Market Transformation and Resource Acquisition: Challenges and Opportunities in California's Residential Efficiency Lighting Programs

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ABSTRACT

California's energy efficiency lighting programs continue to be an integral component strategy to displace dirty conventional energy supply resources while ensuring the ongoing evolution of the lighting market. Although the California lighting efficiency programs have been successful in building the lighting industry and raising customer awareness, the market is not fully transformed. Seventy-five percent of screw-based sockets are still filled with an inefficient alternative. While the federal and state efficiency lighting standards will provide significant savings when fully implemented in 2020, there is significant opportunity to capture savings from residential lighting applications until that time. Programs should continue as long as there are cost-effective energy savings available and must be modified as needed to reach the remaining potential.

To continue to transform the lighting market and fulfill the need to displace the dirtier and more expensive conventional energy source, effective policy should include research and development funding, incentives to promote higher-efficiency products, code and standard development and enforcement, as well as education. With these policies utilities and regulators can achieve the mutual goals of cost effective efficiency resource acquisition and continuous market transformation.

Introduction

This paper addresses how investments in energy efficient lighting programs support the transformation of the lighting market while simultaneously fulfilling resource acquisition goals. These two outcomes of efficiency programs are not at odds with one another; rather, efficiency programs must both transform markets and meet resource acquisition goals if they are to achieve their primary objective of ensuring that customers receive reliable, clean, and affordable energy services at the lowest societal cost.

Recent data shows that California market intervention through lighting efficiency programs has successfully increased the availability, quality, and usage of efficient lighting products. However, the residential lighting market is not fully "transformed," since the majority of available sockets do not contain an efficient lamp. Efficiency programs are therefore still necessary to capture savings with existing technologies as well as to ensure that additional technologies become more affordable and available in the market.

This paper begins with a discussion of market transformation, followed by how past lighting programs established the current status of the residential lighting market. The authors then identify how further intervention is needed to capture the remaining energy savings potential and concludes with recommendations to create the most effective programs that will ensure continual progress towards lighting market transformation.

What Is Market Transformation?

The energy efficiency community has long debated the appropriate degree of regulatory focus on "market transformation," especially with respect to designing and continuing energy efficiency programs. In 2007, the California Public Utilities Commission (CPUC) directed the investor-owned utilities (IOUs) to develop a California Long Term Energy Efficiency Strategic Plan (Strategic Plan) in which they were to indicate "how energy efficiency programs are or will be designed with the goal of transitioning to either the marketplace without ratepayer subsidies, or codes and standards."[1] The Strategic Plan, adopted in September 2008, notes that as early at 1998, the CPUC defined Market Transformation as: "Long-lasting sustainable changes in the structure or functioning of a market achieved by reducing barriers to the adoption of energy efficiency measures to the point where further publicly-funded intervention is no longer appropriate in that specific market."[2] A 1997 CPUC decision is perhaps even more indicative of the prevailing view of the role of market transformation at the time: "The mission of market transformation is to ultimately privatize the provision of cost-effective energy efficiency services so that customers seek and obtain these services in the private competitive market."[3]

The various definitions of "market transformation" raise a number of questions: What is a transformed market and when is a market transformed? How do you measure a transformed market? Can any market ever stay fully transformed if new technologies continually improve the efficiency of the previous version? These questions can best be addressed in two ways. First, the market transformation definition noted above should be modified to acknowledge the dynamic nature of markets. This modification would define market transformation as a continuous process, rather than one defined outcome. Second, a comprehensive set of key metrics and baseline information must be established at the onset of program design to ensure that all stakeholders are operating with the same set of assumptions and that the programs are designed to move the market in a variety of ways.

To address the first point, market transformation should be viewed as a continuous process for technology improvement beginning with research, innovation and demonstration, followed by introduction into the mass market, growing market acceptance, and finally updated efficiency standards and codes to lock in minimum efficiency savings across the market. At each stage of market transformation, different policy tools are useful, and often crucial, to move the market along for a particular technology. Research programs support innovation and demonstration, energy efficiency programs help more efficient products or practices gain market share, and codes and standards ensure that the particular efficiency level of a technology or practice becomes mandatory.[4]

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[1] See Reference CPUC. R.06-04-010; D.07-10-032, p.33.

[2] See Reference CPUC. "*California Long Term Energy Efficiency Strategic Plan.*" Section 1, p.4.

