Shedding Light: The Role of Public Utility Commissions in Encouraging Adoption of Energy Efficient Lighting by Low-income Households

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INTRODUCTION

In the United States, increasing residential lighting efficiency is a cost-effective, though underused, method of addressing high energy prices, energy security and independence, air pollution, and climate change.[1] Despite programs that encourage residential adoption of energy efficient light bulbs,[2] adoption rates have been low; the majority of residential lighting continues to be supplied by the standard incandescent[3] even though lighting alternatives like compact fluorescent lights ("CFL") are 75% more energy efficient.[4] This Note argues that present programs should be more narrowly applied to reach an untapped population that would greatly benefit from efficient lighting: low-income households.[5]

This Note assumes "that policymakers seek measures that will achieve the short- and long-term emissions reductions targets with a minimum of political cost."[6] Thus, this Note considers the relative attributes of proposed efficient lighting programs, including government cost,

1. PHILIP MOSENTHAL & JEFFREY LOITER, OPTIMAL ENERGY, INC., GUIDE FOR CONDUCTING ENERGY EFFICIENCY POTENTIAL STUDIES 1-1 (2007), *available at* http://www.epa.gov/cleanenergy/documents/suca/potential_guide.pdf.

2. Philippe Menanteau & Hervé Lefebvre, *Competing Technologies and the Diffusion of Innovations: The Emergence of Energy-Efficient Lamps in the Residential Sector*, 29 RESOURCES POL'Y 375, 384 (1999) (dating the "first large-scale measures to promote diffusion of energy-efficient lighting technologies in the residential sector by the American electric utilities" to the mid-1980s).

3. *See, e.g.*, Jeff Johnson, *The End of the Light Bulb*, CHEMICAL & ENGINEERING NEWS (Dec. 3, 2007), http://pubs.acs.org/email/cen/html/120607171848.html (noting that in 2006 roughly 10% of the 1.7 billion bulbs sold in the U.S. were compact fluorescent lights ("CFL")); *see also* STEPHEN BICKEL ET AL., U.S. DEP'T OF ENERGY, CFL MARKET PROFILE: DATA TRENDS AND MARKET INSIGHTS 8 (2010), *available at* http://www.energystar.gov/ia/products/downloads/CFL_Market_Profile_2010.pdf ("One in 6.6 medium screw-base lamps shipped today [using estimates from 2009] is a CFL, down from a peak of 1 in 4.5 in 2007.").

4. Sandy Bauers, *New Light Bulbs: Confusing but Enlightening*, CHI. TRIB., Feb. 22, 2011, http://articles.chicagotribune.com/2011-02-22/classified/sc-home-0221-lightblubs-20110221_1_bulbs-cfls-efficiency-advocates.

5. Thomas V. Chema, *In Support of Demand-Side Management*, PUB. UTIL. FORT., Jan. 18, 1990, at 11, 14 ("This is true partly because there is often much efficiency to be gained in this sector and partly because this sector is most likely to be subsidized for fuel costs anyway."); *see also* MARTIN KUSHLER ET AL., AM. COUNCIL FOR AN ENERGY-EFFICIENT ECON., MEETING ESSENTIAL NEEDS: THE RESULTS OF A NATIONAL SEARCH FOR EXEMPLARY UTILITY-FUNDED LOW-INCOME ENERGY EFFICIENCY PROGRAMS 7 (2005) ("The need for low-income energy efficiency programs is ongoing and even growing as energy costs rise and the numbers of low- and limited-income households also increase.").

6. Michael P. Vandenbergh et al., *Individual Carbon Emissions: The Low-Hanging Fruit*, 55 UCLA L. REV. 1701, 1709 (2008).

personal cost, and other psychological barriers.[7] In general, this framework emphasizes the use of efficiency measures over conservation measures. Conservation "reduces the level of demand for a useful service, and is often associated with the loss of amenity," whereas efficiency "reduces the amount of energy required to meet a given level of demand."[8] Household consumers favor the latter.[9] Government regulation of product efficiency standards is one important example of an efficiency tool that has been applied to household lighting.[10] Based on these premises, this Note examines the "effectiveness" of energy efficiency programs by evaluating each program's relative cost, time delay before implementation, and "self-sustainability," the ability to produce permanent behavioral change.

This Note proposes harnessing the abilities of state public utility commissions ("PUCs")[11] to tailor preexisting efficient lighting programs for low-income households, which are particularly susceptible to the common barriers to efficient lighting adoption.[12] Although the exact mandate differs by state, most PUCs regulate and monitor utility services and ensure reliable delivery of electricity at just and reasonable rates.[13]

7. *See generally id.* (identifying reductions in personal motor vehicle idling, reductions in standby power use, and other "low-hanging fruit" programs).

8. Charlie Wilson, *Social Norms and Policies to Promote Energy Efficiency in the Home*, 38 ENVTL. L. REP. 10,882, 10,882 (2008).

9. Vandenbergh et al., *supra* note 6, at 1709; *see also* Hope M. Babcock, *Responsible Environmental Behavior, Energy Conservation, and Compact Fluorescent Bulbs: You Can Lead a Horse to Water, but Can You Make It Drink?*, 37 HOFSTRA L. REV. 943, 948–49 (2009) (explaining that encouraging energy efficient behavior "is difficult to do because of personal habits, which arise from '[r]epeated interactions' and which are a major determinant of individual behavior. It is also extremely difficult to get people to refrain from consuming products that improve the quality of their lives" (footnotes omitted)); Elizabeth B. Forsyth, *Education for Reengergization: Overcoming Behavioral Barriers to Energy Efficiency in the Residential Sector*, 41 ENVTL. L. REP. 11,030, 11,031 (2011) ("[I]n the absence of political will to change the *production* of energy, the Barack Obama Administration should focus even more strongly on changing how we *use* energy.") (emphasis in original).

10. *See, e.g.*, John C. Dernbach et al., *Energy Efficiency and Conservation: New Legal Tools and Opportunities*, 25 NAT. RES. & ENV'T, Spring 2011, at 7, 7–11 (discussing programs such as encouraging states to improve and fund building energy efficiency, as well as mandatory appliance and equipment efficiency standards).

11. The exact name and function of public utility commissions differ by state, but for the sake of simplicity and consistency, this Note refers to them generally as "PUCs" and provides exact names when discussing examples.

12. *See infra* Part I.B.

13. This is generally referred as a PUC's "ratemaking authority." *See, e.g.*, N.Y. PUB. SERV. LAW § 135-o (McKinney 2011); Roger A. Greenbaum, Annotation, *Special Commentary: Recovery of "Stranded Costs" by Utilities*, 80 A.L.R. FED. 1 (2012) (explaining that the PUC ratemaking decisions are approved unless it is shown that the PUC's determination is "without any rational basis or without any reasonable support in the record" (citing Energy Ass'n of N.Y. v. Pub. Serv. Comm'n

Within this relatively undefined area, PUCs may extend the scope of their rules to encompass energy efficiency schemes by characterizing such programs as a method of promoting the reliability and decreasing the costs of the entire electricity grid.[14] This Note identifies three approaches that, if applied together, accommodate for special needs of low-income households and satisfy general policy goals: free and subsidized light bulbs, free audits, and educational projects. The combination of these approaches is low-cost and self-sustaining: PUCs already regulate utilities, meaning no additional procedure or oversight is necessary,[15] and reduced electricity bills, once initial barriers are overcome, will likely compel consumer adoption without significant funding from the state.[16] Using no more than their currently vested powers, PUCs may significantly influence efficient lighting adoption rates by low-income households and thereby generate low-cost, system-wide benefits for those individuals, the state electricity grid, and the global environment. This Note focuses primarily on New York's PUC as a promising example of the potential for such a program.

Part I of this Note discusses the individual and system-wide benefits of extensive residential adoption of efficient light bulbs, market barriers hindering low-income households from adopting efficient lighting, and present laws and programs that should be amended to focus on low-income household behaviors. Part II considers the role and incentives of utilities, and the unique position of PUCs to effectively coordinate system-wide interests. This Part studies New York State as an example and highlights statutory text that can be interpreted to provide authority for different lighting adoption regimes. Part III applies these statutory texts to a selection of efficient lighting programs to illustrate how PUCs can more effectively promote efficient lighting adoption among low-income households. Part IV concludes.

I. INCREASED USE OF ENERGY EFFICIENT LIGHTING IS A LOW-COST, IMMEDIATE, AND SELF-SUSTAINING METHOD OF IMPROVING ELECTRICITY DELIVERY SYSTEMS

The effectiveness of widespread adoption of efficient lighting arises from its relative ease and low cost of implementation, by adopting and

of N.Y., 653 N.Y.S.2d 502 (N.Y. Sup. Ct. 1996))); *see also infra* notes 224–228 and accompanying text.

14. *See infra* notes 37–42, 217–221 and accompanying text.

15. *See infra* notes 207–210 and accompanying text.

16. *See infra* notes 47–52 and accompanying text.

adapting already existing methods of information and program delivery, to combat present deficiencies of the electricity sector. A handful of states have reformed their electricity delivery systems by legally redefining relationships between electricity retailers and consumers.[17] Adoption of efficient lighting is a less burdensome option for states that are unwilling or unable to restructure their electricity markets and are still interested in reaping the benefits of increased electricity efficiency.

One method is to increase the use of energy efficient light bulbs. Because this technology already exists, there are minimal research and development costs.[18] Furthermore, because energy efficiency programs for light blubs have been in place since the 1970s, administrative infrastructure already exists.[19] Finally, from a purely economic perspective, the electricity bill savings alone are sufficient to justify long-term adoption.[20] Retargeting existing programs for low-income households will result in low-cost, immediate, and widespread electrical system benefits.

A. Public and Private Benefits of More Efficient Lighting

In light of increasing energy demand[21] and worsening environmental problems,[22] finding new energy resources is critical.[23] One solution is to

17. Such reforms include revenue decoupling, which "is a policy mechanism that attempts to solve [energy inefficiency] by severing the link between a utility's sale of electricity or gas and its revenues." JOSH CRAFT & JEFF ASLAN, NE. ENERGY EFFICIENCY P'SHIPS, REVENUE DECOUPLING IN THE NORTHEAST 1 (2008), *available at* http://www.neep.org/Assets/uploads/files/public-policy/outreach-and-analysis/Revenue_Decoupling_Brief_Final_Version_1.30.12.pdf. The New York Public Service Commission established decoupling provisions in April 2007. *Id.* at 7.

18. *See infra* Part I.B (discussing the variety and quality of currently available lighting products).

19. Edward H. Comer, *Transforming the Role of Energy Efficiency*, 23 NAT. RES. & ENV'T, Summer 2008, at 34, 34 ("These early efforts consisted of distributing educational information on how electricity is used in the home and how consumers could make their home more energy efficient."). One key aspect of a program for efficient lighting as opposed to other efficient appliances is that "the turn-over time for light bulbs is much shorter than most other electrical appliances . . . so that adoption may occur in a relatively short period of time." Corrado Di Maria et al., *Shedding Light on the Light Bulb Puzzle: The Role of Attitudes and Perceptions in the Adoption of Energy Efficient Light Bulbs*, 57 SCOT. J. POL. ECON. 48, 50 (2010).

20. Di Maria et al., *supra* note 19, at 50 ("[T]here is unambiguous evidence that the payback is typically less than 1 year."); *see also* Vandenbergh et al., *supra* note 6, at 1713–14 (concluding that efficient lighting technology results in "net social savings . . . even if we just account for the cost of energy at current prices and not for other potential cost savings . . . .").

21. *See, e.g.*, Michael P. Vandenbergh & Jim Rossi, *Good for You, Bad for Us: The Financial Disincentive for Net Demand Reduction*, 65 VAND. L. REV. 1527, 1536 (2012) (suggesting "that electricity use in the United States will increase by 45% by 2030" and global demand by 300% (citing ENERGY INFO. ADMIN., INTERNATIONAL ENERGY OUTLOOK 2011, at 209 tbl.D3 (2011))); *see also* Forsyth, *supra* note 9, at 11,031 ("[W]ith a continuation of existing policy, appliance consumption alone is projected to grow by 25% by 2020.").

adopt technology that uses less energy. Increased energy efficiency[24] "avoids burning the fossil fuels normally needed to meet increasing power needs, and therefore, allows our energy needs to be met at a lower cost and with less environmental impact than continuing to build and buy more supply from new generation."[25] Efficiency adjustments can be made in all phases of electricity delivery to decrease overall greenhouse gas emissions:[26] use of renewable resources during generation,[27] improved methods of transmission and distribution,[28] and even adjustments to end-user consumption behaviors.[29]

The electricity sector is the "largest and fastest growing source of GHG emissions globally, with 41 percent of energy-related carbon dioxide emissions in 2007."[30] In the United States, energy production accounts for 87% of total carbon dioxide emissions by metric ton.[31]

22. Megan J. Hertzler & Mara N. Koeller, *Who Pays for Carbon Costs? Uncertainty and Risk in Response to the Current Patchwork of Carbon Regulation for Public Utilities*, 36 WM. MITCHELL L. REV. 904, 907–09 (2010).

23. *See, e.g.*, Noah M. Sachs, *Greening Demand: Energy Consumption and U.S. Climate Policy*, 19 DUKE ENVTL. L. & POL'Y F. 295, 302 (2009) ("[T]he United States must cut its greenhouse gas emissions at least forty percent below current levels . . . to avoid dangerous climate disruption."); Vandenbergh et al., *supra* note 6, at 1702–03 ("An emerging consensus suggests that reducing the risks of catastrophic climate change will require leveling off greenhouse gas emissions in the near term and reductions of 60 to 80 percent from present levels by 2050." (footnotes omitted)).

24. *Calculating Energy Savings*, EPA, http://www.epa.gov/statelocalclimate/state/activities/measuring-savings.html (last visited May 31, 2013) (estimating efficiency impacts "by taking the difference between: (a) [a]ctual energy consumption after efficiency measures are installed [and] (b) [w]hat energy consumption would have occurred during the same period had the efficiency measures not been installed").

