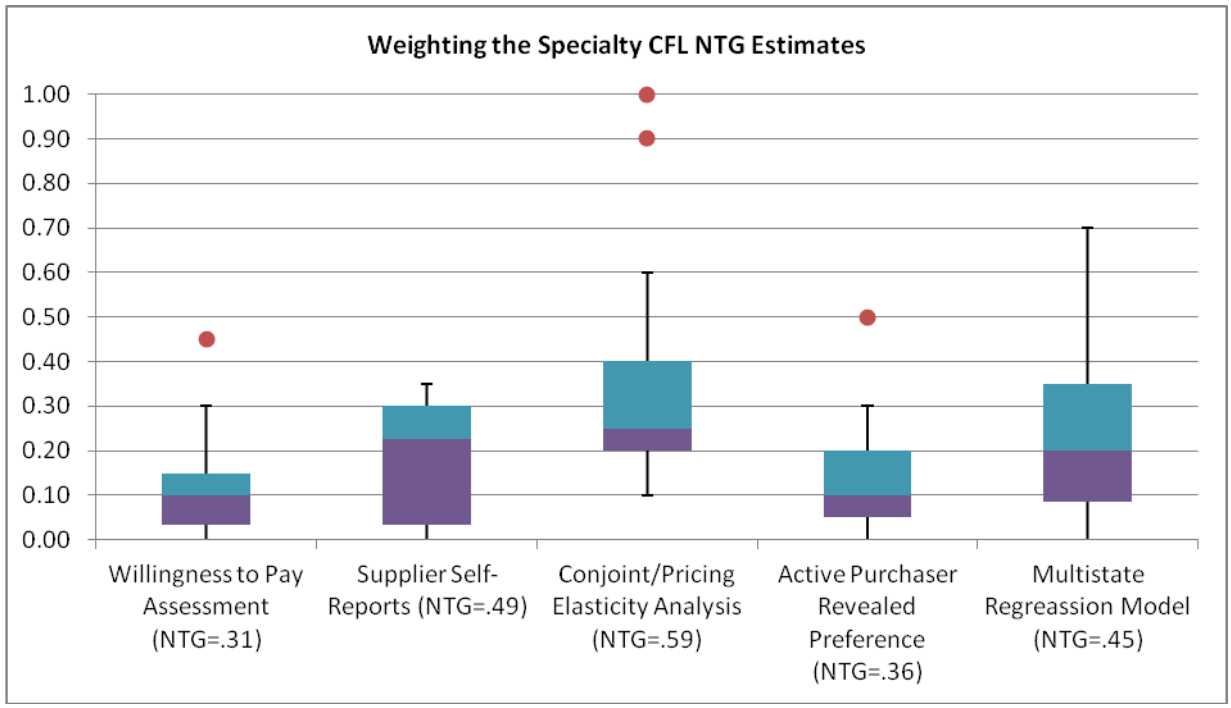
	CFL Manufacturers/ Program Implementation Contractors	Employees of Entities that Implement Programs	Regulators, Evaluators, and Efficiency Experts	All Respondents	Net-to-gross estimate (point estimates produced by the NMR studies)
Willingness to Pay Assessment, *specialty bulbs only*					0.31
Mean	9%	21%	7%	12%	
Median	6%	20%	8%	10%	
Individual values	0, 1, 2, 10, 20, 20%	0, 10, 20, 20, 30, 45%	0, 5, 5, 5, 10, 10, 10, 10%	0-45%	
Supplier Self-Reports, *specialty bulbs only*					0.49
Mean	9%	15%	28%	18%	
Median	3%	13%	30%	23%	
Individual values	0, 0, 2, 4, 20, 25%	0, 0, 5, 20, 30, 35%	10, 25, 25, 30, 30, 30, 35, 35%	0-35%	
Conjoint/Pricing Elasticity Analysis, *specialty bulbs only*					0.59
Mean	55%	25%	28%	35%	
Median	51%	20%	30%	30%	
Individual values	20, 20, 41, 60, 90, 100%	10, 15, 20, 20, 30, 55%	10, 10, 20, 30, 30, 40, 40, 40%	10-100%	
Active Purchaser Revealed Preference, *all CFLs*					0.36
Mean	13%	9%	18%	14%	
Median	15%	10%	15%	10%	
Individual values	0, 1, 10, 20, 20, 25%	0,5, 10, 10, 10, 20%	0, 5, 5, 10, 20, 25, 30, 50%	0-50%	
Multistate Regression Model, *all CFLs*					0.45
Mean	15%	30%	19%	21%	
Median	15%	28%	15%	20%	
Individual values	0, 4, 10, 20, 20, 35%	0, 15, 20, 35, 40, 70%	0, 0, 10, 10, 20, 25, 40, 50%	0-70%	

Figure 3-2: Mean Scores of 2009-2010 Specialty CFL NTG Estimates for Massachusetts



The box-and-whisker plots in Figure 3-3 represent 50% of all responses within the boxes as well as the smallest and largest weights given. Weights that were significantly larger than nearly all other responses are presented here as outliers.

Figure 3-3: Weighting the Specialty CFL NTG Estimates



Those panel members who explained the rationale behind the given weighted values said they based their weight assignments on the perceived accuracy of the results. One panel member (from the regulator/evaluator/efficiency expert group) said the following:

> *It seemed reasonable to give the majority of the weight to the studies that were done specifically on the specialty products, with the exception of the first one, whose estimate is implausibly low.*

Respondents again expressed a general belief that no one methodology was a perfect estimate of NTG, that using more than one method would be useful, and that more details on each may have led them to change the weights given to some methods. One panel member expressed a lack of comfort with an NTG for specialty CFLs since this category is made up of so many different products.

3.7 Developing a Single 2009-2010 NTG Estimate for Specialty CFLs

This section presents the weighted NTG estimates for respondents who accepted the results of the weighting, or the re-estimated NTG estimates for respondents who did not accept the results and provided estimates that they thought were more accurate.

3.7.1 NTG Estimates for Specialty CFLs – Round One Comments

In the first round of the survey, the respondents who changed their final NTG estimates for specialty CFLs all increased the ratio, reiterating that the true net effects were likely higher than for spirals. One panel member from the employees of entities that implement programs group gave a final estimate of 2.0, explaining that:

> *Specialty CFLs are relatively new to the market, and consumer awareness of this class of CFLs is still growing. Energy Efficiency Program Sponsors are having tremendous impacts in this market with their Specialty CFL promotion by raising awareness through marketing and retail events, increasing product availability, achieving better merchandising through end caps displays at retail, and significant price reductions throughout the application of mid-stream incentives. All of these actions result in a high net-to-gross and considerable spillover effects.*

A panel member from the regulator/evaluator/efficiency expert group suggested that a point estimate for specialty bulbs would be too precise and recommended reporting a range of NTG ratios instead, especially if the is it being used to assess program cost effectiveness or to adjust electricity forecasts for program or measure effects.

3.7.2 NTG Estimates for Specialty CFLs – Round Two Comments

After reviewing the summarized responses and comments from other experts about specialty CFLs, panelists again expressed the highest average level of confidence in their own responses

(7.0), with the CFL manufacturers/program implementation contractors group expressing the highest average level of confidence among the groups (8.4). As one member of this group stated:

> *Based on my experience, I am pretty confident in my responses, and I am more confident in other respondents' answers for specialty as there seems to be a higher level of agreement on increased NTG ratios than on standard spirals.*

Aside from their own individual responses, the CFL manufacturers/program implementation contractors group expressed the highest level of confidence in the regulators/evaluators/ efficiency experts group. The employees of entities that implement programs expressed equal confidence in their own group and the regulators/evaluators/efficiency experts group, and the regulators/evaluators/efficiency experts expressed the most confidence in their own group. One member of the regulators/evaluators/efficiency experts group explained the lack of confidence in other experts' responses as follows:

> *We have to go back to basic research on market change drivers. Few of the professionals on these lists are experienced with the types of analysis that would drive NTG values much higher than our ex-post simplified approaches show. The evaluation experts will be knowledgeable with these approaches and some of the market research people will know them. But the market does not work the way these analysis techniques suggest that they do. Much of the time that a participant says that they would take the action anyway, they are taking that action as a result of the effects of the program on the market acceptance and adoption metrics. It's the same with suppliers, contactors, and trade allies. Unless they really understand the market, you get bad information that is statistically unreliable. I'm not sure how these people understand this, or even if they do.*

As with spiral CFLs, the lowest level of confidence was in the responses of the CFL manufacturers/program implementation contractors group. Panelists cited similar reasons mentioned in the previous section as well as the following:

> *In particular, I think the program implementers and their contractors want these programs to have high net to gross ratios so they will continue to be financially justified as the bare spiral CFL program phases down.*

> *Being a consultant, I trust myself first and then my peer group, regulators/evaluators/efficiency experts. I trust the program implementers and manufacturers who have something to gain from the NTG decision last.*

Experts also reemphasized the overall lack of confidence in responses from all groups that was expressed earlier. One member of the CFL manufacturers/program implementation contractors group stated:

> *It's hard to rate confidence in other respondents as there seems to be trends in answers based on the groups each has been segmented into and as everyone has different areas of expertise.*

Others commented on issues specific to specialty CFL NTG estimates. As one member of the employees of entities that implement programs group affirmed:

> *Given the current methodologies for calculating net to gross, it is clear that none are perfect, and the current methods are as much an art as they are a science. So, given this uncertainty it is difficult to have a high level of confidence in either my own or others views concerning the accuracy and precision of the results.*

A member of the regulators/evaluators/efficiency experts group agreed:

> *Overall uncertainty is high here. We should approach this exercise with some collective humility, in part because the track record of specialty CFL programs is not long enough or diverse enough to allow us to draw robust conclusions.*

Table 3-3 summarizes the panelists' confidence in responses as described above.

Table 3-3: Confidence in Responses – Specialty CFLs

How much confidence do you have in your own responses as well as the responses of the other panel members? In the table below, please use an "X" to indicate your level of confidence in the various groups' NTG estimates by using a scale from 0 to 10, where 0 means "not at all confident" and 10 means "extremely confident."				
Category	**Own Responses**	**CFL Manufacturers/ Program Implementation Contractors**	**Employees of Entities that Implement Programs**	**Regulators/Evaluators /Efficiency Experts**
CFL Manufacturers/ Program Implementation Contractors				
Mean	8.4	6.4	6.4	6.6
Individual Responses	7, 8, 8, 9, 10	3, 5, 7, 8, 9	4, 5, 7, 7, 9	5, 5, 7, 7, 9
Employees of Entities that Implement Programs				
Mean	5.8	5.0	5.5	5.5
Individual Responses	3, 5, 5, 6, 7, 9	3, 4, 5, 8*	3, 6, 6, 7*	3, 5, 6, 8*
Regulators, Evaluators, and Efficiency Experts				
Mean	6.6	5.2	5.1	5.7
Individual Responses	4, 4, 5, 5, 6, 7, 8, 9	3, 3, 4, 4, 5, 5, 6, 7	3, 3, 3, 3, 4, 5, 6, 6	3, 4, 4, 5, 5, 7, 7, 7
All Respondents				
Mean	7.0	4.9	5.2	6.0
Individual Responses	3-10	3-9	3-9	3-9

In round two of the survey, nine out of 19 respondents modified their original estimate for specialty CFLs. Three quarters of the regulators/evaluators/efficiency experts group (6 out of 8 respondents) and half of the employees of entities that implement programs group (3 out of 6 respondents) modified their initial estimates; in contrast, none of the five from the CFL manufacturers/program implementation contractors group changed their initial estimates, which reflects the high level of confidence this group expressed in their own answers. (Table 3-4)

Table 3-4: Whether Panelists Modified Initial Responses or Not – Specialty CFLs

Category	Modified Estimate	Did Not Modify Estimate	Total
CFL Manufacturers/ Program Implementation Contractors	0	5	5
Employees of Entities that Implement Programs	3	3	6
Regulators, Evaluators, and Efficiency Experts	6	2	8
All Respondents	9	10	19

The majority of the NTG estimates that changed were increased, aside from the two outliers who reduced their estimates but remained outliers with ratios well above the average. Those who changed their initial estimates offered different reasons for doing so. One member of the employees of entities that implement programs group stated:

> *I re-ranked the studies such that the Price Elasticity Analysis received a much higher weighting. Given the price of the CFL specialty bulbs, I think that people would be much more sensitive to price change.*

The following comments are from members of the employees of entities that implement programs group who altered their estimates:

> *It is hard to deny that specialty models have sold far less well than bare spirals and in far fewer outlets. Therefore, those sales increases that have occurred are more readily attributable to utility program activity. I am persuaded that the NTG ratio for specialty products should be slightly higher than I originally estimated.*
>
> *For the wide range of specialty bulbs examined and the fact that the studies looked at them as a whole, I am convinced that my original estimate was too low.*
>
> *These specialty bulbs have very low market penetration and the kind of price tag that we saw with the early CFLs (prices made you gasp, the term "compact" made you wonder at the sense of humor of those involved in the nomenclature). I expect that the impact of current programs is much higher than the current studies showed.*

Though the two outliers reduced their initial NTG estimates, both ratios still remained outliers. These panel members explained their above average estimates as follows:

> *After reviewing the other responses, it was obvious to me that as a program implementer, I am biased about the effectiveness of CFL lighting programs. However, I also believe that the other respondents are either unaware or ignoring the impact that CFL programs are having in reducing the price of specialty CFLs, which is a large component of overcoming a barrier to consumers purchase of these products, and participating in CFL programs such as those sponsored by the MA PAs.*

> *We are missing a very large hole in addressing market effects and the things that drive diffusion and adoption in this analysis, so it has to be added.*

Over half (10 out of 19) did not change their initial estimates, stating similar explanations to those given in round one. Across both groups (those who modified their responses and those who did not), many panelists were still uncomfortable with the results for specialty CFLs, with one member of the CFL manufacturer/program implementation group stating:

> *I believe that most panelists feel that the NTG for specialties should be higher than what was found in most methods with 14 of the 20 suggesting revised estimates of .50 or above.*

Another member from regulators/evaluators /efficiency experts group agreed:

> *I think the NTG results from all of these studies for specialty bulbs are problematic, If asked to perform a meta analysis of all studies in the study and given my interpretation of the available evidence nationwide, I would recommend an overall NTG for CFL specialty bulbs of 0.70, but I can't use these MA results and this weighting scheme to get there.*

Others expressed similar issues, but focused on their lack of confidence in the methods used. An expert from the employees of entities that implement programs expressed a similar view:

> *My estimate is not based on rigorous, defensible, direct evidence, but on indirect evidence from other studies, and experience with evaluating changes in individual technology markets…I recommend further analysis.*

And one from the CFL manufacturers/program implementation contractors group stated:

> *I believe that the program has had a large impact on moving many more products than would otherwise have been sold and I am not confident that the evaluation methodologies capture this impact accurately.*

Overall, there was a general lack of confidence in the analytic methods used to calculate the specialty CFL NTG ratio.

3.7.3 Final NTG Estimates for Specialty CFLs

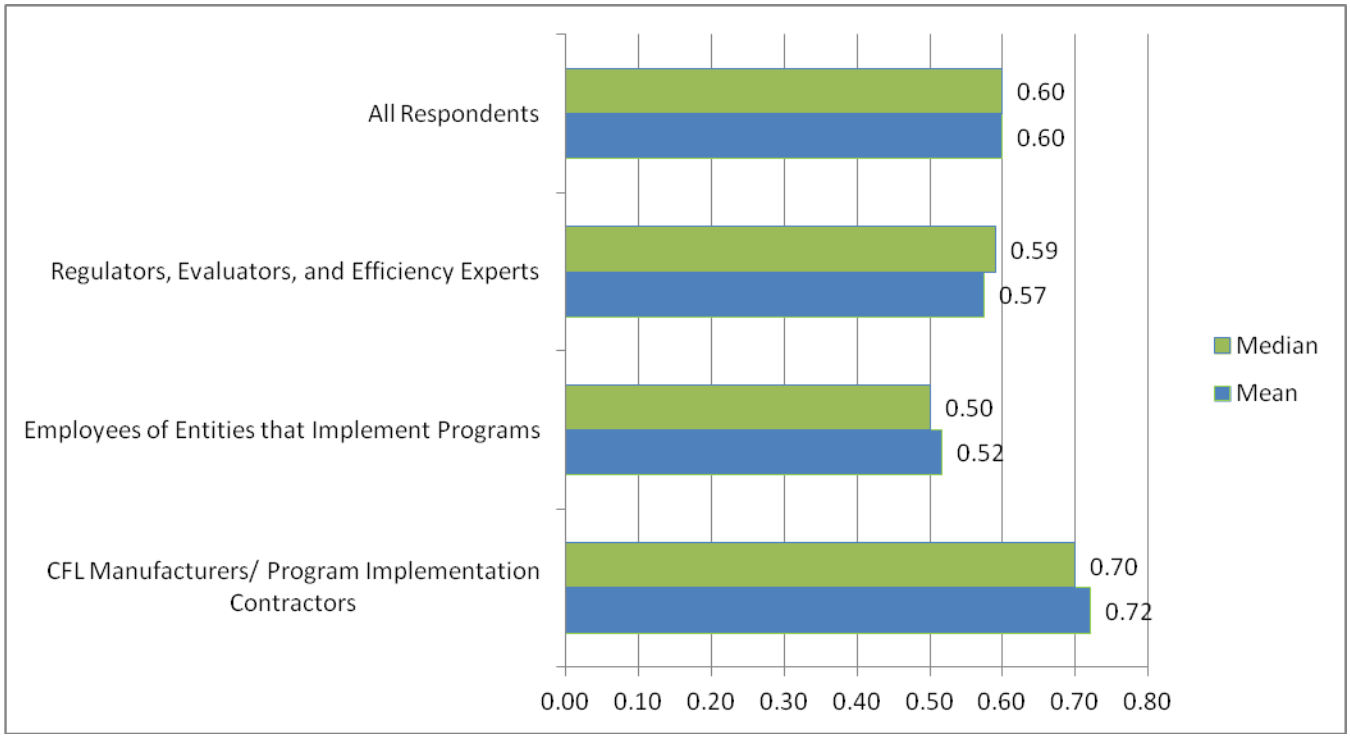
Table 3-5 and Figure 3-4 show the mean and median NTG estimates after panel members weighted or re-estimated the specialty CFLs NTG ratio. (Table 3-5 and Figure 3-4)

These estimates were calculated without the two outliers, 1.15 and 1.25, resulting in a reduced sample size. One outlier was a member of the employees of entities that implement programs group, while the other was a member of the regulators/evaluators/efficiency experts group.

