R1615 Light Emitting Diode Net-to-Gross Evaluation

REVIEW DRAFT

April 16, 2017

SUBMITTED TO:
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Executive Summary

The Connecticut Energy Efficiency Board (EEB) contracted NMR Group, Inc., (NMR) with subcontractors DNV GL and The Cadmus Group (the evaluation team), to estimate net-to-gross (NTG) ratios for light emitting diodes (LEDs) in 2015 and predict prospective ratios through 2018 and beyond for the Retail Products Program.

lertook five tasks: in-depth interviews with suppliers and program staff, sales ı, demand elasticity modeling, benchmarking, and a consensus panel. These carried out between August 2016 and February 2017—a time of political ith implications for lighting efficiency standards and programs. Some of the ented in this report hinge on federal rulemaking, political appointments, and lic agencies. This report attempts to note if the certainty of results is particularly the political climate and if they should be interpreted with caution.

Comment [GR1]: Slight hyperbole? Do they really uncertainties, or might they be significantly affected

led Net-to-Gross Estimates

sults from the five research tasks the R1615 study makes the following ions:

ctive LED NTG ratios for all non-hard-to-reach (HTR) LEDs (inclusive of [A-line], reflector, and other specialty bulbs) of 63% for 2015 and 57% for

ler prospective LED NTG ratios of 47% for 2017, 40% for 2018, 36% for 33% for 2020, with the caveat that these numbers be re-evaluated in the e due uncertain market dynamics and rapid change.

nel LED NTG ratios of: 83% for 2015, 77% for 2016, and 67% for 2017, 60% 56% for 2019, and 53% for 2020.

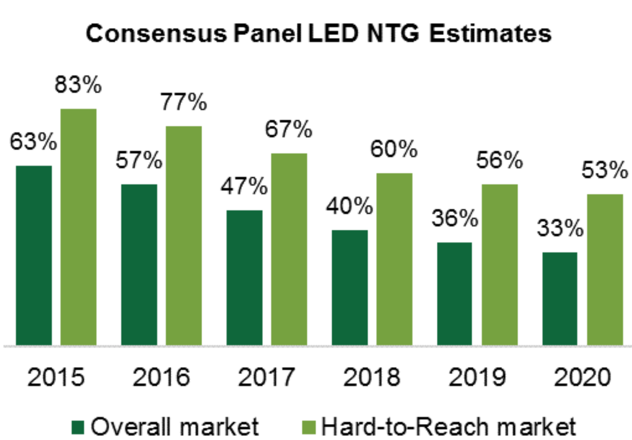
Comment [GR2]: Please compare/contrast to 201 2016 PSD values

Comment [GR3]: And if there is insufficient time t does NMR recommend that it be used as is? The te some uncertainty.

Comment [GR4]: Please compare/contrast to 201

Comment [GR5]: Ditto. Or, if no previous HTR NT

nendations come from the consensus panel which engaged lighting experts iated NTG values based on R1615 primary and secondary-research tasks and lge of the industry. participated in a ɔuilding process to these final ions. The panel took e of months after the ection but in the early new administration February 2017). Thus, of uncertainty remains re of the market and if new administration ɔnd to previously



eases for lighting efficiency standards in 2020 (under the Energy Independence ct [EISA] of 2007) and a 2017 Department of Energy (DOE) rule to expand the ce lamps to include reflectors and other bulb types. As such, the panel that the prospective estimates beyond 2017 be reevaluated ideally in d no later than 2019.

Comment [GR6]: How, if at all, should the 2018 v number needs to be nailed down within the next few

For the next Three Year Plan, what is the latest that have to be completed by? Probably by mid to late s

recommended NTG estimates are lower than the current value assumed in the *icut Program Savings Documentation*, which stipulates an LED NTG of 82%.[1] e was derived from the R86 lighting NTG study conducted in 2014 and 2015, *esidential LED Market Assessment and Lighting Net-to-Gross Overall,*[2] **but the anelists believe the lighting market has changed substantially enough npletion of that study to warrant an adjustment to the PSD to reflect the mended prospective NTG ratios**. Panelists agreed that HTR channels, such ores, are more price sensitive, and therefore demonstrate higher NTG ratios.

Comment [GR7]: Footnote 1 below is to the Octo Year Plan, not the 2017 PSD.

us panel considered developing separate NTG ratios for reflector bulbs. r reviewing the available retrospective and prospective estimates in the face of out adoption of the EISA, the expanded definition of general service lamps, at panelists' annual estimates only demonstrated differences of five percentage [3] the panelists concurred that the evidence does not support separate reflector

et-to-Gross Estimates

ed on three empirical approaches to estimate LED NTG ratios, which, together ts of the benchmarking exploration described below, fed into the consensus . These included supplier interviews (n=16), sales data modeling (based on 17 ying levels of LED program activity), and demand elasticity modeling (drawing ata from the Retail Products Program). Table 1 presents the results of the

v/deep/lib/deep/energy/conserloadmgmt/2016_2018_CLM_PLAN_FINAL.pdf.

izect.com/sites/default/files/CT%20Residental%20LED%20Lighting%20Market%20Assessmen nting%20NTG%20%28R86%29_Final%20Report_06.19.15.pdf.

eir 2015 estimate for standard LEDs was 66% and their estimate for reflector LEDs was 62%.

ble 1: Estimated and Recommended LED NTG Estimates

	Retrospective[1]		Prospective				
	2015	2016	2017	2018	2019	2020	2021
g Strategy Bulbs	100%	100%	-	-	-	-	-
SD	82%	82%	-	-	-	-	-
r interviews	61%	61%	40%		38%		35%
eling	70%	70%	-	-	-	-	-
ty	61%	61%	-	-	-	-	-
nel /	**63%**	**57%**	**47%**	**40%**	**36%**	**33%**	**-**

erviews addressed 2015-2016 estimates together, while the sales data and demand elasticity sed only 2015. The consensus panel recommended separate estimates for 2015 and 2016.
odel includes only program data, the estimate is net-of-freeriders, which excludes spillover.

e NTG. Supplier interviews yielded a retrospective NTG ratio of 61% for 2015 mand elasticity modeling estimated a net-of-freeridership (which excludes 015 of 61%, and sales data modeling resulted in the highest NTG ratio of 70% consensus panel relied more heavily on the supplier interview and demand eling results, expressing some concerns about the methodology of the sales level of robustness.

NTG. Suppliers expected program rebates will continue to be valuable in the e they provide first cost decreases. They also emphasized that the rapidly es of LEDs independent of the program will make the program less influential. nated steadily decreasing prospective NTG ratios of 40% in 2017, 38% in 2019, 21. As mentioned, the consensus panel recommended placeholder NTG ratios similar estimates, steadily decreasing from 47% in 2017 to 33% in 2020.

uppliers and demand elasticity modeling estimated lower retrospective NTG ctor LEDs than standard LEDs. Suppliers predicted the opposite relationship in 9, but ultimately attributed a higher prospective NTG ratio for standard LEDs LEDs in 2021. The consensus panel discussed several theories of why reflector NTG ratios may be lower than for standard LEDs, such as the affinity between characteristics of reflectors (such as long life and, for many, dimmability), the ance of reflector CFLs leading consumers to LEDs as the energy-efficient or LEDs have been on the market longer than standard LEDs, reflector LEDs at price parity with halogen reflectors, and halogen reflectors were never high quality. Nonetheless, the lack of specific evidence supporting these mall differences in standard and reflector/specialty NTG estimates (5% or less),

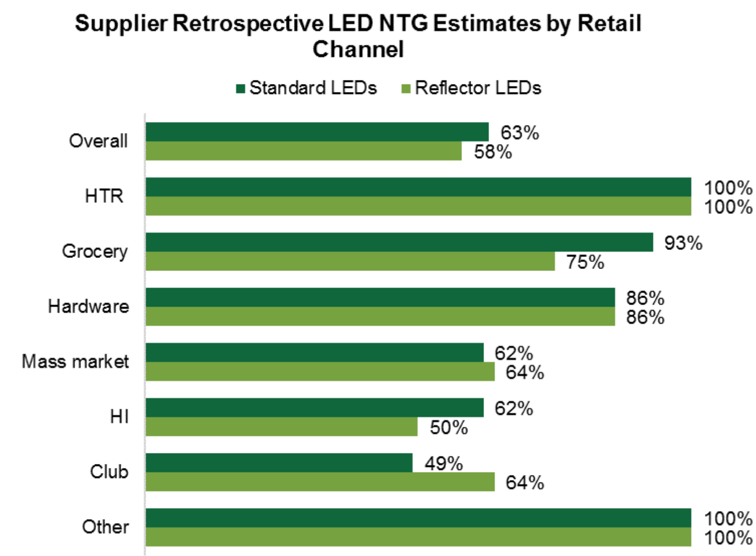
Comment [GR8]: What is the value from 2017 PS

Comment [GR9]: Why is this lower than any of th

Comment [GR10]: Though price parity – or near p been examined.

s only represented 13% of program LED sales in 2015 led the panel to sing the same NTG for standard and reflector bulbs.

el. Suppliers estimated higher NTG ratios for HTR channels than other iding that underlied the consensus panel's decision to recommend consistently NTG estimates. Demand elasticity modeling also made estimates by retail sample sizes for were too small to lysis.



to Other Net- tio Estimates

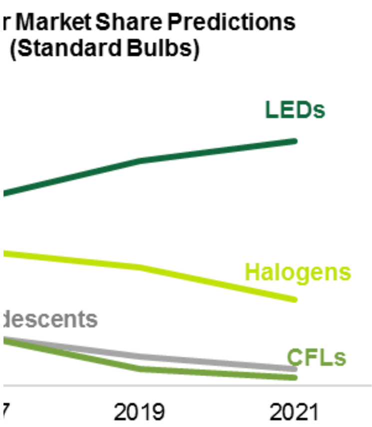
chmarking effort it research for programs have etrospective LED the years of 2012 ing from 73% to median value of data from other do not display a of increase or decrease over time. Ultimately, the consensus panel determined narking studies were too dated or geographically distant to strongly factor into ations.

ds and Predictions

o gathered information on market trends that may affect NTG ratios through ng past market share trends and predictions of future market share, the R 2.0 specification, and the program decision to phase out CFLs by early 2017.

ales data show that halogens and CFLs currently dominate the residential ED market share has been on the rise. Connecticut residents were most likely ased halogen bulbs in 2015. Similar to the nation as a whole and its neighboring cticut's sales of LEDs among a subset of retailers sharply increased in recent rs projected that regionally in 2021, LEDs would represent 60% of the standard nd 54% of the reflector bulb market. Meanwhile, they anticipated that all other uld decrease in market share.

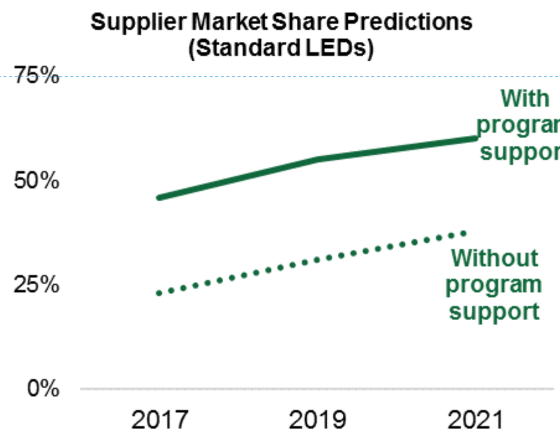
Comment [GR11]: The NEMA lamp shipment dat



When it came to speculating on the impacts of non-program factors, suppliers expected that EISA 2020 would usher the decrease in halogen sales and increase in LED sales. They anticipated that ENERGY STAR 2.0 will 1) cause CFL sales to gradually decrease because the specification excludes most CFLs which, in part, has slowed manufacturers' production of them, and 2) stimulate LED sales to increase, with some suggesting LEDs and halogens will take the place of CFLs. Additionally, they predicted that ENERGY STAR 2.0 coupled with EISA 2020 will greatly les and significantly decrease CFL market share.

Comment [GR12]: But haven't they done this nati

suppliers emphasized that program support in the next several years will LEDs' steadily increasing dominance in the regional market. For example, they that, LEDs would only account standard bulb market in 2021 am support (versus 60% with ort). Suppliers did not believe am's phase-out of CFLs would ales decline faster than they ut suppliers did recognize that CFLs would create a potential arket for a low-price, energy ative to incandescents and ey speculated that program Ds will increase the likelihood rs would choose LEDs over incandescents in the absence of CFLs.



Comment [GR13]: Which is only slightly above wl of 2016

NS AND RECOMMENDATIONS

ve and Prospective Net-to-Gross

s panel first estimated NTG values based on R1615 primary and secondary-s and their knowledge of the industry and later came to consensus on ions. Panelists predicted that the future LED market will grow independent of oort and estimated steady NTG declines from 2015 to 2020. After careful they determined that the level of uncertainty and quickly moving variables eevaluating the prospective estimates in the near future. Panelists explained nnels are more price sensitive, and therefore demonstrate higher NTG ratios.

Comment [GR14]: Is the makeup of this panel dis

nmendation. The study recommends using the NTG ratios resulting from the nsus panel: for non-HTR LEDs overall (inclusive of standard [A-line], reflector, ıer specialty bulbs): 63% for 2015, 57% for 2016, 47% for 2017, 40% for 2018, ›r 2019, and 33% for 2020. Prospective estimates should be reevaluated next r by 2019 at the latest. The consensus panel suggests measuring the HTR el by adding 20 percentage points annually to attribute to the HTR channel: ›r 2015, 77% for 2016, and 67% for 2017, 60% for 2018, 56% for 2019, and ›r 2020.

ıels

;, including home improvement (HI), mass market, and club stores, composed rogram sales so the relatively high freeridership estimated by suppliers drove tively low NTG estimates. The consensus panel results aligned with supplier lts that higher NTG ratios should be associated with the HTR channels, yet ; composed a small share of program sales.

ımendation. Further targeting the HTR channel has the potential to increase ›gram's cost effectiveness. The program should continue incentivizing lower- ENERGY STAR-qualified LEDs at HTR retailers. It may also wish to test the ffectiveness of including higher-priced LEDs with specialty features such as with dimmability and high color-rendering index in the HTR channel.

Comment [GR15]: More importantly, will it increas relatively fixed budgets?

plementation

elasticity data relied on data detailing in-store promotional events and ȷ displays. Field staff collected these data when visiting stores to ensure ith retailer contractual agreements: 1) verifying prices and shelf signs that ducts were included as part of the program and 2) tracking off-shelf ȷ displays of program bulbs (e.g., clip strips, end caps, pallet displays).

ımendation. Improving the level of detail in the tracking of in-store andising displays (ideally product model number or brand and bulb type) would se the likelihood of identifying the impact this program component has on m sales.

Section 1 Introduction

The Connecticut EEB contracted the evaluation team to estimate retrospective and prospective LED NTG ratios from 2015 through 2018 or beyond for the Retail Products Program, which largely supports light bulbs and light fixtures. The study, known as R1615, produced LED NTG estimates for 2015 through 2020.

Comment [GR16]: "and"?

ROUND

pleted a lighting NTG study in 2014 and 2015 (R86), which provided estimates of-freerider ratios for standard and specialty compact fluorescent lamps (CFLs) ated as one category) for 2013.[4] The R86 study recommended applying a CFL and LED NTG of 82% for 2013 and 2014; the *Connecticut Program Savings n* for the 2017 program year lists a NTG of 82% in keeping with the study, a NTG of 74% for CFLs.[5]

Comment [GR17]: To the footnote: The PSD RR

npletion of that study, Eversource and the United Illuminating Company (UI) *2016-2018 Electric and Natural Gas Conservation & Load Management Plan* 3 CL&M Plan). The plan called for the continued phasing out of CFLs from ngs through 2018, while shifting support to both standard and specialty LEDs. r the Connecticut Department of Energy and Environmental Protection (DEEP) plan, ENERGY STAR® released Lamp Specification 2.0. Very few CFLs meet e exact number is uncertain, but market intelligence suggests that number is n models); this prompted the Companies to adjust their Lighting Strategy to Ls in early 2017, coincident with the implementation of the ENERGY STAR n date. By Spring 2017, the Companies anticipate supporting only standard LEDs.

Deleted: in 2016 and 2017

Comment [GR18]: One could access the ES QPL Later on the report says this number was 7 in early

an also called for supporting lighting products in multiple retail channels, e considered as serving HTR consumers who are less likely to purchase or use nt bulbs mostly due to cost barriers.

the unit and saving goals for the Retail Products Program as well as the e program represents of all residential savings. The plan does not differentiate f CFLs and LEDs, specialty and standard products, or retail channels to be each year. The table makes clear that the Companies will still rely heavily on ducts Program to achieve a significant share of residential savings over the program cycle, but they do anticipate the savings falling precipitously in 2018.

Comment [GR19]: Though the Plan's Performanc specify the minimum number of LEDs expected to b were based on agreed to minimum LED market sha

DNV GL. *R86: Connecticut Residential LED Market Assessment and Lighting Net-to-Gross*

izect.com/sites/default/files/CT%20Residental%20LED%20Lighting%20Market%20Assessmen hting%20NTG%20%28R86%29_Final%20Report_06.19.15.pdf.

refers to these values as *net realization percentages*, but the formula is the same as that for NTG ; - *freeridership) + spillover = NTG*. The PSD does not associate spillover with LEDs or CFLs; rates assigned to them are therefore 18% and 26%, respectively (page 315).

r the decline stems from the assumption *at the time the plan was written* that e of the Energy Independence and Security Act (EISA), to be implemented in , will essentially make LED bulbs the new baseline. It also assumed that the) price decreases would lead to a higher natural adoption rate prior to 2020. in savings also reflects a reduction in claimed Delta Watts, the result of the lower wattage general service halogens and a greater number of CFL to CFL LED replacements (rather than assuming all CFLs and LEDs replace or halogen bulbs). Together, these assumptions have implications on the etime the Companies can claim for bulbs sold: if the assumed baseline wattage oached that of the program bulbs being offered, then the program may not be post-2019 savings into their cost effectiveness tests. Stressing that nothing is dynamic market, it is possible, if not likely, that market changes may lead to of a retail-based residential lighting program in the next program cycle. d legislative requirements would only accelerate this phase out.

Comment [GR20]: Only in part. The decline was a reality that the costs for LEDs were falling rapidly, th made a commitment to LEDs on a global basis, that applications an inferior product, and that industry su

Comment [GR21]: The ML estimates were develo discussions with the Companies and the Board's co diminished post EISA savings, but not necessarily z

Deleted: legislative and

le 2: Retail Products Unit and Savings Goals 2015 to 2018

(2016 to 2018 CL&M Plan)

	2015	2016	2017	2018
	2,211,792	2,684,921	2,631,667	2,435,933
	605,963	671,181	670,385	601,615
	2,817,755	3,356,102	3,302,052	3,037,548
Savings				
	51,420	67,192	62,020	53,967
	13,648	16,539	15,794	13,304
	65,068	83,731	77,814	67,271
f Residential Savings				
	40%	58%	53%	42%
	65%	60%	59%	51%
	43%	58%	54%	44%

Comment [GR22]: Provide LT savings and % too than annual savings.

n began with the supposition that four important developments in the lighting the approval of the three-year C&LM plan may have an impact on the esidential retail lighting plans for the 2016 to 2018 cycle. Knowledge of these informs the interpretation of the NTG and market share trends discussed in ut the study focuses greatest attention on the ENERGY STAR Lamp 2.0 lue to its immediate effect on program offerings and market trends.

GY STAR Lamp 2.0 Specification:[6] As mentioned earlier, ENERGY STAR ed its final Lamp 2.0 Specification, and it has important implications for GY STAR qualification for both CFLs and LEDs. The specification adjusts

Comment [GR23]: Please update or eliminate the

ting of this report, the administration's proposed budget called for the elimination of ENERGY //www.bloomberg.com/graphics/2017-trump-budget/). Given that the budget remains a proposal h 17, 2017), we have not addressed this issue in the report.

re life and efficacy requirements, among other factors, but the most important ıtions are these: very few CFLs will meet the new standard as of January 2017, ome low-cost LEDs (see more below) now qualify for ENERGY STAR. The ment of Energy (DOE) allowed LEDs qualified under the new specification to eled and sold as ENERGY STAR starting in Summer 2016. Program staff ed during in-depth interviews that they have added these newly qualified LEDs product mix and will phase CFLs out of the program early in 2017.

Deleted: 2017

Comment [GR24]: Cite YTD LED program share

line LEDs: A variety of non-ENERGY STAR qualified LEDs had been around ew years, but the shelf space devoted to them skyrocketed over the months up to the evaluation. Often called *value-line* LEDs, some lighting and energy-ıcy experts fear that these less expensive LED models may suffer from poor (premature failure, lack of omnidirectionality, limited durability, and onable light quality) stemming from a rapid increase in manufacturing that may e quality control in order to meet customer demand.[7] While the new ENERGY specification allowed some lower-cost models to qualify for the label,[8] ous others that still fail to meet the ENERGY STAR specifications remain on helves. Their increasing availability and very low price will likely have impacts lighting market. The impacts could be positive, such as leading to greater ner adoption of all LEDS (including ENERGY STAR models); they could be e, if value-line LEDS prove to be poorly performing and turn consumers off to s (including ENERGY STAR models); or they could be a mixture of the two.

Comment [GR25]: This discussion fails to acknov cost 15K models get qualified that the prevalence o decline.

Rulemaking on EISA 2020 Implementation: As explained above, the original egislation called for a second wave of standard increases to go into effect in y 2020. As written, the next wave of standards would bar the manufacture, and sales of bulbs that did not meet the 45 lumens/watt backstop included in ginal EISA 2007 legislation. Yet, the legislation also allowed the DOE to issue by January 1, 2017 that could alter certain aspects of the rule.[9] In two rules December 29, 2016 and published January 18, 2017, the DOE expanded the on of *general service lamp* to include many specialty bulbs that had previously exempt from EISA. Although it remains to be seen whether EISA and these vill be enacted or enforced by the new administration, as it now stands, on y 1, 2020, all general service lamps must meet a 45 lumens/watt standard and ger be manufactured or imported into the United States.

Comment [GR26]: While the new admin may not requirements, can they refuse to enact them? Is the review period? If so, when is it over?

nber 2016 Election: In January 2017, the Republican party took control of both egislative and Executive branches of government. Members of the new stration have voiced skepticism about the role of human activity in climate and are generally less supportive of energy-efficiency and renewable energy

dip in quality in the mid-2000s, which permanently led some consumers to reject them. These ar a similar fate if value-line LEDs prove to be of low quality.

ed *value-line* LEDs as those LEDs that did not qualify for the ENERGY STAR label under

lso considered increasing the lumens per watt standard for CFLs and LEDs but ultimately sideration.

red to fossil fuels.[10] A prior failed legislative attempt to overturn the lighting ıcy standards of EISA nevertheless resulted in a budget rider that remains in hat bars Congress from allocating funds towards its enforcement. As of March the new administration has not addressed the EISA legislation directly, but commentators expect the law will not be enforced and may be overturned.

ket impacts of these developments, as well as how Eversource and UI will ese developments, challenge all efforts at estimating prospective NTG ratios. n, this study takes advantage of the collective knowledge of lighting program and implementers outside of Connecticut and evaluators with experience in nd beyond to review retrospective NTG estimates for Connecticut for 2015, stimates from other jurisdictions, and the most recent residential lighting market vailable to estimate prospective NTG for Connecticut through 2021.

Comment [GR27]: I will argue that while the four i and do add uncertainty – they need to be put in the evolving global LED lighting market.

And what of CA and European lighting standards?

Outcome and Objectives

udy outcomes included estimates of 2015 NTG ratios and predictions of 2016 ratios for LEDs. Where possible, results are reported separately for standard, all other specialty LEDs—specialty bulbs are defined here as anything other and reflectors LEDs, such as globe, 3-way, and candelabra bulbs).

Comment [GR28]: Though the ES does not addre

ly objectives included:

te 2015 NTG ratios overall and for standard and reflector LEDs (the most on specialty bulb) and compare these to 2013 estimates (when possible) and assumptions included in the 2016-2018 C&LM Plan and 2015 and 2016 PSDs; he studies in other jurisdictions and stay apprised of changes in the lighting in response to federal standards and ENERGY STAR specifications as well nges in the availability of various bulb types;
e NTG estimates for 2013 and 2015, supplier and model-based predictions of sales, and the information on NTG trends in other areas and on market changes vene a panel of lighting experts to use a consensus-building approach to p prospective (forward looking) NTG ratios standard and reflector LEDs for o 2018, and possibly through 2021.