25. Sandra Levine & Katie Kendall, *Energy Efficiency and Conservation: Opportunities, Obstacles, and Experiences*, 8 VT. J. ENVTL. L. 101, 102–03 (2006); *see also* Brandon Hofmeister, *Bridging the Gap: Using Social Psychology To Design Market Interventions To Overcome the Energy Efficiency Gap in Residential Energy Markets*, 19 SOUTHEASTERN ENVTL. L.J. 1, 8–9 (2010) (estimating that "investing in utility energy efficiency programs averages 2.5 cents in upfront costs per kilowatt-hour saved" compared to seven to fourteen cents or more per kilowatt-hour to build a new fossil fuel fired power plant).

26. Forsyth, *supra* note 9, at 11,031–32 (noting how "[m]uch of the electricity generated to power homes is wasted" through inefficient transmission, home design, and household appliances).

27. *See, e.g.*, William Moomaw et al., *Renewable Energy and Climate Change*, *in* INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, SPECIAL REPORT ON RENEWABLE ENERGY SOURCES AND CLIMATE CHANGE MITIGATION 161, 172–74 (Ottmar Edenhofer et al. eds., 2011), *available at* http://srren.ipcc-wg3.de/report/IPCC_SRREN_Ch01.pdf.

28. *See id.* at 174.

29. *See id.*

30. INT'L ENERGY AGENCY, SECTORAL APPROACHES IN ELECTRICITY: BUILDING BRIDGES TO A SAFE CLIMATE 3 (2009), *available at* http://www.iea.org/publications/freepublications/publication/sectoral2009.pdf.

31. *What Are Greenhouse Gases and How Much Are Emitted by the United States?*, U.S. ENERGY INFO. ADMIN., http://www.eia.gov/energy_in_brief/greenhouse_gas.cfm (last updated June

Electricity generation is predominantly fossil fuel based and coal use alone resulted in 8.7 billion gigatons ("Gt") of carbon dioxide emissions in 2007.[32] To achieve the International Energy Agency's ("IEA") recommended "equilibrium temperature,"[33] "global energy-related CO_2 emissions need to be lower than today's levels by 2030 . . . and on a rapidly declining path thereafter."[34] As detailed below, efficient lighting both directly and indirectly reduces GHG emissions.[35] Although an 80% reduction of GHGs by 2050 would have significant incremental costs to consumers, a 17% reduction of GHGs by 2020 could potentially be met at a net savings to consumers by aggressively pursuing energy efficiency.[36]

A second benefit of increased energy efficiency is the reduction of peak demand, which increases the reliability of the United States' power grid and reduces carbon dioxide emissions.[37] In order to reliably provide electricity to end-users, each segment of the grid must have sufficient capacity to meet maximum load, known as "peak demand,"[38] which fluctuates throughout the day.[39] As a result of the need to meet peak demand, increased energy use requires the addition of more electricity plants, which means additional capital investment and environmental harm.[40] In addition, forgoing new power plants is cost effective: as

21, 2012); EPA, INVENTORY OF U.S. GREENHOUSE GAS EMISSIONS AND SINKS: 1990–2009, at 3-1 (2011), *available at* http://www.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2011-Complete_Report.pdf.

32. INT'L ENERGY AGENCY., *supra* note 30, at 25.

33. Moomaw, *supra* note 27, at 169.

34. INT'L ENERGY AGENCY, *supra* note 30, at 28.

35. *See, e.g.*, CHRISTIANA FIGUERES & MARTINA BOSI, ACHIEVING GREENHOUSE GAS EMISSION REDUCTIONS IN DEVELOPING COUNTRIES THROUGH ENERGY EFFICIENT LIGHTING PROJECTS IN THE CLEAN DEVELOPMENT MECHANISM 1 (2006), *available at* http://figueresonline.com/publications/lighting_and_CDM.pdf ("Energy efficiency can reduce the need for capital-intensive supply investments and is one of the most promising sectors for improving the adequacy and reliability of power systems, increasing energy security and reducing emissions . . . ."); *see also infra* notes 36–51 and accompanying text.

36. Hofmeister, *supra* note 25, at 11.

37. *See, e.g.*, Eric Martinot & Nils Borg, *Energy-Efficient Lighting Programs: Experience and Lessons from Eight Countries*, 26 ENERGY POL'Y 1071, 1079 (1998).

38. JONATHAN KOOMEY & RICHARD E. BROWN, THE ROLE OF BUILDING TECHNOLOGIES IN REDUCING AND CONTROLLING PEAK ELECTRICITY DEMAND 3 (2002), *available at* http://enduse.lbl.gov/info/LBNL-49947.pdf.

39. STEVE HEINEN ET AL., INT'L ENERGY AGENCY, IMPACT OF SMART GRID TECHNOLOGIES ON PEAK LOAD TO 2050, at 6 (2011), *available at* http://www.iea.org/publications/freepublications/publication/smart_grid_peak_load.pdf; *see generally* KOOMEY, *supra* note 38 (defining peak demand).

40. EUGENE HONG ET AL., NAVIGANT CONSULTING, INC., U.S. LIGHTING MARKET CHARACTERIZATION VOLUME II: ENERGY EFFICIENT LIGHTING TECHNOLOGY OPTIONS 9 (2005), *available at* http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/ee_lighting_vol2.pdf. The

compared to the $2.50 per watt it costs to build a new coal power plant, it only costs $0.025 per watt to decrease demand by replacing light bulbs.[41] Depending on the effects of efficient lighting on heating and cooling needs of buildings, adoption of efficient lighting alone could decrease peak electricity demand by between 7% and 11%.[42]

Third, energy efficiency programs complement sustainable energy solutions, like renewable fuels. Energy efficiency measures are often faster to implement than creating new energy supply in part because they "do not require lengthy siting, permitting, or construction processes."[43] In response, efficiency standards can be first implemented to stabilize energy demand,[44] giving time for new energy supplies like renewable fuel development to become cost effective.[45] As estimated by the Department of Energy ("DOE"), renewable fuels could reduce electricity generation by 22% by 2020, and the combination of renewables and efficiency could result in a 44% drop in that same time.[46]

Finally, increased efficiency across the electricity delivery path and decreased demand by end-users also makes economic sense.[47] Despite

United States Environmental Protection Agency ("EPA") estimates that the average carbon dioxide emission rate of coal-fired electricity generation in the United States, the nation's predominant source of electricity generation, is 2,249 lbs/MWh. *Air Emissions*, EPA, http://www.epa.gov/cleanenergy/energy-and-you/affect/air-emissions.html (last updated Oct. 17, 2012). This suggests that foregoing the creation of a single coal generator with a capacity of approximately 350,000 MW could eliminate the production of almost 400,000 tons of carbon dioxide per hour of operation. *See id.*

41. Forsyth, *supra* note 9, at 11,032–33 n.30 (quoting Thomas R. Blakeslee, *Energy Saving: Much Cheaper Than Building Power Plants!*, RENEWABLEENERGYWORLD.COM (Nov. 12, 2009), http://www.renewableenergyworld.com/rea/news/article/2009/11/energy-saving-much-cheaper-than-building-power-plants); *see also* Johnson, *supra* note 3 ("Using CFLs or solid-state lighting would save about 4% of this total electricity, savings which would avoid building the equivalent of roughly 20 new 1,000-MW nuclear power plants.").

42. Jens Schoene et al., *Energy-Efficient Lighting's Impact on Peak Load*, ELEC. LIGHT & POWER, http://www.elp.com/index/display/article-display/8776922390/articles/utility-automation-engineering-td/volume-16/issue-7/features/energy-efficient-lightings-impact-on-peak-load-losses.html (last visited May 31, 2013).

43. Sachs, *supra* note 23, at 304.

44. Rachel Kirby, *Doing More with Less: Incorporating Energy Efficiency into a National Renewable Energy Standard*, 8 SUSTAINABLE DEV. L. & POL'Y 26, 26 (2007).

45. *Id.*

46. *Id.*

47. *See* Babcock, *supra* note 9, at 950 ("If every one of the 110 million households in the United States replaced a conventional sixty-watt incandescent bulb with one CFL, the energy saved by that small action would be enough to power a city of 1.5 million people. One swapped-out bulb per house could power all the homes in Delaware and Rhode Island. In terms of greenhouse gases not emitted into the atmosphere, one swapped out bulb per 110 million households is equal to taking 1.3 million cars off the road and would save enough electricity to turn off two power plants permanently or avoid building the next two, assuming the demand level for electricity did not creep back up.

the higher purchasing price of efficient lighting, the use of less electricity over the life of the bulb provides households with overall savings.[48] As estimated by the IEA, each $1 spent on efficiency projects avoids an average of $2 in investment in energy supply.[49] Reduction in the overall electricity demand may also "lower the wholesale market clearing price for electricity because less energy is needed."[50] Finally, because the energy in lamps not converted to light is lost as heat, increased efficiency will mean less heat loss, which may help residents save on cooling bills.[51] Hypothetically, then, so long as awareness of the availability of efficient lighting and information about its private benefits is properly understood, the inherent cost savings of adopting efficient lighting should be sufficient impetus to drive a self-sustaining adoption program.[52]

Despite seemingly obvious private and public benefits, adoption rates of efficient lighting continue to be low.[53] At present, the residential sector is one of the heaviest consumers of electricity in the United States, and wastes a significant amount of that electricity by utilizing inefficient light bulbs.[54] The residential sector consumes 39% of electricity delivered in the United States,[55] and, as of 2011, 13% of that was used to power lighting.[56] In 2001, the average home had forty-five total light

Therefore, if every U.S. household substituted just one CFL for one incandescent bulb, the savings in electricity and resultant environmental benefits would be impressive. Just one CFL can prevent 690 pounds of greenhouse gases from being emitted into the atmosphere and 200 pounds of coal from being burned in power plants." (footnotes omitted)).

48. Levine & Kendall, *supra* note 25, at 102.

49. Sachs, *supra* note 23, at 303; *see also* Levine & Kendall, *supra* note 25, at 102 ("Investing in energy efficiency results in achieving energy needs for about one-third to one-half the cost of buying more power on the open market."). This cost-savings is particularly apparent when the life-cycle cost of different lighting technologies is taken into consideration. *See, e.g.*, U.S. DEP'T OF ENERGY, LIFE-CYCLE ASSESSMENT OF ENERGY AND ENVIRONMENTAL IMPACTS OF LED LIGHTING PRODUCTS, PART I: REVIEW OF THE LIFE-CYCLE ENERGY CONSUMPTION OF INCANDESCENT, COMPACT FLUORESCENT, AND LED LAMPS 3, fig.ES.1 (2012), *available at* http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/2012_LED_Lifecycle_Report.pdf.

50. Levine & Kendall, *supra* note 25, at 102.

51. HONG ET AL., *supra* note 40, at 14.

52. *See, e.g.*, T.M.I. Mahlia et al., *Cost-Benefit Analysis and Emission Reduction of Lighting Retrofits in Residential Sector*, 37 ENERGY & BUILDINGS 573, 573 (2005).

53. *See, e.g.*, Di Maria et al., *supra* note 19, at 51.

54. *Id.* at 49 ("[C]ompared with the average efficiency of lighting in the industrial (80 lm/W), or the commercial sector (50 lm/W), the 16.8 lm/W estimated for residential use . . . demonstrates the enormous potential for energy savings." (internal citations omitted)).

55. *Electricity Explained: Use of Electricity*, U.S. ENERGY INFO. ADMIN., http://www.eia.gov/energyexplained/index.cfm?page=electricity_use (last visited May 31, 2013).

56. *Frequently Asked Questions: How Much Electricity Is Used for Lighting in the United States?*, U.S. ENERGY INFO. ADMIN., http://www.eia.gov/tools/faqs/faq.cfm?id=99&t=3 (last

bulbs, 87% of which were incandescent lamps.[57] Incandescent bulbs consume 90% of total energy used for residential lighting,[58] but convert only 5 to 10% of electricity input into light and emit the rest as lost heat.[59] In total, incandescent bulbs "consume[] the most energy and provide[] the least amount of light nationally,"[60] but remain popular "because they possess many attractive properties that more efficient light sources cannot reproduce easily."[61] The current status of adoption demonstrates that broad distribution of information is not enough: households are interested in more than just economic savings.[62] Broad adoption will require identifying and addressing those additional interests.

B. General Barriers to Household Adoption of Efficient Lighting and Special Difficulties for Low-income Households

Unlike lighting consumers in the commercial sector, residential consumers utilize bulbs in a personal setting, which makes adoption of new technologies contingent on preferences other than just cost-benefit calculations.[63] Many of these preferences result from the incandescent

updated Jan. 9, 2013); *see also* U.S. ENERGY INFO. ADMIN., DOE/EIA-0383(2011), ANNUAL ELECTRICITY OUTLOOK 2011 WITH PROJECTIONS TO 2035, at 123 (2011), *available at* http://www.electricdrive.org/index.php?ht=a/GetDocumentAction/id/27843.

57. U.S. DEP'T OF ENERGY, U.S. LIGHTING MARKET CHARACTERIZATION, VOLUME I: NATIONAL LIGHTING INVENTORY AND ENERGY CONSUMPTION ESTIMATE, at xiii (2002), *available at* http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/lmc_vol1_final.pdf. A more recent study published in 2012 estimates that the average number of household bulbs has increased to 67.4 per household. U.S. DEP'T OF ENERGY, RESIDENTIAL LIGHTING END-USE CONSUMPTION STUDY: ESTIMATION FRAMEWORK AND INITIAL ESTIMATES 4.4 tbl.4.1 (2012), *available at* http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/2012_residential-lighting-study.pdf.

58. U.S. LIGHTING MARKET CHARACTERIZATION, *supra* note 57, at 38 tbl.5-7.

59. HONG ET AL., *supra* note 40, at 12.

60. U.S. LIGHTING MARKET CHARACTERIZATION, *supra* note 57, at 62.

61. *Id.* at 11.