Table 3-5: Weighted or Re-Estimated NTG – Specialty CFLs

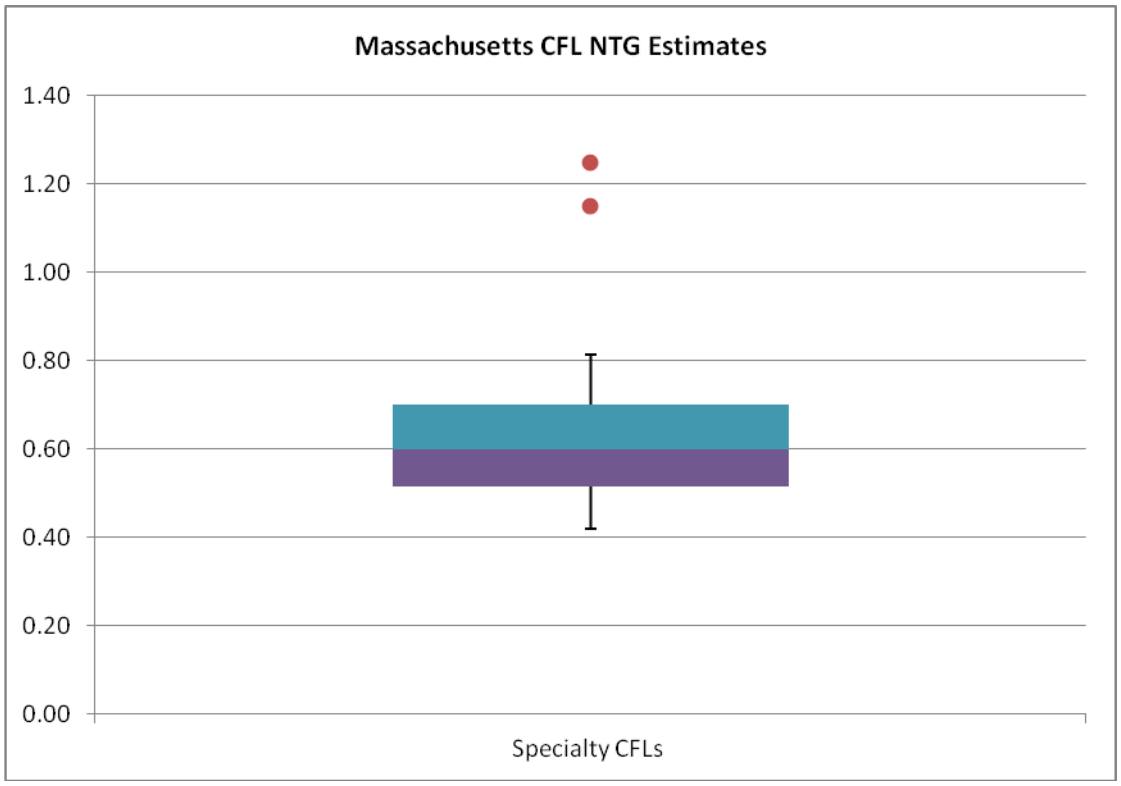
Weighted or Re-estimated NTG				
	CFL Manufacturers/ Program Implementation Contractors	**Employees of Entities that Implement Programs**	**Regulators, Evaluators, and Efficiency Experts**	**All Respondents**
Sample Size	*5*	*5*	*7*	*17*
Median	0.70	0.50	0.59	0.60
Mean	0.72	0.52	0.57	0.60

Figure 3-4: Weighted or Re-estimated NTG Ratios for Specialty CFLs



The box-and-whisker plots in Figure 3-5 represent 50% of all responses within the boxes as well as the smallest and largest weights given. Other than the two outliers, the estimates (17 out of 19) all fell within the same range, although not as narrow a range as with spiral CFLs. (Figure 3-5)

Figure 3-5: Massachusetts CFL NTG Estimates – Specialty CFLs Only



Many of the experts made additional comments on the NTG for specialty CFLs as a whole and offered recommendations for future estimates. As one member of the CFL manufacturers/ program implementation contractors group reflected:

> *There's a slippery consideration here. I believe consumers buy specialty CFLs after they've tried and become convinced of the merits of spiral CFLs. This would make specialty CFL purchases a form of free-ridership for some because when the consumer purchases a specialty CFL, he/she does so with prior intent, thus a lower NTG. I reject this argument because I believe price is still a barrier, and the price discount/rebate is what encourages the consumer to try the specialty CFLs.*

Another member from the regulators/evaluators/efficiency experts stated:

> *We should not confuse relatively high net to gross ratios for specialty CFL programs with a measure of the overall utility desirability of investing in them. Because the physical size, color, dimmability, warm up time, and light distribution attributes of CFLs are inherently different than those of traditional specialty incandescents, the performance disadvantages of CFLs are more evident in applications inherently intended to showcase those aspects of performance. The history of utility programs suggests that utilities that offer large enough incentives for those products can persuade some customers to buy them. That*

> *does not mean the customers' experience with the products will be a good one or that they will purchase additional units with their own money in the future. Persistence and customer satisfaction studies would be warranted to investigate this. Utilities will not ultimately be able to transform the market for specialty CFLs to the extent they have for bare spiral CFLs (which is still a fairly modest extent), so they and their regulators should not use high NTG ratios for them as a reason to shift program funding heavily in that direction.*

Experts from the employees of entities that implement programs group gave some input on presenting the results of this study:

> *I recommend reporting NTG means in two different ways: those based on the ratios the studies provided along with the weights given for those studies, and NTG rates provided independently by panelists.*
>
> *I think it is a viable option to withhold these results from any final decision on validity and application until program designers, administrators, and evaluators are more comfortable with the results.*

Other panelists offered suggestions for future estimates. A member of the CFL manufacturers/ program implementation contractors recommended the following:

> *Future analyses both for specialty and general service CFLs should be based on actual full category sales data. Where that is not available the influence of various program factors should be calibrated with data from behavioral research on the relative influence of factors of these types on purchasing decisions. Decades of research support the conclusion that elements of the immediate in-store environment (price, placement, point of purchase promotion) will have the greatest influence on the selection decision because they are typically the dominant situational factors and situational factors are the primary determinants of most human behavior.*

Two members from the regulators/evaluators/efficiency experts group offered input as well:

> *This market, in particular, deserves greater scrutiny. Indeed, it may even warrant separate questions regarding different types of specialty products (budget permitting) as I suspect that the NTG could vary considerably by product type.*
>
> *It is extremely important to get a better handle on what is likely to happen in the specialty CFL market in the absence of programs. For example: Will prices continue to drop? Will retailers more aggressively advertize to sell these higher end CFL specialty products in the absence of a program? Will manufacturer research, development and design on specialty bulbs lead to reduced specialty prices anyway? How will EISA introduction affect specialty market, if at all?*

Without these results it is difficult to advise on needed program design changes for this market.

4 Developing a Single 2009-2010 NTG Estimate for All CFLs

This section presents the weighted NTG estimates for respondents who accepted the results of the weighting, combined with the re-estimated NTG estimates for respondents who did not accept the results and provided estimates that they thought were more accurate.

4.1 NTG Estimates for All CFLs – Round One Comments

Those respondents who changed the final estimate in the first round all increased the NTG ratio. One panel member (from the regulator/evaluator/efficiency expert group) gave a final estimate of 2.50, explaining that this value accounts for the missing causes that were not studied, such as market effects, spillover, repeat purchases caused by the program, and increased demand over the long term. Another panel member computed a weighted average for overall NTG using the re-estimated NTGs for standard and specialty products.

4.2 NTG Estimates for All CFLs – Round Two Comments

After reviewing the summarized responses and comments from other experts, panelists expressed the highest average level of confidence in their own responses.

Aside from their own individual responses, the CFL manufacturers/program implementation contractors group expressed an equal average level of confidence in the responses of employees of entities that implement programs group and those of the regulators/evaluators/efficiency experts group. The employees of entities that implement programs group expressed the highest level of confidence in the regulators/evaluators/efficiency experts group. The regulators/ evaluators/efficiency experts group expressed the highest level of confidence in their own group.

Again, panelists expressed the lowest level of confidence in the responses of the CFL manufacturers/program implementation contractors group. Panelists reiterated the same reasons for this as those mentioned in the previous sections as well as the following:

> *I believe that that those that work every day on program design, implementation and evaluation have a better understanding of program impacts than do manufacturers and implementation contractors.*
>
> *I generally have a lot of confidence in all mean scores from each of the groups. I have slightly less in the CFL manufacturers/implementation contractors category because the responses I've read in this document seem to show somewhat more of a preconceived notion about what the results should be than for some of the other groups.*

Some experts expressed doubts about the validity of having a combined NTG for spiral and specialty CFLs. One member of the CFL manufacturers/program implementation contractors

group said, "I don't see the value in creating a combined net to gross." Another member of the same group agreed, stating:

> *As a manufacturer's representative, I was initially inclined to lean towards advocating for one overall NTG for all CFLs in order to make the programs easier to implement, but the difference in awareness and usage on specialties does not allow me to reconcile this all-in-one NTG approach.*

Others, however, supported the combined estimate. Members of the regulators/evaluators/ efficiency experts group said the following:

> *One question I wish you had asked is my confidence in the group as a whole to come up with an accurate NTG. I have very high confidence in this (in the order of 8-9) since the group is diverse, represents multiple perspectives and knowledge bases, and the majority of the individual overall NTG values are very closely clustered. NTG, by nature, is inexact. While these are all good estimates, we don't have a very good sense of what the real confidence levels are around these, and probably all have lower confidence around someone else's answer.*
>
> *There's still a lot of uncertainty here, particularly regarding specialty products. That said, there is some comfort that all but two of the respondents had answers within a narrow band.*
>
> *The outliers concern me, but leaving those 2-3 aside, all the other scores are in a very narrow range. Overall, this is very encouraging.*

Table 4-1 summarizes the panelists' confidence in responses as described above.

Table 4-1: Confidence in Responses – All CFLs

How much confidence do you have in your own responses as well as the responses of the other panel members? In the table below, please use an "X" to indicate your level of confidence in the various groups' NTG estimates by using a scale from 0 to 10, where 0 means "not at all confident" and 10 means "extremely confident."				
Category	**Own Responses**	**CFL Manufacturers/ Program Implementation Contractors**	**Employees of Entities that Implement Programs**	**Regulators/Evaluators /Efficiency Experts**
CFL Manufacturers/ Program Implementation Contractors				
Mean	7.6	5.2	5.8	5.8
Individual Responses	5, 6, 8, 9, 10	4, 4, 5, 6, 7	4, 5, 5, 7, 8	4, 5, 6, 7, 7
Employees of Entities that Implement Programs				
Mean	6.3	4.8	5.5	6.0
Individual Responses	3, 6, 6, 7, 7, 9	3, 4, 5, 7*	3, 6, 6, 7*	3, 6, 7, 8*
Regulators, Evaluators, and Efficiency Experts				
Mean	6.9	5.4	5.3	6.3
Individual Responses	5, 6, 6, 7, 7, 7, 2, 9	4, 4, 5, 6, 6, 6, 6, 6	3, 4, 5, 5, 6, 6, 6, 7	5, 6, 6, 6, 6, 7, 7, 7
All Respondents				
Mean	6.9	5.2	5.5	6.1
Individual Responses	3-10	3-7	3-8	3-8

* "Don't Know" responses were omitted

In the end, eight out of 19 respondents modified their original NTG estimate for all CFLs. Two out of five members of the CFL manufacturers/program implementation contractors group changed their initial estimates for all CFLs; one-half of the members of the employees of entities that implement programs group (3 out of 6 respondents) changed their initial estimates; and three out of eight of the regulators/evaluators/efficiency experts group modified their initial estimates.

Table 4-2: Whether Panelists Modified Initial Responses or Not – All CFLs

Category	**Modified Estimate**	**Did Not Modify Estimate**	**Total**
CFL Manufacturers/ Program Implementation Contractors	2	3	5
Employees of Entities that Implement Programs	3	3	6
Regulators, Evaluators, and Efficiency Experts	3	5	8
All Respondents	8	11	19

All of the respondents who modified their original estimates for all CFLs had modified at least one of their other two original NTG estimates. Overall, only two out of the 19 respondents modified all three NTG estimates. Many of those who re-estimated their final NTG ratio stated that they merely adjusted it based on the new weights or estimates they'd given earlier in the survey. One member of the CFL manufacturers/program implementation contractors group went one step further in recalculating:

> *I adjusted it based on the new estimates for spiral and specialty and then weighted them according to 2010 sales volumes: 78% bare-spiral sales and 22% specialty sales, in keeping with reported incentivized sales volumes.*

Another expert from the regulators/evaluators/efficiency experts group increased the initial estimate for the following reason:

> *This upward adjustment appears justified and needed to me to ensure efforts to promote specialty bulbs are not prematurely terminated.*

One of the outliers again explained the reason for giving a higher-than-average NTG estimate:

> *We have a long way to go in this field and so far have looked to the simple approaches (self-reports, econometrics, etc.). We have not used and cannot now use experimental design, so that is out, but we have to go back to market adoption literature and look at the what drives diffusions of innovations and why adopters adopt. You will notice that the energy program evaluation field is not taking note of these better approaches. There needs to be an adoption metric for innovators, early adopters, early majority, late majority and laggards and the approach for each has to follow the reasons these segments adopt the technology. For example, late majority buy because the early majority has shown them the way. So the vast amount of the late majority adoption is driven by the early majority. The market follows a pattern; you have to measure and understand this pattern. The EE field has missed all of the vast amounts of literature on adoption and what drives it. You cannot do NTG analysis well without doing this.*

Of those who did not alter their initial estimates, some expressed confidence in their final estimates. One member of the regulators/evaluators/efficiency experts group stated:

> *This seems to be in the correct range and is based on a weighting of all the approaches. I like this composite, bottom up score, and think it best represents how accurate I feel the various results to be. I realize it's on the low side compared to the other panelists; however, I've reviewed my responses and still agree with the scores given.*

Another member of the employees of entities that implement programs group concluded:

> *I have confidence in each of the studies. I believe that each of the studies will provide valid estimates. I believe that taken as a group the estimates will indicate*

the range in which the true NTG estimate is in. Since they are equally valid estimates there is no basis to provide them different weights.

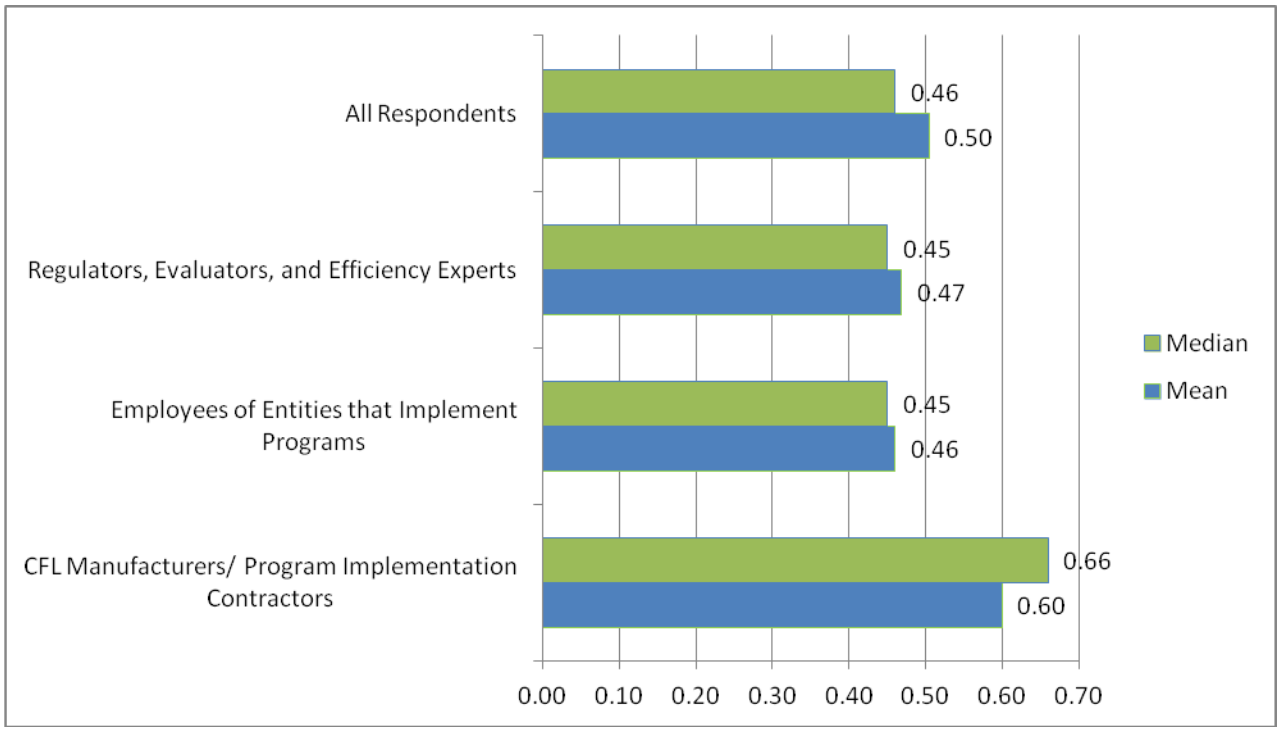
4.3 Final NTG Estimates for All CFLs

Table 4-3 and Figure 4-1 show the mean and median NTG estimates after panel members weighted or re-estimated the NTG ratio for all CFLs. (Table 4-3 and Figure 4-1)

Table 4-3: Weighted or Re-Estimated NTG – All CFLs

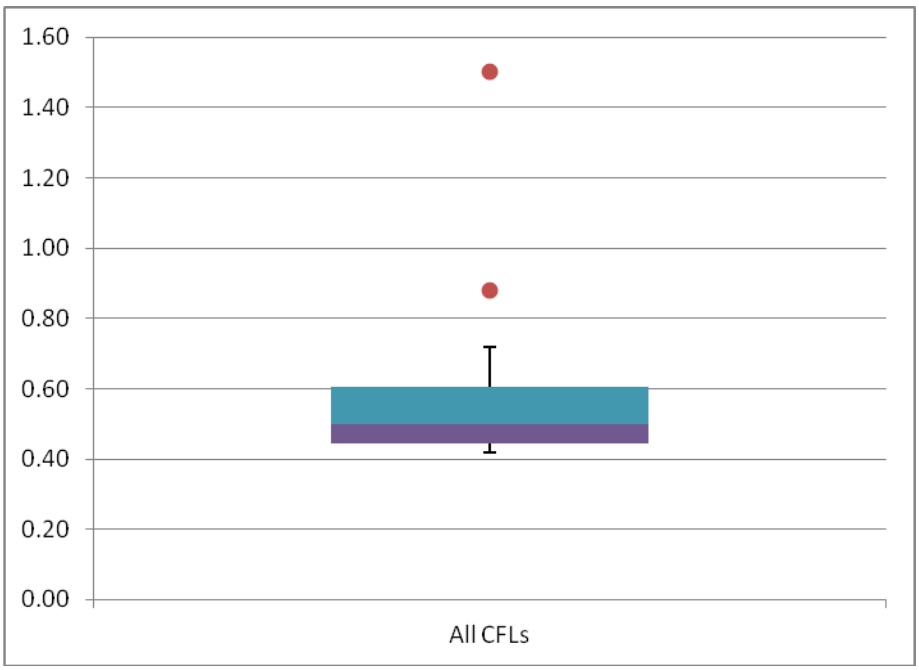
	CFL Manufacturers/ Program Implementation Contractors	Employees of Entities that Implement Programs	Regulators, Evaluators, and Efficiency Experts	All Respondents
Sample Size	5	5	7	17
Median	0.66	0.45	0.45	0.46
Mean	0.60	0.46	0.47	0.50

Figure 4-1: Weighted or Re-Estimated NTG Ratios for All CFLs



The box-and-whisker plots in Figure 4-2 represent 50% of all responses within the boxes as well as the smallest and largest weights given. Other than the two outliers, the estimates (17 out of 19) all fell within a fairly narrow range.