Comment [GR29]: 2015?

es of cabinet member positions at http://www.nbcnews.com/feature/trump-cabinet; accessed

Section 2 Methodology

The R1615 study involved in-depth interviews with manufacturers and high-level buyers (referred to as *suppliers*) and program and evaluation staff, sales data modeling, and demand elasticity modeling. The study also included a benchmarking task that examined LED market trends and NTG in other areas. A team of experts then engaged in a process of examining the results of the various Connecticut and external studies market trends and using them in a consensus approach to develop l standard and reflector LED NTG estimates. Table 3 summarizes the research e key research questions each address—some of which provided market at informed the NTG consensus process. The following section describes these lix A provides additional details.

Table 3: Summary of Research Methods

	Key Research Questions
views and high- managers/ ff)	• Based on supplier estimates of the program impact on sales, what was the NTG ratio for standard and reflector LEDs and what might those ratios be in 2016-2021)? • What will be the likely market and program impacts of the ENERGY STAR Specification? • What are their predictions for market penetration trends for standard and reflector LED products?
icity	• What is the relationship of price and promotion to sales (elasticity)? • What would LED sales be without the program's intervention (baseline sales); and • What is the program freeridership rate?
odeling	• What have been the trends in LED sales from 2009 to 2015 in states with programs and states without programs? • What is the NTG ratio for LEDs in 2015?
l	• What have studies suggested are the recent and prospective LED NTG ratios in other jurisdictions?
TG	• Considering the results of Task 2 – Task 4, what do persons knowledgeable about the CT, regional, and national lighting programs and market predict NTG to be in 2016 to 2020?

'TH INTERVIEWS – METHODOLOGY

, the study included in-depth interviews with program and evaluation staff ?) and lighting suppliers who participated in the program in 2015-2016 (n=16).[11] nterviewees included the following:

ting manufacturers who together accounted for 88% of the Connecticut 2015- ales in the program tracking database
gh-level lighting buyer who accounted for 3% of the 2015-2016 program sales[12]

nterviews, which were completed from September through November 2016, llowing primary topics:

m impacts to determine current (2015) and prospective (2016-2020) NTG R1615)
arket impacts of ENERGY STAR Lamp 2.0 specification
: penetration trends for LED products

Comment [GR30]: Why is 2015 considered curre needs to be given as to why resources were devote given the timing of this report (Spring 2017) and tha retrospectively in CT.

upplier interviews were fielded prior to the 2016 presidential election. Some ndicated that their responses may change based upon the results of the ly assuming a less optimistic future for LEDs under the new administration. If t is likely that at least some suppliers would provide higher prospective NTG er LED market shares than reflected in the results presented here.

interviews were conducted in November and December 2016 and touched on ame topics above (but were not asked NTG-related questions).

spective NTG

etrospective NTG ratios, interviewers asked suppliers a series of questions eir sales of standard and reflector LEDs would have been in the absence of the erally, if a respondent said they would not have sold any of each type of LED t without the program, the sales from this respondent were assigned a NTG If the respondent would have sold LEDs, they were asked a series of questions eir anticipated sales in the absence of the program. If a respondent sold both , they answered each series of questions separately for the two types of bulbs. formula was used to calculate the retrospective NTG ratios for both bulb types:

$$\frac{upplier\ reported\ total\ sales - Supplier\ reported\ sales\ without\ program)}{Total\ program\ sales\ (actual)}$$

hting buyer refers to a purchaser of lighting products for a large chain retailer that participates t program. The data spanned the period of June 2015 through June 2016, which included a m cycles.
is retail lighting buyer interview, we also completed a second "proxy" interview with a high- In this case, the high-level retail buyer elected to have their primary lighting supplier do the stead. This other retail buyer accounted for 16% of 2015-2016 program sales.

› of standard to reflector LED program sales, the study calculated an average ı ratio for LEDs overall. See the interview instrument in Appendix C.1 for further

› were also asked the questions separately for each retail channel through ›ered program-supported bulbs, although to limit the survey's length, the study aining NTG estimates from retail channels with the greatest program sales anufacturers working through several channels.

›f bulbs that each respondent sold through the program was used to weight the ›vided by individual respondents (within a given type of market actor) up to a level.

loes have weaknesses stemming largely from three potential sources of bias, ›elow.

aming or *don't kill the golden goose* bias: This potential bias occurs when ›rs purposely exaggerate how much their lighting product sales would decrease absence of the program. Their motivations would be to ensure that they ıe to receive program discounts/rebates.

***reen retailer* bias**: This potential bias occurs when suppliers underestimate uch their sales would drop in the absence of the program. The reason for doing › be an inflated confidence in their company's ability to market environmentally- › products. This bias might be considered a variation of the *social desirability* well-known concept in program evaluation literature.

of adequate market knowledge: Another potential source of bias is the eration that some suppliers simply lack the broader market knowledge to tently assess what would happen to product sales in the absence of the m. Lighting manufacturers are less prone to exhibit this bias because they must proposals to the Companies indicating how many of each product they think an sell through each retail channel. The study's sample consisted largely of acturers, thereby minimizing the impacts of this potential source of bias.

ıfluence of these three sources of bias on the results and the degree to which ›h other remain unknown.

›ective NTG

ıl of the R1615 study was to develop prospective—that is, forward-looking— LEDs. To develop prospective NTG ratios, the study asked suppliers to predict d and reflector LED market shares for 2017, 2019, and 2021 in Connecticut, that the Companies would continue offering LED rebates through 2021 and › that the Companies would terminate program support at the end of 2016. wing formula, the responses yielded prospective NTG estimates (i.e., program arket share) for both bulb types for each of the three years:

$$\frac{(LED\ market\ share\ with\ program - LED\ market\ share\ without\ program)}{LED\ market\ share\ with\ program}$$

ve NTG method differs from the retrospective approach in the following ways:

- ers predicted the program impacts based on where they believe the market be moving, rather than reviewing past and current market conditions.
- ers predicted the program impacts on LED sales in the Connecticut LED market eral and not just their own LED sales.
- se they were predicting program impacts for the overall Connecticut LED :, the study did not ask them to differentiate among retail channels.

, the analysis weighted market share predictions based on respondents' 2015- sales for each bulb type.

DATA MODELING – METHODOLOGY

a modeling quantified the relationship between lighting program intensity (e.g., nting program spending per household) and LED lighting sales to estimate a ; ratio. It relied primarily on 2015 sales data prepared by the CREED nitiative, although it also leveraged other data sources.[13,14] The LightTracker re primarily generated from two sources: point-of-of sale (POS) state sales data a subset of retail channels, with the notable exceptions of HI, hardware, and ores) and National Consumer Panel (NCP) state sales data (representing a) of retail channels). These two sources collectively represent bulb sales at the ccount for the majority of such sales across the United States.[15] In addition to ker data, the model inputs included a combination of program data from across the nation collected by the evaluation team in coordination with the ive, and household and demographic data collected through various publicly sites. The model input data sources are listed here, and discussed in more

al bulb sales
POS data (grocery, drug, dollar, discount, mass market, and selected club stores)
Panel data (HI, hardware, online, and selected club stores)
nsus Bureau Import data (CFL imports)[16]
GY STAR® shipment data (imports and ENERGY STAR market share)
American Electrical Manufacturers Association (NEMA) shipment data
can Community Survey (ACS) data (household characteristics and raphic data)
er square footage per state (based on the two primary retailer channel data s)

; as a consortium of program administrators, retailers, and manufacturers working together to sary data to better plan and evaluate energy efficiency programs. LightTracker is CREED's first on acquiring full-category lighting data, including incandescent, halogen, CFL, and LED bulb ibution channels in the entire United States. As a consortium, CREED speaks as one voice for trators nationwide as they request, collect, and report on the sales data needed by the energy nity. (https://www.creedlighttracker.com)
n contained herein is based in part on data reported by IRI through its Advantage service for as by LightTracker, Inc. Any opinions expressed herein reflect the judgement of LightTracker, ect to change. IRI disclaims liability of any kind arising from the use of this information.
n Connecticut in 2015, 90% of LEDs and 70% of CFLs were obtained from HI, club, and mass es. In Massachusetts in 2015, 79% of LEDs and 66% of CFLs came from HI, mass count, hardware, and club stores. Estimates of incandescent and halogen sales and all types of dily available, but surveys generally find HI and mass merchandise stores to be the most of bulbs. See *Connecticut LED Lighting Study Report (R154)*. Final delivered to the Energy January 2016. http://www.energizect.com/sites/default/files/R154%20-%20Lighting%20Study_Final%20Report_1.28.16.pdf. NMR. 2015. *Results of the On-site Lighting Inventory: 2014*. Delivered to the Massachusetts Program Administrators and Advisory Council Consultants March 2014. http://ma-eeac.org/wordpress/wp-Lighting-Market-Assessment-and-Saturation-Stagnation-Overall-Report.pdf.
ummarized here focuses on LED-only modeling; however, the LightTracker Initiative included ; as reported for other program administrators. The report discusses the joint CFL/LED Appendix A.

al population surveys, lighting saturation studies and other primary data ion made publicly available through evaluation reports

endix A.1 addresses the strengths and weaknesses of the LightTracker data in : is critical to understand that the contract between IRI (the third-party who :Tracker data) and the evaluation contractor limits the depth of analysis and e data. For example, the contract does not allow for the reporting of which t sales or analysis of sales by lumen bins or other bulb features (even if the included in the original data set or identifiable based on information contained ite these shortcomings, the evaluation team believes that the ability to analyze bulb sales data at the state and national level outweighs the contractual ced on the analysis and reporting.[17]

also summarizes the steps taken to develop key variables in the model. Other , demographics, electricity price, etc.) reflect data as collected from third-party equired no manipulation for inclusion in the model.

Data Model Specification

oal of the model was to quantify the impact of state-level program activity on ED lighting. Appendix A.1.2 includes detailed discussion of the data sources for and the modeling equation. Key aspects of the lighting dataset as analyzed

ales volume and pricing for CFLs, LEDs, halogens, and incandescent bulbs for nnels combined, and broken out by the POS and non-POS channels
eporting by state and bulb type
on of all bulb styles and controllability (e.g., three-way and dimmable)

relies on a market lift approach. The approach first uses the model to predict LED bulbs with and without the program (the counterfactual of no program termined by setting the program variable to zero). This change in count *lift*, or net increase in the number of LED bulbs resulting from program activity. divided by the total number of program LEDs sold (i.e., the gross number of determine NTG:

$$TG = \frac{(LED\ bulbs\ sold\ with\ program - LED\ bulbs\ sold\ with\ no\ program)}{LED\ program\ incented\ bulbs\ sold}$$

sted other factors that influence the sales of efficient lighting, including social, household, and retail channel variables to capture and control for the cteristics of each state that potentially affect the uptake of efficient lighting none were significant predictors of LED purchases. In fact, the regression r the LED program intensity variables proved inconsistent across a number of

htTracker Initiative, evaluator access to market-level bulbs sales at any level of analyses were tailers agreed to provide program administrators and evaluators their sales of program- only.

:ations.[18] The robustness of the models suffered because only 17 states had ınular data to estimate a lamp-specific model. This was largely because LEDs ing market share in 2015, and it was challenging to gain technology-specific ding for a number of states. Additionally, the high cost of LED bulbs means dollars must be spent per LED bulb and that the resulting modeled impact will ı more difficult to detect. In short, the sales data model presented in the section Estimates is the best LED sales data model that could be developed.

Comment [GR31]: Is this limitation clearly noted/e

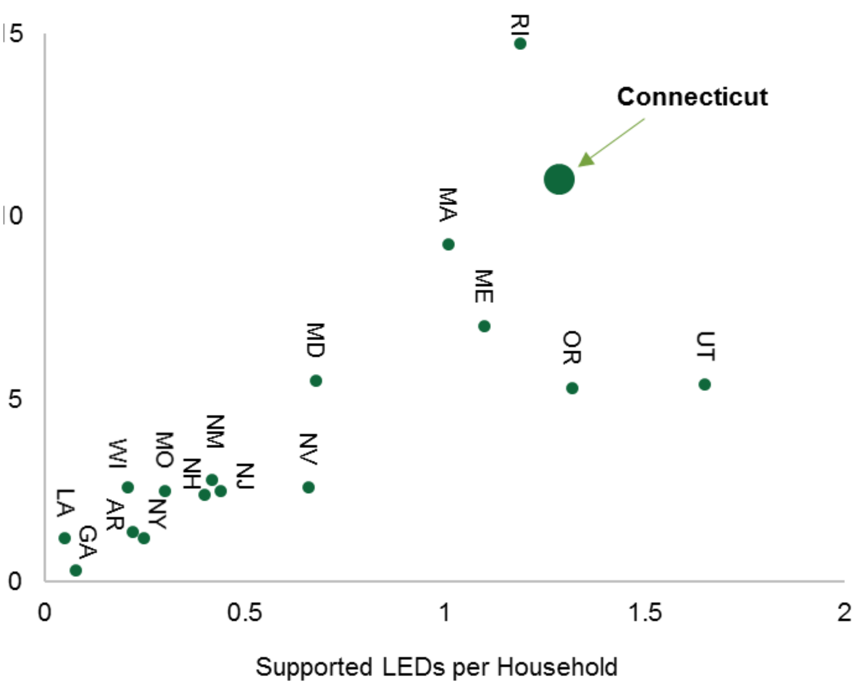
w of Program Support and LED Sales

Comment [GR32]: Lamps and fixtures? How were categorized?

2 compares in detail the measures of program support and LED sales for the uded in the model. The data showed variation across the states: Program .EDs ranged a great deal; Connecticut exhibited the second highest spending household (Figure 1), but the state also ranked highly in the number of LEDs it ı those program dollars. Figure 2 shows the relationship between this ranking er of LEDs purchased per household according to the LightTracker dataset.

:D Program Spending and Bulbs Supported per Household in 2015 by State

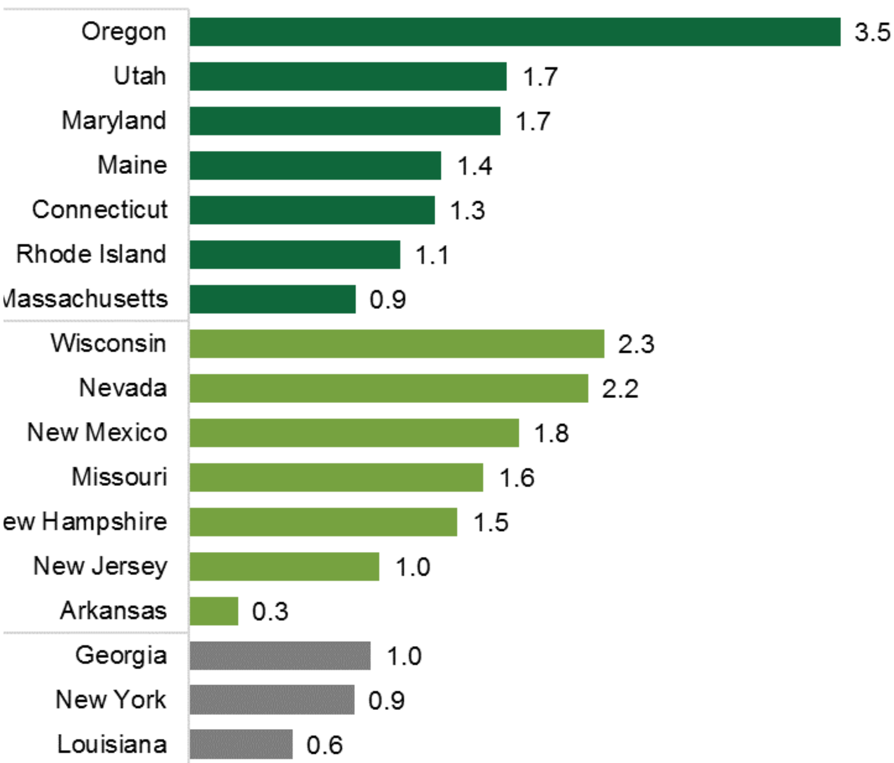
(Based on literature review, n=17 states)



CREED Initiative, Apex Analytics (Apex) developed a combined CFL and LED model for two ȷ these same data, but the results are not yet public. Appendix A.1.2 provides the model which ıot overly sensitive to specification. The model was driven by CFLs, however, which provides ıation for understanding LED NTG and predicting prospective NTG through 2018 and beyond. rrent study (R1615) did not use this joint CFL/LED model.

2: Average LEDs Purchased per Household in 2015 by State

(Based on LightTracker data, n=17 states)



ıssifies the intensity of program spending by the amount spent per household. States spending ıld are classified as *Aggressive* spending, those spending > $1 and < $5 are *Moderate* spending, ng =< $1 are *Low* spending.

/, the level of program support was correlated to the number of bulbs supported . The states with the most aggressive program spending did not always exhibit ımber of overall LED purchases. Connecticut (along with Rhode Island and the top tier of program spending but the middle of overall LED purchases within nple.

ttempted to explain the unexpected findings, arriving at three plausible

s mentioned above, the LightTracker data represent the best source of market-ales data available, but the dataset is not perfect. The point-of-sale data that up part of the overall dataset exclude HI, hardware, and some membership

Comment [GR33]: Was MA adjusted for the ~13% territories? Should it be?

Comment [GR34]: Aggressive states with higher may also be spending more – and more per unit - o fixtures.

some of the most common places at which consumers buy bulbs.[19] Except for ss merchandise channel, retailers in the point-of-sale dataset tend to carry and maller volume of bulbs, and stocking leans towards inefficient bulb types, which bias any effort to describe national sales from these channels only. In contrast point-of-sale data, the panel data that account for the remainder of the racker dataset include all retail channels and retailers. However, a thorough of the data suggests that households likely differ in how diligently they scan g purchases, which could also create bias (e.g., if they were more likely to scan rable purchases). Each of these weaknesses may introduce bias, particularly g to undercounts of purchases made in certain channels (exacerbated by the n distribution of retailers across the nation) or transactions—such as light bulb ses—that may be less memorable (and therefore more prone not to being ed). The model attempts to control for the channel-related bias through the on of a variable for the square footage of retailers not in the POS data, but the tors did not find a satisfactory way to mitigate bias related to inconsistent ng.

d, the modelling team did not have access to estimates of household-level saturation for each state, yet previous research has suggested that prior high of energy-efficient socket saturation reduce current energy-efficient bulb [0,21] In short, the more long-lived bulbs a household already has installed, the ighting purchases it must make. Unfortunately, the lack of saturation rates for f the 17 states preclude us from testing this explanation directly.

and related to the second point, is the history of program activity.[22] Again, ch has shown the importance that the duration of prior program activity has on -efficient bulb purchases. States with long-standing, aggressive programs eded in getting households to adopt these energy-efficient bulbs, and, again, se of longer measure lives, households need to purchase fewer bulbs now as t. In short, other states are catching up to the level Connecticut and some other m states established in prior years.

ID ELASTICITY MODELING – METHODOLOGY

hting products that incur price changes and promotion during the program s valuable information regarding the correlation between sales and prices.

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by channel in Massachusetts, see NMR Group. 2016. *RLPNC 16-3 Lighting Decision Making*. g/wordpress/wp-content/uploads/RLPNC-16-3-Lighting-Decision-Making-Memo.pdf. The sachusetts RLPNC 16-6 Shelf Stocking and Webscraping Study addresses bulb stocking ilability by retail channel.

). *Results of the Multistate CFL Modeling Effort*. at izect.com/sites/default/files/FINAL%20CFL%20Modeling%20Report%20CT%20020210.pdf

l. *Results of the Multistate CFL Modeling Effort (Y2).* At file:///C:/Users/Chris/Downloads/2011-Modeling-Report.pdf

l. *Results of the Multistate CFL Modeling Effort (Y2).* At file:///C:/Users/Chris/Downloads/2011-Modeling-Report.pdf , section 4.

ticity modeling derives from the same economic principle driving program nd for efficient lighting is elastic and changes in price and merchandising nges in quantities sold (i.e., the upstream buydown approach). Demand eling uses sales and merchandising information to achieve the following:

fy the relationship of price and merchandising to sales
t the likely sales level without the program intervention (i.e., baseline sales)
ite freeridership by comparing predicted baseline savings with predicted m savings

ne demand elasticity approach relies only on program data; therefore, the nate is net-of-freeriders, which excludes spillover. Including spillover would NTG estimate and would be higher than net-of-freeriders. However, the data or this adjustment. Estimating freeridership using the demand elasticity model nating price elasticities and coefficients for non-price effects (e.g., in-store d merchandising).

/ is measured as a proportional change in demand relative to a proportional e. For example, if the price of a light bulb decreases by 10% and sales increase elasticity is equal to two. The upstream program approach assumes that ices for efficient lighting products will increase demand. Estimating price d having the price absent program incentives (and therefore the proportional ws researchers to estimate demand for program bulbs absent the program estimate a freeridership ratio, predicted program sales and sales likely to occur am incentives and promotions are first multiplied by savings per-bulb. The atio is then the relationship between the predicted savings without the program cted savings with the program:

$$Freeridership\ Ratio = \frac{Predicted\ Savings\ without\ Program}{Predicted\ Savings\ with\ Program}$$

ind elasticity approach relies exclusively on program data, the model's epended on data quality. Overall, the available data from the Connecticut egy achieved a sufficient quality to support the analysis. However, there were sary adjustments made to several key inputs in the model. The modifications g inputs are discussed in greater detail in Appendix A.2.1:

nality: The demand elasticity model included a seasonal trend provided by ne previous program implementer, to control for seasonal sales variations that from seasonality (i.e., changes in daylight hours) rather than program factors. easonal trend represented the proportion of annual national sales expected to n a given month from a major national lighting manufacturer. Using data at a al aggregation level, including non-program products and areas without ms, limited the degree that resulting trends correlated with program activity.

Variation: The modeling approached combined sales and prices for similar ts (e.g., all 60-watt equivalent A-line bulbs) within the same store rather than ing price and sales variations for each individual model number. Aggregating and sales captures 1) substitutions between comparable program products each category and 2) variations in price across comparable products. The only included sales with price variations as products with no variation in price contribute any information to the model. The greater the price variation levels retailers and lamp styles, the more representative the elasticity estimates e when applied to sales of products that did not exhibit price variations.

otional Displays: Program data contained a comprehensive list of all in-store tional events, but the information on merchandising displays only represented ple of locations. Due to the merchandising data's nature, the model could not sales for observations with missing merchandising data, and substituting andising coefficients would risk overstating program impact. However, not nting for merchandising may overestimate freeridership to the extent that the coefficients do not reflect all the merchandising impact. Ultimately, the study ed display merchandising data from the model.

elasticity model specification is described in detail in Appendix A.2.2. In short, anized bulb and pricing data as a panel, with a cross-section of program bulb each unique retail location, bulb type, and baseline wattage combination. These d over time as a function of price, bulb characteristics (specialty, standard, l retail channel (e.g., club, HI, HTR, and mass market). Nesting elasticity way accounts for differences in retailer strategies and target demographics, as nces in demand given bulb characteristics.

bootstrap standard errors, the distribution of freeridership predictions was buted with a median value nearly identical to the estimated freeridership rate ared to 52%) with precision of +/- 7% at the 90% confidence interval (Appendix

MARKING – METHODOLOGY

g numerous studies, the team identified 11 studies estimating retrospective and TG ratios for upstream lighting programs from 2013 to present to use for R1615 results. Benchmarking the studies offered insights into the validity and ss of the NTG ratio that the R1615 study estimated. Appendix A.3 lists the

NSUS PANEL – METHODOLOGY[23]

tasks yielded multiple estimates of and insights into NTG for 2015 and 2016 s of NTG for 2017 through 2021. Each of the methods, however, has strengths es, and only one approach had the ability to provide predictions for prospective re, the study turned to a team of lighting experts and asked them to engage in

s-panel differed from a Delphi approach: panelists provided only one round of anonymous e *final* decisions were determined during a single meeting through dialogue as opposed to anonymous submittals.

ouilding approach (i.e., consensus panel) to integrate the NTG estimates into nmended values for LEDs for each year (i.e., retrospective for 2015 and 2016 ve for 2017 to 2020). As a first step in this process, the evaluators prepared a ne results from the current R1615 research tasks, results from the 2014/2015 cut NTG study, and recent LED NTG results from other jurisdictions, including engths, weaknesses, and sources of potential bias of the various approaches 'he summary was distributed to the EEB Evaluation Consultants, the leads of R1615 research efforts, and one program manager from a different service ey provided their own assessments of which methods offered the strongest NTG. Then, to reach agreement on appropriate NTG values, the same ovided their own estimates of NTG based on the results of the various methods nformation on prior saturation trends, NTG estimates from other jurisdictions, ertise, and the most current information available on the implementation of the AR Lamp 2.0 specification. In February 2017, the group met to discuss the nd their estimates, ultimately reaching consensus on recommended values for 2020.[25]

Comment [GR35]: Please append this summary.