62. *See, e.g.*, Jabavu Clifford Nkomo, *Consumer Choice in an Energy Efficient Lighting Context*, 16 J. ENERGY S. AFR. 14, 15 (2005) ("Another view is that rather than assuming economic rationality, preferences of consumers are affected by choices of other members of society, so that the different utility functions of different households are interdependent."); *see also* Wilson, *supra* note 8, at 10,883 (emphasizing the importance to consumers of "non-energy benefits" as deduced from behavioral research finding that "households do not consume energy. Rather, they need and enjoy services . . . that are in turn provided or enabled by technologies that convert energy into useful work."); Joel S. Gilbert, *Consistency in Marketing: Sending the Right Message to Large-Volume Customers*, PUB. UTIL. FORT., Sept. 28, 1989, at 19, 22 ("In most cases, the customer is buying productivity, comfort, control, and prestige.").

63. *See, e.g.*, Babcock, *supra* note 9, at 952–53 ("[B]arriers to behaving in an environmentally responsible way," include cognitive heuristics, social norms like autonomy and reciprocity, personal

bulb's current monopoly over the residential lighting market.[64] To ensure quick adoption, new lighting alternatives must meet or surpass the current incandescent offerings.[65] Specifically, residential consumers are looking for the familiar low cost,[66] a common Edison screw base,[67] the typical warm color,[68] and the average 1000-hour life.[69] In addition to these physical concerns, which the lighting industry is addressing with technological advances,[70] there are psychological barriers to efficient lighting adoption, including household members' improper valuation of efficient lighting.[71] As is discussed in detail below, low-income households are particularly sensitive to such barriers because of three commonly shared characteristics: such households have lesser total income,[72] are generally less educated,[73] and are more likely to be

responsibility, and esteem. As Babcock notes: "If external praise is not there, then it is less likely that an individual will feel proud of her good behavior and engage in it.").

64. Menanteau & Lefebvre, *supra* note 2, at 378; *see also* Babcock, *supra* note 9, at 953 ("These problems with CFLs can neutralize any guilt an individual may feel about not conforming to the energy conservation norm, which might otherwise propel her to switch bulbs.").

65. Menanteau & Lefebvre, *supra* note 2, at 379.

66. Walmart was advertising standard incandescent 60-watt bulbs for $0.31 apiece. Peter Bacqué, *Fluorescent Light Bulb Prices Increasing*, RICHMOND TIMES-DISPATCH (July 24, 2011), http://www2.timesdispatch.com/business/2011/jul/24/tdmony01-fluorescent-light-bulb-prices-increasing-ar-1192522/. This behavior is often referred to as the "anchoring effect," which suggests that individuals "make estimates by starting from an initial, familiar value, that is adjusted to yield the final answer." Di Maria et al., *supra* note 19, at 53.

67. HONG ET AL., *supra* note 40, at 7; *see also* Peter Miller, *A Brighter Idea: The Untold Story of the CFL*, 25 ELECTRICITY J., Aug.–Sept. 2012, at 56, 57 ("Lighting fixtures, sockets, and lamps are all designed to function with a bulb that is the same size, shape, and weight of a standard incandescent bulb.").

68. HONG ET AL., *supra* note 40, at 7; *see also* Menanteau & Lefebvre, *supra* note 2, at 382; Miller, *supra* note 67, at 57 ("[Consumers know] whether they want a bulb with the brightness of a 100-watt bulb or the softer light from a 60-watt bulb, even though they may not have the slightest idea what a watt is.").

69. OSRAM SYLVANIA, 4TH ANNUAL SYLVANIA SOCKET SURVEY 9 (2011), http://assets.sylvania.com/assets/Documents/2009_SYLVANIA_Socket_Survey.d81a552e-cb6b-4779-9e56-5da47e838c7f.pdf.

70. *See infra* notes 76–96 and accompanying text (discussing the technological improvements to efficient bulbs).

71. *See infra* notes 105–107 and accompanying text; *see also* FIGUERES & BOSI, *supra* note 35, at 3; Di Maria et al., *supra* note 19, at 49; Martinot & Borg, *supra* note 37, at 1074, 1079.

72. The value of money saved must be considered relative to income. *See, e.g.*, Roger D. Colton, *Prepayment Utility Meters, Affordable Home Energy, and the Low Income Utility Consumer*, 10 J. AFFORDABLE HOUS. & CMTY. DEV. L. 285, 293–94 (2001) ("Low income consumers are frequently forced to decide between competing household necessities (e.g., heat or eat), and are forced to engage in a wide variety of dangerous and/or unhealthy activities in an effort to keep paying their utility bills."). Furthermore, at least one study found "that a 1% increase in income is associated with an increase in the probability of adoption of 0.095%." Di Maria et al., *supra* note 19, at 64; *see also* Nkomo, *supra* note 62, at 17 (2005) ("By reducing household lighting costs without reducing

renters.[74] This Part surveys current bulb designs, addresses the implications of product and personal preferences among consumers, and proposes solutions to these market barriers.

In response to new legally mandated efficiency standards,[75] the lighting industry quickly developed new, more efficient bulb designs. Among the countless lighting efficiency improvements, three notable technologies are halogen incandescent lights, compact fluorescent lights ("CFLs"), and light emitting diodes ("LEDs"). In comparison to the standard incandescent, which generates light at a rate of between ten to seventeen lumens per watt, these technologies generate light at rates of between twelve and twenty-two lumens per watt, fifty and seventy lumens per watt, and twenty-seven to fifty-four lumens per watt, respectively.[76] The degree to which each of these technologies has penetrated the market varies, but each is advancing day-by-day.[77]

Halogen incandescent bulbs are the most similar to the standard incandescent. Both bulbs have the same shape and use the same mechanism to generate light.[78] The efficiency of a standard incandescent increases with the filament's temperature,[79] but is limited by the temperature and rate at which tungsten evaporates; without the tungsten filament, no light is generated.[80] Halogen gases lengthen the tungsten

the lighting levels, it improves its cash flow and releases money for other household needs. Installation can reduce lighting expenditure by more than 70 percent . . . .").

73. *See, e.g.*, Di Maria et al., *supra* note 19, at 51 (noting "the importance of education, information, and environmental awareness in the household's adoption decision"); *see also id.* at 60 ("Of those with primary education, only 13% report having installed CFLs in their dwelling. This proportion increases to 23% for those who have completed secondary education. For those with upper secondary or third level education, the proportion of adopters, 35% and 39%, respectively . . . .").

74. LUCAS W. DAVIS, NAT'L BUREAU OF ECON. RESEARCH, EVALUATING THE SLOW ADOPTION OF ENERGY EFFICIENT INVESTMENTS: ARE RENTERS LESS LIKELY TO HAVE ENERGY EFFICIENT APPLIANCES? 5 (2009), *available at* http://urbanpolicy.berkeley.edu/greenbuilding/davis.pdf.

75. *See* Energy Independence and Security Act of 2007 § 325, 42 U.S.C. § 6297 (2012); *see also infra* notes 153–160 and accompanying text (discussing details of the statute).

76. *Types of Lighting*, U.S. DEP'T OF ENERGY (July 29, 2012, 5:36 PM) http://energy.gov/energysaver/articles/types-lighting.

77. *Compare* U.S. LIGHTING MARKET CHARACTERIZATION, *supra* note 57, at xiii, *with* U.S. DEP'T OF ENERGY, 2010 U.S. LIGHTING MARKET CHARACTERIZATION 82–84 (2012), *available at* http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/2010-lmc-final-jan-2012.pdf.

78. Both halogen and standard incandescent bulbs produce light by heating a tungsten filament. HONG ET AL., *supra* note 40, at 12.

79. *Id.*

80. *Id.* at 12–13.

filament's lifespan[81] and increase the efficiency of the bulb by an estimated 25%.[82]

CFLs, in contrast, use electricity to excite electrons that strike the bulb's phosphor coating and thereby produce light.[83] Notwithstanding aesthetic dissimilarities in early CFLs, recent models have successfully mimicked the majority of incandescent light bulb properties, including small size, warm coloring, limited flickering, and short start-up time.[84] However, CFLs continue to suffer from a shortened lifetime when rapidly turned on and off[85] or operated with a dimmable switch.[86] Additionally, consumers have voiced concerns that CFLs contain mercury that may be hazardous in their homes,[87] though government agencies maintain that the mercury concentrations are minimal and provide guides for proper use and disposal of CFLs in the home.[88] Finally, CFLs use 75% less electricity and on average last ten times longer than the standard incandescent.[89]

Finally, the technology least similar to the standard incandescent in both appearance and function, but with the greatest promise for saving energy, is the LED. Technically not considered light bulbs, LEDs are semiconductors that glow when electricity flows through them.[90] The light intensity of LEDs can easily be tailored,[91] but their light quality is

81. *Id.* at 12 (gases like bromine "promote[] the regenerative halogen cycle" by "deposit[ing] evaporated tungsten molecules back onto the filament, enabling the tungsten filament to operate at higher temperatures without shortening its operating life").

82. *Lighting Choices to Save You Money*, U.S. DEP'T OF ENERGY (July 30, 2012, 7:56 AM) http://energy.gov/energysaver/articles/lighting-choices-save-you-money.

83. Darian Unger, *Modern Innovation Management Theory and the Evolving U.S. Lighting Industry*, 17 J. MGMT. HIST. 9, 11 (2011).

84. Menanteau & Lefebvre, *supra* note 2, at 386.

85. Bradford F. Mills & Joachin Schleich, *Why Don't Households See the Light?: Explaining the Diffusion of Compact Fluorescent Lamps*, 32 RES. & ENERGY ECON. 363, 367 (2010).

86. HONG ET AL., *supra* note 40, at 33. Research is making headway in this area, but there are not yet any commercially viable options. *Id.* at 34.

87. *See, e.g.*, Babcock, *supra* note 9, at 954–56 (describing difficulties of proper disposal in the residential setting); Nkomo, *supra* note 62, at 18 (describing potential harms of mercury).

88. Nkomo, *supra* note 62, at 18 ("In the United States, for example, used or broken CFLs are sent to recycling centres that break the lamps and safely recover the mercury."); *Frequently Asked Questions: Lighting Choices to Save You Money*, U.S. DEP'T OF ENERGY (Aug. 9, 2012, 9:20 AM), http://energy.gov/energysaver/articles/frequently-asked-questions-lighting-choices-save-you-money; *see also* Johnson, *supra* note 3 (remarking on Walmart's "intention to pressure its manufacturer to reduce the small amount of mercury in CFLs").

89. *Lighting Choices to Save You Money*, *supra* note 82.

90. Unger, *supra* note 83, at 11 ("[S]olid-state lighting devices with semiconductor chips that glow with electricity flow, and do not require light sockets.").

91. HONG ET AL., *supra* note 40, at 101.

inconsistent when viewed from different angles.[92] Moreover, the units rapidly degrade because of their own heat.[93] LEDs have become increasingly more price-competitive in relation to CFLs and incandescent bulbs,[94] particularly as retailers "transform light bulbs from a cheap, disposable product into something that consumers might show off to their friends" by "adding functions that could ultimately fit into a larger home automation system."[95] LEDs can use 80% less electricity and last twenty-five times longer than the standard incandescent.[96]

The following table compares key features of incandescent, halogen, CFL, and LED lighting fixtures:

Figure 1: Summary Statistics of Alternative Lighting Technologies

	Incandescent	**Halogen**	**CFL**	**LED**
Wattage[97]	60W	43W	13W	12.5W
Estimated cost/year[98]	$7.32	$5.18	$1.57	$1.50
Estimated lifetime cost[99]	$195	$180	$50	$75

92. *Id.*

93. *Id.* at 103.

94. *See, e.g.*, Diane Cardwell, *LEDs Emerge as a Popular "Green" Lighting*, N.Y. TIMES, Jan. 21, 2013, http://www.nytimes.com/2013/01/22/business/leds-emerge-as-a-popular-green-lighting.html?src=me&ref=general&_r=1& ("[$10 is] a tipping point that would speed mass adoption.").

95. *Id.* For example, because "the light in LED bulbs comes from chips, companies have been able to develop software applications that let users control the bulbs." *Id.*

96. *Lighting Choices to Save You Money*, *supra* note 82.

97. To generate 800 lumens of brightness requires an input of sixty watts, the average specifications of a standard incandescent. *Lighting*, ENERGYSTAR, http://www.energystar.gov/index.cfm?c=lighting.pr_lighting_landing (last visited May 31, 2013) (follow "Brightness").

98. *Id.* (follow "Cost").

99. These estimates include "initial bulb price, light bulb replacement costs and energy costs over 25 years," assuming that "bulbs are on for 3 hours a day." *See The True Cost of a Light Bulb*, ENERGYSTAR, http://www.lightingfacts.com/downloads/TrueCost_FactSheet_06APR11.pdf (last visited May 31, 2013).

Expected life	1x[100]	2x[101]	10x[102]	25x[103]

These technological improvements demonstrate the significant energy savings such alternative technology provides, but the matter of widespread residential adoption remains unaddressed.

In addition to overcoming the cost and product quality barriers to efficient lighting adoption, the market must overcome behavioral barriers.[104] For low-income households, notable barriers include incomplete information,[105] the landlord-tenant problem,[106] and improper pricing of the value of efficient lighting.[107] Addressing these problems requires a variety of complementary programming, all of which can be delivered effectively by PUCs through programs encouraging efficient lighting.[108]

100. EPA, NEXT GENERATION LIGHTING PROGRAMS: OPPORTUNITIES TO ADVANCE EFFICIENT LIGHTING FOR A CLEANER ENVIRONMENT 16 (2011), *available at* http://www.energystar.gov/ia/partners/manuf_res/downloads/lighting/EPA_Report_on_NGL_Programs_for_508.pdf; *see also Why Choose ENERGY STAR?*, ENERGYSTAR, http://www.energystar.gov/index.cfm?c=cfls.pr_cfls_why (last visited May 31, 2013) (estimating a lifetime of 750–1,000 hours).