Figure 4-2: Weighted or Re-Estimated NTG Estimate – All CFLs



Many of the experts made final comments on estimating NTG and studying the CFL market as a whole. One member of the employees of entities that implement programs group expressed confusion with the overall process:

> *I really do not see any basis for providing different weights to valid estimates. I can see discounting some study results completely and weighting them zero as the studies are either valid or not. I also don't see where the alternative NTG estimates are coming from. Unless they are based on studies I do not see that expert opinion really suffices unless bolstered by citations of other studies.*

Another from the same group commented on the final NTG estimate:

> *No one should be surprised with the overall result for all CFLs. NTGRs everywhere are declining over time (except the south, where there are still few programs). Spreading the risk of failure among more technologies, building types, and markets is worth considering, even if the final decision-makers are skeptical of the current research results. I have seen promising, if harder won, results from more comprehensive, community-based efforts. It may be time to restructure program design and evaluation to accommodate more complexity and less certainty.*

Members of the CFL manufactures/program implementation contractors group expressed the following final thoughts:

> *The key point that we can back up is, without CFL programs, the public will return to using incandescents and halogens. No market transformation of any significant type will ever be accomplished without utilities pushing their rate payers to use CFL's.*
>
> *Several times I have seen it mentioned that these studies are not taking into account "market effects, spillover, repeat purchases caused by the program, and increased demand over the long term." Overall, I think that this market transformation information is exactly what these studies are trying to get at. If we can determine the effect of the recent higher incentives on specialty CFLs and the drop in incentives for standard CFLs over the past few years, I think this would give us an excellent picture of whether or not we have created a self-sustaining market within those 31% of sockets. It seems after so long, with only 31% socket penetration, however, there is still a significant impact to be made by programs (in one form or another) and still a large number of the Massachusetts population not being reached.*

Members of the regulators/evaluators/efficiency experts group added these closing comments:

> *The key to efficiently promoting CFL penetration through programs is better tracking of product prices with and without rebates and understanding what fraction of customers sees CFLs as a commodity. The goal should be set to get out of general CFL market when the price reaches $X per bulb.*
>
> *With the extensive and complex mosaic of utility, government, and private sector efforts to influence consumer behavior toward things like purchase of CFLs, it is becoming a 'fool's errand' to try to identify net-to-gross levels for a single particular program. We need to start moving toward using total gross impact as the ultimate goal that all parties seek to attain, with at least some portion of recognition and incentive mechanisms structured accordingly.*

5 Final Net-to-Gross Estimates

Table 5-1 shows the mean and median NTG estimates after panel members weighted or re-estimated the NTG ratio and the range of the original estimates for spiral CFLs only, specialty CFLs only, and all CFLs (Table 5-1). Overall, the range of estimates provided by the Delphi panel was fairly narrow and within the range of the unadjusted NTG estimates developed for the program. The Delphi panel provided a median NTG ratio estimate of 0.43 for spiral CFLs, with a mean of 0.45. This falls within the range of the original estimates provided by the various NTG methods described previously. The final median weighted NTG ratio provided by the Delphi panel for specialty CFLs was 0.60, and the mean NTG ratio was also 0.60. This estimate falls just outside of the range of estimates provided by the various NTG methods employed.

The median NTG estimate of 0.43 for spiral CFLs appears reasonable and is what we would recommend. While the median estimate of 0.60 for specialty CFLs is slightly higher than any of the estimates provided by the evaluation team's estimates, the Delphi panelists as a group expressed a fairly strong belief that the specialty NTG should be higher than the spiral NTG; this seems reasonable, and we recommended using a value of 0.60 for the specialty CFL NTG. Finally, the NTG estimates shown in Table 5-1 for all CFLs weight the median NTG estimates for spiral CFLs and specialty CFLs according the number of bulbs supported by the program for each category; hence we recommend a NTG of 0.47 for all CFLs.

Table 5-1: Accuracy of Estimates – Spiral CFLs

	Weighted or Re-estimated NTG				
	CFL Manufacturers/ Program Implementation Contractors	**Employees of Entities that Implement Programs**	**Regulators, Evaluators, and Efficiency Experts**	**All Respondents**	**Original Estimates**
	Spiral CFLs Only				
Sample Size	*4*	*5*	*7*	*16*	
Median	0.49	0.43	0.42	0.43	0.36- 0.49
Mean	0.51	0.43	0.43	0.45	
	Specialty CFLs Only				
Sample Size	*5*	*5*	*7*	*17*	
Median	0.70	0.50	0.59	0.60	0.31 - 0.59
Mean	0.72	0.52	0.57	0.60	
	All CFLs				
Sample Size	*5*	*5*	*7*	*17*	
Proportional allocation of spiral and specialty NTG, based on medians	0.54	0.45	0.46	0.47	

Appendix A First-round survey Instrument

Estimating the Net-to-Gross Ratio for the 2009-2010 Massachusetts ENERGY STAR Lighting Program	**Comments and Questions**
Thank you for participating in our study. The goal of this study is to decide which of several net-to-gross estimates (NTG) developed for the 2009 and 2010 Massachusetts ENERGY STAR Lighting Program, if any, is most accurate, and to develop final Massachusetts-specific NTG numbers for 2009 and 2010 based on your responses and those of your fellow experts on this panel. After receiving responses to this survey, we will summarize them and send them to you and the other panel members, and ask you to review the results to decide if you would like to change any of your responses. It is also possible that your responses and your explanations for them could influence other panel members in the second (and final) round of the survey.	
Please respond to the questions in each section to the best of your ability. Please record your responses in the cells shaded in blue. For your convenience, this worksheet has been protected; you will be able to enter data only in cells shaded blue.	
Please note that as you respond to the survey, some questions may be shaded out based on your responses to questions that appear earlier in the survey. If a question is shaded dark grey with red font crossed out, please skip it.	
Before answering any questions, please review the other tabs:	
"Program Description," which briefly reviews the history and current structure of the Massachusetts ENERGY STAR Lighting Program	
"Background Data," which provides key indicators, over time, of program and market activity in Massachusetts and elsewhere	
"Net-to-Gross Methods," which explains how the various net-to-gross (NTG) estimates shown in the questions below and in the tab "Background Data" were developed	
In all of the NTG estimates presented below and in the other tabs, "gross" refers to program-supported CFL sales or purchases (not energy savings), and "net" refers to total market-level sales or purchases—possibly including both program-supported and non-program-supported CFLs—that would not have been sold or purchased in the absence of the program.	
We are asking for your assessment of the Massachusetts NTG estimates for 2009-2010 only, not for any other states or years. The other NTG estimates are shown (in the tab "Background Data") to help inform your assessment of the 2009-2010 Massachusetts NTG estimates. We are asking you to assess the accuracy of these estimates for 2009 and 2010 together, since some of the estimates are for 2010 only, and others are for 2009-2010 together; there are no 2009-only estimates.	
When we ask you to explain your reasoning for a given response, please consider carefully—your reasoning will be shared with other panel members in the second (and last) round of this survey, and could affect their assessments in the second round.	
Assessing the 2009-2010 NTG Estimates for Spiral CFLs	
MA Willingness to Pay Assessment: Estimated NTG of 0.49 (Spiral CFLs only)	
See "Background Data" cell 33N and "Net-to-Gross Methods" rows 9-17	
Please select a response from the drop-down menu below	
Q1. How accurate do you think this estimate is—that is, how well do you think it reflects the actual, underlying net-to-gross ratio in 2009-2010 in Massachusetts for spiral CFLs? — *no response recorded yet*	
PLEASE ANSWER THE ABOVE QUESTION BEFORE CONTINUING	
Q2. Why do you give this response? Please type an explanation of your reasoning below.	
MA Supplier Self-Reports: Estimated NTG of 0.39 (Spiral CFLs only)	
See "Background Data" cell 36M-N and "Net-to-Gross Methods" rows 19-23	

Appendix B Second-round survey Instrument

Delphi Panelist Response Summary

Estimating the Net-to-Gross Ratio for the 2009-2010 Massachusetts ENERGY STAR Lighting Program

Dear Panelist,

Thank you again for your assistance in the first round of our Delphi study.

In consideration of your time we are offering $500 to you or a charity of your choice after you complete this survey, which is the second and final round of the study.

This document contains your original responses to the survey plus a summary of the estimates made by you and your fellow panel members. We have also attached the spreadsheet with your original responses and the background information. We request that you review and reflect on the summary of responses, and, if necessary, provide revisions to your estimates from the first round.

We estimate that this second, and final, round should take less of your time than the first round—probably about 30 to 40 minutes. **We would like to have your final responses by May 16, 2011**. We will be contacting you in the next few days by phone to make sure you have received the study and to see if you have any questions. In the meantime, if you have any questions at all, please contact me at 617-284-6230, Ext 18 or kvontrapp@nmrgroupinc.com.

Best Regards,

Kiersten von Trapp

Research Associate
NMR Group, Inc

Phone: 617-284-6230 x18

Fax: 617-284-6239

Email: kvontrapp@nmrgroupinc.com

1 Review of Delphi Study Objectives and Process

1.1 Objective

The goal of this study is to assess the net impact of the 2009 and 2010 Massachusetts ENERGY STAR® Lighting Program on the sales of Compact Fluorescent Lights in Massachusetts. The Massachusetts ENERGY STAR Lighting Program is an on-going effort to encourage the use of ENERGY STAR-qualified lighting among residential customers. The Massachusetts Program Administrators (PAs) also work with other regional programs through the Northeast Energy Efficiency Partnerships (NEEP) to leverage program effectiveness by aggregating markets and coordinating consumer messaging. Additionally, all PA lighting initiatives are coordinated with and designed to support the national ENERGY STAR program.

The input from the Delphi panel will aid in deciding which, if any, of several net-to-gross (NTG) estimates developed for the program is most accurate, and help develop final Massachusetts-specific NTG numbers for 2009 and 2010 based on the responses of the experts on the panel. *We are aware that every NTG method has its own shortcomings, which is why we have convened this panel and are asking for your expert judgment.*

1.2 Process

Previously, we presented data on NTG estimates for spiral CFLs, specialty CFLs and CFLs overall sold during the 2009-2010 period of the Massachusetts ENERGY STAR® Lighting Program.

In this document, we have summarized the estimates and comments made by you and your fellow panel members. The summary estimates are organized by three categories of panelists:

1) CFL manufacturers and program implementation contractors (n=6)
2) Employees of entities that implement programs (n=6); these entities could be utilities or government agencies
3) Regulators, evaluation contractors and efficiency experts (n=8); the efficiency experts may work for efficiency advocacy groups, think tanks, or firms that provide program design support

- ***Please review the summary of estimates provided by other panel members, the reasoning associated with those estimates, and your initial estimates. In doing so, please consider carefully the estimates and comments of the other respondents.***
- ***If you wish to modify your projections and assumptions****:*
    - Enter your revised estimates in the tables provided and please state any reasons for changing your projections. Please understand, however, that we are most interested in what <u>you</u> believe is most likely, and we are not interested in trying to achieve a

consensus. If you find some estimates or comments simply off the mark, please consider only those that you believe are plausible and tell us why.

- If you would like to see how your changes affect your weighted NTG estimates, please write over your original responses in the first-round survey (which are included in the attached spreadsheet).

- ***If you <u>do not</u> wish to modify your projections or assumptions:***
  - For each set of estimates, mark the box labeled "No."
- ***The sections asking if you want to change your previous responses are 4.7, 5.8, and 6.1.***
- ***Please add any comments on the appropriateness of the other assumptions and comments listed.***
- ***Return your completed survey:***
  - Simply save your responses and email the document (kvontrapp@nmrgroupinc.com). Alternatively, you may fax or mail the document to us (Fax: 617-284-6239; Mailing address: NMR Group, Inc., 50-2 Howard St., Somerville, MA 02144).

2 Additional Information, Comments, and Questions

This section reiterates some information, provides some additional information, attempts to answer some of panelists' questions, and presents some of panelists' general comments without a response. Later sections summarize panelists' reasoning for their specific survey responses.

First, we want to reiterate that summaries of the various NTG studies may be found online: http://www.nmrgroupinc.com/delphi.html. Many questions asked by panelists are answered there.

Also, many of the comments focused on issues with specific NTG methods. We are aware that no one method can be considered definitive, which is why we have asked you and the other panelists to offer your expert judgments.

Question: *My one big question … has to do with past program impacts … It seems to me that we need a policy decision on whether past program impacts are reflected in NTGs. It further seems to me that the answer to that question hinges on what question we are trying to answer about NTGs. Is it "what was the marginal impact of this year's program"? If so, then past program impacts are irrelevant. Or is it "what is the five year impact of our CFL efforts" (or some other longer period)? If that is the question, then past year's program impacts would matter. How is this going to be resolved?*

Response: In the round one instrument, we attempted to explain this, but could have been much clearer and more explicit. We said "all methods estimate the NTG for a given program year or a few years, and do not attempt to calculate possible spillover from program activity to CFL sales in non-program states," and "we are asking for your assessment of the Massachusetts NTG estimates for 2009-2010 only, not for any other states or years." To put it in the panelist's terms, yes, we are looking for the marginal impact of this year's program, and past program impacts are irrelevant.

Comment: [*None of the methods*] *includes on-sites verification of pre and post conditions over time, or includes longer-term market monitoring and cause and effect testing with key informed market actors….CA market effects reports demonstrates clearly that there is no such thing as a local utility market. For example, NY purchases have been impacted by CA programs and market push efforts….Market effects, spillover, repeat purchases caused by the program and increased demand over the long term are not fully accounted.*

It is true that past activities in Massachusetts and other active states very likely did have an effect on current CFL sales in non-program states, and have thereby affected the baseline. To some extent, this may be reflected in some of the earlier NTG estimates for Massachusetts—i.e., 2.77 in 2006 and 2.15 in 2007 (see the "background data" tab in the round one instrument). These earlier NTG estimates, computed for single program years, already account for much of the cumulative savings from market effects and spillover in non-program states.

Moreover, the methods we used are not capable of estimating the long-term effects of the Massachusetts program on CFL markets in other states. We simply do not have the data to inform such an estimate; we do not know what has been happening in non-program states through the years—which speaks to the importance of establishing state-by-state data trends now for emerging technologies such as LEDs.

Comment: *Inasmuch as the MA program did not offer price discounts for standard spiral CFLs in 2010 except in stores serving hard-to-reach customers, when the respondents bought their CFLs would make a difference because respondents buying spiral CFLs in 2010 supposedly paid more than those buying them in prior years …. Therefore, the concept of NTG for spirals in 2010 is confusing.*

Response: It is true that the 2010 Massachusetts program provided upstream incentives for regular spiral CFLs only for channels identified as targeting "hard-to reach" (HTR) customers; these are low-income, ethnic, non-English-speaking, and less educated customers. The channels are discount stores, dollar stores, and small grocery stores. However, the program pays upstream actors for shipments, and the NTG methods are based on sales; many of the CFLs incentivized in 2009 were very likely still on the shelves and being sold in 2010.

Comment: *The first issue with the methodology of the data collection in the selection of in house visits. If one selects those homes that have recently purchased CFLs AND are willing to take part in the survey, these participants may already have a greater tendency to purchase ENERGY STAR and are part of a subset of Americans who will take the amount of time required to participate in an on-site survey. Without knowing the makeup of the sample population, it is difficult to assess the bias, but if the respondents are able to take the time for a survey and answer that they would be willing to pay more for CFLs, they may not be an accurate representative sample.*

Response: The homes were selected through an RDD (random-digit dial) telephone survey, supplemented in Massachusetts by a sample of cell-phone only households, and interviewing in Massachusetts was conducted in both English and Spanish. We recruited households for the on-site visit whether or not they had recently purchased CFLs, had any CFLs in the home, or even if they were aware of CFLs. We paid each householder $150 for completing an onsite in order to increase cooperation rates. We weighted the results to adjust for householder education and home ownership/renter status as estimated by the United States Bureau of the Census's 2006 to 2008 *American Community Survey*.

Comment: *None of the methods includes longer-term market monitoring*.

Response: That is true, but the data trends for Massachusetts, as partially shown in the "background data" tab, are much more complete than those available for many other program states, let alone non-program states. This is an issue that the energy efficiency industry needs to address collectively.

Comment: *It would have been very helpful to see state sales per household prior to MA entering into the programs so we could have seen some baseline trends.*

Response: As shown in the "background data" tab, Massachusetts has records of program-supported CFL sales going back to 1998, but has estimates of market-level sales going back only to 2005 (the first year that NMR became responsible for the evaluation). We agree that market-level sales per household going back to 1998 in Massachusetts—and preferably every other state in the U.S.—would have been extremely helpful, and might have allowed much more powerful modeling.

Comment: *I'd like to see the saturation numbers for specialty lamps in the homes.*

Response: In the 2010 Massachusetts in-home assessments, specialty bulbs of any kind filled 31% of all sockets, and specialty CFLs filled 7% of all sockets. Specialty bulbs include dimmable, three-way, tubes/bent tubes, flood shaped, candelabra shaped, globe shaped, bullet shaped, bug lights of any bulb type, and A-shaped CFLs.

Question: *Your Background Data document states that some of the methods should not be used for a 2009 NTG, yet all of your questions, including those involving these methods, require an estimate for 2009-2010. Did I miss something?*

Response: Some NTG estimation methods—Willingness to Pay, Conjoint/Pricing Elasticity Analysis, and Active Purchaser Revealed Preference—cannot estimate a NTG for 2009 because they are based on consumer responses in 2010. The Multistate Regression Model addressed 2009 and 2010 because study sponsors from various states were interested in different time periods; as it turned out, the 18-month model worked better than the 2010 model. We wanted to have a NTG estimate to cover the entire period, and are asking panelists to take these differences into account. We know it is difficult.