How many people in total?

anels help limit the bias introduced by any single method or evaluation study mmending a NTG value. Instead, the reliance on multiple estimates and the dom of individuals familiar with the Retail Products program and programs l nationally limits individual bias to successfully assess a rapidly changing

r from another jurisdiction was invited but declined participation.
e evaluation team successfully used this approach recently in Massachusetts, as documented in ınd DNV GL, 2015. *Multistage Net-to-Gross Assessment Overall Report.* Delivered to the PAs ultants in August. http://ma-eeac.org/wordpress/wp-content/uploads/Multistage-Lighting-Net-to-nt-Overall-Report.pdf.

Section 3 Net-to-Gross Estimates

The study examined NTG ratios through supplier interviews, sales data modeling, demand elasticity modeling, and benchmarking. A panel of lighting experts considered the results of these approaches and market intelligence to arrive at recommended NTG values retrospectively for 2015 and 2016 and prospectively for 2017 through 2020. Table 4
esults of the R1615 efforts.

ble 4: Estimated and Recommended LED NTG Estimates

	Retrospective[1]		Prospective				
	2015	2016	2017	2018	2019	2020	2021
g Strategy Bulbs	100%	100%	-	-	-	-	-
SD	82%	82%	-	-	-	-	-
r interviews	61%	61%	40%		38%		35%
eling	70%	70%	-	-	-	-	-
ty	61%	61%	-	-	-	-	-
nel /	**63%**	**57%**	**47%**	**40%**	**36%**	**33%**	**-**

erviews addressed 2015-2016 estimates together, while the sales data and demand elasticity
sed only 2015. The consensus panel recommended separate estimates for 2015 and 2016.
odel includes only program data, the estimate is net-of-freeriders, which excludes spillover.

describes the consensus panel's reasoning behind their recommendations. In
tors drove their decision making, as described in more detail below:

/ declines. After anonymously providing estimates, the consensus panel used
erage of their estimated NTG ratios for the LED market overall which they
provided for 2015 through 2016. They recommended 63% for 2015 and 57%
6.

term uncertainty. Panelists' average estimates for 2018 through 2020
ued the steady decline from 2017: 47% for 2017, 40% for 2018, 36% for 2019,
% for 2020. Through discussion, the panel decided that the market holds too
uncertainty to make concrete predictions and, as such, the estimates should be
uated in late 2017 or 2018—or by 2019 at the latest.

ype. The consensus panelists ultimately decided to combine standard and
or bulbs into a single category of non-HTR LEDs due to the similarity in
te estimates and uncertainty regarding the adoption and implementation of the
ule that expands the general service lamp definition to include reflectors and
other specialty bulb types.

ction across markets. One of the themes stretching across panelists' reports
market was that incentives appear more pivotal for incenting HTR customers

hase LED bulbs. Therefore, they recommended that increasing NTG estimates HTR market by 20 percentage points across years would result in fair tes.

SPECTIVE NTG ESTIMATES: LEDS OVERALL

tasks resulted in overall 2015 LED NTG ratios ranging from 61% to 70%. ts—coupled with additional market information—led the consensus panel nend an overall non-HTR LED NTG ratio (inclusive of standard (A-line), and other specialty types) of 63% for 2015 and 57% for 2016.

ares the retrospective LED NTG ratios across research activities by bulb type ratios that the consensus panel recommends.

stimated and Recommended Retrospective LED NTG Estimates[1]

		LED Bulb Type				HTR – All LED Styles
		All	Standard	Reflector	Specialty	
g Strategy Bulbs		*100%*	*68%*	*23%*	*9%*	-
SD		82%	-	-	-	-
r interviews		61%	63%	58%	-	100%
eling		70%	-	-	-	-
ity modeling[2]		61%	73%	62%	40%	-
nel /	**2015**	**63%**	**63%**	**63%**	**63%**	**83%**
	2016	**57%**	**57%**	**57%**	**57%**	**77%**

erviews addressed 2015-2016 estimates together, while the sales data and demand g addressed only 2015. The consensus panel recommended separate estimates for

odel includes only program data, the estimate is net-of-freeriders, which excludes

2016 period, suppliers estimated an overall LED NTG ratio of 61%, the sales resulted in an overall LED NTG ratio of 70%, and demand elasticity estimated rs of 61%. In comparison, the last supply-side-based LED NTG estimate for program (for the 2014 period) was 74% and the 2017 PSD uses a value of n the recommendations of the R86 Lighting NTG study).

ibuted a decline in program attribution to increasing availability of LEDs, prices, and broader consumer acceptance of LED products. In the words of

ustry has been saying for over a year now, publicly, that the LED transition is ng. It's happening partially because of programs like the Massachusetts and *icut programs, [but also] partly because of non-ENERGY STAR high-quality, low-priced products from major manufacturers."*

r the past several years outside of Connecticut have estimated overall LED nging from 73% to 100%, with a median value of 85% (n=9 studies). The most / comparable, recently conducted study relied on consensus panel to estimate NTG ratio of 95% for Massachusetts for 2014. The individual research efforts ere included supplier interviews, demand elasticity modeling, sales data l comparison area approaches, with empirical estimates ranging from 75% to ssachusetts consensus panel predicted a prospective NTG ratio of 93% for achusetts. Section 3.3 includes details and further benchmarking discussion.

spective NTG Estimates by Bulb Type

and demand elasticity modeling attributed greater program impact on bulb sales compared to specialty and reflector sales. Yet the consensus eved that the estimates were adequately similar and the uncertainty great assign standard, reflector, and specialty bulbs the same NTG.

views and demand elasticity modeling both explored NTG by bulb type. The rrived at the somewhat unexpected finding that NTG or net-of-freeriders e higher for standard LEDs compared to reflector and specialty LEDs.

nated a standard LED NTG ratio of 63% and reflector LED NTG of 58%. Table nand elasticity results overall and by bulb type. With greater elasticity, specialty andard (-1.88) LEDs exhibited higher net-of-freeridership rates (62% and 73%, when compared with reflector LEDs (40%).

Deleted: Table 26

ıs panelists reported the likely explanations for the lower NTG for reflector planation ties directly to the characteristics of LEDs: reflectors are directional light only shines downward), are typically located in recessed cans installed n other difficult to access fixtures (making a long-life bulb appealing), and are to dimmer switches. While standard LEDs do come in non-dimmable models e to be omnidirectional, these features are not necessary for reflectors. Another r lower elasticities for specialty products stems from the fact that there are few tives to using a specialty bulb in particular applications. For example, re unlikely to install anything but a flame-style, small-screw base bulb in a signed for such bulbs. Likewise, panelists noted that reflector CFLs have not enetrated the market, creating less market competition for energy-efficient . The panelists concurred that the uncertainty in the estimates—and the fact NTG estimates by bulb type varied by five percentage points or less (Appendix oo great to justify assigning separate NTG ratios for standard, reflector, and . Thus, they recommended the same retrospective and prospective estimates .EDs presented in Table 5 be applied to reflector and other specialty bulbs as

Comment [GR36]: While dimmability is not "nece standard lamps, I'd opine that more interior reflector circuits than are standard fixtures.

Table 6: LED Elasticities and Freeridership by Bulb Type

(Demand elasticity modeling results)

	Average Elasticity	Freeridership	Net-of-Freeridership
	-0.84	60%	40%
	-2.20	38%	62%
	-1.88	27%	73%
	-1.61	**39%**	**61%**

spective NTG Estimates by Retail Channel

suppliers' estimates, the big box stores, with relatively low NTG ratios, overall NTG ratios.

ıterviews and demand elasticity analysis were able to provide NTG estimates l channels. The contract covering the LightTracker data prevented the sales ı from providing similarly detailed results.

discounted bulbs in six retail channels:

y
are
ch as Lowe's
narket retailers, such as Target
such as Costco

il channel-level estimates resulted in higher NTG ratios in the HTR channels G ratios in the big box stores, including HI, mass market, and club channels cause big box stores composed over 90% of the program's 2015-2016 program dard LEDs and LED reflectors, the NTG estimates for these channels largely e program-level NTG results. For example, HI retailers represented 68% of ; and had NTG ratios of 62% for standard LEDs and 50% for specialty LEDs. represented 18% of program sales and had NTG ratios of 49% and 64% Finally, mass market retailers, representing 6% of program sales had NTG and 64%, respectively.

ıs panel determined that HTR channels rely on program support more than s. Panelists, therefore, assigned higher NTG ratios for HTR channels, adding points to their recommended annual estimates.

Comment [GR37]: Spell out

Comment [GR38]: Have we definitively defined "b

Deleted: Figure 3

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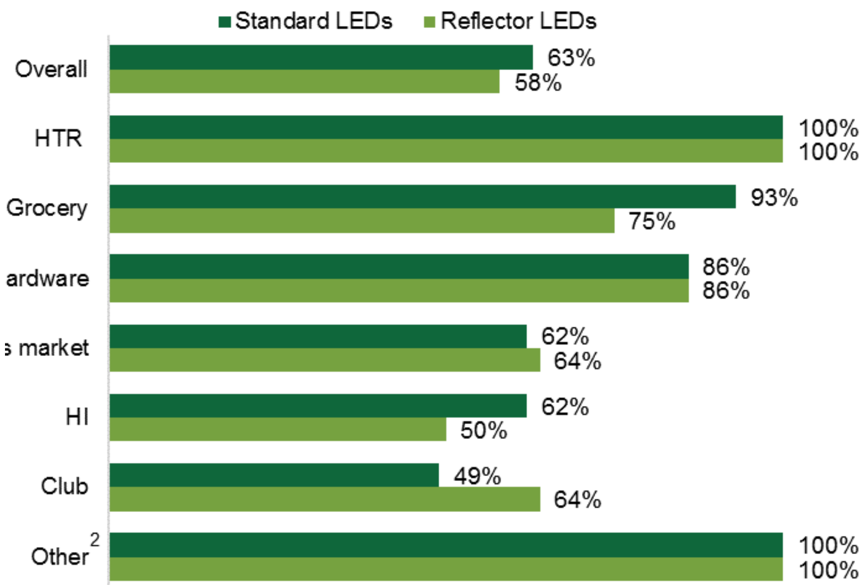
rogram staff, the program considers stores HTR based on two factors: 1) if the store is located community with a large minority and/or elderly population and 2) if it is a discount store, such as ean State Job Lot. For the purpose of analysis, the study used the second criterion to classify

ED Retrospective NTG Estimates by Retail Channel for 2015-2016

(Supplier interview results, n=16)[1]



e sizes vary by retail channel.
represents LED sales through special program-driven community or corporate events.

the number of supplier interviewees who provided NTG estimates (i.e., sample
retail channel and the percentage of total program sales through that channel
nterviewees cumulatively represented. Except for the hardware channel, the
rs cumulatively accounted for the vast majority of program sales. Furthermore,
channel accounted for only a very small percentage of 2015-2016 program LED
both standard and reflector LEDs).

Comment [GR39]: Do we need a graphic that sho through each retail channel? Or add it to this Figure

Comment [GR40]: Or include retail channel progr

Retrospective LED NTG Estimates and Program Sales by Retail Channel and Bulb Type

(Supplier interviews results)

Standard LEDs			Reflector LEDs		
n	NTG	% of Program Sales[1]	n	NTG	% of Program Sales[1]
2	100%	99%	2	100%	99%
2	93%	68%	1	75%	59%
2	86%	27%	2	86%	27%
7	62%	100%	9	50%	99%
4	62%	100%	3	64%	100%
3	49%	100%	4	64%	98%
1	100%	100%	1	100%	100%
16	**63%**	**99%**	**16**	**58%**	**99%**

2015-2016 program sales through the respective channel which estimators represented.

:lasticity modeling showed particularly high net-of-freeridership among :ket retailers.

:ed by retail channel, LEDs sold in mass market stores exhibited particularly :eridership at 85%, which is counter to what the suppliers estimated. nass market retailers produced the greatest estimated elasticity for LEDs (- noticeably higher than that of LEDs overall (-1.61) (Table 8). Recall that greater an greater price sensitivity. According to program data, however, mass market unted for only 5% of LED sales in 2015, yet club and HI stores accounted for ales (Table 20 in Appendix A.2.1).[27]

Deleted: Table 8

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.ED Retrospective Net-of-Freeridership and Elasticities by Retail Channel

(Demand elasticity modeling results)

Channel	Elasticity	Net-of-Freeridership
	-1.52	55%
	-1.68	63%
nd grocery[1]	-0.53	42%
narket	-2.72	85%
ll	**-1.61**	**61%**

tores represented a limited percentage of sales in the model; a such, the analysis aggregated d grocery.

ole average markdowns across retail channels indicates that differences ties were a primary driver of differences in freeridership.

average prices per LED by retail channel. Before and after applying incentives, :rs exhibited the highest price per bulb.

average markdown (i.e., the incentive as a share of the original price) was channels, ranging from 46% to 55%. With relatively comparable markdown nces in elasticities between channels served as the primary driver of lifferences between retail channels.

:tailers may provide an opportunity to lower program freeridership with increased program focus. narket retailers typically do not move the same volume as HI and club retailers. Additionally, will likely be influenced by the prevalence of and competition from lower-priced, non-ENERGY

Table 9: Price per LED by Retail Channel

(Lighting program data – 2015)

nel	Average Values			
	Initial Price per Bulb	Rebate per Bulb	Final Price per Bulb	Markdown %
	$ 10.07	$ 4.66	$ 5.41	46%
	$ 9.84	$ 4.54	$ 5.30	46%
cery[1]	$ 13.41	$ 7.09	$ 6.32	53%
:	$ 8.67	$ 4.74	$ 3.92	55%
	$10.12	**$4.79**	**$5.33**	**47%**

ity modeling required adequate sample sizes for statistical significance so it grouped HTR and . HTR retailers alone had the lowest final price per bulb ($3.50). After removing HTR bulbs from average weighted final price per bulb was still $6.32, suggesting that grocery stores dominate tegory.

ECTIVE NTG ESTIMATES

predicted decreases in LED NTG from 2017 to 2021, dropping from 40% he consensus panel also expected declines, recommending placeholder at drop from 47% in 2017 to 33% in 2020. However, the panel also nded reevaluating NTG in the near future to verify or alter these ve values, citing the rapidly changing and uncertain lighting market.

e primary-research tasks had the ability to measure prospective NTG ratios— iews. This was done by asking suppliers to estimate market share with and ogram in 2017 to 2020.[28] As shown in Table 10, suppliers predicted steadily ospective NTG ratios of 40% in 2017, 38% in 2019, and 35% in 2021. They : standard LED NTG would be 39% in 2017 but hold steady through 2021 at 's estimated lower NTG for reflector LEDs in 2017 through 2021, starting at ning to 33%.

is panel considered the results of the supplier interviews and various market l intelligence to estimate prospective NTG. The panel reached a consensus 7% for combined non-HTR LED NTG (standard [A-line], reflector, and other s) in 2017, and expected steady declines after that: 40% for 2018, 36% for % for 2020. Due to market and legislative uncertainties they suggested that be reevaluated in 2017 or 2018 and no later than 2019. The panel recognized NTG may be slightly lower than standard NTG, but they predicted that the e close enough (varying by five percentage points or less) and the uncertainty to use the same estimate for all types of LEDs.

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e prospective market share estimation method differs from the retrospective one, which was rs estimating the impact of the program on their organization's sales. Therefore, the two not directly comparable, and the study discusses only prospective estimates here.

were asked about overall market share, suppliers did not address prospective channel. However, as noted, the consensus panel explained that other market oints to a stronger program impact on the HTR channel than other types of y suggested prospective LED NTG estimates 20 percentage points higher for et than for the market overall: 67% for 2017, 60% for 2018, 56% for 2019, and

ble 10: Prospective NTG Estimates by Year and Bulb Type

(Supplier interview results)

Bulb Type	n	Prospective		
		2017	2019	2021
ard	13	39%	35%	37%
tor	13	41%	43%	33%
	13	**40%**	**38%**	**35%**

are also considerably lower than the Massachusetts consensus panel overall LED NTG ratios of 85% for 2017 and 78% for 2018 (Section 3.3), oted earlier, the market has changed considerably since the panelists there ir estimates, which likely limits their current applicability.

Comment [GR41]: So, is this even worth noting th

MARKING

he literature used in the benchmarking effort. As mentioned previously, overall ios ranged from 73% to 100%, with a midpoint of 85% (n=9 studies). As eviously, these values are higher than the overall net-of-freeridership and NTG ed for R1615: 61% from demand elasticity modeling, 70% from sales data 61% from supplier interviews. Underscored by the consensus panel, the other states, however, were developed prior to the R1615 research, and given anging market, it is not surprising that Connecticut values would differ from r studies. Some of the NTG values examined represented deemed or assumed ners did not clearly define the source of the estimate. The values for Efficiency Xcel Colorado (91%), and Entergy Arkansas (80%) came from demand and y modeling. Many of these efforts included participant spillover and spillover in addition to freeridership, possibly providing further evidence that mand elasticity modeling effort may underestimate the Connecticut program

Comment [GR42]: Which were measured/modele

views also informed the Xcel Colorado and PG&E estimates. Connecticut mate for reflector LEDs (58%) was much higher than the only NTG ratio for nd in literature: PG&E's 2013-2014 upstream lighting program evaluation DNV GL resulted in a NTG ratio of 27% for reflector LEDs. The reader should wo to three years that have passed since that evaluation and the geographical tween California and Connecticut do not make the R1615 and the California tly comparable. The California estimates also stand out as being far lower than

Comment [GR43]: In fact, one would assume tha further over time.

/eloped, which could reflect a more mature LED market in the state or variations on methods used there.

Table 11: Benchmarking Retrospective NTG Estimates

ity/Company	Associated year	LED NTG	Research methods
ewide	2016[1]	93%	Prospective NTG prediction from consensus panel
ewide	2014	95%	Retrospective NTG estimate from consensus panel[3]
ewide	2012	92%	Assumption[4]
;iency Maine	2013-2014	77%	Price elasticity
ewide	2014	82%	Demand elasticity, sales data modeling, supplier interviews
est			
l	2015	91%	Demand elasticity, store-intercepts, supplier interviews
not yet public)	2015	85%	Literature review
ıEd	2014-2015	73%	Store-intercepts
;E	2013-2014	40% / 27%[2]	Choice model and supplier interviews
Ξ		42% / 28%	
G&E		35% / 28%	
;	2014	100%	Assumption[2]
; Energy	2015	85%	Assumption[2]
ergy	2013	80%	Demand elasticity modeling

rospective NTG prediction developed in 2015 based on research completed in 2014.
flector LEDs, respectively
derived from individual studies ranged from 75% for supplier interviews to 98% from sales data 3.
rom program savings assumptions (such as from a PSD)

olished prospective NTG ratios, estimating as far forward as 2018 (Table 12). sults from a consensus panel held in Massachusetts in May of 2015, it resulted atios of 85% for 2017 and 78% for 2018. These rates are considerably higher dicted by the supplier interviewees from R1615 which estimated 40% for 2017, Massachusetts estimates are dated given the rapid change in the market. The nel concurred with this perspective.

Comment [GR44]: There are two footnote “3” bel

Comment [GR45]: Can something be said as to v much lower?

Table 12: Benchmarking Prospective NTG Estimates

egion	Entity/Company	LED NTG		Research methods
		2017	2018	
	Statewide	40%	-	Supplier interviews
	Statewide	85%	78%	Consensus Panel

s panel considered the strengths and weaknesses of each study to guide the ne most reliable NTG values to use for Connecticut's LEDs. Ultimately, the nel determined that all studies were too dated or geographically distant to into their considerations. The bullets below address additional strengths and of the studies; these assertions come the authors of the literature and the e consensus panel:

nd and price elasticity modeling. Using inputs such as price, promotional , product placement, and sales variations within a specified program period, asticity modeling approaches offer statistically reliable results compared to es like in-depth interviewing, literature reviews, or consensus panels. For both cticut studies, some retail channel data were missing which may have led to plete results that do not take into account the full picture. The Xcel Colorado d elasticity modeling had a low measurement error, signaling its potential ity; on top of that, it was weighted with two other research effort results (store pts and supplier interviews). The Xcel study included spillover in addition to ership.

ier interviews. R1615, the 2014 Connecticut study, the Xcel Colorado, and nia studies drew from supplier interviews. While suppliers offer context and a understanding of the market, and can represent a large portion of sales in a interview, they may be biased because of their inherent interest in program uation because their companies leverage program incentives.

intercepts. Store intercepts offer the opportunity to collect details on ners' true decision-making process; they also offer the opportunity to achieve nough sample sizes to estimate NTG with statistically significant precision. The d Illinois study, for example, had a sample size of 726. It includes spillover and ticipant spillover. The California study's choice modeling inputs included store pt data.

nsus panels and literature reviews. Qualitative efforts drawing on the ctives of industry experts and industry-wide data create the opportunity for checks and assessments of the reasonableness of quantitative findings. The chusetts study used a consensus panel. The MidAmerican literature review so perspective based; researchers used the average NTG values associated ograms which they perceived as comparable to the MidAmerican program and eographically close to Illinois—they do not account for nationwide dynamics.

m savings documents. A few of the values from the benchmarking effort are ed values that administrators have used in their program planning entation. It is unclear from where the Rhode Island, SPS New Mexico, and nergy Texas NTG ratios came so these should be considered with caution.

Comment [GR46]: Why is such an old RI TRM va

Section 4 Market Trends and Predictions

The following section reports residential lighting sales trends and suppliers' predictions for upcoming sales trends that informed the consensus NTG process described above.

T MARKET TRENDS

ed sales data show that halogens and CFLs dominate the residential a whole in 2015, yet LED market share has been on the rise.

esidents were most likely to have purchased halogen bulbs in 2015, with the ehold having purchased 2.9 of them that year; in comparison, households y 1.5 LEDs, on average (Figure 4). LightTracker panel sales data (adjusted by e of retail space) showed that across all residential bulb sales in 2015 in LEDs accounted for less than one-fifth purchases (16%), while halogens 38% of them.

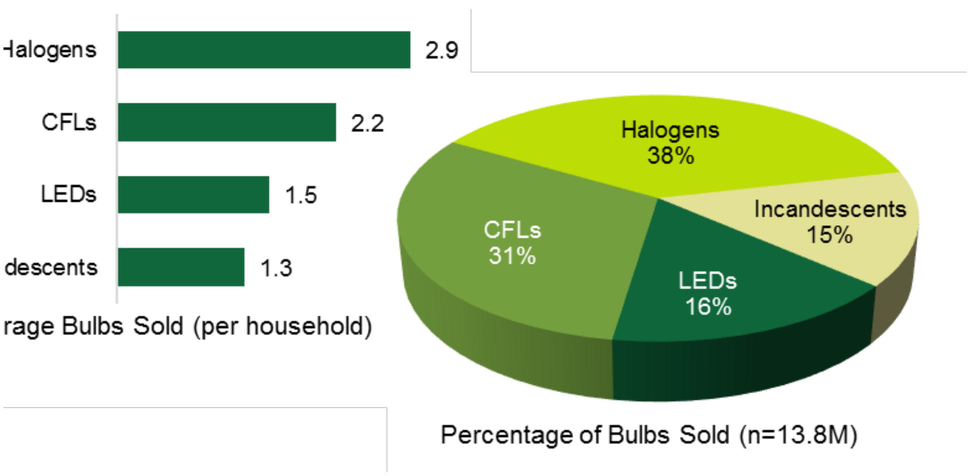
Comment [GR47]: What % were program LEDs?