101. EPA, *supra* note 100, at 16.

102. *Frequently Asked Questions: Lighting Choices to Save You Money*, *supra* note 88.

103. *Id.*; *see also CFL Glossary*, ENERGYSTAR, http://www.energystar.gov/index.cfm?c=cfls.pr_cfls_glossary#rated_life (last visited May 31, 2013) ("For all light bulbs, lifetime is determined by operating a sample of bulbs according to industry test standards. . . . The ENERGY STAR CFL criteria require additional testing to show that the sample can withstand a number of short start cycles and monitors early failures throughout testing.").

104. *See, e.g.*, Miller, *supra* note 67, at 58–60 (providing an example of the progress that has been made with CFLs in California).

105. Menanteau & Lefebvre, *supra* note 2, at 383.

106. *See, e.g.*, Davis, *supra* note 74, at 8 (describing the problem as a "principal-agent problem" where "[t]he principal (the tenant) is hiring the agent (the landlord) to provide housing services. Problems arise . . . because the two parties have different incentives."); Hofmeister, *supra* note 25, at 14–15 (discussing misaligned incentives of landlords and homebuilders, who bear the "capital costs of efficiency measures" and, respectively, tenants and homeowners, who are responsible for "ongoing energy costs"). In 2010, an estimated 32% of homes in the United States were tenant-occupied. Forsyth, *supra* note 9, at 11034. Of these renters, "approximately 70 percent of renter households had incomes below the national median and more than 40 percent had incomes in the bottom quartile." JOINT CTR. FOR HOUS. STUDIES OF HARVARD UNIV., RENTER DEMOGRAPHICS 17 (n.d.), *available at* http://www.jchs.harvard.edu/sites/jchs.harvard.edu/files/ahr2011-3-demographics.pdf.

107. *See infra* notes 126–131 and accompanying text; *see also* Scott F. Bertschi, Comment, *Integrated Resource Planning and Demand-Side Management in Electric Utility Regulation: Public Utility Panacea or a Waste of Energy?*, 43 EMORY L.J. 815, 828–29 ("Empirically, consumers will not invest in conservation measures unless they produce returns through reduced energy costs between 30-100 percent . . . utilities seldom receive over 15 percent return on their invested capital.").

108. *See infra* Part III.

Electricity consumers lack basic information regarding both efficient appliance alternatives and their personal electricity consumption.[109] Although "[s]ocial actors are competent masters of their routines and habits . . . there is no reason to expect them to . . . know how to think and act responsibly about efficiency choices."[110] In particular, regarding efficient bulbs, "the packaging information about CFL performance is too technical and hard for the average consumer to understand. Consumers need the equivalent of a Rosetta stone to decipher the differences among CFLs."[111] Importantly, the federal government took key steps in addressing this problem when it introduced mandatory "Lighting Facts" labels.[112] However, PUCs can still help improve upon this system by educating households about label components.[113]

At present, residential consumers receive only limited electricity cost information: "most bills have a stable price for power that provides no incentive to use less power."[114] Current metering practices mean

109. Mats Bladh & Helena Krantz, *Towards a Bright Future? Household Use of Electric Light: A Microlevel Study*, 36 ENERGY POL'Y 3521, 3530 (2008) ("Information about the existence of low-wattage lamps and their relative prices is one problem. But knowledge about own use and consumption is another problem."). *See generally* MONICA NEVIUS ET AL., CONSUMER UNDERSTANDING OF KEY LIGHTING FACTS AND IMPLICATIONS FOR ENERGY SAVINGS (2012), *available at* http://www.aceee.org/files/proceedings/2012/data/papers/0193-000193.pdf (summarizing survey information regarding knowledge of information on the Lighting Facts labels instituted by the Federal Trade Commission collected from 650 New York consumers).

110. Forsyth, *supra* note 9, at 11,038 (quoting Loren Lutzenhiser, *Marketing Household Energy Conservation: The Message and the Reality*, *in* NEW TOOLS FOR ENVIRONMENTAL PROTECTION: EDUCATION, INFORMATION AND VOLUNTARY MEASURES 49, 56 (Thomas Dietz & Paul C. Stern eds., 2002)).

111. Babcock, *supra* note 9, at 954 (footnotes omitted); *see also* NEVIUS ET AL., *supra* note 109, at 6-232 ("As common wattages of general purpose incandescent bulbs are replaced by multiple options . . . . Consumers wishing to recreate the quality of incandescent lighting with EISA-qualified bulbs will need to understand concepts such as lumen and color rendition.").

112. The labeling requirements came into effect on January 1, 2012. *FTC Extends Deadline for New "Lighting Facts" Labels to January 1, 2012*, FTC (Apr. 7, 2011), http://www.ftc.gov/opa/2011/04/bulblabeling.shtm. Furthermore, the Lighting Facts label takes advantage of the ENERGY STAR qualification system, which many households were previously aware of. *See* U.S. DEP'T OF ENERGY, ENERGY EFFICIENCY TRENDS IN RESIDENTIAL AND COMMERCIAL BUILDINGS 39 (2010), *available at* http://apps1.eere.energy.gov/buildings/publications/pdfs/corporate/building_trends_2010.pdf (reporting that 78% of responding households recognized the purpose of the ENERGY STAR label and 76% of consumers were "influenced at least partly in their appliance purchase decision by the presence of the label"). Through 2006, ENERGY STAR program efforts are responsible for an estimated 4.8 exajoule ("EJ") of primary energy savings. MARLA SANCHEZ ET AL., LBNL-329E, SAVINGS ESTIMATES FOR THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY'S ENERGY STAR VOLUNTARY PRODUCT LABELING PROGRAM 18 (2008), *available at* http://enduse.lbl.gov/info/LBNL-329E.pdf.

113. *See infra* III.C.i.

114. Levine & Kendall, *supra* note 25.

consumers "cannot calculate how much electricity . . . any one item in their home or apartment uses, nor do they usually know their real-time energy use in the residence."[115] Lacking real-time estimates of electricity use and cost, consumers cannot adjust their consumption to account for electricity cost that varies based on season, time of day, weather, type of power, and geographic location.[116] Providing user-friendly pricing information could help households recognize the savings available through efficient lighting.[117]

Renters face additional behavioral barriers.[118] First, almost 15% of renters pay a fixed utilities price, which is included in their rent, and never see the electricity bill at all.[119] Because these tenants "do not face any marginal cost of using energy . . . they tend to use their appliances more intensively."[120] Second, due to the landlord-tenant relationship, renters are less likely to invest in energy efficient appliances because they are only concerned with short-term investments; long-term improvements will likely be used and enjoyed by another person.[121] As a group, renters tend to use their appliances more intensively, but paradoxically invest in fewer efficient appliances.[122] Delivering bills that itemize electricity usage to households could lead to both energy and monetary savings that landlords alone would likely not be able to incentivize.[123] More detailed billing information is particularly useful when combined with appliance standards,[124] which solve this landlord-

115. Sachs, *supra* note 23, at 309.

116. Levine & Kendall, *supra* note 25.

117. *See* Bladh & Krantz, *supra* note 109, at 3530 ("[O]nly the user of lamps can balance consumption and needs, since only he or she knows the latter."); Forsyth, *supra* note 9, at 11,033 (describing how consumers have difficulty "understanding which products save energy and on what payback periods, and which energy retrofits a consumer might need" and that obtaining such information, independently or with professional help "is burdensome and expensive").

118. *See supra* note 106 and accompanying text.

119. *See, e.g.*, Davis, *supra* note 74, at 3 (According to a 2005 estimate, "13.4% of all renters (4.2% of all households) have their utilities included in the rent. These households do not face any marginal cost of using energy and thus tend to use their appliances more intensively.").

120. *Id.*

121. Di Maria et al., *supra* note 19, at 59; Sachs, *supra* note 23, at 307 (Light bulb purchasers "have little incentive to identify, or pay extra for, the most energy-efficient tools and appliances if they are not internalizing the long-term operating expenses of their choices."); *see also* Mills *supra* note 85, at 365 (discussing the "Double Hurdle" decision-making process wherein households first determine "whether to actively explore purchasing CFLs" and then determine "the intensity of adoption"). With respect to homeowners, "because society is increasingly mobile . . . [homeowners] may be reluctant to invest in conservation measures if [they] anticipate[] [they] will move to another residence soon." Bertschi, *supra* note 107, at 828.

122. Bertschi, *supra* note 107, at 828.

123. *See supra* note 106 and accompany text.

124. *See infra* notes 153–160 and accompanying text.

tenant problem by obligating landlords to purchase efficient appliances.[125]

A final psychological barrier to residential adoption of efficient lighting is caused by the inability of households to properly price the value of efficient lighting; in other words, "to most people a CFL is merely another way to provide light after the sun goes down."[126] Studies indicate that it is the "perceived relative cost, rather than the actual one" that determines consumer behavior.[127] The perceived costs are often higher than actual costs. First, "consumers are not used to thinking in terms of global costs as far as electrical appliances are concerned," and remain "highly sensitive to the first cost of appliances."[128] The relatively small savings from decreased energy consumption means consumers have "very high implicit discount rates and rarely consider additional initial costs that cannot be compensated for in several months,"[129] which economists have estimated to range from 25 to 300%.[130] Purchasing myopia may be corrected or at least mitigated by free bulb distributions and educational programs.[131]

Second, economists observe that because consumers may be more drawn by a bargain as opposed to preference for a specific bulb type, "[a] sharp increase in sales following a significant reduction of prices does not necessarily lead to a permanent change in purchasing behaviour."[132] Many of these new purchasers "do not wish to make further purchases unless there are financial incentives."[133] This outlook increases the likelihood of reversion: even if a marketing program induces a consumer to purchase one efficient bulb, the discontinuation of the program may result in the consumer returning to using cheaper incandescent bulbs.[134] In theory, therefore, subsidized products and services, once begun, would need to be indefinite, a conclusion that conflicts with the aim to limit government expenditures.[135] Providing consumers with information on

125. Davis, *supra* note 74, at 8.

126. Miller, *supra* note 67, at 57.

127. Di Maria et al., *supra* note 19, at 53.

128. Menanteau & Lefebvre, *supra* note 2, at 383.

129. *Id.*

130. Sachs, *supra* note 23, at 309–10. Returns to customers from CFLs range from $5 to $15 per lamp. Martinot & Borg, *supra* note 37, at 1078.

131. *See infra* Parts III.A, III.C.

132. Menanteau & Lefebvre, *supra* note 2, at 385.

133. *Id.*

134. *See, e.g.*, Babcock, *supra* note 9, at 969–70 (describing how, without a change in behavioral norms, inefficient habits will return in the absence of incentives, which only produce moderate results in the first place).

135. *See* Vandenbergh et al., *supra* note 6, at 1709.

electricity use and efficient appliances is an important component of a "sustainable" program where subsidies can be reduced or eliminated and the program still remain in place.[136]

Finally, even if consumers are convinced to install more efficient lighting in their homes, some studies suggest that there may be a "rebound effect": taking advantage of the greater efficiency of their appliances, households keep these appliances on longer.[137] Studies vary regarding the estimated effects, but one estimate suggests usage increases by 5 to 12% for household illumination.[138] The literature discussing low-income households appears even more diverse: one study estimates a rebound effect of 50 to 200%,[139] whereas another suggests "any rebound effect resulting" may be "linked to situations of suppressed demand due to insufficient supply."[140] A recent study of the situation in the European Union, where incandescent bulbs were banned as of September 2012,[141] reported that a 10% increase in lighting energy efficiency led to a less than 5% reduction in energy consumed for lighting per capita. The study concluded that "rebound effects in the lighting market were still strong, . . . [but did not] suggest backfire."[142] The rebound effect is harder to address, particularly given the relative uncertainty of its scope, but may be mitigated through educational programs.[143]

Low-income households are especially prone to cost and psychological barriers,[144] and would benefit from more information on their electricity

136. *See infra* Part III.C.

137. *See, e.g.*, Roger Foquet & Peter J.G. Pearson, *The Long Run Demand for Lighting: Elasticities and Rebound Effects in Different Phases of Economic Development* (Basque Ctr. for Climate Change, Working Paper 2011-06, 2011) *available at* http://www.bc3research.org/index.php ?option=com_wpapers&task=downpubli&iddoc=36&Itemid=279&lang=en (summarizing the recent literature on the rebound effect specific to lighting demand).

138. *Id.* (citing Lorna A. Greening et al., *Energy Efficiency and Consumption—The Rebound Effect*, 28 ENERGY POL'Y 389, 398 (2000)).

139. *Id.* (citing Joyashree Roy, *The Rebound Effect: Some Empirical Evidence from India*, 28 ENERGY POL'Y 433, 435 (2000)).

140. FIGUERES & BOSI, *supra* note 35, at 7 (These considerations, which may be useful in evaluating the degree of rebound effects of low-income households in the United States, which also may have insufficient access to electricity for cost reasons.); *see also* Foquet & Pearson, *supra* note 137, at 18 ("[A] 10% increase in per capita income appeared to generate 35% more lighting use and, all other things being constant, energy requirements.").

141. Foquet & Pearson, *supra* note 137, at 2.

142. *Id.* at 17.

143. *See infra* Part III.C.

144. Stephen R. Tully, *The Contribution of Human Rights to Universal Energy Access*, 4 NW. U. J. INT'L HUM. RTS. 518, 521 (2006) ("[M]inimum levels considered essential to satisfying basic needs [in Brazil are defined as] . . . 80 kilowatt per hour (kWh) per month"); *see also supra* notes 72–74 and accompanying text.

use. More efficient lighting options would enable them to better control their household consumption.[145] Because electricity bill savings represent a greater proportion of a low-income household's income, programs targeting low-income households are more likely to become self-sustaining in the long run.[146] Support for low-income households is also wanting under many current efficiency-endorsing programs.[147] PUCs can bridge the gap.