Comment: *With the extensive and complex mosaic of utility, government, and private sector efforts to influence consumer behavior toward things like purchase of CFLs, it is becoming a 'fool's errand' to try to identify net-to-gross levels for a single particular program. We need to start moving toward using total gross impact as the ultimate goal that all parties seek to attain, with at least some portion of recognition and incentive mechanisms structured accordingly.*

MA Willingness to Pay Assessment: Estimated NTG of 0.49 (Spiral CFLs only)

Question: *A willingness to pay study would be a good indicator of what percentage they were willing to pay at market prices as long as they have not yet received a coupon. I think if consumers have already received a coupon there could be a lot of downward price bias. Did this show up in the data?*

Response: The vast majority of program-supported sales in Massachusetts occurred through negotiated cooperative promotions, or agreements with upstream market actors, and discounts were reflected in the prices of CFLs on the shelves; buyers did not receive coupons.

MA Active Purchaser Revealed Preference: Estimated NTG of 0.37 (Spiral CFLs only)

Question: *What types of stores did this take place in (home improvement, grocery, hardware, a mix)?*

Response: There were 105 intercept interviews in total, including 9 in grocery stores, 12 in hardware stores, 17 in discount stores, 37 in mass merchandise stores, and 30 in home improvement stores.

MA/CA Multistate Regression Model: Estimated NTG of 0.45 (All CFLs)

Comment: *I'm confused by the question as it states that the approach yielded an NTG of 0.53, but the referenced cells say 0.45.*

Response: The correct figure is 0.45. This is the figure that was used in weighting the various methods. We apologize for the error.

Comment: *It is unclear why this is called the MA/CA model, when the description does not mention California. My only awareness of this methodology for California was in the CFL Market Effects, which did not estimate an NTG and failed to account for important factors such as the maturity of the market.*

Response: We refer to this as the MA/CA model only to suggest that it has been used in the past. The model did in fact produce a NTG for California for 2008 (a NTG of 0.23). As noted in the "net-to-gross methods" tab, the current model improves over the earlier model.

Question: *I am interested in the range of factors that were considered in the analysis. Are the evaluators confident that they identified all of the most important potential variables?*

Response: We made a best-faith effort to collect and analyze data that represent the most important variables. Budget, time, and data availability, however, limited our ability to explore *every* variable we would have preferred to include in the analysis (*e.g.*, price of CFLs in each market area, market share of CFLs versus all other lighting products, *etc.*). In reality, respondents exhibited a great deal of variability in when they self-reported buying the CFLs found in their homes. This variability contributes to a low maximum-likelihood R^2 and wide confidence intervals. Yet, we explored a wide range of variables that the literature and reviewers of various NTG estimation methods in Massachusetts and beyond have suggested may influence CFL purchase behavior. The table below lists the variables attempted in the purchase models, denoting whether they were statistically significant in the model ultimately recommended to the Program Administrators.

Independent Variables Attempted in Purchase Model	**In Final Purchase Model**	**Comment**
Program Characteristics - verified by clients as accurate before modeling began		
CFLs incented per household	Y	
CFL budget spent per household	N	
% of budget spent on incentives	N	

Independent Variables Attempted in Purchase Model	In Final Purchase Model	Comment
% of supported CFLs that were standard spiral	N	
Various combinations of these variables	N	Combining these variables attempted to capture the effects of multiple aspects of program activity, but none of the combination variables was significant in final models
Years supporting CFLs in any program	N	
Years supporting CFLs in an upstream program	N	
Prior program support - sum years supporting CFLs in any form and years supporting CFLs in upstream program	N	This variable is not significant in the final model presented.
History of CFL Use, Electricity Rates, and Payment of Electricity Bill		
CFL Saturation at the beginning of the time period; determined from CFLs found in the home and self-reported date of purchase	Y	
Electricity rate - EIA or utility records	N	This variable is not significant in the final model presented, but was found to be significant in alternative models presented to the clients; however, it behaved as a proxy variable for "East Coast" and "long-standing programs", showing a negative relationship with price as many households in these areas already used CFLs and didn't need to buy as many.
Duration of CFL Use - self-reported	N	
Pay own electricity bill - self reported	N	
Housing and Demographic Factors - self-identified by respondent unless otherwise noted		
Race	Y	
Size of Home	Y	
Respondent owns home	Y	
Unemployment at beginning of 2009 - Bureau of Labor Statistics	Y	
Satisfaction with Standard of Living	Y	
Education	N	
Income	N	
Ethnicity	N	
Language	N	
Number of people living in the home	N	
Change in unemployment from 2008 to 2009 - Bureau of Labor Statistics	N	
Environmental and Energy Opinions		

Independent Variables Attempted in Purchase Model	In Final Purchase Model	Comment
Various indicators of opinions about personal efficacy regarding energy conservation	Y	
Prioritization of the environment or the economy	N	
Various indicators of opinions about global warming	N	
Various indicators of opinions about energy scarcity, conservation	N	
Tendencies toward Early Technology Adoption		
Various indicators of early adopter behavior	N	These variables are not significant in the final model presented, but were found to be significant in alternative models presented to the clients
Influence of the Retail Market		
Purchase CFLs at various types of stores - self-reported	Y	Variables for individual stores performed best in the reported model; in alternative models, the variable for combined Warehouse, Mass Merchandise, and Home Improvement stores performed best.
Concentration of Various Big Box stores in county (square feet per household)	N	Determined from the websites of Home Depot, Lowes, Wal-Mart, and Menards (where applicable)
Distance (in time traveled) to nearest Big Box Store - self-reported	N	
Data Collection Variations		
Status as a "revisit" household, visited in 2009 and 2010	N	Some households took part in both the 2009 and 2010 efforts. This variable is not significant in the final model presented, but was found to be significant in alternative models presented to the clients
Treatment of "don't know" responses by onsite technician	N	Some technicians allowed "don't know" responses to questions about when CFLs were purchased; others did not. This variable is not significant in the final model presented, but was found to be significant in alternative models presented to the clients

Question: *Data from studies clearly demonstrated that residents were poor reporters of what was installed. Why should we believe that their recollection of mostly unplanned purchases of CFLs would be more accurate?*

Response: The self-report of purchase dates is one of the chief limitations of the study. We would prefer to have had accurate sales data, but they are not consistently available at a market level; in fact, many participating stores refuse to share sales data on non-supported CFLs. We

believe that asking respondents about purchases while they are looking at a CFL improves reporting, but by how much we cannot say with certainty. We do have evidence that is more accurate than estimates over the phone, as discussed in the multistate modeling report delivered early in 2010. This evidence includes a systematic tendency for respondents to report over the phone that they purchased more CFLs than when answering the same question onsite. The systematic nature of this tendency leads us to believe that the onsite purchase data, based on questions about individual bulbs as respondents walked around their homes, are the more accurate of the two. Moreover, among the 75 households visited both in 2009 and 2010, we found close correspondence between the two visits in the number of CFLs they self-reported as purchased and the change in the number of CFLs counted by trained technicians. Specifically, respondents said they had purchased 241 CFLs between the two visits, while the technicians counted a total of 228 new CFLs in the homes during the second visit.

Comment: *The final models do not include either the price of CFLs or the price of electricity. Models are almost certainly mis-specified, which may account for the low pseudo R-square.*

Response: We did use electricity rates in some models and the results indicated that the electricity price variable was a de facto proxy for East Coast and, therefore, long-standing program. The correlation was *negative*—meaning that CFL purchases were *lower* in places with *higher* electricity prices. Other models worked better than this one with electricity price and avoided the confusion of "East Coast" and "electricity price." Regarding prices for CFLs, we concur that it would be beneficial to test the behavior of this variable in the model. The primary reason we did not, however, is that most of the clients could not afford the in-store inventory work needed to collect prices for CFLs. Moreover, we have found both participating and non-participating stores to be reluctant to allow such work. This was a challenge for our own conjoint and revealed preferences work in MA, although, in the end, we were able to achieve a representative sample. The ability of this variable to improve the pseudo-R^2 is unknown, however. Work completed recently for the CPUC and the MA PAs (not reported here as it did not yield a NTG ratio) indicate that prices for CFLs do not vary that greatly between program and non-program areas. Program bulbs are, on average, still cheaper, but not as much as one might expect. Sales, other promotions, etc., often make the prices of CFLs in non-program areas comparable to those in program areas.

Comment: *The large confidence interval reported around this estimate from this approach is an indicator that these regression approaches have not yet been fine tuned enough to use in MA. My experience is that the results from these models are very sensitive to the variables one chooses to add to the regression and how one defines "strong" or "weak" existing CFL programs.*

The model is not fine-tuned to any one area but represents all of them; intervals are equally wide for other areas. The wide interval largely reflects the remaining uncertainty in the model, and that is a shortcoming. However, it also reflects the fact that the model is non-linear and based on probabilities. The typical linear assumptions about confidence intervals don't necessarily apply

here, although we cannot deny that we would prefer much tighter intervals even for a non-linear model.

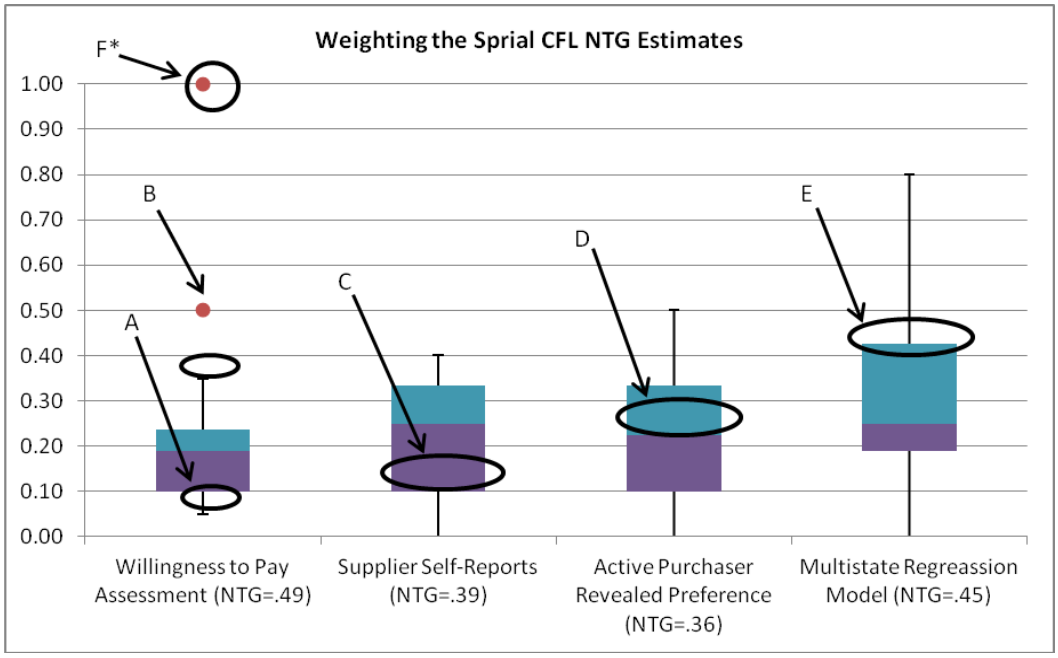
Comment: *The respondents could be asked if they have ever paid over X amount for a CFL which might give a good indication of whether or not they were program supported purchases.*

Response: Until a couple of years ago, we would have agreed that asking respondents the price they paid for a CFL and where they purchased it would help identify in-program purchases. In fact, we used this method successfully ourselves in work conducted in 2008. However, more recent work completed for the CPUC and the MA PAs (not reported here as the effort did not yield a NTG ratio) indicate that prices are not that different between program and non-program areas or stores. Programs bulbs, on average, are still cheaper, but not that much cheaper. For this reason, we no longer believe the method is as useful as it once was to identify program bulbs.

3 Overview of the Data Summary Figures: Box and Whisker Plots

We have summarized the numerical responses with a box and whisker plot, which is a way of graphically summarizing the distribution of a set of numerical data. Below is an example of a box and whisker plot for responses to question 9, the weighting scores given to the different NTG ratios for spiral CFLs only. The box plot identifies several key data points:

- The smallest response (the bottom whisker, labeled "A" in Figure 1)
- The largest response (the top whisker, labeled "B" in Figure 1)
- The first quartile response (the bottom of the box (red), labeled "C" in Figure 1)
- **The median response (the midpoint of the distribution, labeled "D" in Figure 1)**
- The third quartile response (the top of the box (blue), labeled "E" in Figure 1)
- In some cases, responses that are significantly larger or smaller than nearly all other responses are presented outside of the box plot (labeled "F" in Figure 1), and are not included in the median
- The box represents 50% of all responses (i.e., responses ranging from the first quartile to the third quartile)
- A smaller box, such as the box of responses attributing weights to the willingness to pay methodology, indicates that responses are clustered across a relatively small range
- A larger box, such as the box of responses attributing weights to the multistate regression methodology, indicates that responses are spread across a relatively large range

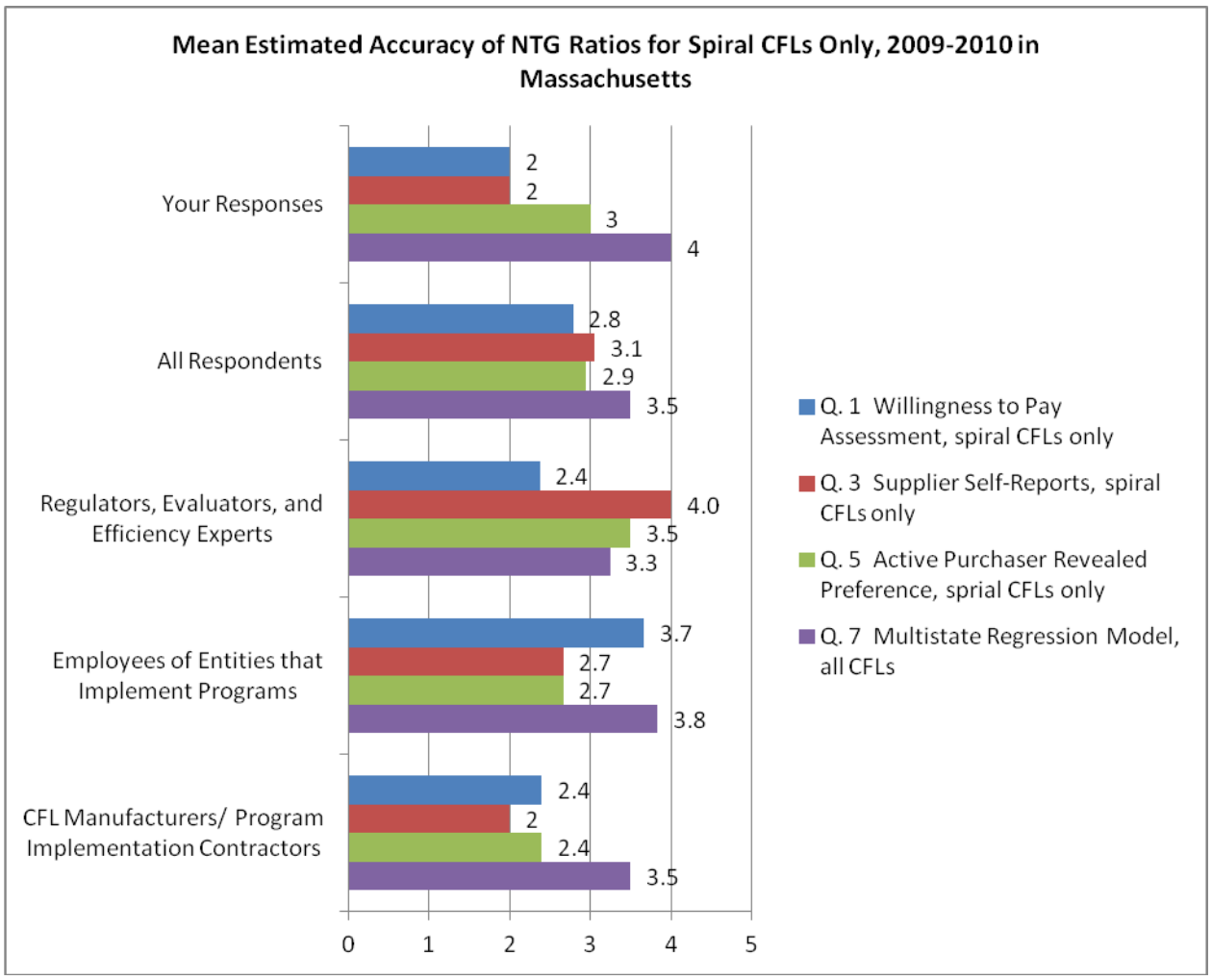


* Outliers were identified in SPSS, which flagged those values that were 1.5 times the interquartile range or greater.

4 Data Summary: Assessing the 2009-2010 NTG Estimates for Spiral CFLs

In this section, we present a summary of responses to questions pertaining to Massachusetts NTG estimates for spiral CFLs only. The following table and graph summarize these responses, after which we summarize respondents' reasoning for their ratings of each of the methods.

How accurate do you think these estimate are—that is, how well do you think they reflect the actual, underlying net-to-gross ratio in 2009-2010 in Massachusetts for spiral CFLs?					
SCALE: 1=Very inaccurate, 2=Somewhat inaccurate, 3=Neither accurate nor inaccurate, 4=Somewhat accurate, 5=Very accurate					
	CFL Manufacturers/ Program Implementation Contractors	**Employees of Entities that Implement Programs**	**Regulators, Evaluators, and Efficiency Experts**	**All Respondents**	**Your Responses**
Sample Size	*5*	*6*	*8*	*19*	
Q. 1 Willingness to Pay Assessment, *spiral CFLs only (NMR NTG estimate=0.49)*					
Mean	2.4	3.7	2.4	2.8	
Individual values	2, 2, 2, 2, 4	2, 4, 4, 4, 4, 4	1, 1, 2, 2, 2, 3, 4, 4,	1-4	2
Q. 3 Supplier Self-Reports, *spiral CFLs only (NMR NTG estimate=0.39)*					
Mean	2	2.7	4.0	3.1	
Individual values	1, 1, 2, 2, 4	1, 1, 2, 4, 4	3, 4, 4, 4, 4, 4, 4, 5	1-5	2
Q. 5 Active Purchaser Revealed Preference, *spiral CFLs only (NMR NTG estimate=0.37)*					
Mean	2.4	2.7	3.5	2.9	
Individual values	1, 2, 2, 3, 4	1, 2, 2, 3, 4, 4	2, 2, 3, 3, 4, 4, 5, 5	1-5	3
Q. 7 Multistate Regression Model, *spiral CFLs only (NMR NTG estimate=0.45)*					
Mean	3.5	3.8	3.3	3.5	
Individual values	2, 3, 4, 4, 4	3, 3, 4, 4, 4, 5	2, 2, 2, 4, 4, 4, 4, 4	2-5	4



4.1 MA Willingness to Pay Assessment: Estimated NTG of 0.49 (Spiral CFLs only)

Ratings of the accuracy of the willingness to pay method for spiral CFLs were mostly either somewhat accurate (8 out of 19 respondents) or somewhat inaccurate (8 out of 19). Across all categories, respondents cited the following issues with this method:

- Small sample size
- Absence of spillover
- No accounting for past program or market transformation effects
- Weakness of self-reporting

The most common concern with this method was the weakness of self-reporting and its dependence upon consumers' responses to hypothetical situations. Respondents reasoned that, due to a social desirability bias, consumers will report what they think the interviewer wants to hear, but their behavior may not follow expressed attitudes or intentions. As one panel member (from the regulator, evaluators and efficiency experts group) stated:

> *"A social desirability bias, especially with in-home, face-to-face inquiry, is likely to result in an inflated willingness to purchase spiral CFL bulbs at higher prices."*

CFL manufacturers and program implementation contractors were most likely to rate this method as somewhat inaccurate (4 out of 5 respondents), with one emphasizing the fact that the Massachusetts program is well established and, therefore, promotions and rebates are not likely to have a large impact on consumers' spiral CFL purchase decisions.