Comment [GR48]: Though nearly half of sales we

Contrast to NEMA data to more current.

gure 4: Residential Lighting Sales in 2015 in Connecticut

(Based on LightTracker adjusted panel data)



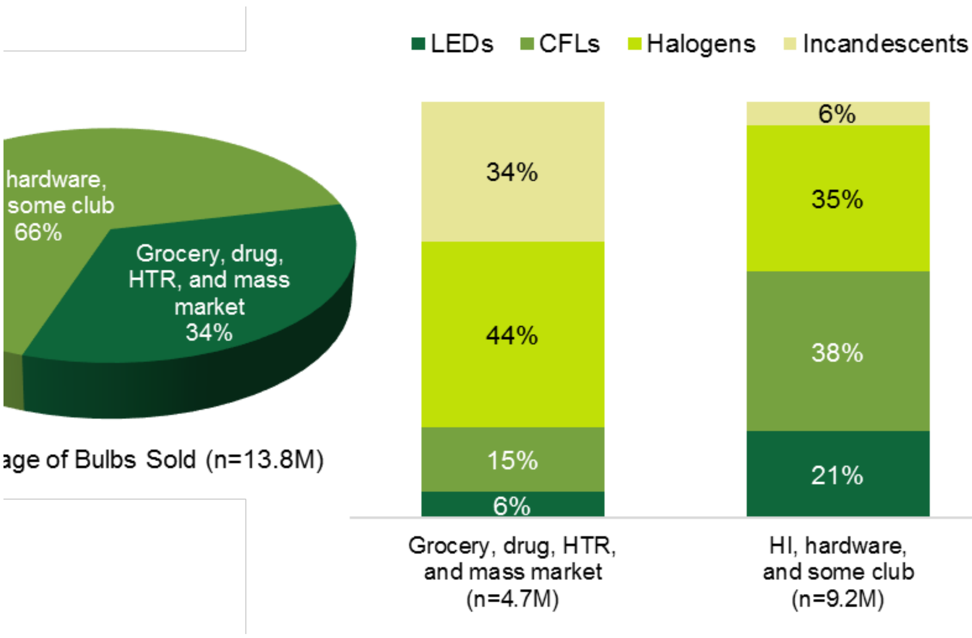
panel data included two types of data for 2015—one projected from scanned hased products obtained from a voluntary consumer panel and one derived a. The projected sales consumer panel data included HI, hardware, and some while the POS data came from grocery, drug, HTR, and mass market retailers; p accounted for about one-third of 2015 bulb sales in Connecticut (34%). As re 5, LEDs (21%) and CFLs (38%) accounted for much larger shares of the HI, l club retailer group's sales in comparison to the grocery, drug, HTR, and mass group's sales (6% and 15%, respectively). The latter group had considerably of halogen and incandescent bulbs than the former group.

ıe grocery, drug, HTR, and mass market retailers represented the minority of Connecticut, they were the only data available for looking back at actual trends Therefore, the trends illustrated and discussed below may overestimate and halogen sales and underestimate CFL and LED sales.

Comment [GR49]: "will likely"

: Residential Lighting Market Shares in 2015 in Connecticut by Retailer Group

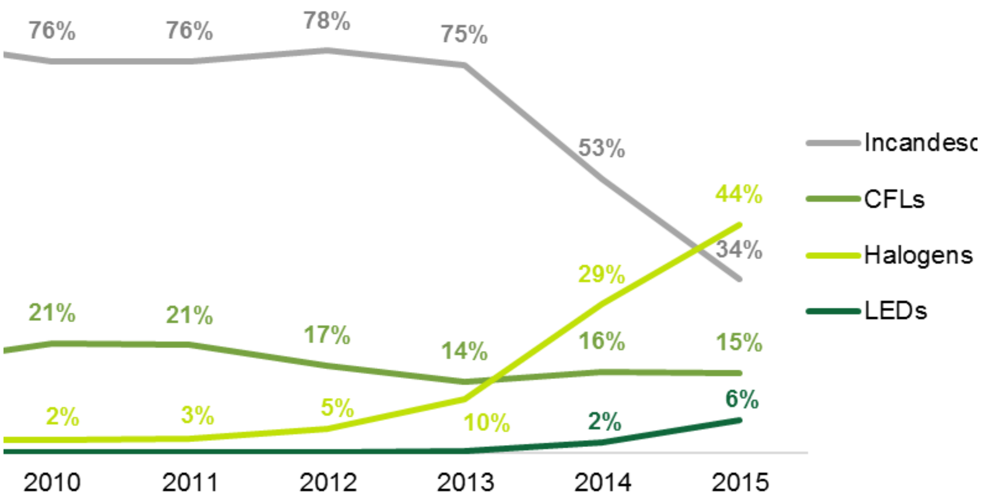
(Based on LightTracker adjusted panel data)



ꞋOS data for the grocery, drug, HTR, and mass market retailers shows that bulbs decreased from representing four-fifths of the market in 2009 (80%) to ıe-third of the market in 2015 (34%). As shown in Figure 6, halogen bulbs prising only 3% of those retailers' market in 2009 but growing to represent more of it in 2015 (44%). CFLs experienced little change over the seven-year period, 5%, peaking in 2010 and 2011 at 21%, and finishing at 17% of that market in epresented less than 1% of that market until 2014 (2%) and then tripled in n one year (6% in 2015). As discussed in detail below, suppliers estimated that inue to rapidly gain market share in the coming years, while shares of halogens, andescent bulbs will decline.

Residential Lighting Sales Trends from 2009-2015 in Connecticut

(Based on subset of retailer LightTracker POS data)[1]



sales from the grocery, drug, HTR, and mass market retailers only.

ET SHARE PREDICTIONS

e prospective NTG estimates described in Section 3.2, suppliers provided their Connecticut LED market share estimates assuming, first, that the Lighting nued through 2021, and, second, that the program ended in 2016.

onnecticut interviewees, however, also served the Massachusetts program. To urces, suppliers engaged in one interview covering related topics in both states. Massachusetts evaluation, suppliers were asked to predict market shares for hnologies for 2017, 2019, and 2021, not only LEDs. As with the Connecticut-ates, the suppliers first assumed that the Massachusetts program continued to discounts through 2021, and second assumed the program ended LED 016. Due to the length of the interview, the study did not ask for Connecticut-ates for all bulb types, and instead uses Massachusetts responses as a proxy ut market share predictions.

Comment [GR50]: How many?

icut and Massachusetts market share estimates presented below differ. ιis is most likely a result of methodological differences in data collection and lifferences in the lighting markets between the two neighboring states. The pecific market share estimates obtained to calculate NTG ratios addressed nd did not ask for estimates for other bulb technologies. In Massachusetts to provide market share estimates for all technologies, and those estimates 100%. It is likely that, in Massachusetts, suppliers adjusted their market share l they arrived at values that summed to 100%. In Connecticut, suppliers likely response for LED market share since they did not have to compare them to es.

ıdy presents the unweighted market share estimates for both Connecticut and s.[29] This reflects a decision made by the Massachusetts Program ; and Energy Efficiency Advisory Council consultants reflecting that state's eds. Showing the unweighted data for both states increases comparability in nnecticut and Massachusetts and avoids any confusion that could arise from of this report and similar Massachusetts reports.[30]

expect that continued program activity boosts standard and reflector ket shares by 13 to 16 percentage points, resulting in a 2021 predicted nare of 61% and 53% with the program. They expect the trajectory of are will increase 41% in the with program scenario and 50% in the without scenario.

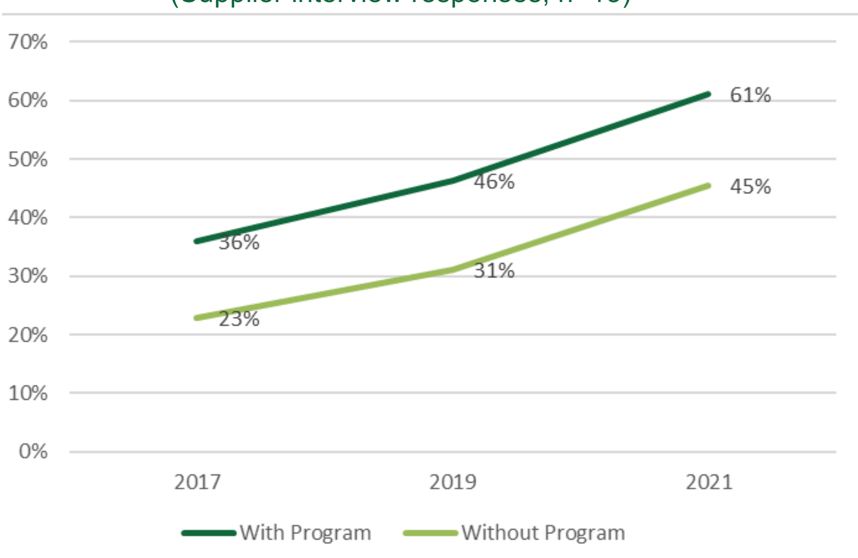
Comment [GR51]: "without"?

Comment [GR52]: Given 2016 NEMA data, these significant underestimates.

ıppliers predicted that standard market share with the program would be 36% asing to 46% in 2019 and 61% in 2021. Market shares without the program d to be 23% in 2017, 31% in 2019, and 45% in 2021. Predicted market shares am were one-fourth to one-third higher than without the program. The expected 41% between 2017 and 2021 in the scenario with program support and 50% without program support.

arket Share Predictions for Standard Bulbs by Year in Connecticut

(Supplier interview responses, n=13)



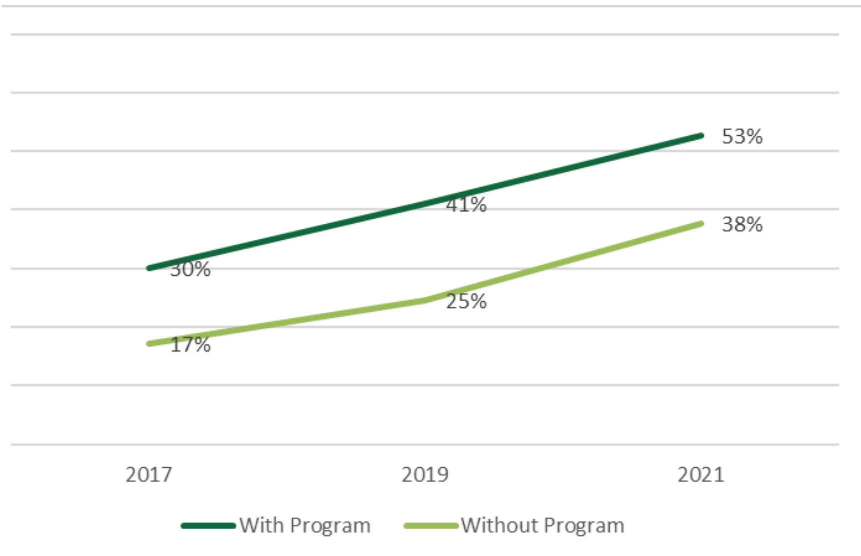
; presented in Section 3.2 remain weighted by the proportion of sales associated with each e weighting method used in prior Connecticut studies.

tudy presented one set of market share estimates for Massachusetts and the Massachusetts d another set of estimates.

:ut suppliers predicted slightly lower market shares for reflector LEDs. They flector market share of 30% in 2017, 41% in 2019, and 53% in 2021. Predicted et share without the program were between 13 and 16 percentage points lower: 25% in 2019, and 38% in 2021. Predicted market share with the program was igher than without the program. The expected trajectory of growth was slightly r standard LEDs at 43% between 2017 and 2021 in the scenario with program 5% in the scenario without program support.

arket Share Predictions for Reflector Bulbs by Year in Connecticut

(Supplier interview responses, n=13)



expected that program rebates will continue to be valuable because they e first cost of LEDs, but the rapid adoption of LEDs independent of the will decrease the influence of the program.

o explain their market share predictions, the most frequent explanation (46% s) was that if the Connecticut program continued, uld support a higher level of LED sales because e biggest barrier to LED sales. However, nearly ne respondents (38%) also observed that LED reasing at a rapid rate and cited this as a reason the program more attribution for LED sales in

"Without the program, people [wouldn't] pay for LEDs"

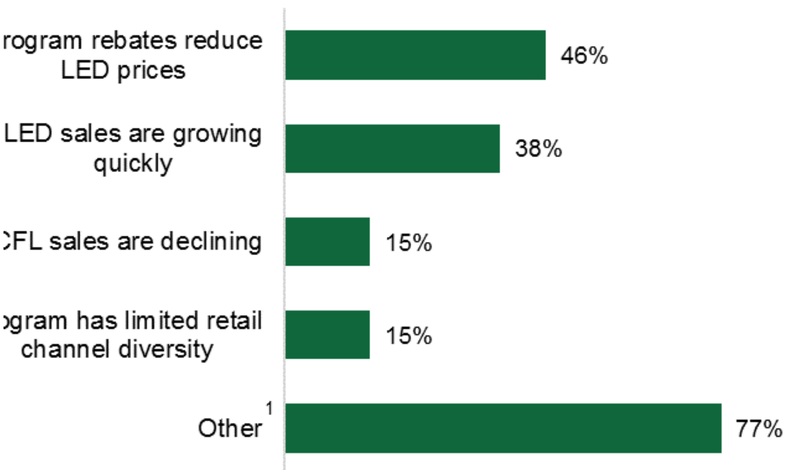
-Supplier interviewee

to recall that the suppliers made their predictions e of the LED market prior to the 2016 presidential n that some of the suppliers noted that a Trump uld change their thoughts about the future of the residential lighting market, it ıt, if asked today, they would attribute greater impact to the program for future ection 4 offers further context for external market factors.

/ee described numerous dynamics that played into the estimates; these re unique from the other more common responses. Thus, the *Other* category is represented by a large percentage (77%). Among the interviewee's the interviewee pointed to various aspects of the LED industry changing, such ctions; lamp, socket, and fixture markets transforming; and advancements in

Figure 9: Explanations for Prospective NTG Estimates

(Supplier interview responses, n=13)



nse percentages exceed 100% because multiple responses were allowed.
s that were mentioned only once.

g to the Massachusetts suppliers' predictions, program support in the ral years will remain vital to LEDs' steadily increasing dominance in the narket.

ers serving Massachusetts—most of whom also participated in the Connecticut vided predictions of market share for all bulb technologies in the presence and e program from 2017 to 2021. The Massachusetts suppliers predicted that, nnecticut Lighting Strategy continue, LEDs would grow to represent one-half of (55%) and reflector (49%) bulb markets by 2021 (Figure 10 and Figure 11).

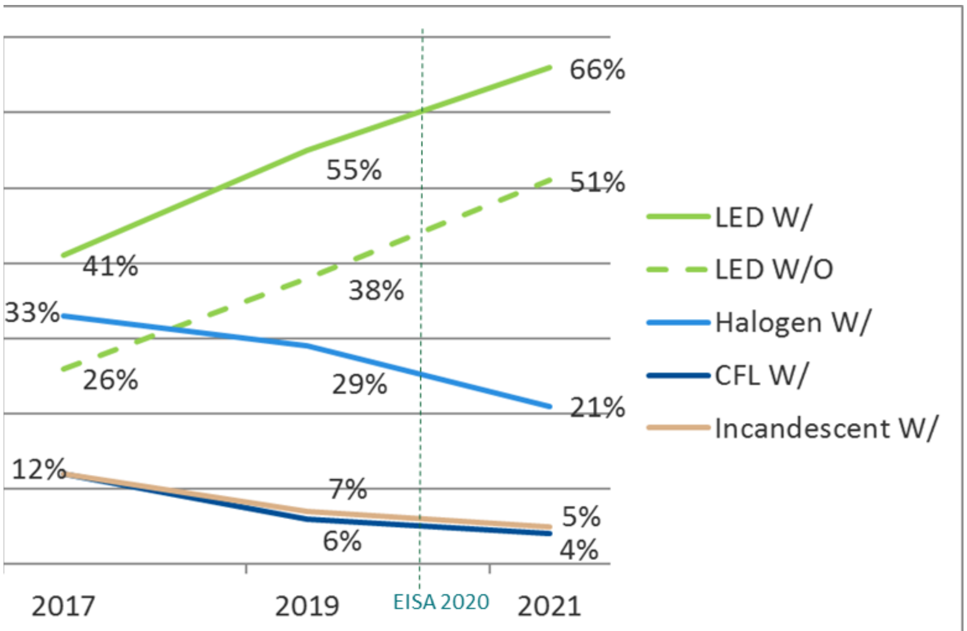
---

es responses in full included 1) the assumptions that halogens will go away in 2020 due to EISA; hat ENERGY STAR is a trusted brand with many consumers; 3) greater general availability of ısing will have different mixes of lighting sockets/fixtures than existing homes; 5) the LED fixture g bigger; 6) the Connecticut program has lower rebates and smaller product allocations than the pstream lighting program; 7) A-lamps will continue to be a popular lamp type; 8) LED prices are LED adoption in Connecticut is lower than it is in Massachusetts; 10) the simultaneous existence STAR and non-ENERGY STAR LEDs will help LEDs stay competitive with halogens; and 11) s improve LED technology.

rogram, standard LEDs would not account for one-half of market share until ectors would only reach 47% market share by 2021. Suppliers predicted that are of all other bulb types would decline in the presence (shown) and absence f the program. For standard bulbs, incandescent and CFL bulbs garner very of the market share (less than one-fourth) in 2017 and decline from there. g onto market share longer, falling from 33% in 2017 to 21% in 2021. Reflector ghtly, driven largely by the expectation that incandescent reflectors would retain for a longer period of time—an assumption that the recent DOE rulemaking expanded definition of general service lamps brings into question.

e 10: Market Share Predictions for Standard Bulbs by Year in Massachusetts[1]

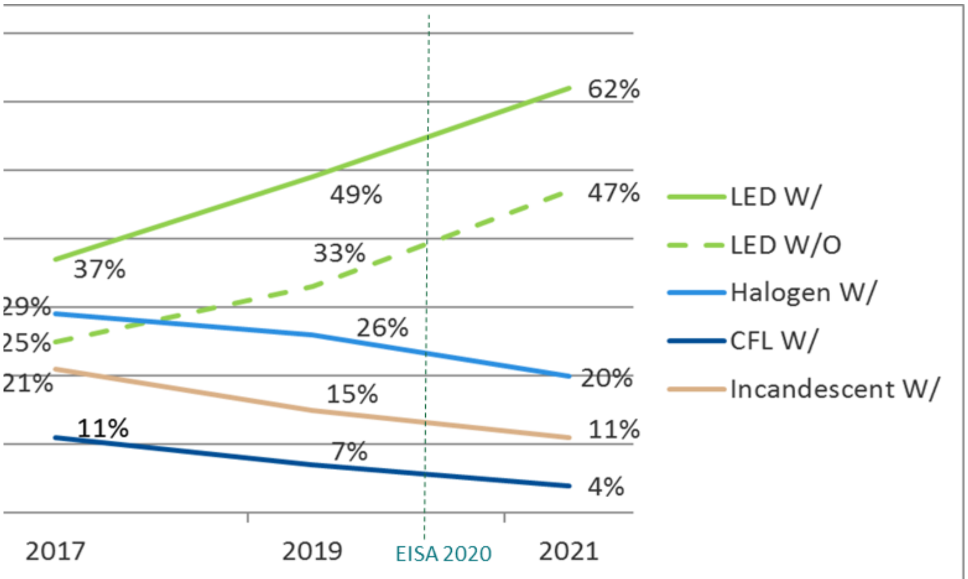
(Supplier interview responses, n=15)



ogram; W/O = without the program. All other trend lines assume the program will still be es after 2016.

e 11: Market Share Predictions for Reflector Bulbs by Year in Massachusetts[1]

(Supplier interview responses, n=15)



ogram; W/O = without the program. All other trend lines assume the program will still be
es after 2016.

ET IMPACTS OF ENERGY STAR 2.0

summarizes the interview responses of participating lighting market actors e implementation of the new ENERGY STAR specification 2.0. The key this new specification are that

FLs will no longer be qualified for the ENERGY label (as of January 17, 2017, were), and

previously unqualified LEDs will qualify for the label. These newly qualified tend to have shorter measure lives (15,000 hours) and often lack dimmability me other functions when compared to many LEDs previously qualified under GY STAR 1.1 (25,000 hours for general service with most being dimmable).

Comment [GR53]: Is this true?

While the shorter measure life was a spec change, re: dimmability requirements, was there?

icially went into effect on January 2, 2017, the DOE allowed manufacturers to bel bulbs under ENERGY STAR 2.0 in the summer of 2016. Programs across cluding the Connecticut Lighting Strategy—have started to offer newly qualified mpanies have also accelerated the timeline for removing all program incentives d will cease to offer them in 2017 instead of 2018. The program and evaluation explain that this decision rested on the fact that they only incent ENERGY d products because the more rigorous testing provides greater assurance of he product.[32] As part of its benchmarking efforts, this study has confirmed that ram administrators still offering CFLs in 2016 will also remove them from their ngs in 2017, citing the same reasons as the Companies in Connecticut.

sked suppliers to reflect on 1) ENERGY STAR 2.0's impacts on the market as ; impacts on the LED market, specifically; and 3) its impacts on the halogen fically. This sequential ordering of questions may make responses appear the following section. For example, when first asked about the ENERGY STAR n the market generally, only three interviewees suggested that it would cause ncrease; however, when asked what its impact would be on LEDs specifically, viewees predicted that it would cause LED sales to increase.

al ENERGY STAR 2.0 Market Impacts

anticipated that ENERGY STAR 2.0 will cause CFL sales to decrease and LED sales to increase, with some suggesting LEDs and halogens will lace of CFLs.

gure 12, when asked to project the impacts of ENERGY STAR 2.0 specification market in Connecticut, suppliers were most likely to say that it will cause CFL ase (36%), LED sales to increase (21%), or would have no impact (21%). Some oredicted that both LEDs and halogens would take over parts of the CFL lost A few lighting suppliers noted that all their products were already compliant STAR 2.0.

ent envisioned a scenario where the new specification would cause the AR share of total LED lamp sales to increase initially from current levels and y decrease. The initial increase would be due to the new specification, including ie LED lines which were not formerly ENERGY STAR qualified.[33] However, the ared that consumers would then shift to the even less expensive value-line still lack ENERGY STAR qualification. Assuming they are satisfied with the e bulbs, it could lead to decreases in ENERGY STAR market share, even if arket share increases.

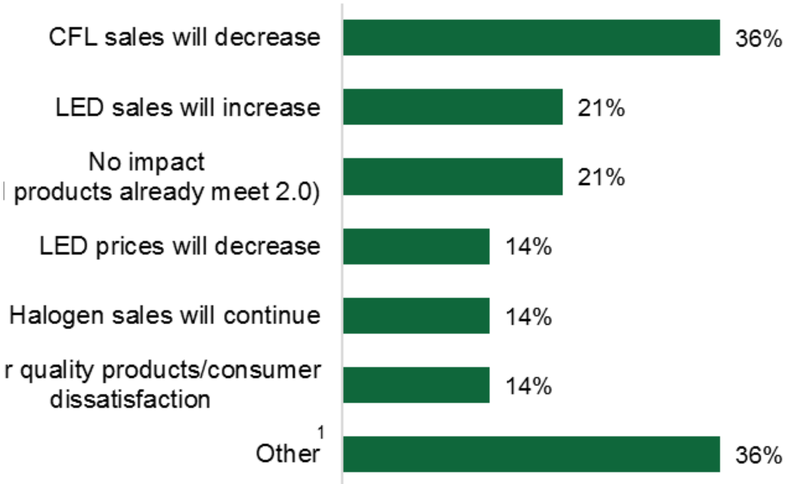
ippliers raised concerns about the quality of some of the new ENERGY STAR- products; one was concerned that inconsistent quality could lead to customer .

oreliminary work for Study R1616, the interviews addressed the invigorated HTR component of egy. The decision not to offer CFLs will lead the program to shift from CFLs to LEDs in the reach customers considered HTR.

resses value-line LEDS that still will not qualify for ENERGY STAR 2.0 in Market Impacts of Non- LEDs.