C. Current Efficiency Programs: Problems, Growth, and the Continued Failure to Accommodate for Low-income Household Needs

Public programs promoting efficient lighting have been indispensable in creating and developing the residential sector niche markets that have led to increasing returns to adoption.[148] In 2009 and 2010, slightly over 70% of United States households reported using CFLs.[149] Despite these improvements, federal action continues at a halting pace[150] and state programs remain a patchwork of experiments.[151] Furthermore, the results are not as strong as they might be, for example, the majority of U.S. residents are estimated to be internalizing less than 14% of potential benefits.[152] Present infrastructure and programming should be directed at

145. Nkomo, *supra* note 62, at 15 ("There is a lack of reliable data on energy use as well as low awareness levels, and households do not know the proportion of their electricity bill going to various end uses to enable them to optimise on energy usage.").

146. *See supra* notes 5 and accompanying text.

147. *See infra* notes 190–194 and accompanying text.

148. Menanteau & Lefebvre, *supra* note 2, at 388. Examples include improved product performance responsive to consumer demands. *Id.* at 385. Because research and development costs for efficient lighting technology are steep, continued investment in bulbs likely would not have occurred without the certainty of consumer demand. *Id.* at 379. Overcoming initial development costs was necessary for efficient lighting manufacturing to become self-sustainably price competitive against standard incandescent bulbs. *Id.*

149. SYLVANIA, *supra* note 69, at 15. United States survey participants report "using the CFL to replace an incandescent lamp that was operated an average of about four hours/day." Evan Mills, *Evaluation of European Lighting Programmes: Utilities Finance Energy Efficiency*, 19 ENERGY POL'Y 266, 272 (1991). If one replaces a sixty watt incandescent with a thirteen watt CFL, she can expect an annual saving of seventy kilowatts per year per replaced bulb. *Id.* Further assuming that the average household uses a total of 600 kWh per year for lighting, "households participating in the most effective programmes (four to six lamps/house) achieved at least 50% savings in electricity used for lighting . . . ." *Id.*

150. *See infra* notes 161–169, 175–178 and accompanying text.

151. *See infra* note 188.

152. U.S. DEP'T OF ENERGY, RESIDENTIAL LIGHTING END-USE CONSUMPTION STUDY, *supra* note 57, at xiii tbl.ES-3. This calculation utilizes the report's data that on average residential households have six CFLs per home and an average of forty-five bulbs in total.

low-income households to deliver immediate, cost-effective energy to the public and targeted populations.

The Energy Independence and Security Act of 2007[153] ("EISA") remains crucial for the promotion of efficient lighting technology. The EISA has been described as the "strongest example of command-and-control regulation for energy efficiency."[154] The Act "sets a performance standard [for bulbs] of light output (lumens) for energy used (watts)"[155] and requires that the Federal Trade Commission ("FTC") develop new labels to "help consumers compare the brightness and estimated energy costs of various types of light bulb."[156] Once fully implemented in 2020, the EISA standards are projected to result in a 33% decrease from 2009 levels in residential lighting energy demand,[157] save the average American household upwards of $200 a year,[158] eliminate the need for thirty new power plants, and prevent the equivalent of the carbon dioxide emissions from 17 million cars.[159] The following table summarizes the EISA's lighting standards:

Figure 2: General Service Incandescent Lamps[160]

Rated Lumen Ranges	**Maximum Rate Wattage**	**Minimum Rate Lifetime**	**Effective Date**
1490–2600	72	1,000 hrs	1/1/2012
1050–1489	53	1,000 hrs	1/1/2013
750–1049	43	1,000 hrs	1/1/2014
310–749	29	1,000 hrs	1/1/2014

153. Energy Independence and Security Act of 2007 § 325, 42 U.S.C. § 6297 (2012). The Energy Independence and Security Act ("EISA") stipulates standards for other appliances as well, but these provisions are outside the scope of this Note.

154. Forsyth, *supra* note 9, at 11,034.

155. U.S. DEP'T OF ENERGY, CONSUMER LIGHT BULB CHANGES: BRIEFING AND RESOURCES FOR MEDIA AND RETAILERS 8 (n.d.), *available at* http://energy.gov/sites/prod/files/consumer_light_bulb_changes.pdf.

156. *Id.* at 9, 14; *see also* FRED SISSINE, CONG. RESEARCH SERV., RL 34294, ENERGY INDEPENDENCE AND SECURITY ACT OF 2007: A SUMMARY OF MAJOR PROVISIONS 7 (2007), *available at* http://www.seco.noaa.gov/Energy/2007_Dec_21_Summary_Security_Act_2007.pdf (providing a section-by-section analysis of energy efficiency standards for certain types of bulbs).

157. U.S. ENERGY INFO. ADMIN., *supra* note 56, at 64.

158. Miller, *supra* note 67, at 62.

159. *Id.*

160. Energy Independence and Security Act of 2007 § 321, 42 U.S.C. § 6291 (2012).

Despite entering into effect on January 1, 2012,[161] the EISA's requirements have met resistance at the federal level that may prevent the Act's effective execution. Opposition peaked in July 2011 with the introduction of the Better Use of Light Bulbs Act ("BULB Act"),[162] which sought to repeal the EISA's sections imposing energy efficiency standards for light bulbs, and to prohibit any federal, state, or local lighting requirement that could be satisfied by only mercury-containing bulbs.[163] As described by its supporters, the BULB Act was intended to enhance consumer choice regarding "the cost, type, and efficiency of the lighting that works best for them," instead of permitting the government to stipulate lighting options.[164]

Although the BULB Act failed in the House of Representatives,[165] the debates surrounding the prompt implementation of the EISA illuminate the political hurdles that efficient lighting faces at the national level, and indicate the types of issues that must be addressed through future policymaking. Proponents of the BULB Act criticized the EISA for federally banning the manufacture and sale of incandescent light bulbs;[166] for forcing consumers to purchase efficient bulbs instead of allowing them to choose to use cheaper incandescent bulbs;[167] and for instituting mandates that could only be met with "bulbs that contain dangerous mercury."[168] Texas State Representative Joe Barton, who sponsored the BULB Act, also questioned the reliability of more energy-efficient technologies, arguing that the "$6 CFL bulb won't last 10,000 hours if it's turned on and off 2,500 times."[169]

Supporters of the EISA maintained that, "at a time when Americans continue to experience downward financial pressures, energy efficient light bulbs present an every-day solution to much needed cost-savings."[170] Using evidence from the Natural Resources Defense Council ("NRDC"), EISA supporters estimated that "repealing the

161. *See id.*

162. Better Use of Light Bulbs Act, H.R. 2417, 112th Cong. (2011).

163. *Digest for H.R. 2417*, GOP.GOV, http://www.gop.gov/bill/112/1/hr2417 (last visited May 31, 2013) (summarizing the provisions of the bill).

164. *Id.*

165. *H.R. 2417 (112th): Better Use of Light Bulbs Act*, GOVTRACK.US, http://www.govtrack.us/congress/bills/112/hr2417 (last visited May 31, 2013).

166. *Digest for H.R. 2417*, *supra* note 163.

167. 157 CONG. REC. H4823 (daily ed. July 11, 2011) (statement of Rep. Joe Barton); *see also id.* at H4825 (statement of Rep. Michael Burgess).

168. *H.R. 2417 (112th): Better Use of Light Bulbs Act*, *supra* note 163.

169. 157 CONG. REC. H4823 (daily ed. July 11, 2011) (statement of Rep. Joe Barton).

170. 157 CONG. REC. H4824 (daily ed. July 11, 2011) (letter of Holly R. Hart).

energy efficiency standards would cause a seven percent or $85 increase in energy costs for the average household."[171] Supporters of the EISA further argued that the BULB Act "would undermine job growth, strand investments that have been made to make sure that we meet these new standards, waste $12 billion a year on unnecessary electricity bills, . . . increase pollution,"[172] and create legislative uncertainty.[173] The supporters of the EISA also countered the critics by noting that passing the BULB Act would have provided an advantage to companies who had not made similar investments to improve bulb efficiency, essentially punishing lighting manufacturers who had previously invested in order to comply with forthcoming regulations.[174]

Opposition to the EISA bulb efficiency requirements continued, despite the failure of the BULB Act, via federal restrictions on the DOE's ability to spend money to enforce the Act. A rider to the 2012 appropriations legislation prohibited the DOE from using any allocated funds to enforce lighting energy efficiency standards in fiscal year 2012.[175] At the time, proponents of the EISA remained positive that the restrictions on DOE expenditures were only a nine-month setback.[176] However, this limitation has been extended at least another year with the adoption of an amendment to the fiscal year 2013 Energy and Water Appropriations Bills that again limits the DOE's ability to spend money

171. *Id.*

172. 157 Cong. Rec. H4826 (daily ed. July 11, 2011) (statement of Rep. Henry Waxman).

173. 157 Cong. Rec. H4827 (daily ed. July 11, 2011) (letter from NEMA); *see also* Menanteau & Lefebvre, *supra* note 2, at 384, 388 (explaining that a wide diffusion of efficient bulbs helps to ensure "that the expectations of agents, consumers, industrialists and distributors regarding future development of the technology [are] in harmony").

174. 157 Cong. Rec. H4827 (daily ed. July 11, 2011) (letter from NEMA).

175. Consolidated Appropriations Act of 2012, H.R. 3671, 112th Cong. § 315 (2011):

None of the funds made available in this Act may be used—

> (1) to implement or enforce section 430.32(x) of title 10, Code of Federal Regulations; or
> (2) to implement or enforce the standards established by the tables contained in section 325(i)(1)(B) of the Energy Policy and Conservation Act (42 U.S.C. 6295(i)(1)(B)) with respect to BPAR incandescent reflector lamps, BR incandescent reflector lamps, and ER incandescent reflector lamps.

176. As stated by Senate Energy and Natural Resources Chairman Jeff Bingaman (D-N.M.), original author of the 2007 law, "the decision is likely to have 'little practical consequence on which incandescent light bulbs are available in stores because, starting Jan. 1 [2012], it will be illegal to produce or import the inefficient, wasteful bulbs in the United States.'" *Congress Passes FY 2012 Appropriations, Limits Funding for Energy Efficiency*, ALLIANCE TO SAVE ENERGY, http://ase.org/efficiencynews/congress-passes-fy-2012-appropriations-limits-funding-energy-efficiency (last updated Jan. 5, 2012).

to enforce EISA standards.[177] Additional opposition has also been seen on a state-by-state basis, but only Texas has adopted an anti-EISA provision.[178] Predictions by politicians and experts of the negative consequences of the lack of federal enforcement are substantially similar to the projected results of repealing the EISA.[179] Despite this opposition from the House, the DOE in 2012 pushed back by announcing $7 million more funding to go to three companies "with a particular focus on technologies that help to lower the cost of LED lighting by improving the manufacturing process."[180]

In addition to public policy disagreements, many consumers have also been resistant to change. A survey of preliminary studies indicates that "despite manufacturer preparation and support for the requirements, consumer awareness [of the EISA] remains low, with potentially high dissatisfaction as consumers do learn about the law."[181] Common misunderstandings include the belief that the "EISA bans the incandescent light bulb and requires consumer[s] to purchase CFLs."[182]

177. Pete Kasperowicz, *House Votes to Block Enforcement of Energy Efficient Light Bulb Standards*, THEHILL.COM (June 5, 2012, 9:14 PM), http://thehill.com/blogs/floor-action/house/231117-house-votes-to-block-enforcement-of-light-bulb-standards.

178. *Compare* Karl Stephan, *Texas' Light Bulb Law: Not the Brightest Bulb on the Tree*, MANUFACTURING.NET (Jan. 15, 2013, 2:11 PM), http://www.manufacturing.net/articles/2013/01/texas%E2%80%99-light-bulb-law-not-the-brightest-bulb-on-the-tree (describing a Texas law that allows sales of tungsten-filament argon-filled light bulbs "in defiance of the federal EISA law"), *with* Joshua Cook, *Why We Need the "SC Light Bulb Freedom Act,"* Greer-TAYLORSPATCH (Jan. 7, 2013, 5:20 AM), http://taylors.patch.com/blog_posts/why-we-need-the-sc-light-bulb-freedom-act (describing a similar South Carolina law that failed to pass the state Senate).

179. *See supra* notes 169–173 and accompanying text; *Congress Passes FY 2012 Appropriations, Limits Funding for Energy Efficiency*, *supra* note 176 (noting a "greater uncertainty in the marketplace, as states may choose to individually implement standards creating a patchwork of competing regulations for manufacturers" and describing how compliant manufacturers will further be disadvantaged by the "increase[d] imports of inefficient foreign bulbs"); *NEMA Reiterates that Lightbulb Efficiency Standards Remain, Consumers Retain Diverse Options for Efficient Lightbulbs*, NEMA (Dec. 16, 2011, 12:00 AM), http://www.nema.org/media/pr/20111216a.cfm (noting the potential harm to light bulb manufacturers and confusion to customers, and emphasizing that a lack of federal enforcement may also "allow those who do not respect the rule of law to sell inefficient light bulbs in the U.S. without fear of enforcement, creating a competitive disadvantage for compliant manufacturers").

180. Tina Casey, *Congress Revives Zombie Light Bulbs as Energy Dept. Funds New Tech*, TRIPLEPUNDIT.COM (June 11, 2012), http://www.triplepundit.com/2012/06/doe-funds-new-light-bulb-research-despite-balky-congress/.

181. SCOTT DIMETROSKY & KATIE PARKINSON, THE LIGHTS THEY ARE A CHANGING: EARLY RESULTS FROM EISA 2007, at 2-148 (2012), *available at* http://www.aceee.org/files/proceedings/2012/data/papers/0193-000044.pdf.