In contrast, employees of entities that implement programs were most likely to rate the program as somewhat accurate (5 out of 6 respondents). Respondents in this group said the willingness to pay estimate is a reasonable indicator for how well the program is doing in reaching its market and expressed a preference for the use of using multiple methodologies. One of them said:

> *"The effect of the program may be to increase the total number of lamps purchased, not just whether any lamp would be purchased or increase in quantity demanded per unit price versus increase in the CFL demand due to factors other than the price; So asking for willingness to pay for one lamp does not represent the program accurately. Additionally, asking the question in the absence of any true decision-making and not asking questions of people who had not purchased CFLs recently decrease the validity and perhaps underestimates the effect of the program. Also the NTG based on willingness to pay estimates for bare spiral is expected to e higher than for the specialty CFLs, yet the data methods produce lower estimates for specialty bulb, which is counter intuitive."*

The regulator/evaluator/efficiency expert group gave a wide range of accuracy ratings to this method. Some members from this group said that the hedonic pricing element was positive, while others said focusing only on price while omitting other key factors, such as advertising, was a weakness. One of them said the following:

> *"Willingness to pay estimation methods address one of many factors that affect net to gross estimates for CFL programs, price customer willing to pay for perceived value of lighting product and features. I prefer this method over some of the others because the primary objective for many of these programs is to reduce CFL prices, thus it makes sense to infer that if prices have dropped and customers report being more likely to buy CFLs at these lower price points, then the program has had a significant effect in increasing sales of this product. It is important to at least list all of the other factors that may affect net CFL purchases*

> *before reaching a decision on the relative contribution that price discounts or drops in CFL prices may have had on customer decisions. The other key factors in determining the likelihood of customers purchasing CFLS in the current year are likely to be: impact of mass media and advertizing practices, channel specific promotion policies, social norms about how and when to purchase light bulbs, and impact of word of mouth "advertizing" thru family members and influential neighbors. As a result I am only somewhat certain that these NTG estimates are accurate without an examination of the relative role of the other factors listed above."*

In contrast, another member of the regulator/evaluator/efficiency expert group said this:

> *"The approach uses a very unreliable willingness to pay approach and assumes that the rest is driven by econometric relationship between price and demand. We already know both of these approaches are exceptionally poor predictors. Willingness to pay approaches have already been largely rejected in our field as reliable and market and product barriers have more of an impact than price."*

4.2 MA Supplier Self-Reports: Estimated NTG of 0.39 (Spiral CFLs only)

Over one-half of the respondents (10 out of 19) rated the self-report method for spiral CFLs as somewhat or very accurate. Panel members mentioned the following strengths of this method:

- Accounting for non-residential sales controls for any upward bias
- Advantage in simplicity and face validity
- Retailers/Suppliers have a better idea of the market at the macro level

The following issues with this method were also cited:

- Absence of spillover
- No accounting for past program and non-program influence
- Manufacturer/Retailer bias when answering questions that may determine the fate of the program
- Low NTG

The most common concern with this method was that manufacturers' and retailers' responses will be inaccurate; trade allies may not have informed judgments about sales in the absence of the program, and could either exaggerate or underestimate effects, which could lead either to a

higher or a lower NTG. One panel member (an employee of an entity that implements programs) put it this way:

> *"Respondents may perceive an incentive to overstate the effect of the program to keep the program running. But an equally plausible scenario is that they perceive an incentive to understate the effect of the program to increase the perceived influence of the retailers themselves on the market."*

However, others said that manufacturer and retailer responses constitute a strength of this method. Respondents reasoned that retailers have a better idea of market behavior at the macro level and that asking people who have market experience provides a distinct advantage over other methods.

CFL manufacturers/program implementation contractors and employees of entities that implement programs assigned this method a wide range of accuracy ratings. The majority of regulator/evaluator/efficiency experts identified the program as somewhat or very accurate (7 out of 8 respondents). The respondent who rated this method as very accurate found it encouraging that a consensus had been attempted for manufacturers and high-level buyers and that the stocking and purchasing decisions of supply-side market actors are critical to bulb availability for consumers.

One of the employees of entities that implement programs said:

> *"Given the low Net to Gross number that was derived from this evaluation method, I believe that manufacturers and chain retailers were overly optimistic in their estimations of consumers' willingness to purchase CFLs absent MA EEPS CFL programs. The economic downturn, and the resulting reduction in CFL sales and increase in incandescent sales in 2010 makes one think that perhaps the good economic times prior to 2009 created a false sense of awareness of consumer behaviors."*

Another said the following:

> *"I do not think self-report bias is a major concern here. Your sample frame and range of cohort interviews mitigate any potential bias by weighting upstream and downstream players. Any survey research that relies on human response is vulnerable to threats to validity. This particular method has additional protection against that risk by robust sales tracking in both participant and non-participant markets. Accounting for non-residential sales also controls for any bias upwards. Although not expressing accounting for past program and non-program influence does add some threat to validity for capturing the underlying program effects, it can be managed by performing a meta-analysis of research methods that document a range of responses, and by the fact that the cohorts in this study may have provided some evidence of past program influence in their responses that can be teased out by further analysis. Overall, this is a strong study*

methodologically, and could be used alone, or in concert with other studies. Perhaps the only major weakness is the lack of a baseline comparison."

A member of the regulator/evaluator/efficiency expert group had this to say:

"The fact that a census was attempted for manufacturers and high level buyers is very encouraging. This is an interesting value in that it's one of the lowest NTGs of the methods used, even though these market actors have a predisposition towards the program continuing. With that in mind, you would expect a bias towards responses that would lead to an overly high NTG. While supply-side market actors are not the end-users of the product, their stocking and purchasing decisions are critical to bulb availability for consumers. Purchasing decisions around lighting are ultimately a result of both individual customer preferences and availability."

And another said this:

"It is important that this estimate includes commercial sales, since DIY stores now offer product variety and pricing sufficient to induce many small commercial buyers to purchase there instead of through electrical contractor/wholesale channels."

And another:

"I think it is almost impossible to get an unbiased estimate from suppliers about what the market would have done in the absence of the program. As a result I place more weight on customer responses, even given their biases."

And yet another:

"While supply-side market actors are not the end-users of the product, their stocking and purchasing decisions are critical to bulb availability for consumers. Purchasing decisions around lighting are ultimately a result of both individual customer preferences and availability."

One of the manufacturer/program implementation contractors said this:

"By taking the consumer entirely out of the picture, this approach seems flawed. Retailers can make assumptions based on past sales, but without consumer input it may be hard to determine the future of the market."

And another said this:

"These are phone interviews with individuals who don't have the actual data in front of them and don't have the time to compile the data even if they were inclined. Depending on who is being interviewed, that particular person often may not know or understand all of the dynamics of the program. The value based on this type of survey research is highly speculative."

4.3 MA Active Purchaser Revealed Preference: Estimated NTG of 0.37 (Spiral CFLs only)

Respondents gave a range of accuracy ratings to the active purchaser revealed preference method, with approximately one-quarter choosing somewhat accurate (5 out of 19 respondents), one-quarter choosing neither accurate nor inaccurate (4 out of 19), and one-quarter choosing somewhat inaccurate (5 out of 19). Across all categories, respondents cited the following issues with this method:

- Absence of spillover
- Small sample size
- Weakness of self-reporting and hypothetical questions
- Low NTG is counterintuitive
- Focuses only on price as a driver of decision-making

The most common concerns with this method were the small sample size and the inaccuracy of self-reporting. However, four out of eight regulator/evaluator/efficiency experts indicated that the method was either somewhat or very accurate. These respondents suggested that this method was not as hypothetical as the willingness to pay method and responses are more accurate when the customer has just made a purchase. As one member from this group stated:

> *"The active purchaser method involves less speculation on the part of respondents because they are interviewed within minutes to hours of the act of making a purchase. At this time customers are able to make what is probably a more realistic assessment of what motivated the purchase and if price changes would have caused a different outcome. This is the preferable method to me because we are asking customers within minutes of when they made a decision as opposed to months afterward and, as a result, is the best way of understanding what motivated customer purchase decisions and if the program directly or indirectly caused the purchase."*

CFL manufacturers/program implementation contractors and employees of entities that implement programs assigned a range of accuracy ratings to this method. Two respondents from the CFL manufacturers and program implementation contractors group suggested that this estimate should be used as an additional indicator or a guide for program design, but not as a stand-alone NTG ratio.

The following three comments came from members of the regulator/evaluator/efficiency expert group:

> *"This method assumes that CFL purchase behavior is driven entirely by price point."*
>
> *"The active purchaser method involves less speculation on the part of respondents, because they are interviewed within minutes to hours of the act of making a purchase. At this time customers are able to make what is probably a more realistic assessment of what motivated the purchase and if price changes would have caused a different outcome."*
>
> *"Econometric price models have not been shown to be reliable for CFLs."*

4.4 MA/CA Multistate Regression Model: Estimated NTG of 0.45 (All CFLs)

The majority of respondents rated the multistate regression model as somewhat accurate (12 out of 19 respondents). Respondents who preferred this method of the four options given reasoned that it was the most defensible model during the time period, and had the most robust methodology. Strengths citied for the multistate regression model included:

- A larger and more random sample
- Tries to account for many variables that affect the program, including past program activity
- Avoids social desirability bias

Across all categories, respondents cited the following issues with this method:

- Date of purchase accuracy is uncertain
- Erroneously treats non-program states as a baseline
- NTG estimate includes specialty CFLs, which should have a higher NTG than spiral CFLs

The most common concern with this method is that using non-program states as a control may no longer be reliable. As one member (from the employee of entities that implement programs group) stated:

> *"I question the comparison of "program states" to "non-program" states for the purpose of controlling for the presence and strength of existing CFL programs, as I believe that program states have had such a profound effect on the national CFL*

> *market that spillover from program states is now benefiting consumers in "non-program" states, essentially eliminating "non-program" states."*

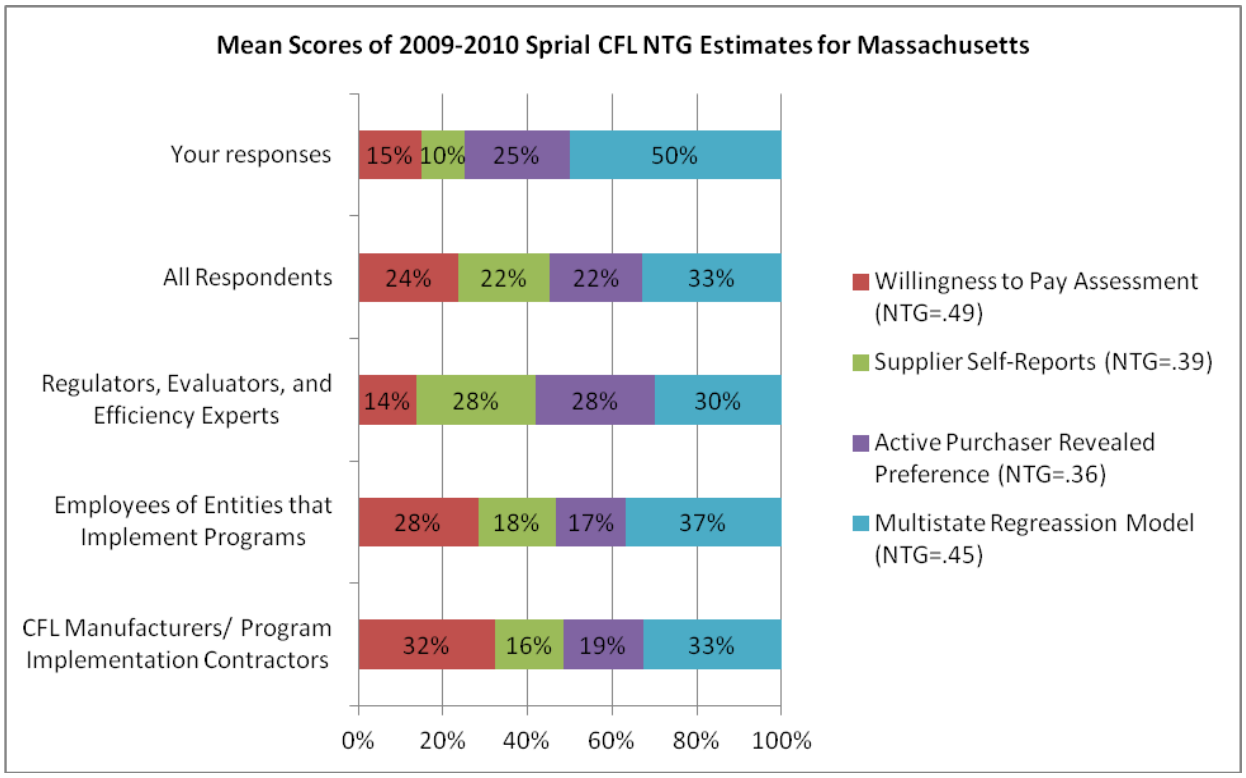
Three out of five respondents from the CFL manufacturer/program implementation contractor group, four out of six respondents from the employees of entities that implement programs group, and five out of eight respondents from the regulator/evaluator/efficiency expert group rated the multistate regression model as somewhat or very accurate.

Some of the other comments about this method are addressed in section 2 above.

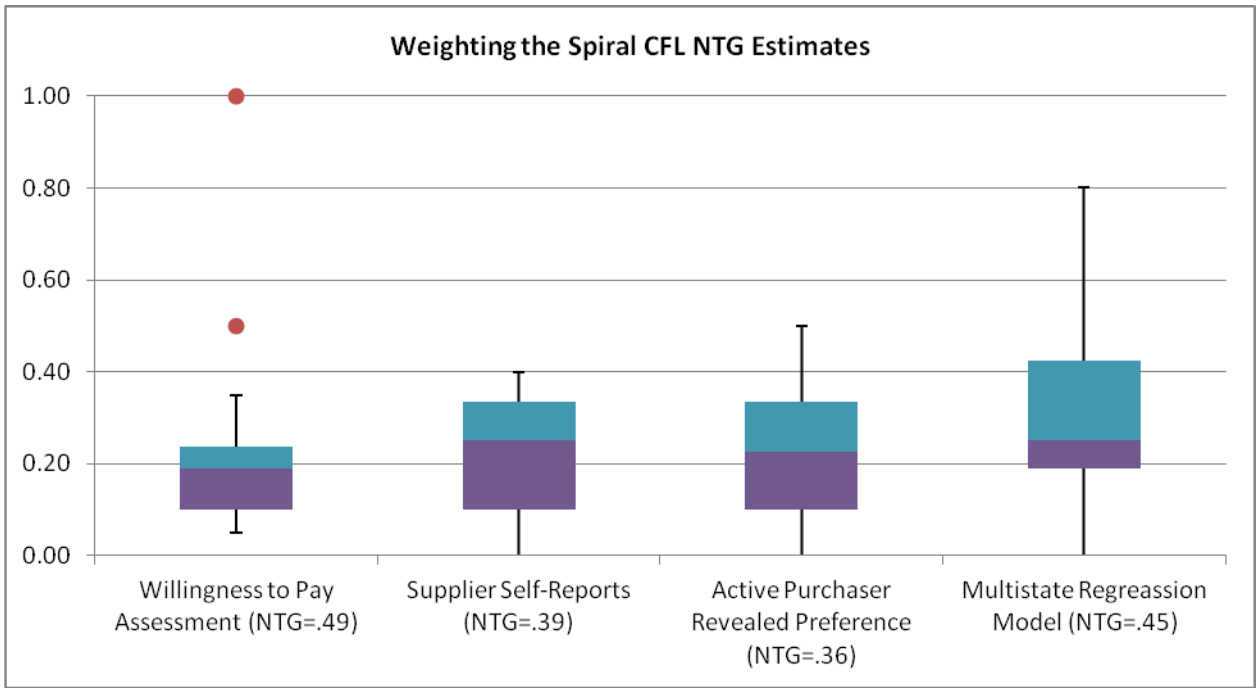
4.5 Weighting the 2009-2010 Estimates for Spiral CFLs

In this section, we present a summary of responses to questions pertaining to the weighting of the 2009-2010 Massachusetts NTG estimates for spiral CFLs. The following table and graph summarize these responses, after which we present respondents' reasoning for their weightings of each of the methods.

Q9. Please provide a score or weight of 0% to 100% for each of the 2009-2010 NTG estimates for Massachusetts, thinking about spiral CFLs only. The weight represents the relative importance you think each NTG estimate deserves compared to the others, for spiral CFLs only. The weights should sum to 100%.						
	CFL Manufacturers/ Program Implementation Contractors	**Employees of Entities that Implement Programs**	**Regulators, Evaluators, and Efficiency Experts**	**All Respondents**	**Your responses**	**Net-to-gross estimate (point estimates produced by the NMR studies)**
Willingness to Pay Assessment, *spiral CFLs only*						0.49
Mean	32%	28%	14%	24%	15%	
Median	22%	23%	10%	20%		
Individual values	10, 15, 18, 25, 25, 100%	20, 20, 20, 25, 35, 50%	5, 10, 10, 10, 10, 15, 20, 30%	0-100%		
Supplier Self-Reports, *spiral CFLs only*						0.39
Mean	16%	18%	28%	22%	10%	
Median	18%	18%	28%	25%		
Individual values	0, 0, 10, 25, 30, 33%	0, 0, 10, 25, 35, 40%	10, 20, 25, 25, 30, 35, 40, 40%	0-40%		
Active Purchaser Revealed Preference, *spiral CFLs only*						0.37
Mean	19%	17%	28%	22%	25%	
Median	23%	10%	33%	23%		
Individual values	0, 10, 20, 25, 25, 33%	0, 5, 10, 10, 25, 50%	10, 10, 20, 30, 35, 40, 40, 40%	0-50%		
Multistate Regression Model, *all CFLs*						0.45
Mean	33%	37%	30%	33%	50%	
Median	25%	33%	23%	25%		
Individual values	0, 16, 25, 25, 50, 80%	0, 15, 25, 40, 60, 80%	10, 20, 20, 20, 25, 40, 40, 65%	0-80%		



The following box-and-whisker plots represent 50% of all responses within the boxes as well as the smallest and largest weights given. Weights that were significantly larger than nearly all other responses are presented here as outliers.