[3] See Reference CPUC D. 97-02-014. These definitions (which are consistent with literature of the period), arose during California's efforts to restructure the electricity industry when the Commission was focused on getting the utilities out of the resource procurement business (including energy efficiency) and leaving these key decisions up to the "market." One of the state's first actions to address the electricity crisis of 2000 and 2001 was to restore the utilities' resource planning and procurement responsibilities. Today, the Commission's energy efficiency objectives should be aligned with both the utilities' procurement responsibilities and the state's commitment to reduce greenhouse gas emissions in the near- and long-term.

[4] Code enforcement is also necessary to ensure that savings from mandatory standards are achieved.

From a manufacturer's perspective, the market is transformed only when it is no longer profitable (or legal) to continue manufacturing products with subpar efficiency levels. Manufacturers will continue to produce and retailers will continue to sell inefficient products as long as there is a market for it. Therefore, the cycle of market transformation is critical to retire inefficient technologies (by updating codes or standards), encourage manufacturers to develop and invest in the next generation of more efficient technologies (through research and development programs) and ensure that retailers stock the most efficient products and those are the ones demanded by consumers (through efficiency programs). As manufacturers and retailers are generally part of a national industry, it is increasingly important to develop coordinated approaches to most effectively engage them at a level that alters the types of products they produce for the market. Still, California has shown that it can drive the national market through use of the full range of efficiency-promotion policies discussed above.

This process of market transformation is different from the single outcome, discussed above, of discontinuing efficiency programs based on a narrow definition of what a transformed market looks like. The proposed modification to the traditional definition illustrates a dynamic and continuous process: as one efficiency level becomes mandated, policies and programs focus on pulling the next generation of efficient products to market. Until the theoretical limits for energy efficiency are reached, energy can always be used more efficiently and the market for that particular product or end-use will continue to change.

Thus, a dynamic definition of market transformation means that each of the noted policy tools will continue indefinitely for every energy end use, although the level of efficiency they promote will improve as technology advances and markets change. Ceasing this cycle by considering a market fully "transformed" when a particular technology is accepted as a standard practice or as part of the code will stifle innovation and halt efficiency gains. If pursued continuously, this cycle will ensure innovative developments of the next generation efficient technology and ensure that minimum efficiency levels required for various technologies can cost effectively become increasingly stringent over time..

To address the second point, a comprehensive set of key metrics and baseline information must be agreed upon at the onset of efficiency program development to ensure that the 'end point' (or series of end points) is clearly defined. It is imperative that a common terminology and set of metrics be identified in advance of program development and deployment to (1) best design programs that advance multiple aspects of the market (e.g., sales, awareness, technology deployment, etc.), (2) best answer the question 'when is the market transformed?' for a given product, (3) minimize contention surrounding when it is time to discontinue a particular efficiency program or a program's support for a particular level of efficiency, and (4) determine when it is necessary to modify programs to pull the next generation of a particular product to market. For example, while some might call a market transformed when prices reach a certain level or most consumers know of a product, others might conclude that a market is not transformed unless a technology is widely adopted. There are a number of metrics used to determine various levels of market transformation. However, one critical metric that must be considered is the amount of remaining cost effective potential that can be reached by continuation or modification of a particular program. Section V, below, includes further discussion on metrics that measure movement towards market transformation.

Market Transformation and Resource Acquisition

The CPUC definition of market transformation as an outcome "where further publicly-funded intervention is no longer appropriate in that specific market" [5] has led to the assertion that market transformation activities are an alternative to energy efficiency "resource acquisition."[6] For example, a recent white paper asserted that the focus of efficiency programs shifted from being designed for resource acquisition needs to being designed for market transformation purposes.[7]

This distinction fails to recognize that these goals are interconnected. A utility's role in promoting and investing in energy efficiency results from the obligation of regulators and utilities to provide customers with affordable and reliable energy services at minimum societal costs. If a utility can incentivize customers to use energy more efficiently, and do so at a lower societal cost than procuring conventional sources of electricity, they should always do so. It also saves customers money in avoided energy costs, either directly from less usage or system-wide through lower costs to procure less energy, improves reliability, and reduces the environmental impacts of energy services. The dynamic description of market transformation implies a synergy between this use of energy efficiency as a resource and the policy goals of market transformation. Specifically, the main goal of policies to transform markets toward technologies that reduce energy consumption is in fact to reduce the societal costs of energy consumption. This is the very same principle that drives California and other states to require utilities to invest in efficiency to supplant supply side resource acquisition.