Expected Impacts of ENERGY STAR 2.0 on Connecticut Lighting Market

(Supplier interview responses, n=14)



nse percentages exceed 100% because multiple responses were allowed.
clude all effects which only a single respondent mentioned. These include 1) the possibility that hare will increase as it takes over CFL market share; 2) the prospect of an increase in the quality ne new specification; 3) a prediction of higher LED prices due to the new specification; 4) the program incentives to make the more expensive LEDs more competitive with other lamp l 5) the prospect (discussed above) that the new specification would cause the ENERGY STAR) lamp sales to initially increase from current levels and then eventually decrease.

GY STAR 2.0 Impacts on LEDs and Halogens

ers also asked the lighting suppliers about the impacts of the ENERGY STAR on on LED bulbs in particular. Over one-half of respondents (53%) said that the ion will lead to an increase in LED sales (Figure 13). Most suppliers cited lower nain driver of these increased sales. They speculated that the new specification e sale of less expensive LEDs that would be more cost competitive with other ologies, particularly if program incentives were still available—especially for s. One respondent also thought that LEDs would grab some of the market share uld be losing. Two respondents thought that higher LED costs could lead to a LED market share as long as alternative lower-cost lamp technologies were still

rs predicted that the new specification would lead to lower quality LEDs. One ined that consumers do not care much about the shorter lifespan of some of ERGY STAR-qualified bulbs, but that consumers may have issues with some not being omnidirectional.

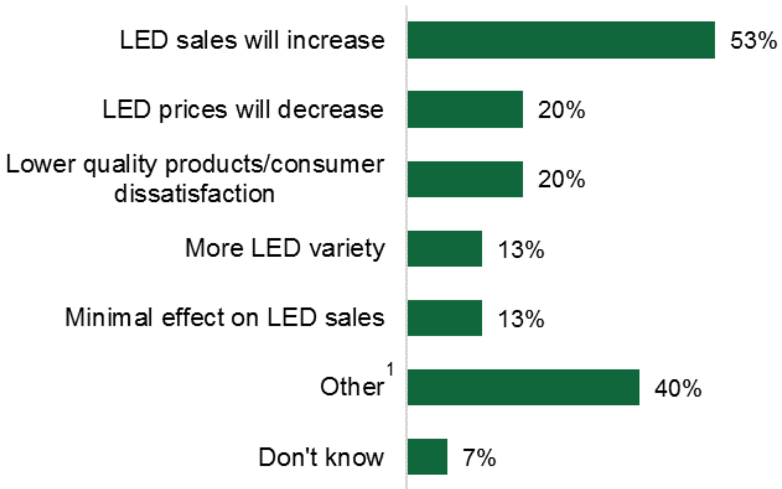
t LED prices could increase not only for higher efficacy general purpose also for newer LED technologies such as higher-wattage and three-way

Comment [GR54]: But they still are omnidirection were slightly relaxed in 2.0

Comment [GR55]: Explain. As in more efficient th Tier 2?

ıure 13: Expected Impacts of ENERGY STAR 2.0 on LEDs

(Supplier interview responses, n=15)



ınse percentages exceed 100% because multiple responses were allowed.
clude all effects which only a single respondent mentioned. These included 1) helping ENERGY EDs compete better with non-ENERGY STAR LEDs, 2) more variety in LEDs, 3) less variety in ch impact because all their products already meet the new ENERGY STAR specification, 5) the will cause the ENERGY STAR share of total LED lamp sales to initially increase from current eventually decrease, and 6) the specification will result in customers only purchasing ENERGY ogram rebates are available.

ussed their opinions about the impact of the new ENERGY STAR specification They did not agree as to whether halogen sales would increase, decrease, or due to the new specification. Those who predicted that halogen sales would ned that most halogens would be unable to meet the EISA 2020 efficacy manufacturers may reduce production. Likewise, the increasing popularity and st of LEDs would also take away market share from halogens.

vho thought halogen sales would remain the same or possibly increase pointed in CFL market share as an opportunity for halogens. They noted that once ar, halogens will be the lowest cost option for price-sensitive customers. One so observed that there continues to be a segment of the lighting market that incandescent and/or halogen technologies over CFLs and LEDs.

dents noted that whether the Connecticut program continues to rebate LEDs factor as to whether halogen sales would increase or decrease. They theorized ıram removed LED subsidies, many customers would switch back to halogens easons.

GY STAR 2.0 on CFLs

predicted that ENERGY STAR 2.0 will greatly curtail CFL sales and tly decrease CFL market share.

ENERGY STAR 2.0, which means that most CFLs no longer qualify for the nufacturer reported that his company briefly considered producing CFLs that e new specification but eventually decided against it. Two manufacturers said panies planned to stop producing CFLs, and others noted that a major national retailer announced it will stop selling CFLs in 2017. Some interviewees at not only would CFL sales decline, but CFL diversity also would decrease. nt hypothesized that the majority of future CFLs sales will be limited to more -wattage models. Only one respondent explicitly thought that much of the lost hare would go to halogens.

Comment [GR56]: Identify. What is their timefram stopped making CFLs?

Comment [GR57]: If public, can this be named? V in 2016 (but for 2017 implementation?)

Comment [GR58]: Because of higher LED costs i standard lamp categories?

T IMPACTS OF CFL PHASE-OUT

opined that the program's CFL phase-out would not intensify declining , but they perceived that program support is vital in LEDs taking over that are.

rogram staff, at the start of 2012, only 1% of program incentive dollars went to he 2012 to 2015 cycle 57% on average was devoted to LEDs. Currently, LEDs out 70% of program incentives. The Companies had anticipated continuing to me CFLs through 2018, but, as a result of ENERGY STAR Specification 2.0, trategy will shift to an all-LED program at some point in 2017.

Comment [GR59]: Be more specific as there are incentives being offered right now in May 2017.

Comment [GR60]: It already has. This language i language referring to Spring 2017 as the CFL end d

ed their perspectives on this programmatic shift: The consensus was that CFL clining sharply anyway, and the removal of program support would not have n this trend. One supplier predicted that some retailers would continue to sell se would be limited to 60W- and 75W-equivalent multi-packs, high-wattage ay products. The lighting suppliers predicted that LEDs would take over most market share, with halogens also gaining some sales.

also emphasized that continued program support was necessary to ensure that ot halogens--captured the lost CFL market share, especially in the 60W-, 0W-equivalent ranges. They claimed that if the program failed to make these ompetitive, many consumers would seek out halogens and lower cost and CFL bulbs still on the shelves. One supplier summarized,

Comment [GR61]: Understand the comment abou given higher prices; somewhat less as to so applyin for their large market share.

am stays, we will see LED market share go up, and we will see every other e go down, at least a little bit. If the program goes, halogen market share is o up. LED market share will fill the void of CFLs and probably some of the cent market as it dies. But if Massachusetts or Connecticut—or any other lled out today, the sale of LEDs would be reduced by significant margins. The halogen-compliant products would be increased by significant margins."

Appendix A Methodology – Additional Details

The following appendix offers additional details on the methodology behind the research findings.

A.1 Sales Data Modeling

appendix section includes additional details on the methods for conducting modeling.

Data Sources and Inputs

ing Sales

ker POS data set includes lighting sales data for grocery, drug, dollar, club, and distribution channels. These data represent actual sales that are scanned at ter for participating retailers.

Comment [GR62]: Does this include HI? what pe cover?

esents a panel of approximately 100,000 residential households across the e provided a handheld scanner for their home and instructed to scan every make that has a bar code. For Connecticut, the NCP included approximately ds in 2015. The use of a scanner avoids potential *recall bias* that is prevalent nethods that ask about lighting purchases, although some bias likely remains often and for which products panelists remember to scan their purchases.

Comment [GR63]: Spell out

dataset the LightTracker Initiative received from IRI included detailed records purchases, the data required a considerable cleaning effort to ensure integrity of all the necessary bulb attributes. For example, not all records had some of cal variables populated, including bulb type, style, wattage, or had clearly ues (e.g., 60 watt CFLs).[34]

review and quality control of the dataset, LightTracker then re-classified, populated missing records, created additional variables, and performed cements to the data, as described below.

issing records, validate existing records, and include additional bulb attributes, ted a proprietary Universal Product Code (UPC) database with approximately rom four sources:

acturer product databases provided to LightTracker;
t catalogs downloaded from manufacturer web sites via python-code based *raping*
t offerings downloaded from retailer web sites

earlier, the contract with the third-party data source precludes including many of these nalysis, but the evaluators can use such data to identify errors and reclassify certain products .

ated lookups of online UPC databases, such as www.upcitemdb.com

ıext merged the bulb database with the POS/Panel data, populating fields ərarchy of data sources believed to be most reliable. Prioritization was typically following order: manufacturer specifications, UPC lookups, original IRI-based es. Web lookups also served to determine final assignments for a large number

ghtTracker investigated the bulb assignment and the quantity of bulbs per ‹amining the average price per unit and identifying outliers in terms of per bulb rocess helped identify misclassification of certain bulb types (e.g., bulbs that as low cost LEDs but were really LED nightlights, so needed to be considered vell as bulb counts that sometimes represented box shipments (e.g., a package ıaving 36 bulbs was really a six-pack of CFLs that was shipped with six box).

ram Activity

program activity, LightTracker utilized internal resources of evaluation teams :REED members (including NMR working for the EEB) and conducted a ɘw of publicly available reports found on the internet or provided by program or their evaluators,[35] and reached out to local utilities when reports were not gram activity data collected included:

:laimed CFL and LED upstream bulbs (broken out by bulb type) reported by rogram
am CFL and LED incentives
ıpstream program budget

oted that, where available, LightTracker leveraged program expenditures as :tly by administrators; otherwise they defaulted to ENERGY STAR reported as a proxy. Data from each program administrator were aggregated by state. s assigned a modeling flag based on the source of and confidence in the data ss all major program administrators, as outlined in Table 13. As an example, ı no program activity (verified across members of each evaluator team) was A *1* was assigned if LightTracker had successfully collected all program activity m every program administrator (including any muni or coop activity) in a state. ned to any state that had some program administrator data captured but other nistrator data (usually overall program expenditures) derived from ENERGY as assigned to the remaining states where the sole data points were derived ʼ STAR. The modeling team was then able to iterate through the model using most accurate data.

e approach relied on searches in the ENERGY STAR® Summary of Lighting Programs gystar.gov/ia/partners/downloads/FINAL_2015_ENERGY_STAR_Summary_of_Lighting_Progr and also referenced the www.dsireusa.org website.

›rogram State Classification based on Accuracy of Program Data for Sales Data Modeling

(Classifications made by LightTracker)

Non-program State	LightTracker (solely)	LightTracker and ENERGY STAR	ENERGYSTAR (solely)
0	1	2	3
Alabama Delaware Kansas Kentucky Mississippi Montana Nebraska North Dakota Tennessee Virginia	Arkansas[2] Connecticut[2] Georgia[2] Louisiana[2] Maine[2] Maryland[2] Massachusetts[2] Missouri[2] Nevada[2] New Hampshire[2] New Jersey[2] New Mexico[2] New York[2] Oregon[2] Rhode Island[2] Utah[2]	Arizona California Colorado Idaho Iowa Ohio Pennsylvania Texas Washington Wyoming	Florida Illinois Indiana Michigan Minnesota Oklahoma South Carolina South Dakota Vermont West Virginia

ıg is associated with the source and confidence in the data.
in the sales data modeling.

ut program activity, the modeling team restricted the data to the 17 states with iled level of program activity gathered (noted in Table 13), which ranged from ; of LED program activity to very high ones. This decision reflected two factors: ɔ use the strongest data available on program activity, and 2) the fact that LED remained small compared to other bulb types, limiting the model's ability to pact of program activity on sales, which the researchers feared would result in (concluding that programs had no impact, when in fact they did)[36] simply w statistical power and incomplete data. The evaluators recognize the small nd limitation to states with programs as shortcomings of the resulting model.

menclature, failing to reject the null hypothesis when in fact the alternative hypothesis is true.

n, Table 14 shows the results of the Connecticut 2015 LED sales data model ·am states included. Utilizing the non-program states adjusted r-squared to go ıll of the predictors to no longer be significant.

: LED Sales Data Model with Program and Non-Program States
(n=27 states)

		Model Coefficient & P-Value
dependent ariables ow 1 = gression efficient ow 2 = value of efficient	Intercept	0.489
		0.844
	LED Program Spending per Household	0.056
		0.431
	Non-POS Retailers Sqft per Household	0.003
		0.980
	Political Index	0.030
		0.324
	Average Electricity Price	-0.268
		0.113
odel Adjusted R-squared		-.048

ence and Absence of Retailers (Channel Variables)

conducted secondary internet research in order to determine the number and ·e footage of store locations in each state for five primary energy efficient bulb ıe Depot, Lowes, Walmart, Costco, and Menards (a combination HI, mass ocated in the Midwest).[37] These data were utilized as explanatory variables in e these retailers sell such a large quantity of light bulbs but their concentration s across the nation.

Data Model Specification

oal of the model was to quantify the impact of state-level program activity on ED lighting. Key aspects of the lighting dataset as analyzed include:

ales volume and pricing for CFLs, LEDs, halogens, and incandescent bulbs for nnels combined, and broken out by the POS and non-POS channels
eporting by state and bulb type
on of all bulb styles and controllability (e.g., three-way and dimmable)

orm of the model is specified below, followed by a more detailed discussion of es for each variable.

ıal model, and Menards is an important and expanding retailer in the Midwest. To exclude it key retailer that could affect the results.

$$\text{ıles per } HH_i = \beta_0 + \beta_1 * \text{LED Program Spending per HH} + \beta_c * \sum_1^c \text{Channel Variables} + \beta_d * \sum_1^d \text{Demographic Variables}$$

les per HH$_i$ = Total LED sales in state i divided by the number of households

***ı Spending per HH$_i$* =** The number of 2015 retail lighting program dollars per state i. Equal to total retail lighting program expenditures in state i (LED n-incentive) divided by the number of households in state i.

Comment [GR64]: Did program data provide this i.e., LED vs CFL spending?

And how were lamp vs. fixture expenditures treated the dataset?

ıbles:

' per HH$_i$ = The average non-POS retail square footage per household in state ı-POS sqft divided by the number of households in state i.

Variables:

***x$_i$* =** A state-level partisan voter index developed by Cook Political Report,[38] ntial election voting results through 2014 as a state-level partisan proxy. A .0 value represents greater Democratic influence and a value less than 1.0 ter Republican influence.

***:tricity Cost$_i$* =** The State-level average residential retail rate of electricity, ly from the Energy Information Agency (EIA)[39]

el intercept

nary coefficient of interest. This represents the marginal effect or program e expected increase in the number of LED sales for $1 in additional program ıousehold.

Array of regression coefficients for the channel variables and demographic

.

are other factors that influence the sales of efficient lighting, and the team number of demographic, social, household, and retail channel variables to :ontrol for the unique characteristics of each state that potentially affect the :ient lighting products. The study tested the following predictor variables, but nsignificant predictor of LED purchases:

---

cal.com/house/pvi
ı.gov/electricity/data/state/

- e Feet of POS Retailers per Household
- n Income
- ge Cost of Living
- holds Built before 1980
- Pays Utilities
- Occupied Household
- ntage of Population with a College Degree

team also explored variance inflation factors (VIF), which serve as a test of ty. The VIF measures how much the variance of estimated regression e inflated as compared to when the predictor variables are not linearly related. VIF value (scale starts at zero) the smaller the correlations among predictor e a VIF over 10 is considered highly correlated. Table 15 shows that the pendent variables have a low level of collinearity and are appropriate to use in lel.

Deleted: Table 15

e 15: Sales Data Model Predictor Variables Inflation Factors

tor Variable	Variable Inflation Factors
e Electricity	2.84
l Index	2.40
ogram Spending per household	1.60
OS Retailers sq. ft. per household	1.24

ws the preferred sales data modeling results, including regression coefficient or all included independent variables. All p-values listed were significant at the ce level.

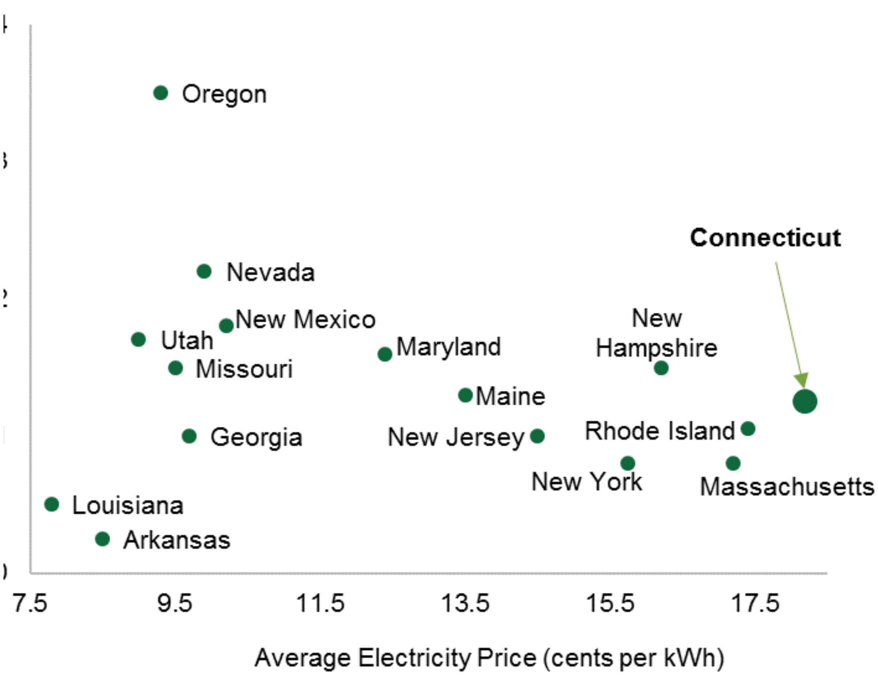
ggests that for each dollar increase in program spending per household, LED d by 0.08 bulbs. The model also suggests that higher statewide square footage ng retailers and greater Democratic influence (versus Republican) were h more LED purchases in a state. Somewhat counterintuitively, the model also e average electricity price had a negative relationship with number of LED gure 14). However, the states with the highest electricity prices also tended to nding programs and higher saturation rates, which, as discussed above, may t bulb purchases.[40]

ted as an outlier with LED per household sales of 3.7 and an average price of electricity of tudy performed a sensitivity analysis by removing Oregon from the model, and found that the ensitive to Oregon's influence.

Table 16: Preferred Sales Data Model Summary Statistics
(n=17 states)

		Model Coefficient & P-Value
dependent ariables ow 1 = gression oefficient ow 2 = value of oefficient	Intercept	-6.30
		0.003
	LED Program Spending per Household	0.084
		0.035
	Non-POS Retailers sq. ft. per Household	0.560
		0.001
	Political Index	0.085
		0.001
	Average Electricity Price	-0.268
		0.000
odel Adjusted R-squared		0.64

: Relationship between LED Sales and Average Electricity Price
(Based on sales data modeling, n=17 states)



ts are shown in Table 17. Note that a NTG ratio based on 2013 data from the source only and using a different model specification yielded an estimate of e increased and widespread adoption of LEDs over the past two years, coupled tion of the panel data and the related data cleaning and altered model

Comment [GR65]: And lower costs?

the reduction in NTG from 87% to 70% seems to make intuitive sense to the
m.

'able 17: LED NTG Sales Data Modeling Estimate Inputs

	Calculation Term	Value
	Total Connecticut LEDs 2015	2,312,398
	LED Program $ per Household Actual	$10.97
	LED Program $ per Household Counterfactual	$0.00
	LED Bulbs Counterfactual	77,485
	LED Bulbs Modeled	1,469,263
	LED Program Bulbs 2015	1,976,639
)	Net LED Bulbs Modeled	1,391,778
	LED NTGR Modeled	70.4%

w of Program Support and LED Sales

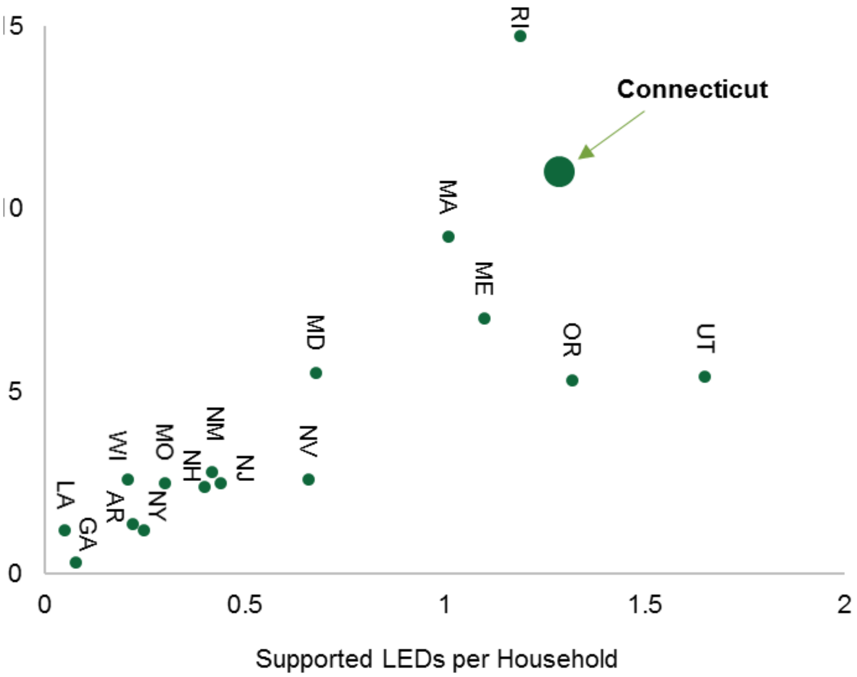
figures compare measures of program support and LED sales for the 17 states
; model. The data show a great deal of variation across the states.

npares program spending and support by household. LED program spending
iinistrative budget) ranged from a high of $15.83 per household in Rhode Island
.26 in Georgia. Connecticut exhibited the second highest spending at $10.97
, but the state also ranked highly in the number of LEDs it supported with those
rs. More generally, the level of program support was correlated to the number
orted per household.

Comment [GR66]: Again, where did this level of p
come from? Was this for bulbs only? Fixture incenti
higher.

LED Program Spending and Bulbs Supported per Household in 2015 by State

(Based on literature review, n=17 states)

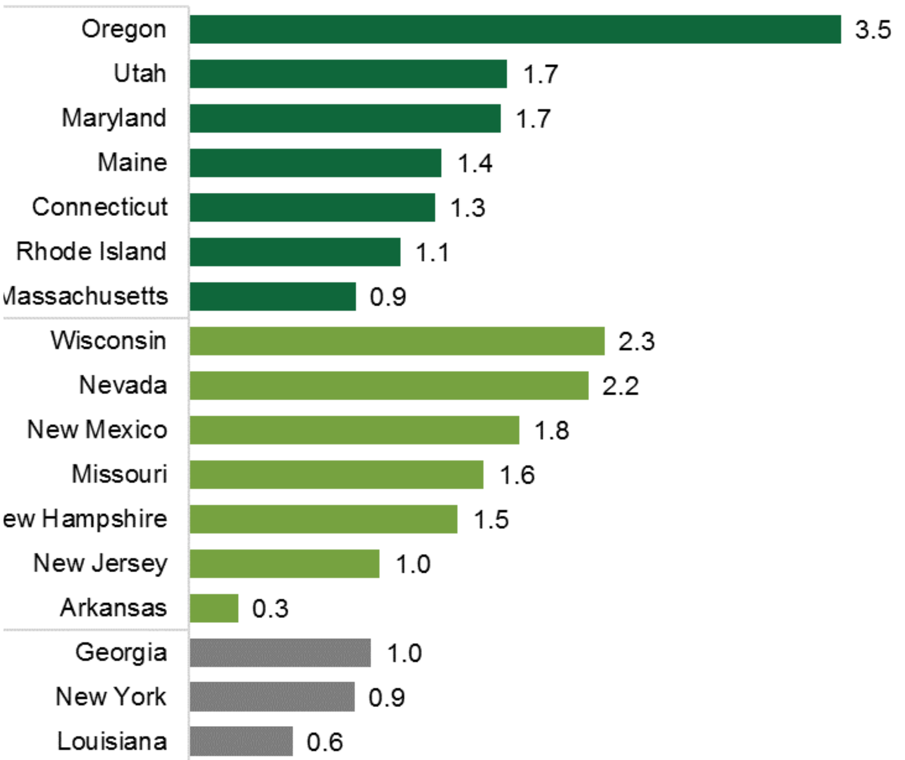


n received a ranking of the intensity of their program spending based on dollars sehold. Figure 16 shows the relationship between this ranking and the number ased per household according to the LightTracker dataset. The states with the ve program spending did not always exhibit the highest number of overall LED onnecticut (along with Rhode Island and Maine) was in the top tier of program the middle of overall LED purchases within the model sample. Massachusetts ted relatively low sales in the LightTracker dataset.