Those panel members who explained the rationale behind the given weighted values said they based percentages on perceived accuracy, validity and/or the robustness of the results. One panel

member (from the employees of entities that implement programs group), however, felt that all of the methods could be seen as providing valid estimates and, therefore, had no specific reason to weight the methods differently from each other.

Respondents expressed a general belief that no one methodology is perfect as well as a general lack of confidence in the methods presented for spiral CFLs. Respondents noted that these methodologies allowed for neither the consideration of past program impacts nor the inclusion of other important motivators that influence the market.

Many suggested that it would be beneficial to rely on more than one method to give a better picture of overall NTG. One panel member (from the employees of entities that implement programs group) had the following recommendation:

> *"A meta-analysis, with appropriate weighting, would enhance the results and provide better guidance on the future effectiveness of continuing with the current program design."*

4.6 Developing a Single 2009-2010 NTG Estimate for Spiral CFLs

This section presents the weighted NTG estimates for respondents who accepted the results of the weighting, or the re-estimated NTG estimates for respondents who did not accept the results and provided estimates that they thought were more accurate.

One panel member (from the CFL manufacturers/program implementation contractors group) emphasized that the NTG estimates are all too low:

> *"In my opinion, CFLs have a NTG of .90 in the first 5 years that incentivized CFLs are available in almost every retail channel; for years 5 - 10 of the program, the NTG will drop to .75; and for years 10 – 15, it will drop to .50. An NTG of approximately .38 is, therefore, inaccurately low. Why? When you blend all types of retailers along with the reality that many of the new retailers in the program fit into the low income/discount retail channel, the NTG should be closer to .70 for spiral CFLs during this time period."*

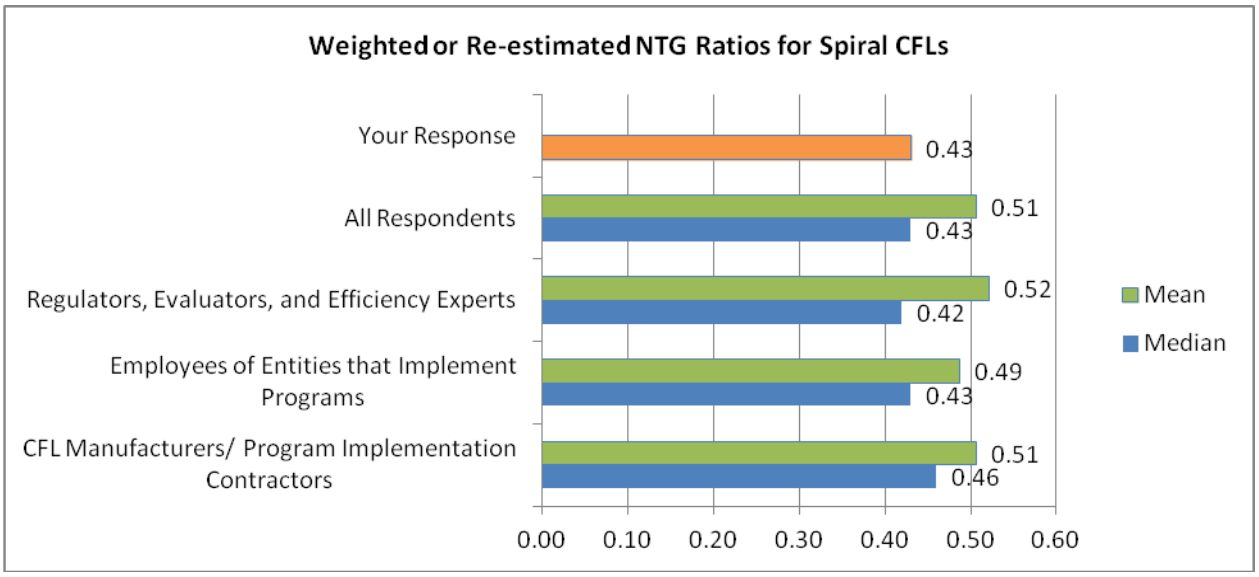
Others focused on the fact that they were not confident that spillover, the effects of prior programs, and other non-program influences were not included, which led to these respondents altering their NTG estimates. One outlier, a panel member from the regulator/evaluator/ efficiency expert group raised the NTG to 1.20, suggesting that the program was responsible for market-level sales 1.2 greater than the sales supported by the program in the 2009-2010 time period. The respondent justified the estimate as follows:

> *"Interviews with key market actors and with manufactures have indicated that the vast majority of market push efforts have been from utility programs, which have led to the diffusion of the innovation; a much better approach is a diffusion of*

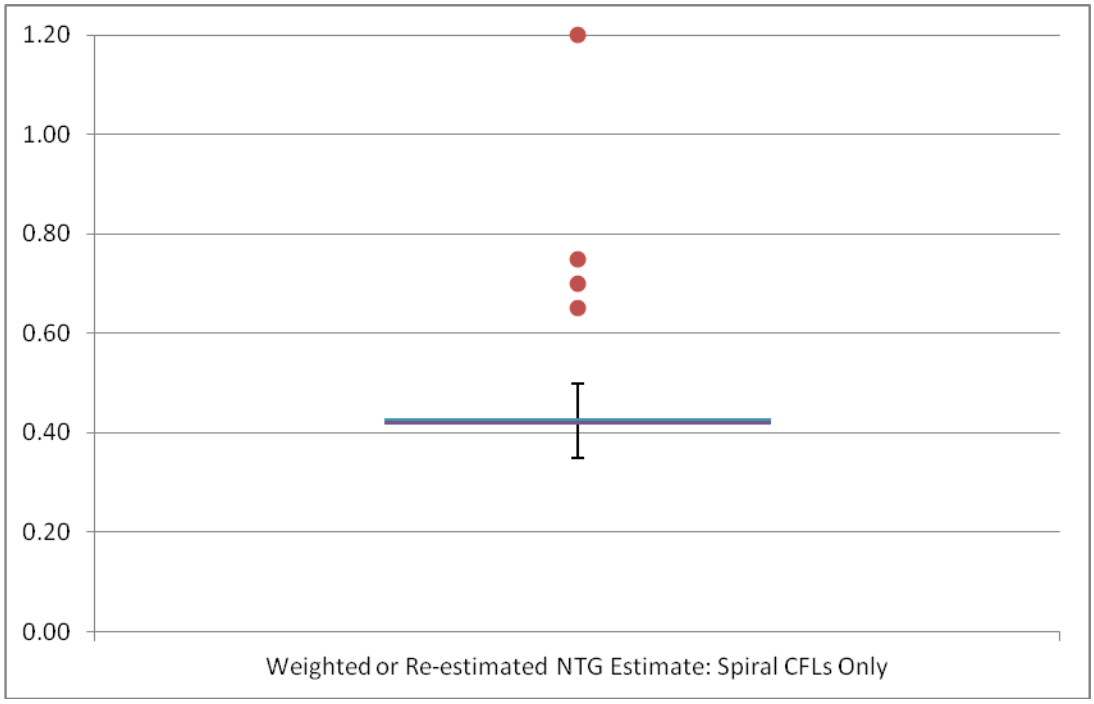
innovation approach because of the lateness and the large gaps in our market tracking and market push approaches."

The following graph shows the mean and individual estimates panel members gave after weighting or re-estimating the spiral CFLs NTG ratio; the table immediately following the graph display the means of the estimates only.

Weighted or Re-estimated NTG Ratios for Spiral CFLs					
	CFL Manufacturers/ Program Implementation Contractors	**Employees of Entities that Implement Programs**	**Regulators, Evaluators, and Efficiency Experts**	**All Respondents**	**Your responses**
Mean	0.51	0.49	0.52	0.51	0.43
Individual values	.35, .42, .43, .49, .65, .70	.42, .43, .43, .43, .46, .75	.39, .40, .41, .42, .42, .43, .50, 1.20	.35 - 1.20	



The following box-and-whisker plots represent 50% of all responses within the boxes as well as the smallest and largest weights given. Other than the four outliers, the estimates (16 out of 20) all fall within a fairly narrow range.



4.7 Re-examining First Round Responses

1. Now that you have reviewed the summary of estimates made by you and your fellow panel members, please review your own estimates below (shaded in green). If you do not want to modify your response, please indicate with an "**X**" in the appropriate box. If would you like to modify your original response, please indicate with an "**X**" in the appropriate box below and modify your response in the column to the right.

	Your Original Response	**Indicate X if you DO NOT want to modify your response**	**Indicate X if you DO want to modify your response**	**If yes, Enter New Responses Here**
OVERALL NTG FOR SPIRAL CFLs (Q11 OR Q12)				

2. Why did you modify (or not modify) your original responses?

Please type your response here:

3. How much confidence do you have in your own responses as well as the responses of the other panel members? In the table below, please use an "**X**" to indicate your level of confidence in the various groups' NTG estimates by using a scale from 0 to 10, where 0 means "not at all confident" and 10 means "extremely confident."

Estimates	**Not at All Confident (0)**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**Extremely Confident (10)**	**Don't Know**
Your Own												
CFL Manufacturers/ Program Implementation Contractors												
Employees of Entities that Implement Programs												
Regulators/Evaluators/Efficiency Experts												

4. Why did you give these ratings of your confidence in yours and other panel members' NTG estimates?

Please type your response here:

5. Do you have any additional thoughts or comments?

Please type your response here:

5 Data Summary: Assessing the 2009-2010 NTG Estimates for Specialty CFLs

In this section, we present a summary of responses to questions pertaining to Massachusetts NTG estimates for specialty CFLs only. The following table and graph summarize these responses, after which we present respondents' reasoning for their ratings of each of the methods.

Mostly, panel members expected higher NTG for specialty CFLs, and many thought all the estimates were too low. Most comments in section 4 (about spiral CFLs) also apply here.

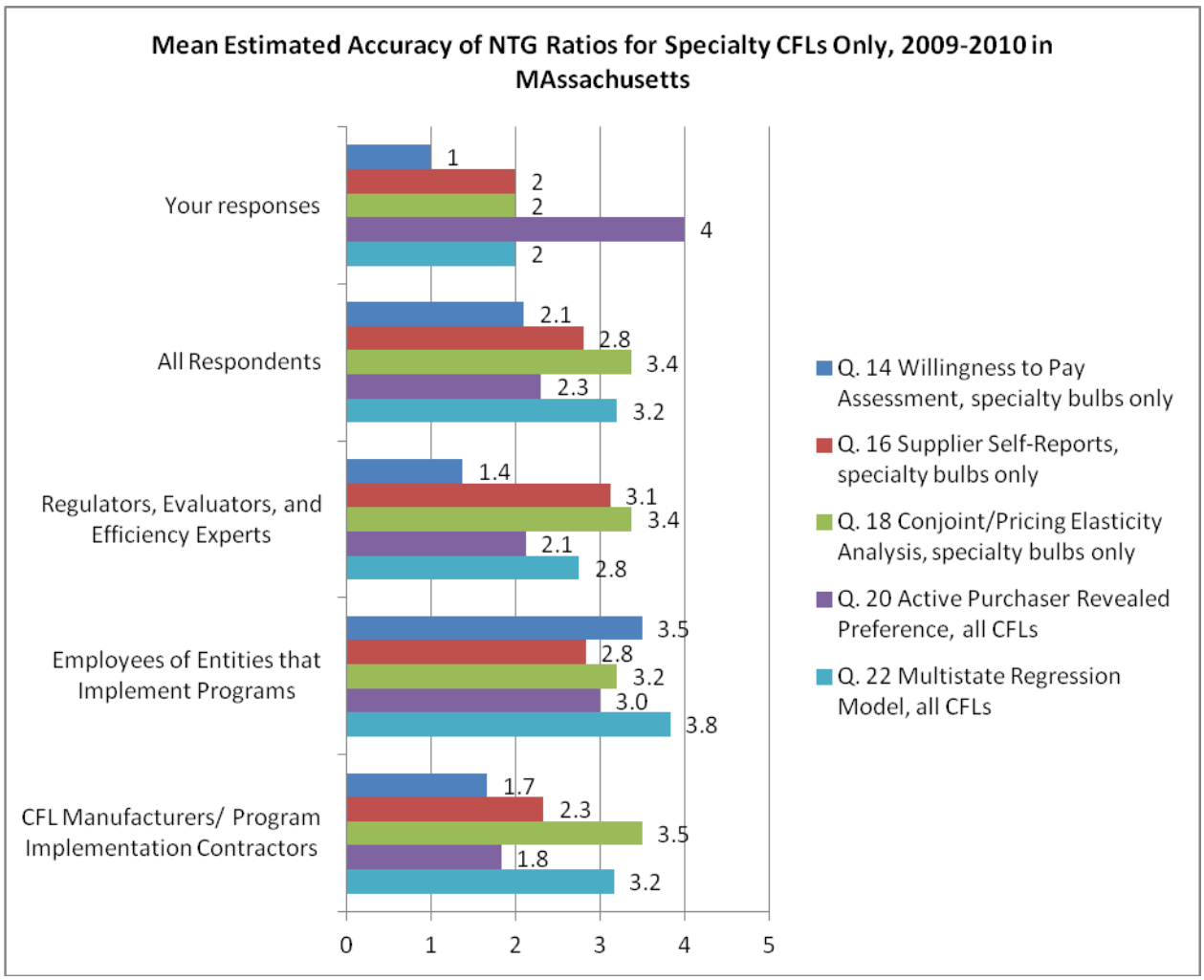
This is from a member of the regulator/evaluator/efficiency expert group:

> *"I believe the net to gross for specialty CFLs is significantly higher, given the short period of time utilities have been promoting them, the lower average availability in retail stores, and the much higher list price for which these products typically sell. Utility rebate amounts tend to be higher for these products as well, increasing the percentage effect the rebate can have on the purchase price. These products are also generally less likely to perform ideally in specialty applications than spiral CFLs do in general purpose applications, so it's reasonable to assume that utilities caused the majority of product sales in this category to occur."*

And from another:

> *"I feel much less comfortable with the NTG for specialty vs. basics because specialty is made up of so many different products."*

How accurate do you think these estimate are—that is, how well do you think they reflect the actual, underlying net-to-gross ratio in 2009-2010 in Massachusetts for specialty CFLs?					
SCALE: 1=Very inaccurate, 2=Somewhat inaccurate, 3=Neither accurate nor inaccurate, 4=Somewhat accurate, 5=Very accurate					
	CFL Manufacturers/ Program Implementation Contractors	**Employees of Entities that Implement Programs**	**Regulators, Evaluators, and Efficiency Experts**	**All Respondents**	**Your responses**
Sample Size	*6*	*6*	*8*	*20*	
Q. 14 Willingness to Pay Assessment, *specialty CFLs only (NMR NTG estimate=0.31)*					
Mean	1.7	3.5	1.4	2.1	
Individual values	1,1,1,1,2,4	1, 4, 4, 4, 4, 4	1, 1, 1, 1, 1, 2, 2, 2	1-4	1
Q. 16 Supplier Self-Reports, *specialty CFLs only (NMR NTG estimate=0.49)*					
Mean	2.3	2.8	3.1	2.8	
Individual values	1, 1, 2, 2, 4	1, 2, 2, 4, 4, 4	1, 3, 3, 3, 3, 4, 4, 4	1-4	2
Q. 18 Conjoint/Pricing Elasticity Analysis, *specialty CFLs only (NMR NTG estimate=0.59)*					
Mean	3.5	3.2	3.4	3.4	
Individual values	2, 3, 4, 4, 4, 4	2, 3, 3, 4, 4	3, 3, 3, 3, 3, 3, 4, 5	1-5	2
Q. 20 Active Purchaser Revealed Preference, *specialty CFLs only (NMR NTG estimate=0.36)*					
Mean	1.8	3.0	2.1	2.3	
Individual values	1, 1, 2, 2, 2, 3	2, 2, 3, 3, 4, 4	1, 1, 1, 2, 2, 2, 4, 4	1-4	4
Q. 22 Multistate Regression Model, *all CFLs (NMR NTG estimate=0.45)*					
Mean	3.2	3.8	2.8	3.2	
Individual values	1, 3, 3, 4, 4, 4	3, 3, 4, 4, 4, 5	1, 2, 2, 3, 3, 3, 4, 4	1-5	2



5.1 MA Willingness to Pay Assessment: Estimated NTG of 0.31 (Specialty CFLs)

Half of the respondents rated the accuracy of the Willingness to Pay method for specialty CFLs as very inaccurate (10 out of 20 respondents), while six out of twenty respondents rated this method as somewhat accurate. The following issues with this method were reported:

- Small sample size
- Absence of spillover
- Weakness of self-reporting
- Low NTG is counterintuitive

The most common concern with this method was the fact that this NTG estimate was too low, especially that it was lower than any of the NTG estimates for spiral CFLs. Respondents reasoned that, for expensive, premium products like specialty CFLs, consumers are extremely sensitive to price. Consumers tend to avoid purchasing specialty CFLs for numerous reason, including the fact that there are numerous substitutes, resulting in an inelastic demand curve. Therefore, program price support plays a major role in purchases of these bulbs and drives capacity development, which would result in a higher NTG estimate. Additionally, panel members emphasized the fact that the market for specialty CFLs is less mature that for spiral CFLs. As one panel member (from the CFL manufacturers/program implementation contractors group) stated:

> *"There are many reasons why consumers resist specialty CFLs. The 50-100-159 3-ways are too bulky to fit in most floor and table lamp shade harps; candelabras don't provide the sparkle that homeowners like in chandeliers and suspended fixtures; some dimmables don't work with incandescent rheostats and they're not as "responsive" as incandescents in ordinary dimming switches. Floods are limited by size. Most are more expensive than standard spirals. Therefore, I believe program price supports play a major role in purchases of specialty CFLs. I'd give specialties alone a high NTG."*

The majority of panel members from the CFL manufacturer/program implementation contractor group (5 out of 6 respondents) and the regulator/evaluator/efficiency expert group (8 out of 8) were most likely to rate this method as either somewhat or very inaccurate. However, the majority of panel members from the employees of entities that implement programs (5 out of 6) rated this method as somewhat accurate. These respondents emphasized the strengths of this method, including that it was based on sound economics, surveying recent purchasers of specialty CFLs, and bolstering the consumer survey with a shelf-stocking survey and hedonic pricing analysis. Others suggested that the willingness to pay method has the potential to provide insight into the effects of the program and could be used as an indicator of how well the program is doing.