Thus, utility efficiency programs have a natural role in the continuing process of market transformation as they pull more efficient products to market and thereby speed up the process of market acceptance. For this to work, efficiency programs must be regularly modified to address the ever changing market conditions and focus new program offerings on pulling the next generation of efficiency products to the market. It is also essential to align efficiency programs with research and development funding priorities and updates to codes and standards, which often requires coordinating with other state and federal regulators and stakeholders.[8]

To achieve significant energy savings and to ensure that market transformation efforts complement the goal of using efficiency as a resource, it is imperative to align the interests of the utilities with the interests of society. The CPUC implemented numerous policies to ensure that the goals of the utilities are properly aligned with the state's objective of ensuring that customers received reliable, clean, and affordable energy services. In particular, the CPUC:

- Removed utility disincentives for investments in energy efficiency by decoupling the utilities' recovery of fixed-costs from sales,
- Set stretch energy saving goals for the utilities,
- Required utilities to invest in efficiency when cheaper than conventional power,
- Adopted an administrative structure that integrates efficiency into utility procurement,

[5] *Supra footnote 2*
[6] This same debate was common in the late 1990s when restructuring was a popular theme.
[7] See Reference Roberts, Thomas, p.1
[8] In California, utilities play an important role in advancing codes, standards and research, but the California Energy Commission (CEC), not the CPUC, has primary responsibility for these policies. In addition, CEC policy on research, codes and standards is often heavily influenced by national policy. For example, California is frequently preempted by federal appliance efficiency standards, including on lighting efficiency standards.

- Delineated clear rules for the efficiency programs,
- Developed a shared savings risk/reward performance-based incentive mechanism
- Adopted the first ever California Long-term Energy Efficiency Strategic Plan, and
- Encouraged all stakeholders to work together to develop the next generation programs.

As a result, California utilities administer significant energy efficiency programs as a means of displacing the need for additional generation and transforming the markets for efficient products and practices. These offerings include, but are not limited to, the following:

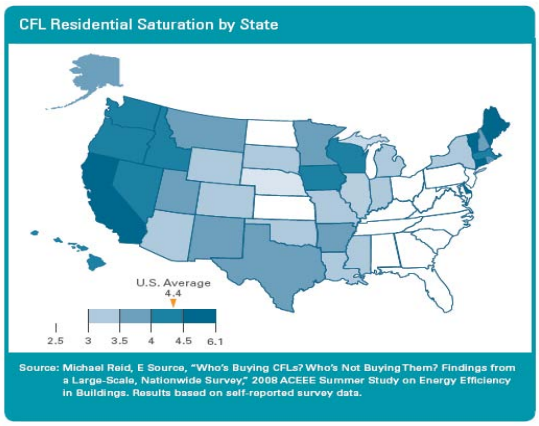
- Early stage and emerging technology programs;
- Incentive/rebate programs that target multiple points in product distribution chains (e.g. end-consumer, contractor, manufacturer, etc);
- Funding to provide the technical basis for efficiency code and standard updates;
- Innovative pilot programs
- Third party programs
- Assistance for local governments (e.g., code compliance);
- Contractor incentives and design assistance for efficient construction

The policy structure in California enables the utilities to carry out extensive programs and encourages them to support and advocate for more stringent codes and standards. Setting up the right policies and pushing towards advancing codes and standards will further advance market transformation while minimizing the tendency to revert to previous manufacturing and purchasing habits, which would undermine efforts towards sustained market transformation. While there can be healthy debate about the prioritization, planning, and implementation of these programs, there is little doubt that they reduce energy use and move new and more efficient technologies to market.

California's Residential Lighting Market

Over the past few decades, lighting programs have been an important part of California's efficiency programs. These programs significantly improved the availability of efficient lighting technologies on the market and by doing so, saved a great deal of energy. California utilities not only played a substantial role in developing the CFL industry through their program efforts, but also actively supported the Federal Energy Independence and Security Act of 2007, which mandates minimum efficiency levels for screw-based lighting products beginning in 2012 (see Section VI below for more details).

Figure 1: CFL Residential Saturation by State



Recent California lighting market effects studies (market studies) indicate that the market in California for CFLs has significantly expanded in recent years. In particular, California investor-owned utility customer awareness of CFLs reached 96% in

2008 and the percentage of households that purchased CFLs exceeded 75% in the same year.[9] Furthermore, as indicated by Figure 1, California households average 6.1 CFLs per home while the rest of the nation averages 4.4 lamps. While this indicates significant progress, there's still significant saving opportunities since CFLs still are not the preferred screw-based bulb for most consumers. Fewer than 11% of the sockets in U.S. homes contain a CFL today.[10] On average, American homes leave nearly 30-40 sockets filled with inefficient bulbs.[11] Although performance is better in California, recent analyses found that the majority of lamps installed in homes are still incandescent bulbs, with only one fifth of sockets filled by the more efficient CFLs.[12] There is clearly room for more savings in residential lighting.

Although efficiency programs increased market penetration of efficient lighting and enabled state and federal lighting standards, the residential lighting market continues to yield significant unfilled potential. Approximately 62% of medium screw-base sockets and 93% of small screw-base sockets are still filled by inefficient lamps.[13] Even in the areas where CFLs are most commonly installed, (e.g., bedrooms and bathrooms) or have moderate or high use sockets (e.g., kitchens, bedrooms, and living rooms), socket penetration is still quite low.[14] The potential to deploy more efficient lighting (and therefore save significant energy) is even greater in three-way and dimmer sockets, where inefficient lighting fills 71% and 63% of the sockets respectively.[15] These results indicate that there is substantial opportunity for significant savings by installing more efficient lighting options in these sockets.

While some of these sockets could be filled by basic CFLs, others (especially dimmers) have unique characteristics that require specialty lamps. These market studies reports illustrate an ongoing need to promote efficient lighting for the sockets that still contain the more inefficient option. Education, promotion of basic specialty lamps, and support for research into alternative efficient lighting options all provide opportunities for ongoing intervention to improve the lighting market.

Despite the data on penetration of efficient lamps, stakeholders and regulators continue to debate about whether or not there is a need to continue lighting programs. Disagreements about attribution of savings, program design, costs of the programs, and upcoming state and federal lighting standards threatened the continuation of residential lighting programs for this program cycle and beyond.[16] Regardless of these disagreements, the CPUC found that there was still significant cost-effective lighting savings to be captured during the current cycle and approved a modified version of the investor owned utilities' lighting programs. The CPUC directed the utilities to reassess their lighting subsidies for basic CFLs and increase investment in the advanced lighting programs to promote technologies that address the harder to reach sockets. In

[9] See Reference CADMUS p.vi-vii.
[10] See Reference U.S. Department of Energy, p.5.
[11] See Reference NRDC.
[12] See Reference KEMA, Appendix E, Table 1, p.1.
[13] *Ibid.* Appendix E, Table 7. p.4.
[14] *Ibid.* Appendix E, Table 22. p.17 (e.g., CFL socket penetration in bathrooms = 24%, bedrooms = 27%) & Appendix E, Table 22. p.17 (e.g., CFL socket penetration in kitchens = 19%, bedrooms = 27%, living rooms = 27% and Bathrooms, = 24%).
[15] *Ibid.* Appendix E, Table 9. p.5.
[16] CA IOU program cycles operate on a 3-year program cycle. Current cycle is 2010-2012, next cycle is 2013-2015

addition, the CPUC authorized the utilities "to explore the incorporation of next generation halogen and incandescent bulbs in their programs" using authorized funding for subsidies.[17]

The Role of Efficiency Programs in Moving the Lighting Market

As noted above, energy efficiency programs are crucial to capturing dependable and affordable savings, while also pulling new technologies from the design stage to general market acceptance. Whether programs target the end-use customer, retailer, contractor, or manufacturer, consistent program intervention is critical to increase the availability and usage of efficient technologies. However, the ongoing debate about when a market is actually transformed threatens the continuity of beneficial programs that achieve real savings and bring new technologies to market. Prematurely discontinuing programs also ignores the important role that efficiency programs play in the market transformation continuum and threatens the advancement of the market as well as resource acquisition needs. If programs are removed before the technology has been locked into codes and standards, before the efficiency level fully becomes standard market practice, or there is no longer a market for inefficient lighting options, manufacturers and retailers will resume selling and stocking the inefficient options and consumers will tend towards purchasing the less expensive and less efficient lighting options.

For example, some advocates claim that the general lighting market is fully transformed based solely on the fact that the Northwest Energy Efficiency Alliance (NEEA) ceased funding their CFL programs. Claiming that a market is transformed based on this fact misses the big picture of the northwest lighting market. The experience of the Northwestern utilities and NEEA cooperation in the lighting market demonstrates that market intervention can effectively promote widespread availability and acceptance of CFLs. The Northwest experience also shows the importance of defining appropriate metrics to determine success at various stages of market transformation before discontinuing successful programs.

Beginning in 1997, NEEA specifically designed CFL programs to (1) increase sales, (2) reduce product prices, (3) increase availability, (4) increase consumer awareness and (5) encourage quality improvement.[18] Although NEEA removed their incentives once these goals were met according to project theory and metrics, the CFL market was not yet sustainable without continued support.[19] When NEEA's funding was removed, utilities continued to carry out the programs rather than remove these offerings all together.[20]

NEEA's efforts also highlight the importance of designing programs to meet specific goals and metrics to ensure success. However, the metrics used to measure the success of the NEEA programs were limited and did not necessarily indicate a fully "transformed market," but only that the defined objectives had been achieved. Moreover, the NEEA experience should not be used as a benchmark for when other states should cease funding for lighting programs, as each market landscape is different depending on size, demographics, and identified metrics of success.

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[17] See Reference CPUC. A.08-07-021 et al. D.09-09-047, p. 122. The best available now halogen bulbs are only about 30% more efficient than regular incandescent bulbs and far less efficient then CFLs.

[18] See Reference Rasmussen, p. 6-182.

[19] *Ibid*. p.6-190.

[20] See: http://www.pse.com/SOLUTIONS/FORYOURHOME/pages/rebatesOnLighting.aspx?tab=2&chapter=1 and http://www.avistautilities.com/savings/rebates/Pages/CFL.aspx for continuing lighting intervention programs

Furthermore, while the NEEA program metrics of sales, price, and awareness are important measures of program success and can indicate a path towards market transformation, saturation (e.g., the percentage of sockets filled with efficient lighting) is also a critical indicator. As noted above, over 75% of sockets in California are still filled with inefficient lamps. Even though sales and awareness are high in California, success cannot be claimed and programs should not be discontinued when savings potential remains. Price, manufacturing production quantities and sales, retail availability, and consumer awareness can all be used to estimate how consumer behavior is affecting the market for a specific product. However, ultimately the transformation of a product should also be gauged by the energy consumption of the particular product being used. In California, as in the rest of the country, the most recent data available indicates that the majority of sockets are filled with inefficient bulbs that consume significant energy.

While efficiency programs were instrumental in reaching the current level of socket penetration, continuing to deliver carefully designed programs is critical to reach the remaining potential until codes and standards are fully implemented. As discussed in Section VI below, even after the codes are implemented, programs will continue driving even greater levels of efficiency. In most of the country, utilities could save huge amounts of energy at very low cost by running well designed lighting programs that target basic lighting applications as well as more targeted strategies (Section VII discusses program recommendations).

Lighting Efficiency Standards

The 2007 Energy Independence and Security Act (EISA) lighting efficiency standards will provide substantial savings when fully implemented in 2020.[21] When all bulbs in the roughly four billion screw-based sockets in the United States shift to CFL-equivalent levels of efficiency, it will prevent approximately100 million tons of CO_2 per year, save more than $10 billion per year in energy costs and eliminate the need for more than 30 large (500 MW) power plants.[22]

However, various stakeholders and regulatory bodies have misinterpreted what EISA will actually require. For example, passage of the law does not mean that the lighting market will automatically be "transformed" when the standards begin to go into effect in 2012, since the standards are only fully phased in by 2020. Furthermore, EISA does not ban incandescent bulbs or require compact fluorescent bulbs to be used. Rather, between 2012 and 2014, the EISA standard phases in a requirement that bulbs use 25-30% less power. In 2020 the law requires roughly CFL-level efficiency (but not the use of CFLs specifically). Between 2012 and 2020 CFLs (which are 75-80% more efficient than the main stream incandescent bulbs) will continue to provide low-cost and above-code savings.

[21] In California, the efficient lighting market is also affected by AB 1109 (Huffman), which requires a 50% reduction in energy consumption from 2007 to 2018 for residential lighting and 25% reduction in consumption in commercial and outdoor lighting. The Huffman Bill will require savings in technologies not covered by EISA (for example many commercial and outdoor light bulbs) and also acts on a different timeline. California plans to implement the EISA requirements early and doing so will help meet the Huffman requirement: Tier 1 implementation will begin in 2011 and Tier 2 will begin in 2018.

[22] NRDC Calculations based on conservative estimate of savings at 10 cents/kWh from the change of 60 to 15 watt bulbs in the roughly 3 billion US sockets which do not yet contain CFLs.

TIER 1 – 2012-2014

Tier 1 of EISA removes low cost, inefficient bulbs from the market starting in 2012. Today's 25 cent incandescent will no longer be available for purchase as EISA sets a slightly higher efficiency requirement for these lamps as noted in Table 1 below.

Table 1: Implementation of Tier 1 – EISA (2007)

Today's Bulb	Becomes	Tier I Standard	Lumens	Lumens/Watt	Effective Date
100W	→	≤ 72 W	1490-2600	~20-36	1/1/2012
75W	→	≤ 53W	1050-1489	~20-28	1/1/2013
60W	→	≤ 43 W	750-1049	~14-17	1/1/2014
40W	→	≤ 29 W	310-749	~13-26	1/1/2014

NRDC calculations based on EISA 2007 requirements, Public Law 110-140.

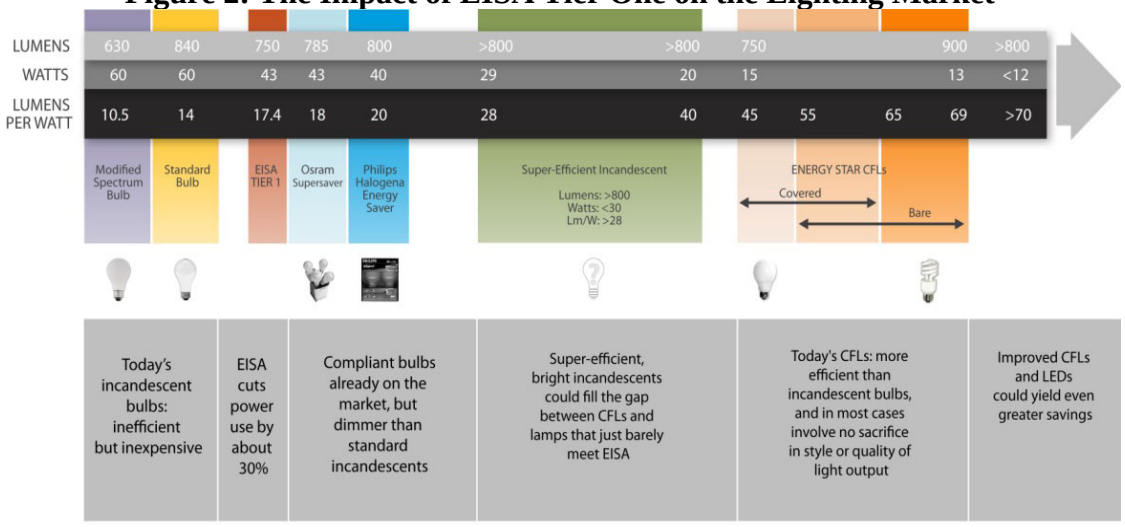
With the most inefficient lamps removed from market due to Tier 1 efficiency levels, more efficient lamps, such as CFLs and new "improved" incandescent lamps, will be expected to increase in sales.[23] However, CFLs will continue to provide significant above-code energy savings and be considerably more efficient than other products on the market. For example, a CFL today can generate as much light as today's 100 W bulb using only 23 W, or less than a fourth as much power.

EISA will require that today's 100W bulb use only 72 W, but CFLs will still be three times as efficient. Similarly, EISA will require today's 60 W incandescent to use only 43 W, but a CFL can provide the same amount of light using only 13 W—this is 80% more efficient than today's incandescent and 70% more efficient than the bulbs that will meet the EISA standard.

After Tier 1 of EISA is fully in place (in early 2014 as noted in Table 1 above), CFLs will still be considerably more efficient than the bulbs that meet the minimum standard. If consumers buy CFLs instead of the new more efficient incandescents, they will save more energy sooner and bring about faster lighting market transformation. In many cases, efficiency programs will remain useful tools to achieve these savings by promoting the most efficient bulb to consumers and filling the remaining sockets (whether basic or hard to reach) with the most efficient option.

[23] The costs of LEDs continue to be prohibitive for many general lighting applications and it is uncertain if they will be commercially competitive or cost effective for wide spread residential applications by 2012.

Figure 2: The Impact of EISA Tier One on the Lighting Market



NRDC Fact Sheet. *"Residential Lighting Efficiency – Where Do We Go From Here?"*2009.

TIER 2 - 2020

Tier 2 requires DOE to set new standards for screw based bulbs. The new standard has not been established yet, but at a minimum the standard must require bulbs to produce at least 45 lumens per watt. This is almost as efficient as current CFLs. Light Emitting Diodes (LED) and "super efficient incandescent" will hopefully be market ready by that time.

Accessing the Remaining Potential

There is still significant energy savings potential in the residential lighting market. Therefore, the debate should not focus on *if* efficiency programs should continue to access the remaining cost effective savings, but *how* best to design programs to ensure they capture the remaining energy savings. Below are a few suggestions to access the remaining potential in California based on current market conditions and the upcoming lighting standards. While the following recommendations are crafted to address the California market, these suggestions are also applicable to other utilities, states, and regions that design and carry out lighting energy efficiency programs. The lessons learned from the markets and program designs in the Northwest and California (such as which metrics to use and what type of targeted programs to design) can inform the development of comprehensive lighting programs in other areas as well.

- **Target sockets that more likely hold inefficient lighting**: In addition to promoting basic CFLs wherever there is potential, programs should target three-way and dimming sockets, which recent studies indicate are dominated by inefficient lamps. Education programs could address perceived barriers to installing more efficient lamps in these sockets while additional programs promoting various specialty bulbs can overcome the unique challenges presented by different types of sockets (e.g., dimmers).
- **Explore more versatile technologies that offer sizable energy savings** There are currently technologies, such as the next generation incandescent lamp, that could deliver

savings of up to 30% of what is possible with traditional incandescent lamps.[24] This level of efficiency will be required by EISA between 2012 and 2014, as discussed above. Additional incentives could encourage manufacturers to produce incandescent lamps that provide at least 50% savings.[25] While this is still lower than the savings provided by a CFL, these bulbs will provide an energy savings alternative for those consumers who are not willing to purchase or install CFL in particular sockets due to customer preferences (e.g., aesthetics, product components, dimmer socket, etc.).

- **Offer a tiered rebate approach to incentivizing efficient lamps:** Since there are increasingly more options of efficient lamps on the market, energy efficient programs could offer varying levels of incentives to continue promoting the basic efficient technologies while simultaneously bringing the more efficient or specialty bulbs to market. For example, higher rebates could be offered for lamps that would more likely be placed into socket types with low efficient lighting saturation rates (e.g., dimmers) Thus, the efficient options that offer preferred performance and more versatile applications should receive a higher rebate initially as these improved technologies build market acceptance. A tiered system would leave in place basic CFL incentives (at lower rebate levels) as these lamps continue to need additional support, but not to the same degree as more advanced technologies.
- **Target existing advanced technologies or practices to bring down cost while pulling the next generation technologies to market:** LED and similar technologies are currently available but are more expensive than most customers are willing to spend. Addition research and development programs should focus on bringing down the cost of these technologies, while improving efficiency, versatility, and quality.
- **Expand education and improved labeling programs:** Awareness and understanding of the numerous lighting options continues to be a real barrier to the uptake of efficient lighting. Most people do not know how to compare lighting products by light output- and a better understanding would allow easier comparison across all product options. Programs that encourage retailers to display lighting options and their applications would build customer awareness and improve efficient lighting penetration. Similarly, programs that support improved labeling requirements and help customers decipher current labeling terminology would improve consumer understanding of which bulbs to purchase. National coordination of these efforts is crucial, as multiple labeling strategies would lead to confusion.

Conclusion

California efficiency lighting programs continue to provide cost effective energy savings and are an important part of the portfolio of programs helping to ensure customers receive affordable and reliable energy services at the lowest societal cost. These programs can satisfy both the short term need of resource acquisition, by displacing fossil fuel generation, as well as the longer term goal of transforming the lighting market, by integrating more efficient products into standard practice.

[24] Philips' "Halogena" and Osram Sylvania "Halogen Super Saver" are on the market; General Electric is also working to release more efficient incandescent bulbs.

[25] Existing products already provide roughly 30% savings that meet the Tier One EISA standard. New coating technology may enable these lamps to achieve approximately 50% savings.

To be most effective in permanently moving the lighting market towards more efficient options, the standard definition of market transformation noted in Section II should be modified to acknowledge the dynamic nature of markets. Rather than a single defined outcome leading towards elimination of the efficiency program, market transformation is a continuous process. This process for technology improvement begins with research, innovation and demonstration, followed by introduction into the mass market through efficiency programs and other means to grow market acceptance, and finally updated efficiency standards and codes to lock in minimum efficiency savings across the market; and continues for each generation of technology. In addition, key metrics and baseline information must be established at the onset of efficiency program design and development to ensure that an agreed upon 'end point' (or series of end points) for a specific program design is clearly defined.

Furthermore, lighting programs should continue to ensure that past successes are not undermined by prematurely removing incentives for efficient lighting technologies and practices before they gain full market acceptance or become code. While some advocates argue that now is the time to remove support for CFLs, the evidence indicates that doing so would leave significant highly cost-effective savings opportunities on the table. Instead, to ensure the remaining potential is captured, programs must be modified where necessary to respond to dynamic market conditions.

Finally, well designed policies encourage greater innovation and adoption of efficiency in ever evolving markets. A comprehensive policy approach has played, and will continue to play, a key role in transforming the lighting market in California and beyond. Efficiency programs are only one strategy of the various methods used by utilities and regulators to encourage continued market transformation towards greater efficiency. When and how each policy strategy is deployed should be guided by the most current information on the state of technology, prices, and customer trends. Only then will utilities and regulators best achieve the mutual goals of resource acquisition and market transformation, and succeed in continually improving levels of efficiency and lowering customer energy service costs.

References

Blumstein, Carl, Seymore Goldstone and Loren Lutzenhiser, "**A Theory-Based Approach to Market Transformation**" Energy Policy 28 (2000) 137-144

CPUC. A.08-07-021 et al. D.09-09-04, "**Decision Approving 2010-2012 Energy Efficiency Portfolios and Budgets**" p.122, September 24, 2009.

CPUC. R.06-04-010; D.07-10-032 "**Interim Opinion on Issues Relating to Future Savings Goals and Program Planning for 2009-2011 Energy Efficiency and Beyond**." October 18, 2007.

CPUC R.94-04-031/I.94-04-032; D. 97-02-014, February 14, 1997.

CPUC."**California Long Term Energy Efficiency Strategic Plan**." September 18, 2008 accessed at <www.californiaenergyefficiency.com>, Section 1 – p.4.

CADMUS p.vi-vii. "**Compact Fluorescent Lamps Market Effects: Final Interim Report**" May 2009. p. vi-vii

Eto, Joseph and Charles Goldman, "**Ratepayer-Funded Energy-Efficiency Programs in a Restructured Electricity Industry: Issues and Options for Regulators and Legislators**" LBNL 41479, May 1998.

Goldstein, David and Philip Fairey, "**Getting it Right Matters: Why Efficiency Incentives Should Be Based on Performance and Not Cost**." ACEEE, 2006.

Keating, K.M., D.B. Goldstein, T. Eckman, and P. Miller. 1998. "**Wheat, Chaff and Conflicting Definitions in Market Transformation**." Proceedings of the 1998 ACEEE Summer Study on Energy Efficiency in Buildings.

KEMA, Appendix E -Table 1, p.1 "**Final Evaluation Report: Upstream Lighting Program**" February 8, 2010. Appendix E – Table 1, p.1

Koomey et al.,"**Defining a Standard Metric for Electricity Savings**," March 9, 2010. *Environmental Research Letters* accessed at: http://iopscience.iop.org/1748-9326/5/1/014017/pdf/1748-9326_5_1_014017.pdf

Miller, Peter, "**Restructuring DSM: Moving Beyond the Utility Monopoly on DSM Resource Acquisition**." ACEEE, 1998.

NRDC, "**Residential Lighting Efficiency – Where Do We Go From Here?**"2009.

Rasmussen, Tami, Jennifer E. Canseco, Anu Teja, "**Are We There Yet? An Assessment of a Decade of Northwest Lighting Market Transformation Efforts**"2008 ACEEE Summer Study on Energy Efficiency in Buildings. p.6-182.

Roberts, Thomas, "**California's Shareholder Incentive Mechanism—A Ratepayers Perspective**" ACEEE, 2009, p.1.

U.S. Department of Energy, Energy Star. "**Big Results, Bigger potential – CFL Market Profile**." March, 2009. p.5