Comment [GR67]: Are the MA LightTracker numb MA LED program sales? Though program sales wo of total sales.

16: Average LEDs Purchased per Household in 2015 by State

(Based on LightTracker data, n=17 states)



ıssifies the intensity of program spending by the amount spent per household. States spending ıld are classified as *Aggressive* spending, those spending > $1 and < $5 are *Moderate* spending, ng =< $1 are *Low* spending.

Apex modeled total energy-efficient bulb market share to estimate a NTG ratio in another state. R1615 and Apex's models both included the use of spending ı variable, but the R1615 LED model excludes CFL incentives. Both studies POS retailers, but R1615 used square footage non-POS per household while lel used percentage of total retailer square footage that was non-POS. Both ıe political index, but Apex's model also included predictors for median income, ı income and political index interaction term. Table 18 provides the model R1615 attempted to include these variables in its model; given R1615's smaller ıcluding more predictor variables restricted the degrees of freedom, causing it atically. In comparison to R1615's sales data modeling NTG ratio of 70%, for the other state's program resulted in a combined CFL and LED NTG ratio

arket Share Model Summary Statistics for a CFL and LED Program
(Apex Analytics results, n=39 states)

		Model Coefficient & P-Value
dependent ariables	Intercept	-2.814
		0.015
	Program Spending per HH	0.024
		0.001
ow 1 = gression oefficient	Percent Sqft NonPOS	0.598
		0.057
	Political Index	0.032
		0.010
ow 2 = value of oefficient	Median Income	0.0000494
		0.020
	Political Index*Median Income	-5.43E-07
		0.011
odel R-squared		0.64

ND ELASTICITY MODELING

appendix section includes additional details on the methods for conducting the city modeling.

ications to Inputs

ınd elasticity approach relies exclusively on program data, the model's ɘpended on data quality. Overall, the available data from the Connecticut ɘgy achieved a sufficient quality to support the analysis. However, there were sary adjustments, as discussed below in regard to several key input categories:

nality
/ariation
tional Displays

onality

ccurate economic analysis critically depends on separating data variations that asonality from those that result from relevant external factors. For example, rella prices fell at the beginning of the rainy season. One might erroneously the price reductions drove sales, when in actuality, the increase in precipitation e to do with it. Skewed estimations result from an analysis that does not account seasonality of umbrella sales.

hting demand elasticity model included a seasonal trend, provided by APT, the ram implementer. The seasonal trend represented the proportion of annual expected to occur in a given month from a major national lighting manufacturer. a national aggregation level, including non-program products and areas without ted the degree that resulting trends correlated with program activity.

sales fall during July (presumably due to longer daylight hours); so if program ses sales in July, analysis underestimates the program's impact if it does not sonal variations. Alternatively, sales tend to rise in October; not controlling for ely overestimates program activity impacts during that month.

a included in the model also fit this pattern, with peak sales in October and 15. Therefore, the model included the seasonal trend to control for seasonal ns.

owed the trend in the second half of 2015, excluding November and December. months of the year, as shown in Figure 17, LED sales were considerably higher would expect given the trend. Additionally, incentive levels for LEDs decreased ut the retailer price absent incentives also decreased, which more than offset l incentives leading to lower LED prices throughout the remainder of 2015.

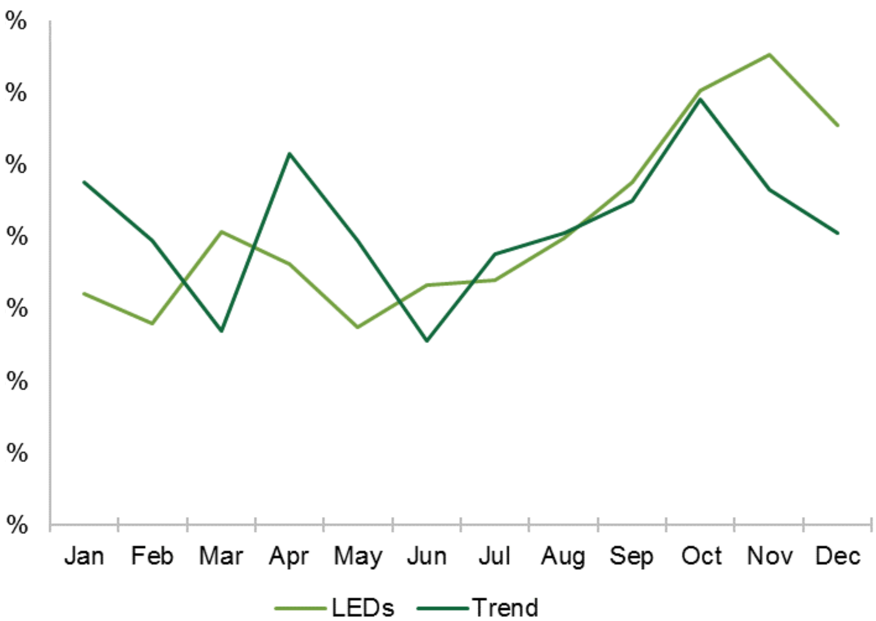
Comment [GR68]: Given the fairly step reduction be the driving factor?

Percent of 2015 LED Sales by Month and Seasonal Trend

(2015 program data and APT seasonal trend data)

Comment [GR69]: For CT only, yes?

Also, note several fold increase in NEMA LED shipr

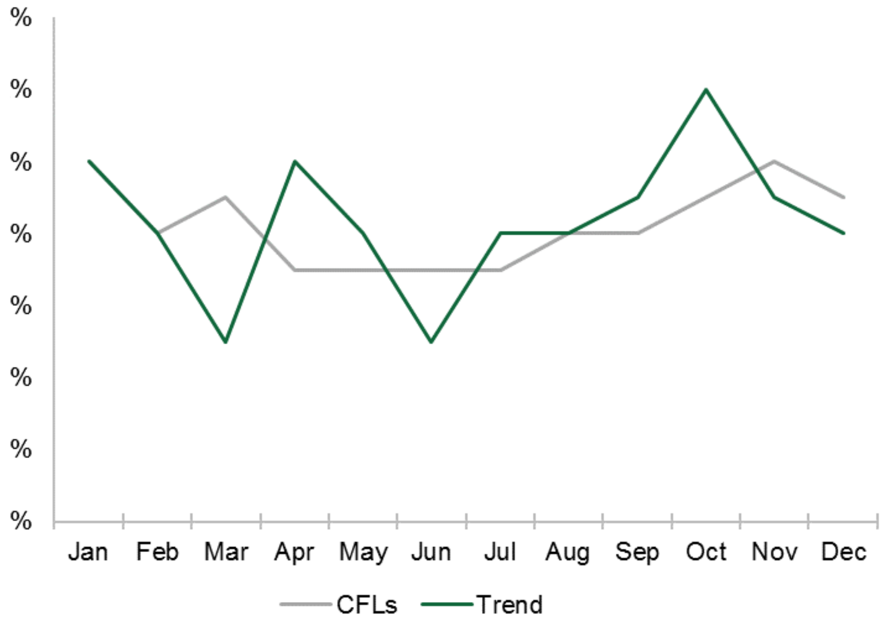


ls also changed for CFLs after March of 2015. Decreased incentive levels and lly increased average bulb prices for CFLs did not appear to correspond with other than April, the month immediately following the decrease in incentives. Figure 18, CFL sales increased in the fall, coinciding with the peak of the d.

Deleted: Figure 18

igure 18: 2015 CFL Sales by Month and Seasonal Trend

(2015 program data and APT seasonal trend data)[1]



and program activity changes over time, there are deviations between the seasonal trend and es. For example, starting in April incentive levels dropped and sales decreased whereas the ı expected increase in sales. And in October the trend peaks but program CFL sales did ı as expected because incentives were lower after March. However, the general pattern holds ummer months and an increase in sales going into fall.

entives by month and technology are shown in Table 19.

Deleted: Table 19

able 19: 2015 Prices per Bulb by Month and Technology

(2015 program data)[1]

Month	Initial Price Per Bulb	Rebate Per Bulb	Final Price Per Bulb
Jan	$3.72	$0.87	$2.85
Feb	$3.55	$0.87	$2.68
Mar	$3.62	$0.86	$2.76
Apr	$2.78	$0.77	$2.01
May	$3.34	$0.79	$2.55
Jun	$3.40	$0.79	$2.61
Jul	$3.39	$0.79	$2.61
Aug	$3.41	$0.78	$2.63
Sep	$3.42	$0.78	$2.63
Oct	$3.42	$0.78	$2.64
Nov	$3.46	$0.78	$2.67
Dec	$3.48	$0.78	$2.69
Jan	$16.49	$6.68	$9.81
Feb	$16.18	$6.59	$9.58
Mar	$16.49	$6.59	$9.90
Apr	$13.83	$5.58	$8.26
May	$14.56	$5.72	$8.84
Jun	$14.53	$5.66	$8.87
Jul	$14.51	$5.65	$8.87
Aug	$14.58	$5.65	$8.93
Sep	$14.45	$5.56	$8.88
Oct	$14.13	$5.49	$8.64
Nov	$14.09	$5.43	$8.66
Dec	$13.94	$5.38	$8.56

ntives in the table are not sale-weighted as they are in the model. These prices reflect the umer faces on the shelf rather than reflecting the ultimate decision of the consumer.

trends differed between CFL and LED bulbs, analysis interacted the seasonal retail channel and with bulb technology to control for changes in sales not e changes at a greater level of granularity.

Variation

stantial number of products exhibited price variation. Additionally, most retailers e products that exhibited price variations.

and prices combined across all comparable products within each unique location. The average price for each bulb type within each store reflects the s-weighted, per-bulb price across all comparable products. Monthly sales um of all sales within each store across the same group of comparable products nd monthly sales for all 60-watt, incandescent-equivalent, general purpose LED gle Home Depot store).

es and prices this way (rather than observing price and sales changes for each del number) presented an advantage: capturing any substitutions between roducts (e.g., a decrease in the average price per-bulb when adding a three-sting bulb to the program).

ose an updated version of a bulb (with a different model number) replaced an nodel. The first model's sales likely drop because the retailer sells off back s the second model's sales increase. Aggregating prices and sales captures oss both products rather than controlling for the sales impacts of factors rice (i.e., products phased out and replaced).

elasticity model only included sales with price variations as products with no rice do not contribute any information to the model. The greater the price ls across retailers and lamp styles, the more representative the elasticity ame when applied to sales of products that did not exhibit price variations.

odel included products that represented 79% of LED sales and 80% of CFL the representativeness varied by retail channel. As shown in Table 20, prices e than 90% of both CFL and LED sales at HI stores, which accounted for 52% sales. Mass market retailers also showed significant variation in prices with esenting over 90% of sales exhibiting changes in price. Club store prices varied of LED sales and 36% of CFL sales exhibiting price variations. Prices varied of sales at HTR retailers for both CFLs and LEDs.

Sales Represented in Demand Elasticity Model by Channel and Technology

(Based on demand elasticity modeling and 2015 program data)

nel	Technology	Percent of Sales in Model	Percent of Total Program Sales (2015)
	CFL	36%	8%
	LED	44%	17%
	CFL	96%	19%
	LED	96%	33%
	CFL	63%	4%
	LED	69%	6%
t	CFL	92%	11%
	LED	94%	3%

Comment [GR70]: These values are often cited ir They need to be brought forward.

ignificant variations occurred for most bulb types, as shown in Table 21.

Deleted: Table 21

1. Sales Represented in Demand Elasticity Model by Type and Technology

(Based on demand elasticity modeling and 2015 program data)

	Bulb Type	Percent of Sales in Model	Percent of Total Program Sales (2015)
	Reflector	92%	13%
	Specialty	26%	5%
	Standard	81%	40%
	Reflector	0%	1%
	Specialty	16%	0%
	Standard	82%	41%

:luded sales representing more than 80% of standard, general service bulbs FLs and LEDs) and 92% of reflector LED sales. Together, these accounted for ales. The model included fewer specialty bulbs (e.g., globe, candelabra): 16% :6% of LEDs. These accounted for only 5% of total program sales. The model le CFL reflector sales as none exhibited price variations; reflector CFLs less than 1% of total program sales.

iodel included 79% of total bulb sales in 2015 that exhibited price variations; xhibited price variations.

iotional Displays

included records of in-store promotional events and product displays. Program ield staff collected these data when visiting stores to ensure compliance with ctual agreements. Field staff verified prices, product placements, and shelf cated products were included as part of the program. They also collected data vhether retailers displayed program bulbs in prominent promotional displays s, end caps, pallet displays).

lata contained a comprehensive list of all in-store promotional events, the merchandising displays only represented a sample of locations that program eld representatives visited within a given week.

rchandising data's nature, the demand elasticity model could not predict sales ns with missing merchandising data. Consequently, the team considered two els:

1 - included all observations with varying prices but did not control for andising
2 - controlling for price, but only using observations with merchandising data[41]

nodels would have allowed for combining the estimated price coefficients from and the estimated merchandising coefficients from the second model to predict mate freeridership, prices correlated with merchandising in the second model. at the first model's price coefficients reflected some merchandising impacts (as not control for merchandising). Adding merchandising coefficients to the first-ates would double-count some of the merchandising's effect, thus biasing s and overstating the program impact.

study utilized the first model, which included in-store promotion data but lay merchandising data. Not accounting for merchandising may overestimate o the extent that the price coefficients do not reflect all of the impact of g.

nd Elasticity Model Specification

lasticity model organized bulb and pricing data as a panel, with a cross-section lb quantities for each unique retail location, bulb type, and baseline wattage These were modeled over time as a function of price and retail channel (e.g., rself, HTR, and mass market). This study also involved testing a variety of to ascertain price impacts—the main instrument affected by the program—on r bulbs. The model adopted the following basic equation (for cross-section i, in

Equation 1

$$) = \sum(\beta_\pi * ID_{\pi,i}) + \sum(\beta_{\theta 1}[ln(P_{it}) * (Retail\ Channel_{\theta,i})]) + \sum(\beta_{\theta 2}[ln(P_{it}) * (Technology_{\theta,i})]) + \sum(\beta_{\theta 3}[ln(P_{it}) * (Bulb\ Type_{\theta,i})]) + \sum(\beta_{\theta 4}[Display * (Retail\ Channel_{\theta,i})]) + \beta_{\theta 5} * Promo + \sum(\beta_{\theta 6}[Trend * (Retail\ Channel_{\theta,i})]) + \varepsilon_{it}$$

atural log
uantity of bulbs sold during month t
tail price per bulb in month t
Channel = Retailer category (HI, mass market, HTR, club)

---

ore than 450,000 fewer sales than Model 1 due to excluding those that do not have ata.

ology = CFL or LED
ype = Product category (standard, reflector, specialty)
ummy variable equaling 1 for each unique retail location, bulb type, and base otherwise
nal Trend = Quantitative trend representing the impact of secular trends not to the program
y = Dummy variable equaling 1 if a product was featured in an off-shelf display period t
= Dummy variable equaling 1 if an in-store promotion event took place in time t
oss-sectional random-error term in time period t

ecification assumed a negative binomial distribution. This served as the best fit e distributions (e.g., log normal, poisson, negative binomial, or gamma). The mial distribution's long right tail coincides with a small proportion of products a disproportionate share of sales.[42]

ted numerous model scenarios to identify the model with the best parsimony ry power using the following criteria:

coefficient p-values (keeping values less than <0.1)[43]
atory variable cross-correlation (minimizing where possible)
AIC (minimizing between models)[44]
g the heteroskedastic consistent covariance matrix and clustered standard to account for heteroskedasticity
zing multicollinearity
zing model fit

erred model specifications with elasticity estimates nested by technology, retail bulb type (general purpose, specialty, and reflector). This accounts for retailer strategies and target demographics, as well as differences in demand aracteristics. Ultimately, models were ranked by lowest AICs and lowest tween monthly actuals and monthly predictions. The model with the lowest rank intuitive specification and parameter estimates was chosen.

t can be examined by comparing model-predicted sales with actual sales. As ure 1, the model-predicted sales very closely matched actual sales without s in a single direction (over- or under-predicting for each month). This indicated fit the data well.

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appendix presents a histogram of monthly bulb sales across all products and demonstrates ch the observations are skewed.
ative variable had many states (such as bulb types), variables were not omitted if one state it, but rather considered the joint significance of all states.
tion criterion (AIC) is a measure of relative quality used compare and assess model fit, as do not define the R-square statistic. AIC also offers a desirable property in that it penalizes odels, similarly to the adjusted R-square.

shows, the two largest discrepancies between predicted and actual sales e end of 2015. Overall, the predictions fit actual sales well, though the model l sales by 1.6% in aggregate.

Figure 19. Predicted and Actual Sales by Month in 2015

(Based on demand elasticity modeling and 2015 program data)

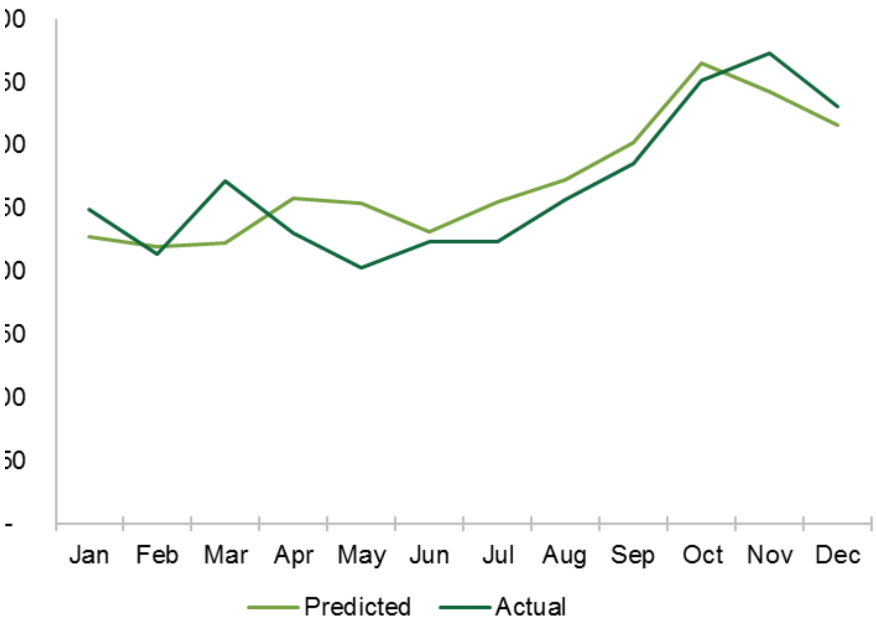


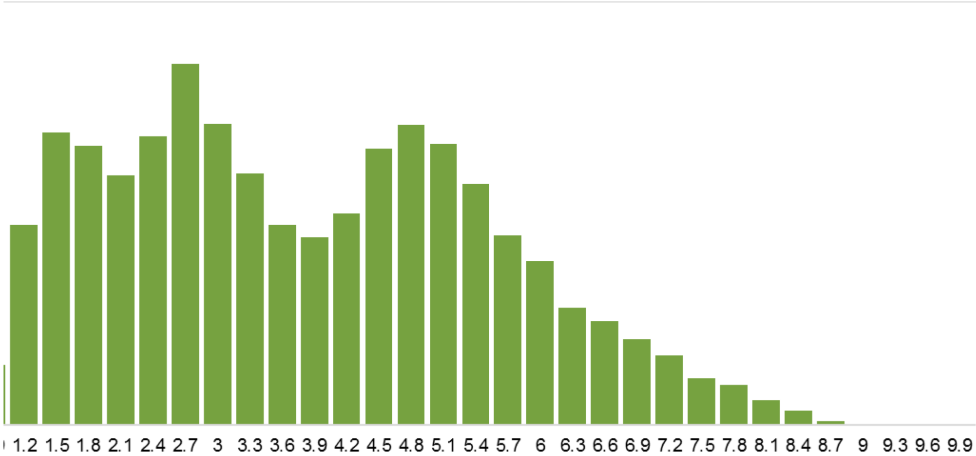
Table 22. Final Demand Elasticity Model Parameters

evel1	Level2	Level3	Estimate	Stderr	Lower CL	Upper CL	Z	ProbZ
			0.00	0.00	0.00	0.00	0.00	0.00
Club	Reflector	LED	-1.11	0.23	-1.56	-0.65	-4.77	0.00
Club	Standard	CFL	-0.75	0.45	-1.63	0.14	-1.65	0.10
Club	Standard	LED	-2.53	1.07	-4.64	-0.43	-2.36	0.02
DIY	Reflector	LED	-0.58	0.09	-0.74	-0.41	-6.77	0.00
DIY	Specialty	CFL	-2.71	0.84	-4.34	-1.07	-3.24	0.00
DIY	Specialty	LED	-2.88	0.12	-3.11	-2.66	24.91	0.00
DIY	Standard	CFL	-0.75	0.10	-0.93	-0.56	-7.81	0.00
DIY	Standard	LED	-1.89	0.09	-2.06	-1.72	21.62	0.00
HTR	Reflector	LED	-0.42	0.09	-0.59	-0.24	-4.68	0.00
HTR	Specialty	LED	-0.77	0.19	-1.14	-0.40	-4.08	0.00
HTR	Standard	CFL	-1.64	0.13	-1.90	-1.38	12.41	0.00
HTR	Standard	LED	-0.54	0.15	-0.82	-0.25	-3.68	0.00
Mass	Reflector	LED	-1.84	0.15	-2.13	-1.55	12.35	0.00
Mass	Specialty	CFL	-1.85	0.63	-3.07	-0.62	-2.95	0.00
Mass	Specialty	LED	1.07	0.41	0.26	1.88	2.60	0.01
Mass	Standard	CFL	-0.54	0.14	-0.82	-0.26	-3.73	0.00
Mass	Standard	LED	-3.11	0.15	-3.41	-2.81	20.33	0.00
			0.03	0.00	0.02	0.04	7.19	0.00
Club	CFL		1.03	2.55	-3.98	6.03	0.40	0.69
Club	LED		2.14	1.10	-0.02	4.29	1.94	0.05
DIY	CFL		3.41	0.42	2.59	4.23	8.12	0.00
DIY	LED		4.19	0.47	3.27	5.11	8.91	0.00
HTR	CFL		5.01	0.52	4.00	6.03	9.65	0.00
HTR	LED		5.22	0.99	3.27	7.17	5.24	0.00
Mass	CFL		2.58	0.48	1.64	3.52	5.40	0.00
Mass	LED		8.68	0.88	6.96	10.39	9.91	0.00

omparative Demand Elasticity Model Fit Statistics by Distribution

sumed Error Distribution	AIC	BIC
gative Binomial	151,528	164,393
isson	644,400	657,257
og-Normal	229,597	242,463
amma	151,901	164,766

igure 20: Natural Log of Monthly Bulb Sales Histogram
(From demand elasticity modeling)



nd Elasticity Model Precision

ing the final model specification, the study calculated precision using *block* idard errors to determine the sensitivity of the net-to-gross ratios. To develop idard errors, analysts drew 1,000 new samples (with replacements drawn at tion level) from the original data, estimating coefficients with each sample, es and saving with and without program incentives, and calculating a new atio. Using this method, the 5th and 95th percentiles in these freeridership nted the lower and upper bounds of the 90% confidence interval, as shown in distribution of freeridership predictions was normally distributed with a median which is very similar to the program freeridership estimate of 52% presented in ure 21 shows the distribution of freeridership predictions from the bootstrap

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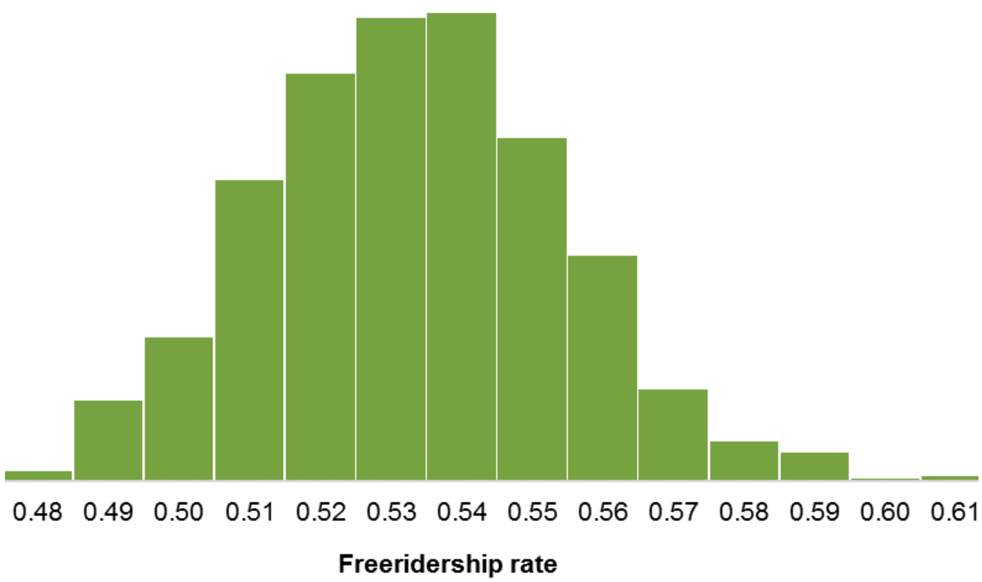
Demand Elasticity Modeling Freeridership Estimate Confidence Interval

ram ership	5% Lower Bound Confidence Interval	95% Upper Bound Confidence Interval	Relative Precision at 90% Confidence
%	49%	56%	± 7%

: Demand Elasticity Modeling Bootstrap Freeridership Estimate Histogram



HMARKING

rking analysis draws on the following references:

p. *Evaluation of Xcel Energy's Home Lighting and Recycling Program*. y 13, 2016. http://www.xcelenergy.com/staticfiles/xe/PDF/Regulatory/CO-CO-Regulatory-DSM-Home-Lighting-and-Recycling-Evaluation.pdf

p. *Arkansas Energy Efficiency Program Portfolio Annual Report*. Docket No. -TF: 2013 Program Year. April 1, 2014. ww.apscservices.info/(X(1)S(g3lbwwyyzpugkz45efpyjmqi))/EEInfo/EEReport rgy%202013.pdf

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Rhode Island Technical Reference Manual for estimating savings from efficiency measures: 2016 Program Year. 2015.
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sagfiles.org/SAG_files/Evaluation_Documents/ComEd/ComEd_EPY7_Evalua
eports/ComEd_Residential_Lighting_PY7_Evaluation_Report_2016-02-
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sulting, NMR, Tetra Tech, DNV GL. *Multistage Lighting Net-to-Gross sment: Overall report*. August 2015. http://ma-eeac.org/wordpress/wp-
t/uploads/Multistage-Lighting-Net-to-Gross-Assessment-Overall-Report.pdf.

s, DNV GL. *R86: Connecticut Residential LED Market Assessment and g Net-to-Gross Overall Report*. June 2015.
www.energizect.com/sites/default/files/CT%20Residental%20LED%20Lighting
arket%20Assessment%20and%20Lighting%20NTG%20%28R86%29_Final%
ort_06.19.15.pdf.

cy Maine Retail Lighting Program: Overall evaluation report*. April 16, 2015.
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Public Service Company. *2014 Energy Efficiency and Load Management* Case No 13-_-UT. August 28, 2013.
www.swenergy.org/Data/Sites/1/media/documents/news/news/file/SPS_2014_
plan.pdf.

ENSUS PANEL

details the consensus panel's decisions, including the steps undertaken and behind the recommended values. Figure 22 illustrates the consensus panel's l LED NTG estimates.

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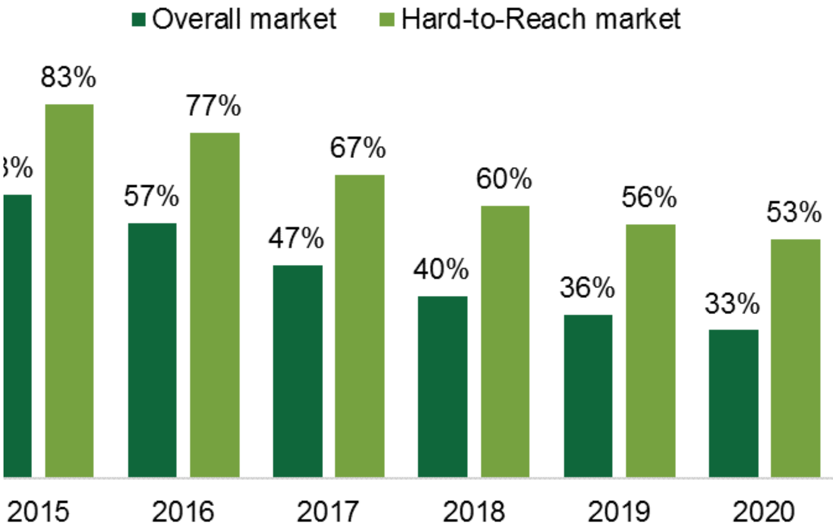
2: LED NTG Retrospective and Prospective Estimates by Market

(Consensus panel results, n=6)



spective and Near-Term

their estimates, panelists highly valued the R1615 results in comparison to the studies. When asked to rate the importance of the three primary activities this evaluation on a scale of one to five, where one equals *not at all important* ls *extremely important*, they rated all three R1615 primary-research tasks the rated demand elasticity modeling (4.2) and supplier interviews (4.4) notably e sales data modeling (3.0) with the explanation that the sales data modeling ethodological weaknesses, such as the inability to control for prior saturation, ze, and unstable specifications (Section 2.2). As such, panelists' retrospective 015 (63%) was nearly identical to the net-of-freeridership estimate from the city modeling and the NTG estimate from supplier interviews, which were both ted the benchmarking studies 2.67 or lower, on average, citing differences in d datedness (Section 3.3).

term

rage LED NTG estimates for 2018 through 2020 assumed a steady decline, 018 to 33% in 2020, or almost one-half of their initial NTG estimate of 63% for one panelist estimated that NTG would slide to 10% in 2020.

tten responses and discussion during the panel demonstrated that panelists deal of uncertainty about the LED market in the long-term. They considered port to be vital to driving LED sales historically and at present. While they at the future LED market should be able to grow independent of program could not reach consensus on *when* that would occur.

reflected on market variables (explored in greater detail in Section 4). They following as driving LED adoption: the influx of value-line LEDs (defined in ielding decreased prices, and the imminent disappearance of CFLs and rollout TAR 2.0 reducing energy-efficient lighting options. One panelist called LEDs a *naut*, estimating that LED prices are declining roughly 20% to 30% each year, ed that changes in federal administration and the resulting uncertainty around ation and enforcement of EISA 2020 add additional layers of confusion.

Comment [GR71]: Agreed

ity in the market led panelists to encourage the EEB to reevaluate the l NTG estimates next year (late 2017 and 2018) or by 2019 at the latest.

Channel

ussion heavily considered HTR market dynamics where prices typically dictate ent penetration is low, and distribution costs are high. Panelists forecasted that res would not carry LEDs in absence of the program. Supplier interview results his distinction, where, for example, standard bulb retrospective NTG was 63% m overall but was 100% for HTR retailers. To acknowledge this particularity, ermined that an increase of 20 percentage points for the HTR market's LED ears would result in fair estimates, starting with 83% in 2015 and ending at 53% e 22).

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Type

provided separate estimates for standard and reflector bulbs. Reflector LED s from the panelists (as well as demand elasticity modeling and supplier re consistently lower than those of standard LEDs, but they did not differ by percentage points for any year. The consensus panelists ultimately decided andard and reflector bulbs into a single category of non-HTR LEDs due to the parate estimates and uncertainty regarding the adoption and implementation le that expands the general service lamp definition to include reflectors and ecialty bulb types.

g this decision, the discussion around reflectors focused on the nature of the nates and the current and future reflector market. While one panelist was vidence supporting differences between standard and reflector LED NTG, d the difference in their estimates. Another panelist concluded that because were introduced before standard LEDs they have had more time to penetrate nother added that, as a result, they are currently at price parity with halogens output. Additionally, one observed that customers perceived halogen reflectors ty; another added that reflectors are natural applications for LEDs due to nt output making them an easier market penetrator. Figure 23 illustrates the nel estimates by bulb type.

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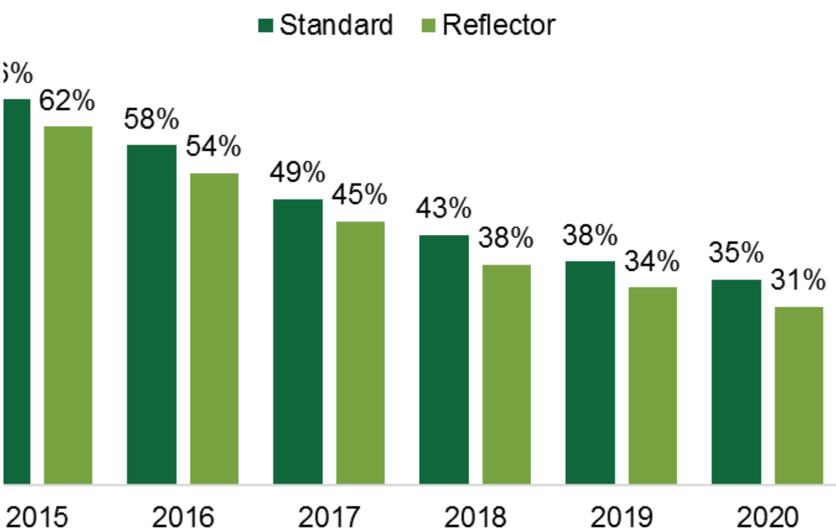
gure 23: LED NTG Retrospective Estimates by Bulb Type
(Consensus panel results, n=6)



Appendix B Additional Results

B.1 Net-to-Gross Estimates by Technology

The demand elasticity modeling analysis estimated freeridership for CFLs in addition to LEDs to estimate an overall program freeridership ratio for 2015. As reported, the overall freeridership for LEDs alone was 39%, and the ratio for CFLs was 67%, resulting in an overall program freeridership ratio of 52% (Table 25). The resulting net-of-freeridership or, in this case NTG ratio, for LEDs (61%) was therefore higher than that of CFLs (33%).

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Though freeridership was lower for LEDs, they accounted for a greater share of sales (58%) than CFLs (42%). However, they accounted for fewer savings that were modeled (53%) and therefore contributed less to overall program freeridership.[45]

Table 25: Net-of-freeridership, Sales, and Savings by Technology

(Based on demand elasticity modeling)

Techno-logy	Modeling Results		2015 Program Data Associated with Modeling			
	Free-ridership	Net-of-Free-ridership[1]	Total Bulb Sales	% of Sales	Total Savings (MWh)	% of Savings
LED	39%	61%	1,605,989	58%	44,022	53%

[46] Section 4 explores changing market shares across bulb types and the program and market transitions to LEDs away from other bulb types, including CFLs.

Deleted:

CFL	67%	33%	1,150,981	42%	38,655	47%
Overall	**52%**	**48%**	**2,756,970**		**82,676**	

[1] Given that the model does not include spillover, the NTG is equal to 1 minus freeridership (i.e., net-of-freeridership).

Table 26 shows average elasticity estimates and freeridership estimated through demand elasticity modeling by bulb type and technology.

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- Specialty (38%) and standard (27%) LEDs were associated with the lowest freeridership rates; they also had high elasticity (-2.20 and -1.88, respectively).
- Like specialty LEDs, specialty CFLs (-2.64) proved highly elastic; however, they had high freeridership (71%). Meanwhile, standard CFLs also had high freeridership (67%), yet they (-0.76) proved the least elastic—they accounted for the largest share of sales in 2015 for a single bulb type (41%).
- Reflector LEDs also had high freeridership (60%) with low elasticity (-0.84).

While specialty bulbs produced lower observed elasticity, they also sell at lower rates than standard and reflector bulbs, producing more noise in the data for demand elasticity modeling. However, specialty bulbs typically do not account for a large share of program sales and had the lowest proportion of sales included in the model due to little price variation. As prices for LEDs decreased through 2015 and program incentives continued to shift to LEDs,[46] the average final prices of standard CFLs increased relative to LEDs. However, demand for standard CFLs remained relatively stable, suggesting somewhat inelastic demand—Appendix A.2 provides more

[46] Section 4 explores changing market shares across bulb types and the program and market transitions to LEDs away from other bulb types, including CFLs.

details on these program trends. The inelastic demand could result from inertia in the market. Utility-sponsored programs have promoted CFLs for many years, and some consumers—absent dramatic changes in price—may be more likely to buy bulbs with which they have the greatest familiarity.

Table 26: Elasticities by Technology and Bulb Type

(Based on demand elasticity modeling)

Technology	Bulb Type	Average Elasticity	Freeridership
LED	Reflector	-0.84	60%
LED	Specialty	-2.20	38%
LED	Standard	-1.88	27%
CFL	Specialty	-2.64	71%
CFL	Standard	-0.76	67%

C Appendix C Interview Instruments

This appendix includes the instruments used for the supplier interviews and program staff interviews.

C.1 Supplier Interviews

Contact Protocol

1. Call potential interviewees to ascertain most appropriate interviewee. Obtain email address(es) of appropriate interviewees. If company refuses interview, determine reasons for refusal and if it's logistical in nature, try to find workaround.

2. Send email interview invitation to appropriate interviewee. This invitation will include:
    a. Explanation of purpose and scope of interview.
    b. Explanation of time frame within which the interview will need to be completed.
    c. Explanation of expected duration of interview and flexibility to complete interview over multiple sessions.
    d. Instructions to propose a convenient interview time.
    e. Contact information for interviewers.
    f. Assurances of confidentiality.
3. Once an interview time has been arranged, the interviewee will be emailed, a couple days in advance of the interview, a summary of the interview topics and a table summarizing their shipments of discounted lighting products through the Connecticut ENERGY STAR Lighting Program disaggregated by lighting product categories and retail channels (for lighting manufacturers). The email will contain additional assurances of confidentiality.
4. At the beginning of the interview, collect information on interviewee's position and overall responsibilities, and experience with the program

C.1.1 Section 1: Program Participation Confirmation and Reasons for Participation

The Nature of Program Participation

1-1. Eversource, United Illuminating, and the Connecticut Energy Efficiency Board jointly participate in an ENERGY STAR Lighting Program. According to our records, your company has supplied/purchased lighting products that have received upstream incentives from the Connecticut ENERGY STAR Lighting Program during the past 12 months. This program has for many years offered upstream buydown or markdown discounts for CFL and LED products that are sold through various Connecticut retailers. Are you familiar with your company's participation in this program?

[IF UNAWARE, FIND SOMEONE WITH THE COMPANY WHO IS AWARE. IF THEY RECOGNIZE THIS PROGRAM BY A DIFFERENT NAME, EXPLAIN THAT FOR THE SAKE OF SIMPLICITY YOU'LL HENCEFORTH REFER TO THE PROGRAM AS "THE CONNECTICUT ENERGY STAR LIGHTING PROGRAM."]

a) Besides getting these financial incentives, are there any other aspects of the Connecticut ENERGY STAR Lighting Program in the past 12 months that your company has actively taken part in?
[IF NOT MENTIONED, PROBE FOR:

- THEIR INVOLVEMENT IN POINT-OF-SALE PROMOTIONS (SIGNAGE, DISPLAYS, PROGRAM COLLATERAL, PRODUCT PLACEMENT) FOR THE CT PROGRAM
- THEIR INVOLVEMENT WITH ANY EXTERNAL MARKETING OF THE CT ENERGY-EFFICIENT LIGHTING REBATES
- THEIR INVOLVEMENT WITH ANY CUSTOMER EDUCATION EFFORTS IN CT CONCERNING LIGHTING PURCHASES]

b) [IF YES TO 1-1a.] What other aspects of this program has your company been involved in?

1-2. **[Previously Interviewed Only]** Has your company's participation or involvement in the Connecticut ENERGY STAR Lighting Program changed since you were last interviewed?

a) If so, how has it changed?

1-3. **[Not Previously-Interviewed Only]** About what year did your company first get involved with the Connecticut ENERGY STAR Lighting Program?

1-4. **[Not Previously-Interviewed Only]** What was your primary reason for getting involved with the Connecticut ENERGY STAR Lighting Program?

1) Retail partners wanted to participate

2) Rebates/discounts were attractive

3) Wanted prices to be competitive with other suppliers

4) Program branding/association helped product sales

4) Other reasons____________________[PLEASE SPECIFY]

1-5. **[Not Previously-Interviewed Only]** Did you have any other reasons for getting involved with the Connecticut ENERGY STAR Lighting Program?

a) [IF YES] What were these?

C.1.2 Section 2: Verifying Program Sales

2-1. Earlier I emailed you a table that shows the types of CFL and LED bulbs that our records show you sold through the Connecticut Lighting Program in the past 12 months. Does the table I sent to you seem correct in terms of the types and volume of CFLs and LED products you sold through the Connecticut ENERGY STAR Lighting Program?

a) [IF NO] [Record any corrections to the table]

2-2. Why did you choose to sell these particular products and packages through the Connecticut ENERGY STAR Lighting Program?

2-3. During the past 12 months, were there any ENERGY STAR lighting products which you sold in Connecticut without selling them through the program?
   a) [IF YES] Which ENERGY STAR lighting products were these?
   b) [IF YES] Why didn't you sell these ENERGY STAR lighting products through the program?

C.1.3 Section 3: Lighting Market Trends

[READ] *Now I would like to get your perspective on some forthcoming changes in the lighting market.*

EISA 2020

3-1. The Energy Independence and Security Act of 2007, otherwise known as "EISA" has established new lumens/watts standards for general service lighting. Are you aware that in 2020 the next phase of these EISA regulations will go into effect? [IF NECESSARY: A GENERAL SERVICE LAMP IS ONE WITH A MEDIUM SCREW BASE INTENDED FOR GENERAL SERVICE APPLICATIONS WITH LIGHT IN THE 310-2,600 LUMEN RANGE].

3-2. [IF AWARE OF EISA 2020, ELSE SKIP TO Q3-4] What do you expect will be the impacts of these 2020 EISA regulations on the Connecticut lighting market? [PROBE FOR WHEN EACH IMPACT MENTIONED EXPECTED (e.g. YEAR)]

[IF NOT ALREADY MENTIONED, PROBE FOR:]

3-2a. **Impact on LEDs - sales volume and lamp variety sold**

[PROBE FOR WHEN IMPACT EXPECTED (e.g. YEAR)]

[PROBE FOR ANY DIFFERENCES IN IMPACTS ON ENERGY STAR LEDs VS. NON-ENERGY STAR LEDs]

3-2b. **Impact on CFLs - sales volume and lamp variety sold**

[PROBE FOR WHEN IMPACT EXPECTED (e.g. YEAR)]

3-2c. **Impact on halogens – sales volume and lamp variety sold**

[PROBE FOR WHEN IMPACT EXPECTED (e.g. YEAR)]

[IF NOT ALREADY MENTIONED, ASK ABOUT THE IMPACT ON NON-COVERED HALOGEN PRODUCTS, PARTICULARLY REFLECTORS]

3-3. How do you expect these 2020 EISA regulations will impact your own company's lighting sales?

Table 27: Impacts of 2020 EISA Regulations

Topics	Interviewee Responses	
3-2 General impacts of regulations		
	Impacts on Sales Levels	**Impacts on Variety of Lamps Sold**
3-2a. Impacts on LEDs		
3-2b. Impacts on CFLs		
3-2c. Impacts on halogens		
3-3 How regulations will impact their own lighting sales		

ENERGY STAR Lamp 2.0 Specification

3-4. Are you aware that in 2017 a new ENERGY STAR specification – 2.0 – is scheduled to go into effect which will adjust measure life and efficacy requirements?

[IF UNAWARE, SKIP TO NEXT SECTION ‘LIKELIHOOD OF PHASE 2 EISA SCENARIOS’]

3-5. [IF AWARE OF ENERGY STAR 2.0] What do you expect will be the impacts of these new ENERGY STAR specifications on the Connecticut lighting market? [PROBE FOR TIMING OF CHANGE (e.g. YEAR) FOR EACH IMPACT MENTIONED]

[IF NOT ALREADY MENTIONED, PROBE FOR:]

3-5a. **Impact on LEDs on both sales volume and lamp variety sold**

[PROBE FOR WHEN IMPACT EXPECTED (e.g. YEAR)]

[PROBE FOR ANY DIFFERENCES IN IMPACTS ON ENERGY STAR LEDs VS. NON-ENERGY STAR LEDs]

3-5b. **Impact on CFLs on sales volume only**

[PROBE FOR WHEN IMPACT EXPECTED (e.g. YEAR)]

3-5c. **Impact on halogens on both sales volume and lamp variety sold**

[PROBE FOR WHEN IMPACT EXPECTED (e.g. YEAR)]

[IF NOT ALREADY MENTIONED, ASK ABOUT THE IMPACT ON NON-COVERED HALOGEN PRODUCTS, PARTICULARLY REFLECTORS]

3-6. How do you expect these new ENERGY STAR specifications will impact your own company's lighting sales?

Table 28: Impacts of Energy Star 2.0 Specifications

Topics	Interviewee Responses	
3-5 General impacts of new ES specs		
	Impacts on Sales Levels	**Impacts on Variety of Lamps Sold**
3-5a. Impacts on LEDs		
3-5b. Impacts on CFLs		
3-5c. Impacts on halogens		
3-6 How new ES specs will impact their own lighting sales		

[PROCEED ONLY IF RESPONDENT ANSWERED YES TO Q 3-1 (I.E. AWARE OF EISA 2020), ELSE SKIP TO Q3-17]

Likelihood of Phase 2 EISA Scenarios

[READ] I next want to draw on your market experience to predict the lighting regulations in effect in the year 2020.

As you likely know, the specifics of Phase 2 EISA are somewhat complicated given additional legislation and the recent DOE proposed rulemaking covering CFLs and LEDs. There are two main issues we would like you to consider for the scenarios in this section.

First, the original EISA 2007 legislation included a backstop standard of 45 lumens per watt for general service incandescent, halogen, CFL, and LED lamps set to go into effect January 1, 2020. This backstop applies to the manufacture, import, and sales of all general service lamps.

Second, on February 12, 2016, the DOE issued a proposed rulemaking that included a new efficiency standard for general service CFLs and LEDs **ONLY**. The DOE has proposed a higher lumens/watt standard for medium-screw based CFL and LED lamps of 85-100 lumens per watt depending on lumen output. This standard is to be effective in January 1, 2020 and would apply to manufacture and import of lamps but would allow all existing non-compliant lamps to sell through. The final ruling on this issue is due on or before December 31, 2016.

For these next questions, I will ask you to estimate the likelihood of each of a number of scenarios in terms of percentage. The total of your estimates should add up to 100%. We have defined three scenarios and will give you the opportunity to define a fourth if you think it is worth considering. First, let me read the three defined scenarios:

Scenario 1: EISA 2007 backstop is strictly enforced with a "hard-stop." In this scenario the EISA 2007 backstop is strictly enforced as of 2020 and lamps that do not meet the specifications may no longer be sold, manufactured or imported into the US after the effective date of the regulation. In this scenario, the proposed CFL/LED federal standard is not implemented.

Scenario 2: In this scenario both the EISA 2007 backstop and the proposed CFL/LED standard are implemented as of 2020. As in scenario 1, the EISA 2007 backstop is strictly enforced. In addition, the proposed CFL/LED federal standard with "sell-through" is implemented. In this scenario, CFL and LED lamps that do not meet the proposed CFL/LED federal standard cannot be manufactured or imported into the US. However, manufacturers and retailers would continue to "sell through" the existing stock of all non-compliant lamps, regardless of technology, until it is depleted.

Scenario 3: The EISA 2007 backstop is repealed and the proposed CFL/LED standard is not implemented. In this scenario, the manufacture and sale of all currently allowed lamp types continues. It is the scenario where the market operates without additional regulations other than those already in place.

Scenario 4: This is a scenario you define if you think that the three scenarios mentioned do not fully represent the likely options.

Before we continue, would you like me to restate the three defined scenarios?