5.2 MA Supplier Self-Reports: Estimated NTG of 0.49 (Specialty CFLs only)

Two-fifths of respondents rated the multistate regression model as somewhat accurate (8 out of 20 respondents), while two-fifths rated it as somewhat or very inaccurate (8 out of 20), and the remaining fifth rate it as neither accurate nor inaccurate (4 out of 20).

Respondents from the CFL manufacturer/program implementation contractor group and the employees of entities that implement programs group gave varied ratings for this method, while seven out of eight respondents from the regulator/evaluator/efficiency expert group rated the multistate regression model as neither accurate nor inaccurate or somewhat accurate. One-half of

this group expressed the belief that suppliers are likely to have a better understanding of the market than consumers and would have a better idea of what would have been sold in the absence of the program. Others felt that this method was more reasonable than willingness to pay and more appropriate to use for specialty bulbs than for spirals.

On the other hand, members across all categories reported the following issues with this method:

- Absence of spillover
- Low NTG is counterintuitive
- Weakness of retailers/manufacturer self-reporting
- Weakness of retailers/manufacturer understanding of market

The most common concern with this method was the uncertainty of the results due to its dependence upon responses from retailers and manufacturers. While some respondents felt that these people would be more familiar with the market, others felt that retailers and suppliers could misinterpret consumer behavior and perceptions. As one panel member (from the regulator/evaluator/efficiency expert group) stated:

> *"Customer preferences for new specialty products are really beyond the experience of most suppliers to accurately predict what would have happened in the market, suggesting that this [NTG] result is highly uncertain."*

Additionally, as respondents pointed out with this method for spiral CFLs, suppliers may perceive and incentive to either over or understate program effects. Panel members again found it counterintuitive that this NTG estimate was lower than any of the spiral CFL NTG estimates; many reiterated the difficulty that specialty CFLs have had breaking into the market and that program price support plays an important role in consumers purchasing decisions. As one panel member (from the CFL manufacturer/program implementation contractor group) confirmed:

> *"Historic sales volumes for specialty CFLs in the absence of incentives are negligible; therefore, any significant sales volume should be attributed to the program and the aggregate impact of all North American efficiency program incentives for the products."*

5.3 MA Conjoint/Pricing Elasticity Analysis: Estimated NTG of 0.59 (Specialty bulbs)

The majority of respondents rated the conjoint/pricing elasticity analysis model as neither accurate nor inaccurate (9 out of 20 respondents) or somewhat accurate (7 out of 20), in addition to one who rated it as very accurate. Strengths citied for this model included:

- Large sample size
- Hedonic pricing analysis
- Based on sound economics
- More realistic/expected NTG estimate

Respondents across all categories expressed the fact that this NTG estimate is closer to what was expected and the method itself is more akin to real-world decision making. As one panel member (from the regulator/evaluator/efficiency expert group) expressed:

> *"The value this methodology yields is more typical of those seen with spiral CFLs earlier in their program promotion cycle - an analogue for where specialty products are now."*

Additionally, respondents felt that this method could be a useful tool to obtain speculative answers and to forecast next year's NTG if consumers have never purchased a CFL. Respondents also cited the following issues with this method:

- Weakness of self-reporting
- Limited number of types of specialty bulbs included
- Not built on a strong understanding of the market

A common concern with this method, expressed mostly by panel members from the regulator/ evaluator/efficiency expert group was the fact that only a few types of specialty CFLs were addressed and expressed a worry that NTGs may be different for different products. Other respondents found conjoint analysis difficult without a good understanding of the market and that this estimation did not include some key barriers and market conditions that impact adoption. In addition, one panel member (from the employees of entities that implement programs group) articulated:

> *"Although the final composite NTG seems more realistic from an intuitive perspective, I am concerned that it is not supported by the other studies. NTGs for specialty CFLs would probably benefit from further analysis of the current studies."*

The majority of respondents from the CFL manufacturer/program implementation contractor group rated this method as somewhat accurate (4 out of 6 respondents). Respondents from the employees of entities that implement programs group gave a range of ratings and six out of eight respondents from the regulator/evaluator/efficiency expert group rated the multistate regression model as neither accurate nor inaccurate.

The following are comments from members of the regulator/evaluator/efficiency expert group:

> *"The methodology is robust and the value it yields is more typical of those seen with spiral CFLs earlier in their program promotion cycle - an analogue for where specialty products are now."*
>
> *"I remain concerned that this approach ultimately focuses exclusively on price, whereas (as noted above) the program impacts consumers in ways other than price."*
>
> *"The controlled study environment does not reflect the typical consumer's actual purchase decision."*
>
> *"Conjoint combined with pricing results is a robust for estimating program-induced sales. Also, by asking respondents to choose among different products with varying characteristics, conjoint avoids directly asking the question, "What are you willing to pay?," and is closer to real-world decision making. Avoiding the willingness to pay questions makes the responses more credible - at least for the bulbs covered."*
>
> *"Conjoint analysis is very difficult to pull off unless there is a good understanding of the different amenities offered by alternative products. I don't think there is enough experience yet with attributes of specialty bulbs to perform an accurate conjoint analysis. However I did think this analysis was very useful in determining the efficiency of the program design in actually reducing prices to customers after rebates. I particularly support the following finding from the report, which suggest rebates alone might not be the best strategy for specialty bulbs. Conjoint study page 22. "These (specialty) CFLs may have realization rates less than one because retailers had more power to choose the prices of these specialty products than the prices of standard, twister-spirals. Thus, retailers would have been able to keep a larger share of the PA incentives."*

And this from an employee of an entity that implements programs:

> *"The conjoint / pricing elasticity is based on sound economics. The hedonic price equations for both spiral and the two types of specialty CFLs work well. The conjoint part of the analysis has a sample size of 300, so this is a plus."*

5.4 MA Active Purchaser Revealed Preference: Estimated NTG of 0.31 (Specialty CFLs only

More than one-half of respondents rated the active purchaser revealed preference model as somewhat or very inaccurate (13 out of 20 respondents). Within each category, panel members gave a range of ratings. Issues cited for this model included the following:

- Small sample size
- Weakness of self-reporting
- Low NTG is counterintuitive
- Focus on price only

Respondents expressed issues with this method similar to those that have arisen in other methods, including the fact that the NTG estimate does not support program theory or intuitive reasoning. One panel member (from the regulator/evaluator/efficiency expert group) summed up the concerns as follows:

> *"This method relies on very hypothetical responses in a situation laden with potential social desirability bias, ignores the effects of prior program years, which could be considerable, assumes that CFL purchase behavior is driven entirely by price point and the sample size is very small."*

However, other respondents felt that the fact that the survey was given at the time of sale, that all specialty CFLs were targeted, and that it was based on revealed preferences of purchasers added value to this methodology. Some panel members suggested using this method as a qualitative reference source or an additional indicator.

A member of the regulator/evaluator/efficiency expert group had this to say:

> *"I have much less confidence in this method regarding specialty bulbs, because of the reduced familiarity. If the customers were in the act of purchasing specialty fluorescents as well as specialty incandescents, I would be somewhat less concerned."*

And a manufacturer/implementation contractor said this:

> *"The method of using the difference in two model-predicted outcomes with an actual outcome without adjusting the predicted outcomes based on the one predicted-to-actual ratio available is a (minor) problem. Two-thirds of the gross sales predictions of this model under-predicted the actual count. This suggests the actual NTGs should be a bit higher."*

5.5 MA/CA Multistate Regression Model: Estimated NTG of 0.45 (All CFLs)

The majority of respondents rated the multistate regression model as neither accurate nor inaccurate (7 out of 20 respondents) or somewhat accurate (8 out of 20). Respondents who preferred this method of the four options given reasoned that it included more information than other methods, had a smaller error associated with it than the willingness to purchase survey, and was a reasonably sophisticated model. Strengths citied for the multistate regression model included:

- Potentially accurate NTG estimate
- Tries to account for many variables that affect the CFL market, including past program activity
- Avoids social desirability bias and small sample issues

Panel members expressed a desire for more detail about this methodology, stating that this NTG estimate had the potential to be accurate if all appropriate explanatory variables were included, but more information would be necessary to be able to determine this. Across all categories, respondents mentioned the following issues:

- Erroneously treats non-program states as a baseline
- Low NTG was counterintuitive
- Including specialty and spiral CFLs in one NTG

While one respondent felt that a low NTG ratio for spirals would be balanced by a higher one for specialty CFLs allowed the final estimate to be in the ballpark of the actual NTG, others felt differently about including both types in a single estimation. As one panel member (from the regulator/evaluator/efficiency expert group) explained:

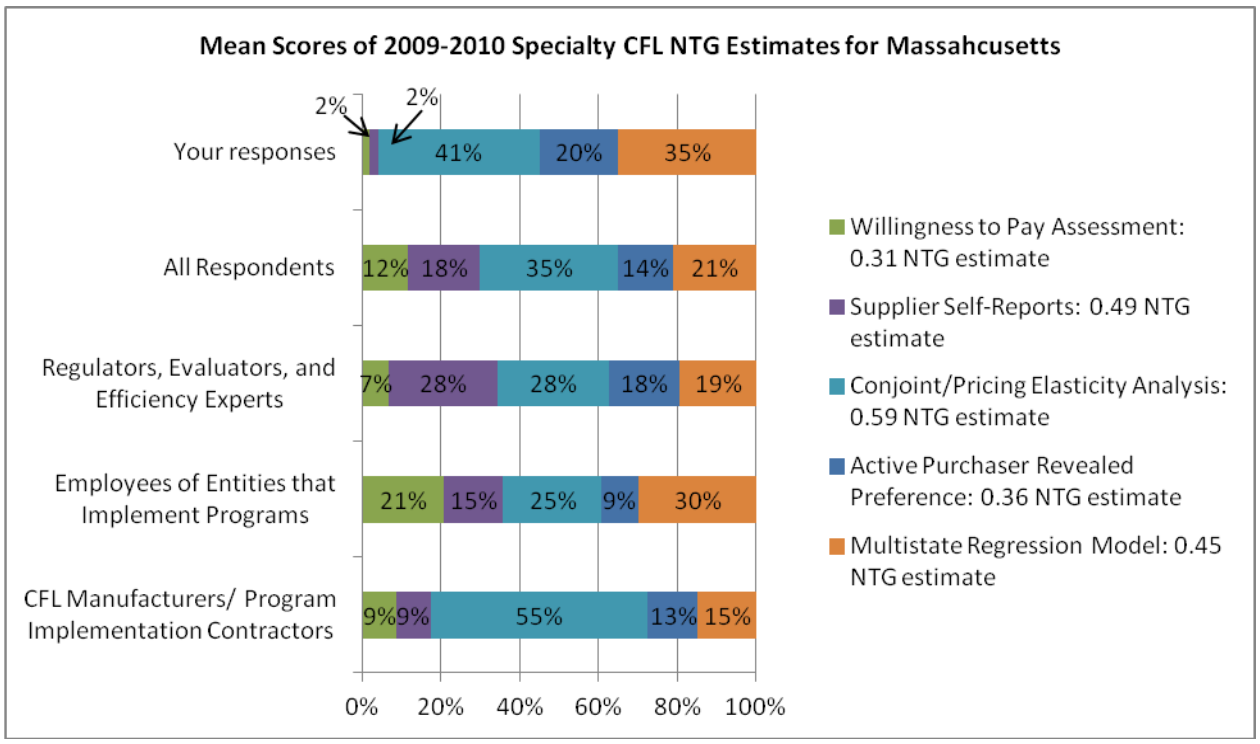
> *"By definition, the multistate model tries to estimate NTG for all bulbs, not specialty CFLs alone. As such this analysis cannot take into account differences in marketing and customer decision making for specialty bulbs. Specialty bulbs are closer to being perceived by customers as a service than a commodity like spiral CFLs."*

One-half of respondents from the CFL manufacturer/program implementation contractor group (3 out of 6 respondents) rated the multistate regression model as somewhat accurate; four out of six respondents from the employees of entities that implement programs group rated this method as either somewhat or very accurate. Five out of eight respondents from the regulator/evaluator/ efficiency expert group rated the multistate regression model as neither accurate nor inaccurate or somewhat accurate.

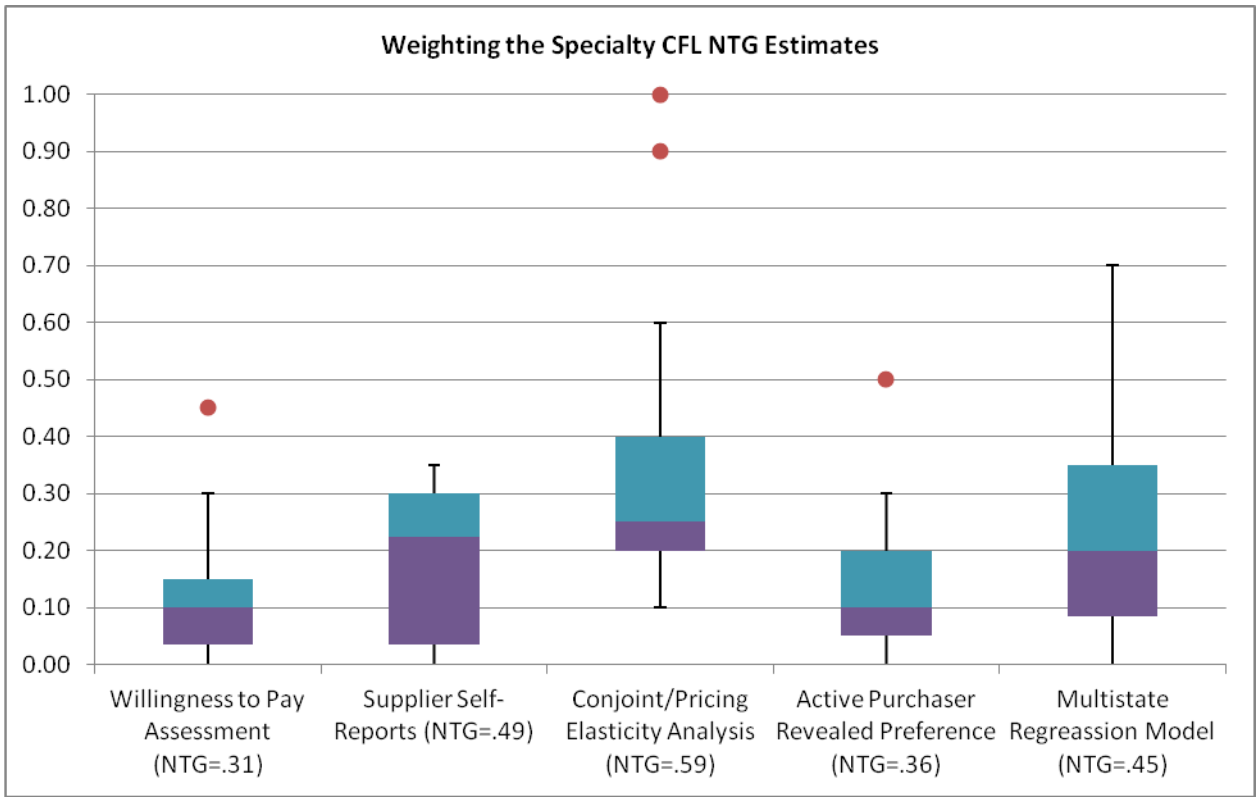
5.6 Weighting the 2009-2010 NTG Estimates for Specialty CFLs

In this section, we present a summary of responses to questions pertaining to the weighting of the 2009-2010 Massachusetts NTG estimates for specialty CFLs. The following table and graph summarize these responses, after which we present respondents' reasoning for their weightings of each of the methods.

	CFL Manufacturers/ Program Implementation Contractors	Employees of Entities that Implement Programs	Regulators, Evaluators, and Efficiency Experts	All Respondents	Your responses	Net-to-gross estimate (point estimates produced by the NMR studies)
Willingness to Pay Assessment, *specialty bulbs only*						0.31
Mean	9%	21%	7%	12%	2%	
Median	6%	20%	8%	10%		
Individual values	0, 1, 2, 10, 20, 20%	0, 10, 20, 20, 30, 45%	0, 5, 5, 5, 10, 10, 10, 10%	0-45%		
Supplier Self-Reports, *specialty bulbs only*						0.49
Mean	9%	15%	28%	18%	2%	
Median	3%	13%	30%	23%		
Individual values	0, 0, 2, 4, 20, 25%	0, 0, 5, 20, 30, 35%	10, 25, 25, 30, 30, 30, 35, 35%	0-35%		
Conjoint/Pricing Elasticity Analysis, *specialty bulbs only*						0.59
Mean	55%	25%	28%	35%	41%	
Median	51%	20%	30%	30%		
Individual values	20, 20, 41, 60, 90, 100%	10, 15, 20, 20, 30, 55%	10, 10, 20, 30, 30, 40, 40, 40%	10-100%		
Active Purchaser Revealed Preference, *all CFLs*						0.36
Mean	13%	9%	18%	14%	20%	
Median	15%	10%	15%	10%		
Individual values	0, 1, 10, 20, 20, 25%	0,5, 10, 10, 10, 20%	0, 5, 5, 10, 20, 25, 30, 50%	0-50%		
Multistate Regression Model, *all CFLs*						0.45
Mean	15%	30%	19%	21%	35%	
Median	15%	28%	15%	20%		
Individual values	0, 4, 10, 20, 20, 35%	0, 15, 20, 35, 40, 70%	0, 0, 10, 10, 20, 25, 40, 50%	0-70%		



The following box-and-whisker plots represent 50% of all responses within the boxes as well as the smallest and largest weights given. Weights that were significantly larger than nearly all other responses are presented here as outliers.



Those panel members who explained the rationale behind the given weighted values expressed basing percentages on perceived accuracy of the results. One panel member (from the regulator/evaluator/efficiency expert group) described

> *"It seemed reasonable to give the majority of the weight to the studies that were done specifically on the specialty products, with the exception of the first one, whose estimate is implausibly low."*

Respondents again expressed a general belief that no one methodology was a perfect estimate of NTG, that using more than one method would be useful, and that more details on each may have changed the weights given to some methods. One panel member expressed a lack of comfort with an NTG for specialty CFLs since this category is made up of so many different products.

5.7 Developing a Single 2009-2010 NTG Estimate for Specialty CFLs

This section presents the weighted NTG estimates for respondents who accepted the results of the weighting, or the re-estimated NTG estimates for respondents who did not accept the results and provided estimates that they thought were more accurate.