182. *Id.* at 2-149 tbl.2, 2-153 ("[In one study] 24% of the [seventy-two] lighting retailers [surveyed] said they had received negative feedback from customers . . . [including] frustration at the

Consumers' fundamental misunderstanding of the EISA could result in failure to comply, consumer backlash, and stockpiling of incandescent bulbs, which "could severely delay, and possibly undermine, the intent of the legislation and the potential for energy efficient lighting in the coming years."[183] If program results in California, which accelerated the application of EISA standards by one year,[184] are any indication of the potential national trend, availability of legacy incandescent bulbs may persist and consumer awareness may remain low for some time.[185] Complementary programming is needed to boost results.[186]

Both federal[187] and state[188] legislation include provisions that supplement mandatory lighting standards, but, as currently designed, do not sufficiently benefit low-income households. Program types include energy labels, ratings, and certification schemes; minimum energy performance standards; building codes; "[b]ulk procurement programs that seek to lower the information gathering and purchasing costs of large quantities of equipment and lighting systems"; rebates or tax deductions; and "[m]arket transformation programs that seek to positively influence consumer behavior and market trends on a voluntary basis through a combination of labeling, building, certification, technical support, and incentives schemes."[189] Unfortunately for low-income

government telling them what to do, as well as dissatisfaction with the CFLs' lighting quality and mercury content.").

183. DIMETROSKY & PARKINSON, *supra* note 181, at 2-159.

184. *California to Begin Bulb Phase-Out*, RESIDENTIAL LIGHTING, http://www.residentiallighting.com/california-begin-bulb-phase-out (last visited May 31, 2013).

185. *See, e.g.*, DIMETROSKY & PARKINSON, *supra* note 181, at 2-154, 2-156 (reporting that "almost half (48%) of retail storefronts indicated that they had legacy 100 watt bulbs available" one year after implementation of the EISA standards and that 45% of customers surveyed were aware of the EISA legislation).

186. Sachs, *supra* note 23, at 298 (Because price signals do not sufficiently alter behavior and consumption habits, the "government needs to play an active role in surmounting these barriers through a toolbox approach that would include product performance standards, information disclosure requirements, and changes in utility regulation." (footnote omitted)).

187. *See generally* Kenneth Gillingham et al., *Energy Efficiency Policies: A Retrospective Examination*, 31 ANN. REV. ENV'T & RES. 161 (2006) (reviewing literature on several types of federal energy efficiency policies).

188. The majority of states have some combination of energy efficiency programs in place. *See Database of State Incentives for Renewables and Efficiency*, DSIRE, http://www.dsireusa.org/ (last visited May 31, 2013) (providing state-by-state information regarding incentives for renewable energy and efficiency).

189. FIGUERES & BOSI, *supra* note 35, at 2–3; *see also* Alexandra B. Klass & John K. Harting, *State and Municipal Energy Efficiency Laws*, *in* THE LAW OF CLEAN ENERGY: EFFICIENCY AND RENEWABLES 57 (Michael Gerrard ed., 2011) (citing state energy efficiency programs including tax incentives, appliance rebates, building codes for both private and public buildings, and energy audit requirements).

households, some of these benefits, like rebates and savings resulting from energy audits, accrue only after unaffordable expenditures are made.[190] Due to their small total income, residents of low-income households are also less likely to benefit from the current efficiency tax incentives, which provide tax credits but not refunds.[191] Finally, energy-efficient buildings codes apply to new buildings, not existing ones.[192] Low-income households as a population are more likely to rent than to own,[193] and due to budget limitations are less likely to live in new, efficient buildings.[194] Given that low-income households could benefit significantly from electricity bill savings,[195] special efforts should be made to help these populations capture energy savings.[196]

II. PUBLIC UTILITY COMMISSIONS HAVE THE UNIQUE AUTHORITY OVER AND RELATIONSHIP WITH HOUSEHOLDS TO INCREASE EFFICIENT LIGHTING ADOPTION

The ideal agent to provide targeted efficient lighting services to low-income households should be able to do so at a low political cost, with relative speed, and in a sustainable manner. Federal action may be influential in this area, but does not promise to be a fast solution: the DOE is prohibited from spending money to enforce standards through 2013,[197] and debates regarding efficiency lighting standards indicate disagreement as to how to proceed at the national level.[198] State legislatures are also valuable actors,[199] but new legislation takes time to

190. *See supra* note 72.

191. Dernbach et al., *supra* note 10, at 8–9.

192. Wilson, *supra* note 8, at 10,882 (describing how energy efficiency in existing houses resists regulatory approaches).

193. *See* Davis, *supra* note 74, at 5.

194. *See, e.g.*, Bertschi, *supra* note 107, at 828 (arguing that a landlord can set higher rents for more energy efficient apartments).

195. *See* Hofmeister, *supra* note 25, at 12 (estimating that low-income households spend between 15 to 35% of their income on energy bills).

196. *See supra* Part I.C.

197. *See supra* notes 174–176 and accompanying text.

198. *See supra* notes 161–180 and accompanying text.

199. *See, e.g.*, Sager A. Williams, Jr., *Limiting Local Zoning Regulation of Electric Utilities: A Balanced Approach in the Public Interest*, 23 U. BALT. L. REV. 565, 577–78 (1994) (discussing laws covering "siting of utility facilities, particularly power generating plants and associated transmission lines. Some states also regulate a variety of business details, such as customer security deposits, customer late charges, failure to pay utility charges, and utility stock offerings and other corporate indebtedness." (footnotes omitted)).

develop, even where political willpower is present. Instead, PUCs,[200] as regulators of the majority of utilities,[201] are uniquely situated to overhaul the state's electricity delivery system[202] and should take immediate action.

By imposing an overarching efficient lighting policy and focusing program delivery on low-income households,[203] PUCs can overcome key market barriers[204] and increase utility efficiency investments with only minor adjustments. This Note engages the charter of New York State's PUC, called the New York State Public Services Commission ("NYPSC"), to demonstrate how PUCs can interpret the language of their statutory mandates to encompass the provision of efficient lighting programs.[205] Consistent with this Note's goal to minimize public costs, the following discussion focuses on the NYPSC's ability to take advantage of three broad categories of popular efficient lighting programs that already exist: free and subsidized light bulbs, free audits, and consumer education.[206]

Although PUCs do not maintain direct relations with electricity consumers, the electric utilities that PUCs regulate do have such a relationship.[207] At present, utilities already:

> set or affect retail prices in most jurisdictions; have monthly communications with retail consumers; control access to efficiency, conservation, and renewable energy generation options; determine the transaction costs households will occur in adopting new technologies or participating in conservation programs; [] lobby for and against demand-related measures with federal, state, and local governments. . . . [;] provide information through bills and advertising that can promote or discourage

200. This Note focuses primarily on state regulation, but PUCs are also regulated at the federal level by the Federal Energy Regulatory Commission ("FERC") and the Securities Exchange Commission ("SEC"). *See id* at 574–75.

201. *See id.* at 576–77.

202. *See* Hofmeister, *supra* note 25, at 61–62.

203. William H. Lawrence & John H. Minan, *Financing Solar Energy Development Through Public Utilities*, 50 GEO. WASH. L. REV. 371, 407 (1982) ("Utilities can accord preferential treatment to some customers, provided that it is not unduly preferential, particularly if it ultimately benefits all utility customers." (internal citation omitted)).

204. *See infra* notes 214–215 and accompanying text.

205. Although PUCs serve a similar purpose in their respective jurisdictions, the exact scope of authority differs based on each PUC's organic statute, which details the contours of agency authority. Extensive discussion and comparative analysis of different legal provisions across states is not attempted here.

206. *See supra* note 188 and accompanying text.

207. Lisa Wood, *Efficiency Close-Up*, PUB. UTIL. FORT., July 1, 2010, at 34, 35.

> demand reduction[; and] . . . maintain large staffs of technicians that interact with households on a frequent basis.[208]

Such frequent interactions with consumers mean that "utilities already have information about how much electricity their customers are using, so there is no additional cost for collection, nor is there any additional intrusion on personal privacy."[209] Furthermore, because interactions occur through existing billing and service networks, utilities already accommodate for the capacity and cost of administrative oversight and additional efforts can be made with little expense or difficulty.[210] Furthermore, electric utilities have the scope, scale, and size needed to effectively make a significant difference in the promotion of efficient technologies.[211] Utilities are "fully aware of the marginal cost of new energy sources" and are "therefore in a better position to appreciate the economic benefit of [conserving] energy."[212]

Despite the potential benefits of the close utility-consumer connection, this relationship can also be dangerous when left unattended because utilities are one of the only information sources consistently available to customers.[213] Utilities serve as critical gatekeepers of information to and from households, a position that means utilities "can act aggressively to induce widespread adoption of new practices and more efficient equipment. Or they can conduct widely publicized programs that comply with applicable mandates and generate goodwill without actually generating major reductions in demand."[214] Utilities have historically followed the latter path and generally underinvested in efficiency programs.[215] This is primarily because of the traditional retail scheme in which utility profit depends on selling more electricity to end-users, which encourages utilities to prefer that less efficient bulbs remain dominant, despite public loss.[216]

208. Vandenbergh & Rossi, *supra* note 21, at 1544 (internal citations omitted).

209. Babcock, *supra* note 9, at 962 (internal citations omitted).

210. Lawrence & Minan, *supra* note 203, at 405.

211. Wood, *supra* note 207, at 34–35.

212. Lawrence & Minan, *supra* note 203,at 402–03 (internal citation omitted).

213. Vandenbergh & Rossi, *supra* note 21, at 1531. Furthermore, customers have limited ability to monitor utility choices themselves. *See* Sachs, *supra* note 23, at 307.

214. Vandenbergh & Rossi, *supra* note 21, at 1531.

215. *See* Michael Malecek, Note, *Money for Nothing: Restructuring Rates to Encourage Conservation*, 11 VA. ENVTL. L.J. 589, 591–92 (1992) ("Traditional cost-of-service ratemaking continues to provide incentives primarily to produce and to sell as much electricity as possible.").

216. Bertschi, *supra* note 107, at 829 (discussing how this relationship between profits and kilowatt hours sold should not exist, because a "revenue requirement is determined in advance of the actual sales, necessitating reliance on estimated sales. Because the cost of producing each additional

Widespread adoption of efficient lighting is an appropriate goal for the NYPSC when one considers the system-wide benefits of efficient lighting. The NYPSC's primary mission is "to ensure safe, secure, and reliable access to electric . . . services for New York State's residential and business consumers, at just and reasonable rates"[217] and "to stimulate innovation, strategic infrastructure investment, consumer awareness, competitive markets where feasible, and the use of resources in an efficient and environmentally sound manner."[218] Increasing the efficiency of lighting satisfies the NYPSC's mandate by increasing reliability of electricity delivery,[219] decreasing the cost of electricity,[220] and providing the consumer demand necessary to fuel bulb manufacturer investments to further cheapen and improve efficient lighting technologies.[221] Such benefits have an immediate and proportionally greater impact on low-income households, which are less able to make future investments in alternative lighting technology[222] and spend a significant portion of income on electricity.[223]

First, the NYPSC can incentivize utilities to independently propose and implement efficiency programs by making it a policy to permit utilities to increase electricity rates to recoup some of their investment costs (its ratemaking authority). The NYPSC may permit a utility to "recover as normal operating expenses through rates the just and reasonable costs of carrying out its responsibilities and home conservation plan under [the Home Insulation and Conservation Act], as determined by [the NYPSC] after public hearing upon reasonable notice."[224] The New York Court of Appeals has held that the NYPSC "is free to entertain, ignore, or assign whatever weight it deems appropriate to factors in setting utility rates."[225] Further, the NYPSC's determination

unit decreases as more units are produced, the utility can make a higher profit by selling more units.") (internal citation omitted)); Malecek, *supra* note 215, at 590–92, 596–600.

217. *Mission Statement*, N.Y. STATE PUB. SERV. COMM'N, http://www3.dps.ny.gov/W/PSCWeb.nsf/ArticlesByTitle/39108B0E4BEBAB3785257687006F3A6F?OpenDocument (last visited May 31, 2013).

218. *Id.*

219. *See supra* notes 37–42 and accompanying text.

220. *See supra* notes 47–52 and accompanying text.

221. *See* 157 CONG. REC. E2321-04 (daily ed. Dec. 16, 2011) (statement of Rep. Rush Holt), 2011 WL 6372537 (discussing the need for regulatory certainty for private sector investment).

222. *See supra* note 72.

223. *See supra* note 195.

224. N.Y. PUB. SERV. LAW § 135-o (McKinney 2011).

225. Abrams v. Pub. Serv. Comm'n, 67 N.Y.2d 205, 211–12 (1986); *see also* Multiple Intervenors, 569 N.Y.S.2d 522, 524 (N.Y. App. Div. 1991) (New York courts have permitted rate

of rates can only be overruled where there is no "rational basis or reasonable support in the record."[226] In previous ratemaking decisions the NYPSC has referred to energy efficiency as a "lawful criterion for determining just and reasonable rates."[227] However, NYPSC should clarify its position on the issue and assure utilities they will be able to recover at least some of the costs expended on efficient lighting investments.[228] Greater certainty of reimbursement for investing in efficiency programs targeted at low-income households will encourage greater investments in these beneficial programs.

Second, the NYPSC has the authority "to prescribe from time to time the efficiency of the electric supply system, . . . of the lamps furnished by the persons, corporations or municipalities generating and selling electric current"[229] (called the lighting supply authority). Efficiency of the electric supply system is a broad term and can be read to include the end user's choices.[230] Specifically, the NYPSC can require that utilities providing light bulbs to customers must provide ENERGY STAR bulbs[231] by pointing to the system-wide benefits of reliability and cost savings that broad adoption of efficient lighting produces.[232] A requirement that only energy efficient light bulbs can be provided will protect efficiency-conscious utilities from being undercut by less efficiency-conscious utilities.[233] Without an efficiency requirement, non-conscious utilities could provide a greater number of cheaper incandescent bulbs and poach customers who prove more sensitive to bulb prices than bulb lifetime electricity costs[234] from efficiency-

charges and differentials based on factors not directly related to the provision of utility services, including for energy conservation).

226. *Abrams*, 67 N.Y.2d at 212; *see also* Dara Gardens Mgmt. Corp, 468 N.Y.S.2d 199 (N.Y. App. Div. 1983).

227. Rate Design for Electric Corporations, 26 Pub. Util. Rep. (PUR) 280, 286 n.11 (1978).

228. There is some support that such a ratemaking would be approved by the New York State courts. *See, e.g.*, Multiple Intervenors, 569 N.Y.S.2d at 524 (upholding NYPSC's "choice of rate-making incentives for effective [demand side management] conservation programs" as "clearly bear[ing] a reasonable relationship to the purpose of the enabling legislation"); *see also* Comer, *supra* note 19, at 36 (discussing by way of example Kansas City Power & Light's recovery "on current basis, costs related to approved [energy efficiency] programs, including internal labor costs" and costs to educate consumers, and for energy audits and rebates).

229. N.Y. PUB. SERV. LAW § 66(3) (McKinney 2011).

230. *See, e.g.*, Multiple Intervenors, 569 N.Y.S.2d at 524.

231. *See infra* Part III.A.

232. *See supra* notes 37–42, 47–52 and accompanying text.

233. *See supra* note 174 and accompanying text.

234. *See supra* notes 126–130 and accompanying text.

conscious utilities.[235] The NYPSC bulb efficiency standards would thus protect efforts of efficiency-conscious utilities and foster their independent efforts, again promoting increased investment in programs for low-income households.

Finally, the NYPSC may:

> fix and alter the format and informational requirements of bills utilized by . . . electric corporations . . . in levying charges for service, to assure simplicity and clarity . . . [and] ensure periodic explanation of applicable rates and rate schedules for the purpose of assisting customers in making the most efficient use of energy.[236]

This is called the billing requirements authority. Under this provision, the NYPSC can mandate in the short term that households receive individual and itemized bills, and, in the long term, that utilities supply consumers with real-time information regarding their electricity use and its varying price. These steps would give households an opportunity to recognize personal savings and, in the aggregate, deliver reliability and cost benefits to the system as a whole.[237] Detailed information is particularly useful to low-income households because of their limited budgets.[238]

The NYPSC can look to these three efficiency statutory provisions as legal bases for adopting a strong efficient lighting stance and promulgating rules to enforce efficient lighting adoption programming or, if a total policy change is too dramatic, may use these provisions to justify the NYPSC approving efficiency programs on a case-by-case basis. Even incremental adoption of efficient lighting programs may compel further independent action.[239] Given that most states have similarly broad PUC organic statutes, PUCs nationwide can, by broadly interpreting their respective statutory authorities and duties, require efficient lighting programs.[240]

235. This is similar to competition concerns in the lighting manufacturing industry with regards to repealing bulb efficiency standards of EISA 2007. *See supra* notes 164–169 and accompanying text.

236. N.Y. PUB. SERV. LAW § 66(12-a) (McKinney 2011).

237. *See supra* notes 37–42, 47–52 and accompanying text.

238. *See supra* note 72.

239. *See infra* note 257 and accompanying text.

240. A coherent policy across states should be encouraged. As "[p]ublic utilities increasingly operate in more than one state . . . it creates the potential for inconsistent rate treatment for the public utility that operates in both." Hertzler & Koeller, *supra* note 22, at 925 (discussing renewable energy, but equally applicable to efficient lighting programs). This makes it more difficult for utilities to recover higher costs related to energy efficient electricity programs. *Id.*

At present, the NYPSC channels "all low-income program funding for residential customers with income at or below 60 percent of the state median household income . . . through the New York State Energy Research and Development Authority's ("NYSERDA") existing EmPower NY program."[241] If a resident qualifies for EmPower NY,[242] NYSERDA schedules a participating accredited contractor to determine if the home would "benefit from improved insulation, reduced drafts, and upgrades to lighting and appliances" at no cost to the resident.[243] The program also includes "[o]n-site energy education [to] offer[] customers additional strategies for managing their energy costs."[244] Without discrediting the importance of EmPower NY, an opt-in program is insufficient to reach the majority of low-income households and more systemic changes are required.[245]

III. ADAPTING EFFICIENT LIGHTING ADOPTION PROGRAMS TO ADDRESS SPECIFIC NEEDS OF LOW-INCOME HOUSEHOLDS

Although statutes can be read expansively, the NYPSC can only exercise the powers granted to it by the New York Legislature. Generally, the NYPSC does not have authority to enforce consumer practices, but may indirectly influence consumer decisions by regulating public utilities.[246] This Part highlights three categories of programming that are relatively easy to administer, effective in altering consumer lighting practices, and interfere only minimally with day-to-day living of consumers[247]: free or subsidized bulbs, free audits, and consumer education.[248] This Note promotes these individual approaches as a

241. *NY PSC Ups Funding for Low-Income Energy Efficiency*, LIHEAPCLEARINGHOUSE, http://www.liheap.ncat.org/news/jan10/nypsc.htm (last updated Feb. 26, 2013).

242. *EMPower Eligibility Guidelines*, NYSERDA, http://www.nyserda.ny.gov/Residential/Programs/Low-Income-Assistance/EmPower-for-Residents/Eligibility-Guidelines.aspx (last updated Dec. 13, 2012).

243. *EmPower Overview*, NYSERDA, http://www.nyserda.ny.gov/Residential/Programs/Low-Income-Assistance/EmPower-Overview.aspx (last updated Mar. 14, 2013).

244. *EmPower for Residents*, NYSERDA, http://www.nyserda.ny.gov/Residential/Programs/Low-Income-Assistance/EmPower-for-Residents.aspx (last updated Dec. 5, 2012).

245. *See, e.g.*, Babcock, *supra* note 9, at 946 (explaining that structural changes need to be made eliminate the negative features of CFLs, which make acquisition and disposal easier, "before the motivational tools identified in the three initiatives can have any effect on consumers.").

246. *See supra* notes 207–210 and accompanying text. Direct regulation of consumers may also be politically contentious. *See, e.g.*, *supra* note 167 and accompanying text.

247. *See supra* notes 6–10 and accompanying text.

248. These programs are considered because they exist, *see supra* note 188–188 and accompanying text, and also because they are relatively low cost and have relatively high feasibility, *see, e.g.*, Wilson, *supra* note 8, at 10,887 tbl.1.

package because "[s]ingle policy tools have been notably ineffective in reducing household energy consumption."[249] In addition to overcoming behavioral barriers,[250] these approaches lower costs.[251] Finally, they are self-sustainable: together, these approaches change consumer behavior, so participation in the market is not contingent on the provision of additional incentives.[252] These approaches specifically accommodate for barriers to adoption generally faced by low-income households including less total income, less awareness of incentive programs, and higher probability of being a renter.[253] These approaches not only provide the public with system-wide benefits, but also enable households to personally benefit from efficient lighting.

A. Free and Subsidized Bulbs

The first step towards widespread adoption of efficient lighting is creating consumer interest in efficient lighting alternatives.[254] This may be particularly important for low-income households that may be relatively more driven by present purchase price than considerations of long-term benefits.[255] EmPower NY currently provides homeowners and renters with free lighting upgrades, if they apply and qualify for the benefit.[256] Free merchandise demonstrates the benefits of efficient bulbs to consumers and induces a preference for efficient bulbs that may alter their future consumption patterns.[257] Even if the NYPSC does not want

249. Forsyth, *supra* note 9, at 11,038 (quoting Thomas Dietz et al., *Household Actions Can Provide a Behavioral Wedge to Rapidly Reduce US Carbon Emissions*, 106 PROC. NAT'L ACAD. SCI. 18,452, 18,453 (2009)) ("[I]nterventions that combine appeals, information, financial incentives, informal social influences, and efforts to reduce the transaction costs of taking the desired actions have demonstrated synergistic effects beyond the additive effects of single policy tools.").

250. *See supra* Part I.B.

251. *See id.*

252. *See supra* notes 6–10 and accompanying text.

253. *See supra* notes 70–72.

254. Martinot & Borg, *supra* note 37, at 1072 ("[I]n immature markets, such as in many non-OECD countries, properly designed subsidy programs can be an important and cost-effective tool for moving markets in the right direction, and in helping markets mature to the point where subsidies become less important.").

255. *See supra* note 72.

256. *EmPower Overview*, N.Y. STATE ENERGY RESEARCH & DEV. AUTH., http://www.nyserda.ny.gov/BusinessAreas/Energy-Efficiency-and-Renewable-Programs/Residential/Programs/Low-Income-Assistance/EmPower-Overview.aspx (last updated May 3, 2013).

257. *See, e.g.*, Jeremy Levin, *Demand-Side Management: Mitigate, Don't Eliminate*, PUB. UTIL. FORT., Oct. 1, 1995, at 37, 39 ("For instance, participants in a [demand-side management] program to install energy-saving compact fluorescent light bulbs may be so satisfied with the product that they install additional bulbs at their own expense. Such indirect benefits are not quantified in standard cost/benefit analyses, but can be significant."); Martinot & Borg, *supra* note 37, at 1077

to provide free bulbs directly,[258] it could supplement EmPower's program by encouraging utilities to provide subsidized bulbs. Initial subsidies may even render future subsidies and free bulbs unnecessary.[259] Rebate programs in the United States "have proven effective at promoting basic lighting improvements with rebates from 20% to 50% of the product price."[260]

These successes notwithstanding, rebate programs give rise to potential inconveniences to both consumers and utilities.[261] To address this issue, some utilities have provided reimbursements for more efficient light bulbs at the wholesale level instead of offering rebates directly to customers.[262] Such programs save the customer the inconvenience of applying for the rebate and save utilities administrative costs because they no longer shoulder the burden of processing individual rebates.[263] Furthermore, upstream rebates lead to larger savings for consumers, reducing the price differential between incandescent bulbs and energy efficient lighting, as well as helping to convince previously reluctant consumers to purchase CFLs.[264]

The NYPSC can encourage utilities to discount bulbs by using its ratemaking authority to permit utilities to recoup some of the necessary expenditures.[265] In order to ensure that the bulbs provided meet acceptable efficiency standards, NYPSC can either exercise its ratemaking discretion and provide rate recovery only where the program provides efficient bulbs,[266] or use its lighting supply authority to require that any bulbs it provides meet a specified efficiency standard.[267] Permitting utilities to recover investments in consumers' efficient lighting uses will encourage utilities to provide subsidized bulbs and allow consumers to take advantage of such programs for both individual and system-wide benefits.

("[R]ecent research on the European domestic lighting sector . . . indicates that households that have been persuaded to buy one CFL tend to buy additional ones if they are easily available on the market.").

258. For example, NYPSC may find it more efficient to leave free bulb efforts to NYSERDA. *See NY PSC Ups Funding for Low-Income Energy Efficiency*, *supra* note 241.

259. *See supra* note 254.

260. *Id.* at 1075.

261. Miller, *supra* note 67, at 59.

262. *Id.*

263. *Id.*

264. *Id.*

265. *See supra* notes 224–228 and accompanying text.

266. *Id.*

267. *See supra* notes 229–230 and accompanying text.

As a whole, providing free and subsidized light bulbs is an important element of a systemic overhaul of the electricity delivery structure. However, given the average consumer's tendency to improperly estimate current costs and future savings,[268] the benefits of providing free products and services may be limited to the short term—once the incentive disappears, the purchasing habits will revert.[269] Low-income households are particularly likely to revert because of their tighter budget constraints.[270] To maintain momentum, the NYPSC should supplement a subsidized bulb program with free audits, which help inform consumers about their potential savings,[271] and educational programs, which help consumers understand the benefits of efficient lighting.[272] Together, such programming can create sustainable change in the use of efficient bulbs by low-income households.

B. Free Audits

A lack of information regarding energy consumption and efficient appliances is a serious impediment to sustained residential adoption of efficient lighting.[273] Low-income households are at a particular disadvantage because they are generally less aware of existing programs and may thus be less likely to seek out and independently discover opportunities for long-term savings.[274] One method of increasing awareness of both consumption and appliances is to provide home audits, which can tailor motives of adoption to suit the individual and personalize economic results.[275] Presently, "the vast majority of homes in North America have not undergone an audit of any type," which means that these homeowners may not recognize the extent of their potentially sizable energy savings.[276] Furthermore, current audit programs[277] are burdensome and expensive to consumers,[278] time-

268. *See supra* notes 126–130 and accompanying text.

269. *See supra* note 134.

270. *See supra* note 72.

271. *See infra* note 275 and accompanying text.

272. *See infra* notes 295–296 and accompanying text.

273. *See supra* notes 126–143 and accompanying text.

274. *See supra* note 73.

275. Patrick Leslie et al., *The Application of Smartphone Technology to Economic and Environmental Analysis of Building Energy Conservation Strategies*, 31 INT'L J. SUSTAINABLE ENERGY 295, 308 (2012).

276. *Id.* at 296.

277. *Id.* ("Current home energy audits consist of trained professionals travelling to individual residences to obtain an estimate of the current site conditions and energy use in order to suggest where building owners are able to reduce their energy consumption.").

consuming to execute,[279] and only deliver information to consumers at the end of each visit.[280] To reduce costs[281] and encourage user engagement,[282] the NYPSC should foster dissemination and promotion of information by making it available online or even by creating smartphone-accessible audit systems[283] for individual use.

Online and smartphone lighting retrofit programs are already available. For example, ENERGY STAR provides a free interactive webpage that instructs consumers on the types of lighting products that would work best in different locations in their home.[284] ENERGY STAR also provides a printable checklist[285] and a calculator to estimate savings.[286] Similarly, smartphone technology may provide personal, mobile, and convenient **"**on-site energy audits by the average consumer.**"**[287] Such devices **"**can record existing conditions, use directed questions to guide more detailed evaluation of energy use, give instant feedback, and even provide an estimate of projected energy savings for a specific upgrade, or aggregate of individual upgrades, in real time as the audit is

278. *See, e.g.*, Forsyth, *supra* note 9, at 11,033 ("[O]btaining such information and the requisite professional help to make [comparisons of life-cycle cost of alternative energy options] is burdensome and expensive." (citing Eric Hirst et al., *Improving Energy Efficiency: The Effectiveness of Government Action*, 10 ENERGY POL'Y 131, 134 (1982)); *id.* at 11,039 & n.102 ("As one recipient of energy-efficiency information noted: 'I've had some information passed on to me . . . but I just can't use it. I don't have the time. If I had somebody else to actually do it, yes, I'd have no problem.'" (quoting Steve Sorrell, *Barrier Busting: Overcoming Barriers to Energy Efficiency*, *in* THE ECONOMICS OF ENERGY EFFICIENCY 287, 295 (Edward Elgar ed., 2004))); *id.* ("[The fact] that company energy managers find it hard to find time for energy efficiency suggests homeowners may find it even harder.").

279. Leslie et al., *supra* note 275, at 305 (noting that it would take the six auditors currently employed fifty-five years to complete energy audits for all 157,000 dwellings in the region); *id.* at 307 (suggesting that an approach using smart phones allows homeowners to simultaneously perform this task, overcoming the lack of qualified personnel).

280. *Id.* at 301 (criticizing traditional energy audits for providing only a snap-shot of energy use).

281. Consumers will save on the expense of paying for a professional and receive new information on an ongoing basis. *Id.* ("Internet connectivity allows the potential smartphone energy audit application to be updated and added onto through its life.").

282. *Id.* ("[A] smartphone audit will be able to run periodic simulations that account for changing conditions and alert the user when specific conditions are met . . . . This has the potential to keep users actively involved and constantly engaged with the energy efficiency of their homes.").

283. *See id.* at 302 (discussing an example of a smartphone application for lighting retrofits).

284. *ENERGY STAR @ HOME*, ENERGYSTAR, http://www.energystar.gov/index.cfm?fuseaction=popuptool.atHome (last visited May 31, 2013) (click on room images to learn about household energy saving tips).

285. *Bulb Purchasing Guide*, ENERGYSTAR, http://www.energystar.gov/ia/products/fap/purchasing_checklist_revised.pdf?365a-9220 (last visited May 31, 2013).

286. *Savings*, ENERGYSTAR, http://www.energystar.gov/index.cfm?c=cfls.pr_cfls_savings (last visited May 31, 2013).

287. Leslie et al., *supra* note 275, at 296.

performed."[288] Online and mobile audit options also give consumers the convenience of auditing on their own time instead of during business hours, which may be very important to low-income households, which may have less flexibility with respect to normal business hours.[289]

NYPSC should use its ratemaking authority to permit utilities to recoup costs of adopting and developing such self-help audit programs for individual use.[290] Once available, the NYPSC should use its billing requirements authority to require utilities to include information regarding these opportunities on household bills.[291]

C. Information Programs

One of the greatest challenges to making households more energy efficient is sustaining the adoption and use of efficiency measures.[292] Because low-income households are generally less educated, there is an increased likelihood that they were not exposed to the benefits and availability of efficient lighting alternatives during their schooling years and need another source for such information.[293] The NYPSC can bolster subsidized product and service programs by encouraging utilities to provide consumers with information on products through reliable labeling and more detailed metering. Although financing and promotional programs are important to raise consumer awareness and initiate adoption of new technology, low-income households are more likely to revert once subsidies are removed because of their sensitivity to initial purchase price.[294] Educating consumers can bridge this gap: for example, surveys comparing Northern and Southern European countries' efficient lighting adoption rates demonstrate that "greater awareness of environmental issues and . . . public measures . . . to promote diffusion of the CFL"[295] perpetuated CFL sales four to five times higher in locations with greater awareness.[296]

288. *Id.*

289. *See supra* note 72.

290. *See supra* notes 224–235 and accompanying text.

291. *See supra* notes 236–237 and accompanying text.

292. *See supra* note 132 and accompanying text; *see, e.g.*, Forsyth, *supra* note 9, at 11,035 (stating that consumers will not adopt significant energy improvements with only information and financing).

293. *See supra* note 73.

294. *See supra* notes 132–135, 259 and accompanying text.

295. Menanteau & Lefebvre, *supra* note 2, at 386.

296. *Id.*; *see also* Andrew McLain et al., *Renewable Energy and Demand-Side Management Committee*, 30 ENERGY L.J. 273, 305–06 (2009) (describing New Jersey's program, which is

Although a lot of information is publicly available,[297] effective delivery to consumers, particularly low-income households, is lacking.[298] One recent study indicated that "less than a third . . . of the lighting retailers planned to educate customers about the new requirements using marketing materials, such as in-store displays, brochures, and flyers."[299] The NYPSC can support information delivery programs by encouraging utilities to circulate general information about energy efficiency programs by using its ratemaking authority[300] and can promulgate new rules under its billing requirements authority[301] that provide consumers with more information on the fluctuating costs of electricity and their personal use rates. In order to accommodate for different education levels,[302] the NYPSC may even require, under its billing requirements authority, a change in the format of billing information.[303] Providing low-income households with knowledge about efficient lighting may change their decision-making processes from being focused on initial purchase price to include long-term benefits, and help them to overcome psychological barriers to more energy-efficient behavior with minimal per capita investment.[304]

1. Educating Consumers About Lighting Labels

The NYPSC should contribute to the usefulness of the mandatory federal "Lighting Facts" labeling program[305] by promoting efforts to assist low-income households in understanding the labels' components. A recent survey by the NYSERDA indicates that many New York State consumers "are not well prepared to put the information on the Lighting

expected to "achieve energy savings of $5.8 million each year and reduce carbon dioxide emissions by more than 330 million pounds over the life of the CFLs.").

297. *See, e.g.*, *Frequently Asked Questions: Lighting Choices to Save You Money*, *supra* note 88; ENERGY STAR, http://www.energystar.gov/ (last visited May 31, 2013).

298. *See supra* notes 105, 109–117, 126–131, 144–147 and accompanying text.

299. Dimetrosky & Parkinson, *supra* note 181, at 2-153.

300. *See supra* notes 224–235 and accompanying text.

301. *See supra* notes 236–237 and accompanying text.

302. *See supra* note 73 and accompanying text.

303. *See id.* Another example is the Green Light New York, which "will demonstrate lighting solutions with a mock up space, exhibits, a day lighting lab, and interactive examples of best practices and solutions" and "provide a venue for lectures, demonstrations, and classes in energy efficiency" in order to accelerate the adoption of national and state efficiency policies. N.Y.C., PLANYC 109 (2011) *available at* http://nytelecom.vo.llnwd.net/o15/agencies/planyc2030/pdf/planyc_2011_planyc_full_report.pdf.

304. *See supra* Part I.B.

305. *See supra* note 112.

Facts label to full use in choosing bulbs."[306] For example, 43% of consumers surveyed were aware of lumens and 35% "demonstrated a correct understanding of the concept," but only 3 to 5% correctly answered "within 200 lumens of the correct value of 800 lumens in a 60-watt incandescent bulb."[307] Since there is "no scale associated with the lumens information on the label," it is unclear "whether consumers will know how to interpret the lumens data when they see it."[308] Consumers demonstrated similarly limited understandings of light appearance and relative efficiencies of different types of bulbs.[309] That the consumer population in general has difficulty understanding lighting labeling suggests that low-income households, who are generally less educated, may have especial difficulty.[310]

The NYPSC can encourage utilities to include key Lighting Facts information by providing utilities recovery under the NYPSC's ratemaking authority[311] for such disclosures and by using its billing requirement authority to require inclusion of such basic information in households' utility bills.[312] The NYPSC's promotion of the Lighting Facts label will help spread a consistent message of high quality efficient lighting information, which will help consumers understand their electricity use decisions and may beneficially shape their preferences.[313] Such information will particularly benefit low-income households who, being on average less educated,[314] may face heightened challenges in understanding the complex scientific labels, on top of the greater need for careful budgeting.[315]

2. More Detailed Metering and Billing Practices

In addition to promoting the spread of general information about the benefits and product design of efficient lighting, the NYPSC can also create more efficiency-conscious consumers by mandating that utilities deliver individualized and itemized billing statements. Pricing information contemporaneous with use will enable low-income

306. NEVIUS ET AL., *supra* note 109, at 6-241.
307. *Id.*
308. *Id.*
309. *Id.* at 6-241 to -42.
310. *See supra* note 73.
311. *See supra* notes 224–228 and accompanying text.
312. *See supra* notes 236–237 and accompanying text.
313. *See supra* note 117.
314. *See supra* note 73.
315. *See supra* note 72.

households to more effectively allocate and control their already limited budgets.[316] At present, little or no real-time information is provided,[317] and the majority of renters receive a proportion of the total housing unit's bill without seeing their own use.[318] Although it may be that this information alone is not sufficient to transform energy use in a household,[319] it will at least make households aware of electricity pricing schemes and the potential for savings, and give households the opportunity to take action.[320] In the short term, the NYPSC can require that all households have individual metering, and, in the long term, the NYPSC can implement a billing system that provides real-time feedback reflecting fluctuating electricity prices.[321]

In fact, the NYPSC has previously expressed support of this view. The NYPSC adopted Administrative Law Judge William H. Arkin's finding that "conversion from master metering to individual metering would reduce electric consumption more than 50% by drawing consumers' attention to their usage patterns."[322] Despite additional costs of new metering equipment and activities, "conversion also would tend to eliminate the costs imposed on all tenants by wasteful consumption in master metered buildings."[323] The NYPSC found more precise metering to be an overall cost-effective endeavor.[324]

316. *See supra* note 72.

317. Bladh & Krantz, *supra* note 109, at 3522 ("[I]ndividual items are not price-marked; the consumer receives an aggregated monthly bill, does not know which appliances contributed, whether consumption is high or low, or if it has increased or decreased."); Sachs, *supra* note 23, at 309.

318. *See supra* notes 114–115 and accompanying text.

319. *See* Babcock, *supra* note 9, at 960–62. *But see* Vandenbergh & Rossi, *supra* note 21, at 1541 ("[J]ust providing real-time information in homes about costs and impacts associated with electric power usage, without introducing price variations, can reduce electricity use by roughly 5 to 15%.").

320. *See supra* note 117.

321. *See* Comer, *supra* note 19, at 35 ("The goal is to use two-way communication to link the consumer and the utility in real time. When combined with time-based electricity rates, customers will have the option to change their consumption in response to price signals that vary by the hour (a process known as demand-response)."); *see also* Babcock, *supra* note 9, at 957 (discussing the future of "smart meters," which process real-time information about household electricity use, tell consumers when electricity is the cheapest, and may be able to automatically turn off appliances during peak demand).

322. Rent Inclusion and Submetering, No. 79-24, 1979 WL 391577 (N.Y. Pub. Serv. Comm'n 1979), *clarified on denial of reconsideration* Rent Inclusion and Submetering, No. 80-20, 1980 WL 566075 (1980); *see also* Hofmeister, *supra* note 25, at 16 ("[C]urrent utility and billing procedures . . . lump all energy consumed into a monthly total with no reference to its source," making it "nearly impossible to accurately monitor the energy costs of any particular measure.").

323. *Id.*

324. *Id.*

Some jurisdictions have begun to deploy smart meters, but even the majority of those jurisdictions do not yet provide households with information on their personal use.[325] One interesting exception is Oklahoma Gas & Electric ("OG&E"), "which not only provides this information directly to its customers, but also includes information on how the customers' neighbors are doing."[326] Under this program, OG&E's household consumers receive:

> monthly bills that compare their level of energy consumption against one hundred of their neighbors who live in comparable size homes and who use the same heating fuel. The monthly statement also contains information that separately compares the household's level of energy consumption with twenty neighbors who have been singled out because of their efficiency in conserving energy.[327]

A recent report indicated that "customers who received these personalized reports in their bills reduced their energy use by two percent compared to those who were sent standard statements."[328] There is also a proposal by Google to promote a "smart meter that will display information online 'almost in real time' for its customers."[329] Less costly suggestions include using "smiley faces on utility bills to reflect the success, or lack of success, of each individual household's efforts to conserve energy,"[330] or "bill stuffers [to] tell stories about what [others] are doing to reduce their electricity consumption."[331]

The NYPSC should utilize its billing requirements authority to support the provision of individualized information because such information will enhance households' understanding of their electricity usage and the relative benefits of efficient lighting alternatives. Detailed information will provide low-income households with an opportunity to better control and budget their limited finances,[332] while simultaneously benefiting the electricity system as a whole.

325. Babcock, *supra* note 9, at 957–58.

326. *Id.* at 958.

327. *Id.* at 963 (footnotes omitted).

328. *Id.* at 964; *see also id.* at 964–67 (discussing the psychology behind such behavioral changes).

329. *Id.* at 958; *see also Google PowerMeter: A Google.org Project*, GOOGLE, http://www.google.com/powermeter/about/ (last visited May 31, 2013).

330. Babcock, *supra* note 9, at 970 (explaining how the smiley faces function as a reward).

331. *Id.* at 962 (noting that such information also prevents participants from feeling duped by changing electricity-use behavior).

332. *See supra* note 72.

IV. CONCLUSION

Although many improvements to energy efficiency lighting technology and adoption have been made in the past decade, continued focus on the issue is important to maintain momentum. With federal stagnation, state authorities will be required to sustain the momentum of consumer demand that is necessary to make investment in lighting technologies permanent. PUCs should embrace their unique authority to oversee state electricity delivery and programs, and actively engage with provisions contained in their organic statutes to promote already existent programs. In particular, PUCs should encourage utilities to focus these programs on low-income households that are uniquely unable or unlikely to adopt effective efficient lighting practices on their own. By combining free or subsidized products and services for low-income residents, and comprehensive information delivery focused on providing individualized billing details, state PUCs can create an immediate, low-cost, and self-sustaining program for widespread residential adoption of efficient lighting that will benefit individuals and the state alike.