[IF YES, DO SO. IF NO, PROCEED]

3-7. So, considering the three defined scenarios, is there another scenario that you think should be considered?

3-8. [IF ANOTHER SCENARIO] “What is that other scenario?” AND RECORD BELOW, IF NO, PROCEED]

Scenario 4: OTHER (SPECIFY)

____

3-9. In terms of percentage, what probability would you assign to Scenario 1 - EISA 2007 backstop is strictly enforced with a “hard-stop” and the proposed 2020 LED/CFL standards are not enacted?

3-10. What probability would you assign to Scenario 2 – both the EISA 2007 backstop and the proposed CFL/LED standard are implemented and manufacturers and retailers would continue to “sell through” all existing non-compliant lamps?

3-11. What probability would you assign to Scenario 3 –The EISA 2007 backstop is repealed and the proposed CFL/LED standard is not implemented?

3-12. [IF APPROPRIATE] And finally, what probability would you assign to the alternative you suggested?

[COMPLETE TABLE BELOW. MUST SUM TO 100%. IF NOT, ASK RESPONDENT TO REVISE PERCENTAGES UNTIL SUMS TO 100%.]

Table 29: Probability of Different EISA2 Scenarios

Scenario	%
1 – Strictly enforced	
2 – Sell through	
3 – Repealed	
4 – Other	
SUM	100%

3-13. Why do you think Scenario [IDENTIFY SCENARIO WITH HIGHEST PROBABILITY IN TABLE ABOVE] is the most likely scenario?

3-14. Do you think any future events—whether political, economic or other types of events—might cause you to change your probabilities?

3-15. [IF YES] How so? Anything else?

3-16. Which future event(s) do you think has the greatest impact on changing your probabilities?

3-17. [IF THEY INDICATED IN RESPONSE TO QUESTION 3-4 THAT THEY WERE AWARE OF THE NEW ENERGY STAR SPECS] Are you aware that the Connecticut ENERGY STAR lighting program may substantially reduce or even eliminate CFL discounts in 2017

3-18. How do you think the withdrawal of program support for CFLs would impact the Connecticut lighting market?

Non-ENERGY STAR LEDs

3-19. Recently the lighting market has experienced a growth in non-ENERGY STAR LEDs that do not qualify according to the new specification, ENERGY STAR Lighting 2.0, which was approved in 2016. These are these less expensive LED models which may lack some features (such as dimmability), have shorter measure lives, use slightly more energy, and may not be as bright when compared to ENERGY STAR-qualified LEDs. Are you familiar with these non-ENERGY STAR LED lamps?

[IF UNFAMILIAR WITH NON-ENERGY LEDS, SKIP TO Q3-20]

3-20. What do you expect will be the impacts of these non-ENERGY STAR LEDs on the overall Connecticut lighting market?

3-21. What do you expect will be the impacts of these non-ENERGY STAR LEDs on sales of LEDs in the Connecticut lighting market?

3-22. What do you expect will be the impacts of these non-ENERGY STAR LEDs on sales of ENERGY STAR LEDs in the Connecticut lighting market?

3-23. What do you expect will be the impacts of these non-ENERGY STAR LEDs on your own company's lighting sales?

Lingering Incandescents

3-24. Are you aware of any continuing availability of traditional incandescent bulbs?

a) [IF YES] What wattages of bulbs are you seeing? Any specific styles/types of bulbs? [Probe whether EISA-exempt bulbs or non-EISA exempt]

b) [IF YES] In what retail channels are these being sold?

c) Why are stores still selling these incandescents?

C.1.4 Section 4: Program Attribution in the past 12 months

Whether They Would Have Sold Any LED Lighting Products without the Program

[READ] *My next set of questions covers your sales of LED lamps in the past 12 months.*

3-25. [MANUFACTURERS ONLY] The Connecticut ENERGY STAR Lighting Program in the past 12 months paid average buydown or markdown discounts of $3.74 to $4.24 per LED A-lamp bulb and $5.49 to $5.62 per LED reflector bulb. Are there any retailers or retailer categories that you worked with through the Connecticut lighting program in the past 12 months that you think would not have been selling any LED products in Connecticut if these discounts had not been available?

a) [IF YES] Which retailers or retailer categories?

b) [IF YES] Why do you say this?

[IF RESPONDENT INDICATED THEY WOULD NOT HAVE SOLD ANY LEDS WITHOUT PROGRAM REBATE, SKIP TO C.1.5 5**]**

3-26. [RETAIL BUYER ONLY] The Connecticut ENERGY STAR Lighting Program in the past 12 months paid average buydown or markdown discounts of $3.74 to $4.24 per LED A-lamp bulb and $5.49 to $5.62 per LED reflector bulb. Do you think you would have sold any LED products in Connecticut if these discounts had not been available?

a) [IF NO] Why do you say this?

[IF RESPONDENT INDICATED THEY WOULD NOT HAVE SOLD ANY LEDS WITHOUT PROGRAM REBATE, SKIP TO C.1.5 5]

Retrospective Net-to-Gross – LED A Lamps

3-27. [MANUFACTURERS ONLY]
[INSTRUCTIONS TO SURVEYOR:

- FIRST ASK THE MANUFACTURER THE FREE RIDERSHIP QUESTION SEQUENCE FOR THE RETAILER CATEGORY THROUGH WHICH THEY SOLD THE MOST LEDS THROUGH THE PROGRAM (SEE TRACKING DATA MATRIX). EXCLUDE ANY RETAILER CATEGORIES THAT THEY IDENTIFIED IN QUESTION 3-25 AS NOT SELLING ANY LED BULBS AT ALL WITHOUT THE BUYDOWNS.
- REPEAT THE FREE RIDERSHIP BATTERY FOR ALL RETAIL CHANNELS WHICH ACCOUNTED FOR AT LEAST 20% OF THE SUPPLIER'S PROGRAM SALES]

The Connecticut ENERGY STAR Lighting Program in the past 12 months paid average buydown or markdown discounts of $3.74 to $4.24 per LED A-lamp bulb. If these program buydown/ markdown discounts and program promotional materials had not been available in the past 12 months, do you think your sales of these types of bulbs through [RETAILER CATEGORY] stores in Connecticut would have been about the same, lower, or higher?

b) [IF THE SAME OR HIGHER] Why do you say this? [RECORD RESPONSE AND THEN SKIP TO NEXT SECTION]

c) [IF LOWER] By what percentage do you estimate your sales of LED A lamps would be lower in the past 12 months if these program buydowns/ markdowns and program promotional materials had not been available? [RECORD % DECREASE]

i. I want to make sure I understand you correctly. You estimate that your sales would have been [PERCENTAGE FROM QUESTION above] % lower without the program support. So if you actually sold 100 LED bulbs in a given week, you think you'd have sold only about [100 – (PERCENTAGE FROM QUESTION 3-13b * 100)] in that period if the buydowns/markdowns hadn't been available? [IF RESPONSE IS ≠ YES, THEN CLARIFY ESTIMATED SALES DECREASE]

[REPEAT QUESTION BATTERIES FOR ALL RETAIL CHANNELS WITH SIGNIFICANT PROGRAM SALES]

3-28. [RETAIL LIGHTING BUYERS ONLY] The Connecticut ENERGY STAR Lighting Program in the past 12 months paid average buydown or markdown discounts of $3.74 to $4.24 per LED A-lamp. If these program buydown/ markdown discounts and program promotional materials had not been available in the past 12 months, do you think your sales of these types of bulbs in Connecticut would have been about the same, lower, or higher?

a. [IF THE SAME OR HIGHER] Why do you say this? [RECORD RESPONSE AND THEN SKIP TO NEXT SECTION]

b. [IF LOWER] By what percentage do you estimate your Connecticut sales of Energy Star LED A lamps would be lower in the past 12 months if these program buydowns/ markdowns and program promotional materials had not been available? [RECORD % DECREASE]

i. I want to make sure I understand you correctly. You estimate that your sales would have been [PERCENTAGE FROM QUESTION

3-24b.] % lower without the program support. So if you actually sold 100 LED bulbs in a given week, you think you'd have sold only about [100 – (PERCENTAGE FROM QUESTION 3-24b.) * 100)] in that period if the buydowns/markdowns hadn't been available? [IF RESPONSE IS ≠ YES, THEN CLARIFY ESTIMATED SALES DECREASE]

Retrospective Net-to-Gross – LED Reflectors

3-29. [MANUFACTURER ONLY]
[IF RESPONSE TO QUESTION 3-25 WAS THAT THEY WOULD NOT HAVE SOLD ANY LEDS WITHOUT PROGRAM REBATE, SKIP TO C.1.5 5]

[INSTRUCTIONS TO SURVEYOR:

- FIRST ASK THE MANUFACTURER THE FREE RIDERSHIP QUESTION SEQUENCE FOR THE RETAILER CATEGORY THROUGH WHICH THEY SOLD THE MOST LEDS THROUGH THE PROGRAM (SEE TRACKING DATA MATRIX). EXCLUDE ANY RETAILER CATEGORIES THAT THEY IDENTIFIED IN QUESTION 3-25 AS NOT SELLING ANY LED BULBS AT ALL WITHOUT THE BUYDOWNS.
- REPEAT THE FREE RIDERSHIP BATTERY FOR ALL RETAIL CHANNELS WHICH ACCOUNTED FOR AT LEAST 20% OF THE SUPPLIER'S PROGRAM SALES]

The Connecticut ENERGY STAR Lighting Program in the past 12 months paid average buydown or markdown discounts of $5.49 to $5.62 per LED reflector bulb. If these program buydown/ markdown discounts and program promotional materials had not been available in the past 12 months, do you think your sales of these types of bulbs through [RETAILER CATEGORY] stores in Connecticut would have been about the same, lower, or higher?

a. [IF THE SAME OR HIGHER] Why do you say this? [RECORD RESPONSE AND THEN THANK AND TERMINATE]

b. [IF LOWER] By what percentage do you estimate your sales of LED reflectors would be lower in the past 12 months if these program buydowns/ markdowns and program promotional materials had not been available? [RECORD % DECREASE]

   i. I want to make sure I understand you correctly. You estimate that your sales would have been [PERCENTAGE FROM QUESTION 3-16b.] % lower without the program support. So if you actually sold 100 LED bulbs in a given week, you think you'd have sold only about [100 – (PERCENTAGE FROM QUESTION 3-16b * 100)] in that period if the buydowns/markdowns hadn't been available? [IF RESPONSE IS ≠ YES, THEN CLARIFY ESTIMATED SALES DECREASE]

[REPEAT QUESTION BATTERIES FOR ALL RETAIL CHANNELS WITH SIGNIFICANT PROGRAM SALES]

3-30. [RETAIL LIGHTING BUYERS ONLY]

[IF RESPONSE TO QUESTION 3-26 WAS THAT THEY WOULD NOT HAVE SOLD ANY LEDS WITHOUT PROGRAM REBATE, SKIP TO C.1.5 5]

The Connecticut ENERGY STAR Lighting Program in the past 12 months paid average buydown or markdown discounts of $5.49 to $5.62 per LED reflector. If these program buydown/ markdown discounts and program promotional materials had not been available in the past 12 months, do you think your sales of these types of bulbs in Connecticut would have been about the same, lower, or higher?

a. [IF THE SAME OR HIGHER] Why do you say this? [RECORD RESPONSE AND THEN THANK AND TERMINATE]

b. [IF LOWER] By what percentage do you estimate your Connecticut sales of Energy Star LED reflectors would be lower in the past 12 months if these program buydowns/ markdowns and program promotional materials had not been available? [RECORD % DECREASE]

    i. I want to make sure I understand you correctly. You estimate that your sales would have been [PERCENTAGE FROM QUESTION 3-30b)] % lower without the program support. So if you actually sold 100 LED bulbs in a given week, you think you'd have sold only about [100 – (PERCENTAGE FROM QUESTION 3-30b) * 100)] in that period if the buydowns/markdowns hadn't been available? [IF RESPONSE IS ≠ YES, THEN CLARIFY ESTIMATED SALES DECREASE]

C.1.5 Section 5: Program Attribution - Prospective

Prospective NTG -- LEDS

[READ] My final set of questions will cover what you think will be the likely future market penetration of LEDs in Connecticut both with and without the Connecticut ENERGY STAR lighting program.

We are going to explore two different scenarios.

In the first scenario the Connecticut Energy Star lighting program continues to offer upstream discounts for LEDs through 2020.

In the second scenario this program is discontinued after 2016.

And just to be clear we're talking about the retail lighting market and not sales through lighting distributors.

Prospective NTG – LED A-LAMPS

3-31. First, let's start by assuming that the Connecticut ENERGY STAR lighting program will continue to provide LED discounts through 2021. Please provide your best estimate of what you think the market shares of these LED A-lamps will be at year-end 2017, 2019 and 2021 with the Connecticut program continuing through 2020. Your predictions should include all LED A-lamps, including both ENERGY STAR and non-ENERGY STAR LED A-lamps.

Table 30: Market Shares for LED A- Lamps
if Connecticut Program Continues to Provide LED Discounts Through 2021

Bulb Type	2015 CREED data (reference point)	2017 CT Retail Market Shares	2019 CT Retail Market Shares	2021 CT Retail Market Shares
LED A— Lamps	16%	%	%	%

3-32. Next let's assume that the Connecticut ENERGY STAR lighting program is discontinued after 2016. Again, please provide your best estimate of what you think the market shares of these LED A-lamps will be at year-end 2017, 2019 and 2021 with the Connecticut program ending in 2016. Your predictions should include all LED A-lamps, including both ENERGY STAR and non-ENERGY STAR LED A-lamps.

Table 31: Market Shares for LED A-Lamps
if Connecticut Program is Discontinued After 2016

Bulb Type	2015 CREED data (reference point)	2016 CT Retail Market Shares	2019 CT Retail Market Shares	2021 CT Retail Market Shares
LED A-Lamps	16%	%	%	%

3-33. What assumptions are you making when predicting this Connecticut market share trend for LED A-lamps both with and without the program?

Prospective NTG – LED Reflectors

Next please provide your best estimate of what you think the market shares of these LED reflectors will be at year-end 2017, 2019 and 2021 with the Connecticut program continuing through 2021. Your predictions should include both ENERGY STAR and non-ENERGY STAR LED reflectors.

Table 32: Market Shares for LED Reflectors if Connecticut Program Continues to Provide LED Discounts Through 2021

Bulb Type	2017 CT Retail Market Shares	2019 CT Retail Market Shares	2021 CT Retail Market Shares
LED Reflectors	%	%	%

3-34. Next let's assume that the Connecticut ENERGY STAR lighting program is discontinued after 2016.
Please provide your best estimate of what you think the market shares of these LED reflectors will be at year-end 2017, 2019 and 2021 with the Connecticut program ending in 2016. Your predictions should include both ENERGY STAR and non-ENERGY STAR LED reflectors.

Table 33: Market Shares for LED Reflectors if Connecticut Program is Discontinued After 2016

Bulb Type	2017 CT Retail Market Shares	2019 CT Retail Market Shares	2021 CT Retail Market Shares
LED Reflectors	%	%	%

3-35. What assumptions are you making when predicting this Connecticut market share trend for LED reflectors both with and without the program?

That's all the questions I had for you today. Thanks again for taking the time

C.2 Program Staff Interviews

Appendix content

Hello, may I speak to [______]? My name is ______, and I'm calling from NMR Group, an independent research firm, on behalf of the sponsors of the Energize Connecticut Residential Retail Products Program. We are conducting interviews with [COMPANY] program staff members most familiar with the Lighting Strategy of this Program. The purpose of my call is to ask you some questions about the design and delivery of the lighting program and also to get your perspectives on the current nature and future direction of the Connecticut lighting market. Is now a good time to speak with you?
Is this a good time for us to speak with you? (IF NOT, SET UP CALL BACK APPOINTMENT).
May I record this conversation?

C.2.1 Responsibilities, Organization

Let's start with a little information about you.

1. What is your position or job title?

2. What are your current responsibilities as manager for Lighting Strategy components of the Residential Retail Products Program? [ALLOW THEM TO RESPOND FIRST IN AN OPEN-ENDED FASHION, AND THEN PROBE FOR THEIR ROLES IN THE FOLLOWING KEY PROGRAM ACTIVITIES]

    a. Program planning? Program design? Management?

    b. Marketing the program to end users (e.g., point-of-sales marketing collateral, signage)

    c. Working with the program implementation contractors

d. Tracking program activity/program tracking data

C.2.2 Program Design, Program Offerings, Hard to Reach

First, I'd like to talk about the program design and the lighting products your program supports.

3. Currently, what types of products does the program support? [PROBE: standard and specialty CFLs (including reflectors), standard and specialty LEDs (including reflectors), fixtures (including downlight kits), lighting controls.]
4. How has the product mix changed since the 2012 to 2015 program cycle? How has the product mix changed since the start of the 2016-2018 program cycle? Why has it changed? [PROBE FOR ENERGY STAR 2.0 AND EISA2 IF NOT MENTIONED; PROBE ON CFLS NO LONGER BEING QUALIFIED AND SOME VALUE-LINE BECOMING QUALIFIED.]
5. How are the types of products sold by program partners determined? [PROBE: Do the Companies determine it? The implementers? The partners?]
6. How are the volumes of products they sell determined? [PROBE: Do the Companies determine it? The implementers? The partners?]
7. Can partners change what they are doing after the MOU has been signed for the cycle?
    a. [IF YES] What kinds of changes can they make?
    b. What can't they change?
    c. What is the process for making these changes?
8. How is it determined which retail channels the lighting suppliers are selling program-discounted lighting product through?

[IF NOT ADDRESSED EARLIER] The 2016 to 2018 plan discussed increasing the promotion of CFLs in retail channels expected to serve “hard-to-reach” customers. I have a few questions about this component of the lighting strategy.

9. Which customers does the program considers to be “hard-to-reach”?
10. Can you tell me about the process of deciding in which stores to sell HTR bulbs?
11. [IF NOT ADDRESSED IN Q10] Do you base HTR sales on store location? Store type? Both? Are there any retailers for which some of the store locations are HTR but others are not?
12. [IF BASED ON STORE TYPE AND NOT ADDRESSED IN Q10 OR Q11] Why target these stores?
13. As you know, as of right now, no CFLs will quality for ENERGY STAR 2.0 but some lower cost LEDs will become qualified. Have you changed your HTR strategy given the new specification?
    a. If so, how? [PROBE: Are you changing the stores you are targeting for HTR? Are you shifting to LEDs in general? Only to lower-cost LEDs that meet Spec 2.0 but not 1.1?]

C.2.3 Program Marketing and Outreach

Now let’s talk about your program’s marketing and outreach efforts.

14. What types of marketing and outreach is currently being done to promote this program?
15. Who develops these marketing/outreach strategies?
16. Who implements these marketing/outreach activities?
17. Are there any marketing/outreach activities designed to target customers who are in hard-to-reach (HTR) lighting market sectors such as low-income customers, or customers for whom English is not their first language?
    a. [If YES] What are these HTR marketing/outreach activities?

18. Which program marketing and outreach activities do you believe have been the most effective? Why do you say this?

19. Which program marketing and outreach activities do you believe have been less effective? Why do you say this?

20. Does your program work directly with lighting suppliers and retailers on content and timing of their own promotional campaigns?

    b. [IF YES] What is the nature of your collaboration

C.2.4 Future of Lighting Market

I'd like to talk more about the future of the lighting market. We are asking manufacturers and suppliers the next question in Connecticut and other states, and we'd like to get your input on these questions as well.

As you likely know, the specifics of Phase 2 EISA are somewhat complicated given additional legislation and the recent DOE proposed rulemaking covering CFLs and LEDs. There are two main issues we would like you to consider for the scenarios in this section.

First, the original EISA 2007 legislation included a backstop standard of 45 lumens per watt for general service incandescent, halogen, CFL, and LED lamps set to go into effect January 1, 2020. This backstop applies to the manufacture, import, and sales of all general service lamps.

Second, on February 12, 2016, the DOE issued a proposed rulemaking that included a new efficiency standard for general service CFLs and LEDs **ONLY**. The DOE has proposed a higher lumens/watt standard for medium-screw based CFL and LED lamps of 85-100 lumens per watt depending on lumen output. This standard is to be effective in January 1, 2020 and would apply to manufacture and import of lamps but would allow all existing non-compliant lamps to sell through. The final ruling on this issue is due on or before December 31, 2016.

For these next questions, I will ask you to estimate the likelihood of each of a number of scenarios in terms of percentage. The total of your estimates should add up to 100%. We have defined three scenarios and will give you the opportunity to define a fourth if you think it is worth considering. First, let me read the three defined scenarios:

> **Scenario 1**: EISA 2007 backstop is strictly enforced with a "hard-stop." In this scenario the EISA 2007 backstop is strictly enforced as of 2020 and lamps that do not meet the specifications may no longer be sold, manufactured or imported into the US after the effective date of the regulation. In this scenario, the proposed CFL/LED federal standard is not implemented.
>
> **Scenario 2**: In this scenario both the EISA 2007 backstop and the proposed CFL/LED standard are implemented as of 2020. As in scenario 1, the EISA 2007 backstop is strictly enforced. In addition, the proposed CFL/LED federal standard with "sell-through" is implemented. In this scenario, CFL and LED lamps that do not meet the proposed CFL/LED federal standard cannot be manufactured or imported into the US. However, manufacturers and retailers would continue to "sell through" the existing stock of all non-compliant lamps, regardless of technology, until it is depleted.
>
> **Scenario 3**: The EISA 2007 backstop is repealed and the proposed CFL/LED standard is not implemented. In this scenario, the manufacture and sale of all currently allowed lamp types continues. It is the scenario where the market operates without additional regulations other than those already in place.
>
> **Scenario 4**: This is a scenario you define if you think that the three scenarios mentioned do not fully represent the likely options.

Before we continue, would you like me to restate the three defined scenarios?

[IF YES, DO SO. IF NO, PROCEED]

21. Considering the three defined scenarios, is there another scenario that you think should be considered?
22. [IF ANOTHER SCENARIO] “What is that other scenario?” RECORD, IF NO, PROCEED]
23. In terms of percentage, what probability would you assign to Scenario 1 - EISA 2007 backstop is strictly enforced with a “hard-stop” and the proposed 2020 LED/CFL standards are not enacted?
24. What probability would you assign to Scenario 2 – both the EISA 2007 backstop and the proposed CFL/LED standard are implemented and manufacturers and retailers would continue to “sell through” all existing non-compliant lamps?
25. What probability would you assign to Scenario 3 –The EISA 2007 backstop is repealed and the proposed CFL/LED standard is not implemented?
26. [IF APPROPRIATE] And finally, what probability would you assign to the alternative you suggested?

[COMPLETE TABLE BELOW. MUST SUM TO 100%. IF NOT, ASK RESPONDENT TO REVISE PERCENTAGES UNTIL SUMS TO 100%.]

Table 34: Probability of Different EISA2 Scenarios

Scenario	%
1 – Strictly enforced	
2 – Sell through	
3 – Repealed	
4 – Other	
SUM	100%

27. Why do you think Scenario [IDENTIFY SCENARIO WITH HIGHEST PROBABILITY IN TABLE ABOVE] is the most likely scenario?
28. Do you think any future events—whether political, economic or other types of events—might cause you to change your probabilities? [IF YES] How so?

The last set of questions I have for you is about a subset of LEDs that do not qualify under ENERGY STAR Version 1.1 and still won't qualify under Version 2.0. These LED bulbs often lack certain efficacy (lumens per watt) and lifetime requirements that keep them qualifying for ENERGY STAR models. Some people call these "value-line" LEDs.

29. Are you familiar with these types of LEDs?

[IF YES CONTINUE; IF NO, GO TO CONCLUSION]

30. What do you think are the strengths of value-line LEDs? What about weaknesses? [Probe: I'm thinking not only about engineering characteristics but also about such things as price, availability, etc.]
31. What impact will value-line LEDs have on the residential lighting market in general? On energy-efficient lighting programs such as Connecticut Lighting Strategy of the Retail Products Program?

C.2.5 Conclusion

32. What would you say are the biggest strengths of the Lighting Strategy?
33. What are its biggest weaknesses?
34. What are the most important opportunities for the Lighting Strategy?
35. What are the threats to the program?
36. Is there anything we did not discuss that you feel is important to understanding the Connecticut Lighting Strategy?

Thank you so much for your time. That is all the questions I have for you.