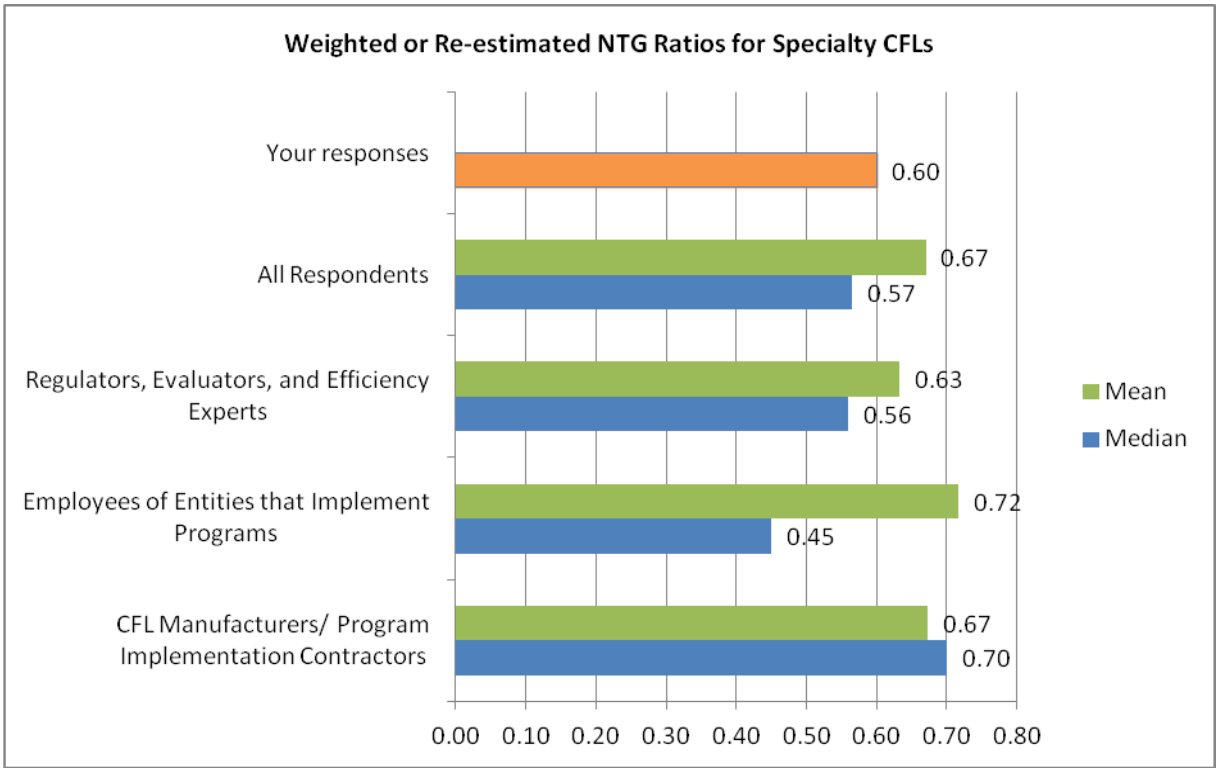
Those respondents who changed the final NTG estimate for specialty CFLs all increased the ratio reiterating that the true net effects are likely higher than for spirals. One panel member (from the employees of entities that implement programs group) gave a final estimate of 2.00, explaining that:

> *"Specialty CFLs are relatively new to the market, and consumer awareness of this class of CFLs is still growing. Energy Efficiency Program Sponsors are having tremendous impacts in this market with their Specialty CFL promotion by raising awareness through marketing and retail events, increasing product availability, achieving better merchandising through end caps displays at retail, and significant price reductions throughout the application of mid-stream incentives. All of these actions result in a high net-to-gross and considerable spillover effects."*

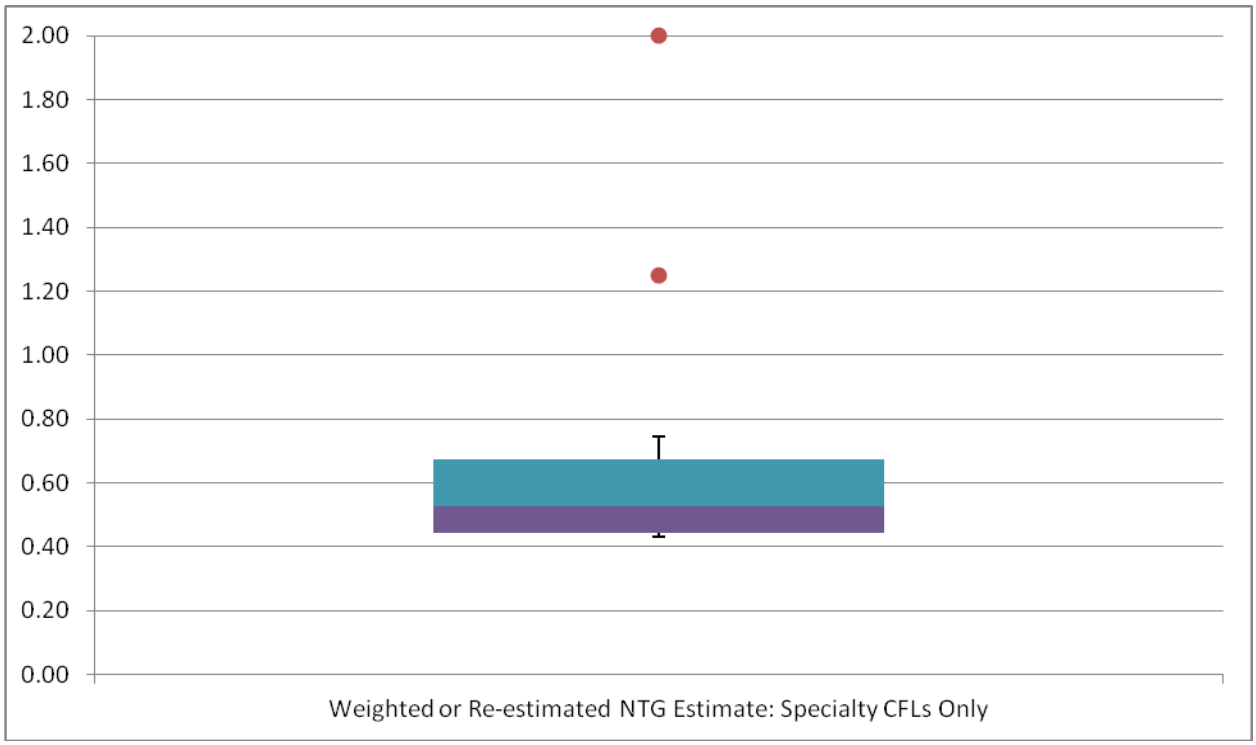
Another panel member (from the regulator/evaluator/efficiency expert group) suggested that a point estimate for specialty bulbs would be too precise and recommended reporting a range of NTG ratios instead, especially if the is it being used to assess program cost effectiveness or to adjust electricity forecasts for program or measure effects.

The following graph shows the mean and individual estimates panel members gave after weighting or re-estimating the specialty CFLs NTG ratio; the table immediately following the graph display the means of the estimates only.

Weighted or Re-estimated NTG for Specialty CFLs					
	CFL Manufacturers/ Program Implementation Contractors	**Employees of Entities that Implement Programs**	**Regulators, Evaluators, and Efficiency Experts**	**All Respondents**	**Your Responses**
Mean	0.67	0.72	0.63	0.67	0.60
Median	0.70	0.45	0.56	0.57	
Individual values	.44, .60, .70, .70, .70, .90	.43, .44, .44, .46, .53, 2.00	.44, .45, .50, .52, .60, .60., 70, 1.25	.43-2.00	



The following box-and-whisker plots represent 50% of all responses within the boxes as well as the smallest and largest weights given. Other than the two outliers, the estimates (18 out of 20) all fall within the same range, although not as narrow a range as with spiral CFLs.



5.8 Re-examining First Round Responses

1. Now that you have reviewed the summary of estimates made by you and your fellow panel members, please review your own estimates below (shaded in green). If you do not want to modify your response, please indicate with an "**X**" in the appropriate box. If would you like to modify your original response, please indicate with an "**X**" in the appropriate box below and modify your response in the column to the right.

	Your Original Response	**Indicate X if you DO NOT want to modify your response**	**Indicate X if you DO want to modify your response**	**If yes, Enter New Responses Here**
OVERALL NTG FOR SPIRAL CFLs (Q26 OR Q27)				

2. Why did you modify (or not modify) your original responses?

Please type your response here:

3. How much confidence do you have in your own responses as well as the responses of the other panel members? In the table below, please use an "**X**" to indicate your level of confidence in the various groups' NTG estimates by using a scale from 0 to 10, where 0 means "not at all confident" and 10 means "extremely confident."

Estimates	**Not at All Confident (0)**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**Extremely Confident (10)**	**Don't Know**
Your Own												
CFL Manufacturers/ Program Implementation Contractors												
Employees of Entities that Implement Programs												
Regulators/Evaluators/Efficiency Experts												

4. Why did you give these ratings of your confidence in yours and other panel members' NTG estimates?

Please type your response here:

5. Do you have any additional thoughts or comments?

Please type your response here:

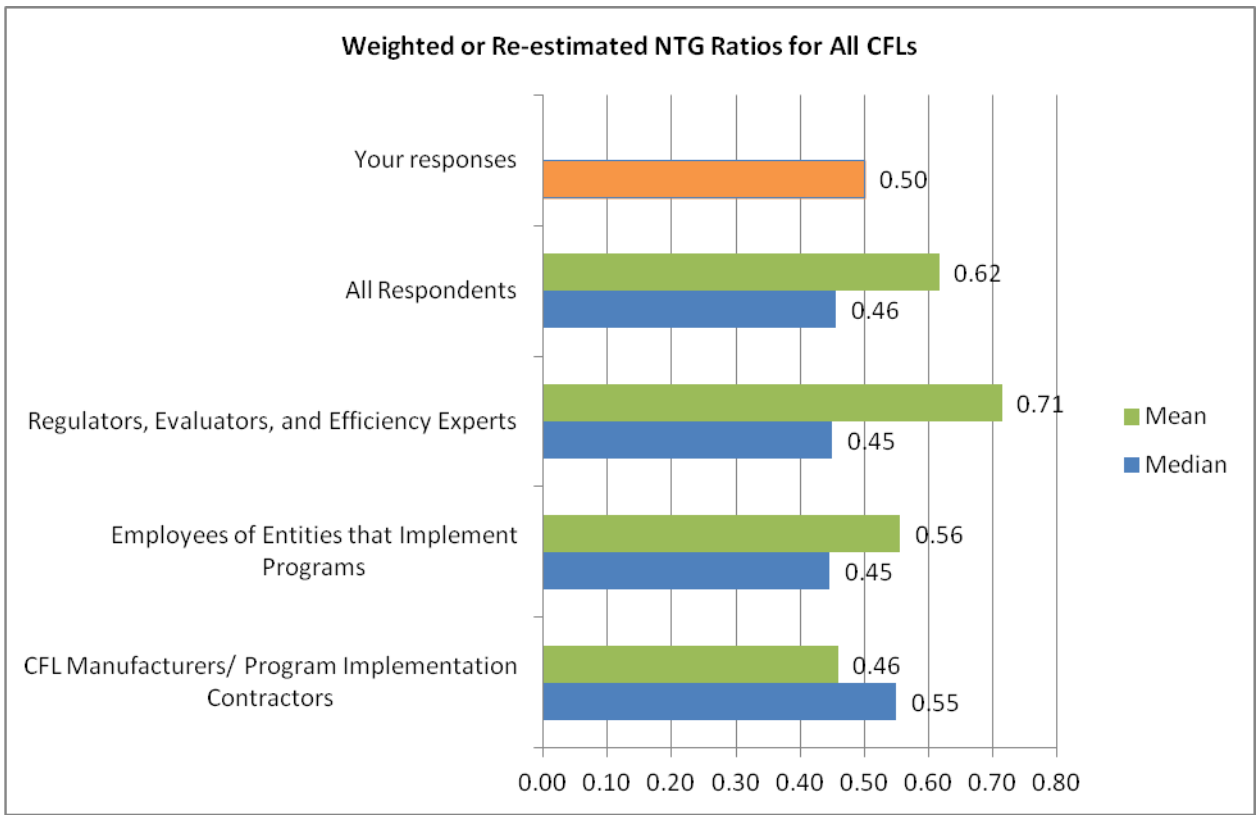
6 Developing a Single 2009-2010 NTG Estimate for All CFLs

This section presents the weighted NTG estimates for respondents who accepted the results of the weighting, or the re-estimated NTG estimates for respondents who did not accept the results and provided estimates that they thought were more accurate.

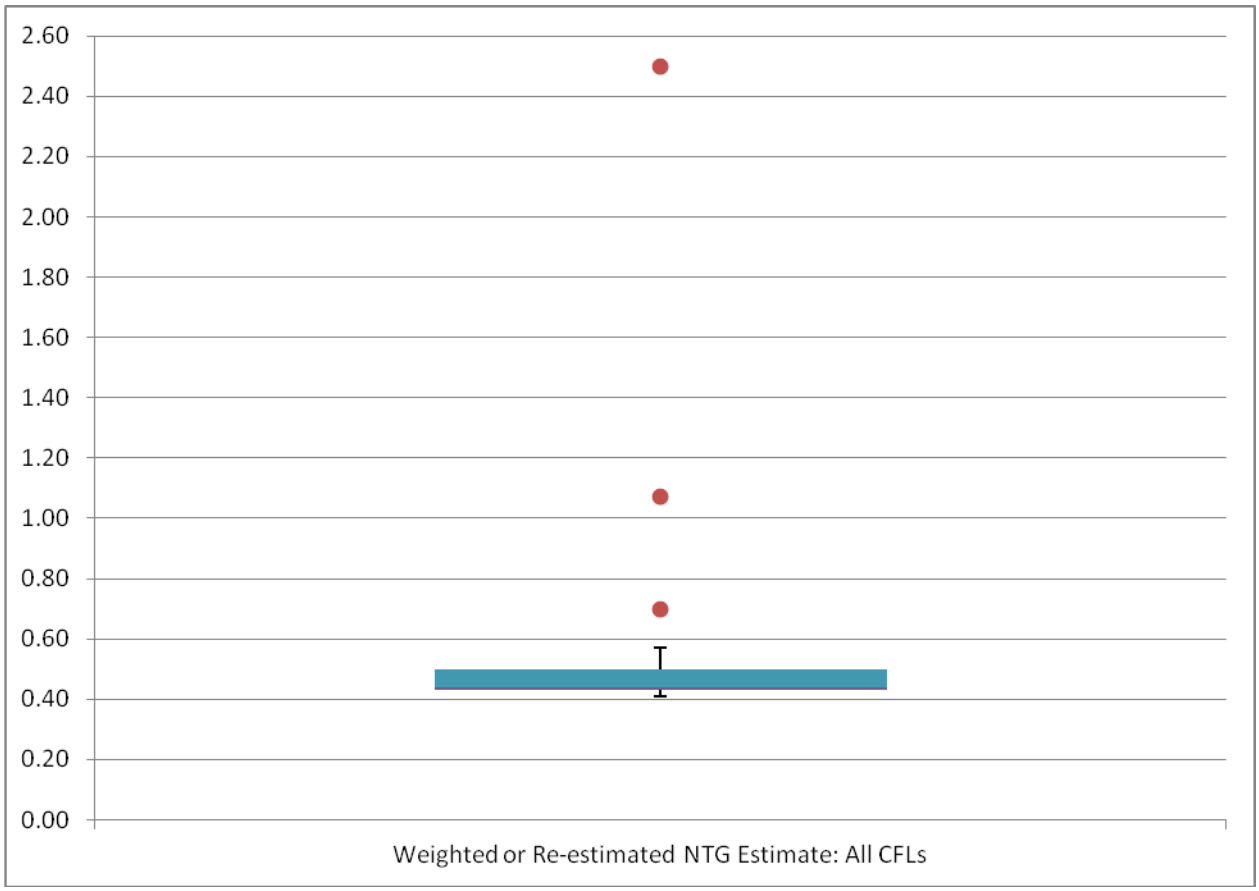
Those respondents who changed the final estimate, again, all increased the NTG ratio. One panel member (from the regulator/evaluator/efficiency expert group) gave a final estimate of 2.50, explaining that this value accounts for the missing causes that were not studied, such as market effects, spillover, repeat purchases caused by the program, and increased demand over the long term. Another panel member computed a weighted average for overall NTG using the re-estimated NTGs for standard and specialty products.

The following graph shows the mean and individual estimates panel members gave after weighting or re-estimating the NTG ratio for all CFLs; the table immediately following the graph display the means of the estimates only.

	CFL Manufacturers/ Program Implementation Contractors	**Employees of Entities that Implement Programs**	**Regulators, Evaluators, and Efficiency Experts**	**All Respondents**	**Your responses**
WEIGHTED OR RE-ESTIMATED NTG (Q26 OR Q27)					
Mean	0.46	0.56	0.71	0.62	0.50
Median	0.55	0.45	0.45	0.46	
Individual values	.43, .44, .50, .60, .66, .70	.43, .43, .44, .45, .46, 1.07	.41, .42, .43, .43, .47, .50, .55, 2.50	.41 - 2.50	



The following box-and-whisker plots represent 50% of all responses within the boxes as well as the smallest and largest weights given. Other than the three outliers, the estimates (17 out of 20) all fall within a fairly narrow range.



6.1 Re-examining First Round Responses

1. Now that you have reviewed the summary of estimates made by you and your fellow panel members, please review your own estimates below (shaded in green). If you do not want to modify your response, please indicate with an "**X**" in the appropriate box. If would you like to modify your original response, please indicate with an "**X**" in the appropriate box below and modify your response in the column to the right.

	Your Original Response	**Indicate X if you DO NOT want to modify your response**	**Indicate X if you DO want to modify your response**	**If yes, Enter New Responses Here**
OVERALL NTG FOR SPIRAL CFLs (Q29 OR Q30)				

2. Why did you modify (or not modify) your original responses?

Please type your response here:

3. How much confidence do you have in your own responses as well as the responses of the other panel members? In the table below, please use an "**X**" to indicate your level of confidence in the various groups' NTG estimates by using a scale from 0 to 10, where 0 means "not at all confident" and 10 means "extremely confident."

Estimates	**Not at All Confident (0)**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**Extremely Confident (10)**	**Don't Know**
Your Own												
CFL Manufacturers/ Program Implementation Contractors												
Employees of Entities that Implement Programs												
Regulators/Evaluators/Efficiency Experts												

4. Why did you give these ratings of your confidence in yours and other panel members' NTG estimates?

Please type your response here:

5. Do you have any additional thoughts or comments?

Please type your response here: