Consumer Federation of America

RESEARCH BRIEF

ELECTRICITY CONSUMPTION AND ENERGY SAVINGS POTENTIAL OF CONSUMER DIGITAL DEVICES: THE ROLE OF CALIFORNIA APPLIANCE STANDARDS LEADERSHIP

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I. INTRODUCTION

Over the past decade, policymakers at the federal and state levels have sharply increased the level and coverage of energy efficiency performance standards, using both legislation and regulation. The requirements to increase the energy efficiency have affected consumer durables,[1] like automobiles, appliances, and buildings, and capital goods used by industry, like heavy-duty trucks, and electric motors.[2]

The Consumer Federation of America (CFA) has conducted economic analyses of many of these energy efficiency performance standards, focusing on the impact upon consumer pocketbooks.[3] CFA has also commissioned public opinion polls about consumer attitudes toward energy efficiency in general and performance standards in particular.[4] We have consistently found strong public support for increasing energy efficiency through standards and our economic analysis shows that this public support is well grounded in the economics of the standards adopted.[5] Our economic analysis shows that higher standards save consumers considerable sums of money because energy saving technologies lower consumer energy bills much more than they increase the cost of consumer durables.

Major consumer durables like automobiles and HVAC equipment (heating and air conditioning) and capital goods, like medium and heavy-duty trucks receive the most attention in the energy policy process, and rightly so. Gasoline used in cars and light duty trucks is the single largest household energy expenditure, reaching over $2150 in 2012.[6] The cost of diesel fuel used for medium and heavy-duty trucks, which is ultimately paid by consumers in the price of the goods and services delivered, was almost $1200 in 2012.[7] Expenditures for home energy (heating, cooling, hot water, appliances) was about $2,000 the same year, with heating being the largest single cost, followed by hot water and air conditioning.[8]

However, the fastest growing component of national energy consumption is the appliance category, which includes a mix of appliances including lighting, televisions and consumer electronics.[9] Moreover, within this broad category, the fastest growing segment of home energy consumption involves what are known as household digital devices, which includes computers,

internet connectivity and video network devices. This paper examines the growing importance and potential consumer benefits of adopting efficiency standards to cover these devices.

Given the dramatic growth in electricity consumption of these household digital devices, it is not surprising that they have begun to attract the attention of policymakers and, given the historic pattern of development of standards across the U.S., it would not be surprising if the state of California is the first to take up the issue of setting standards for these devices. California has traditionally played this leadership role in a number of areas, including not only appliances and buildings, but also for vehicles.[10]

Although the California initiatives are frequently driven and measured by their environmental impacts, they accomplish their environmental goals largely by reducing energy consumption. They are driven by environmental concerns, but they are required to meet economic cost benefit criteria as well.[11] While CFA recognizes and appreciates the importance of the total social costs of energy consumption, our analysis has always focused on a narrower economic standard, the consumer pocketbook test. We always ask, "how does the benefit of reduced energy bills compare to the cost of including energy reducing technologies, i.e. what is the impact on the consumer pocketbook?"

Outline

Section II examines the remarkable increase in and current level of electricity consumption by household digital devices.

Section III discusses the potential savings and costs of increasing energy efficiency of household digital devices.

Section IV explains why the marketplace has failed to incorporate the beneficial technologies into these devices.

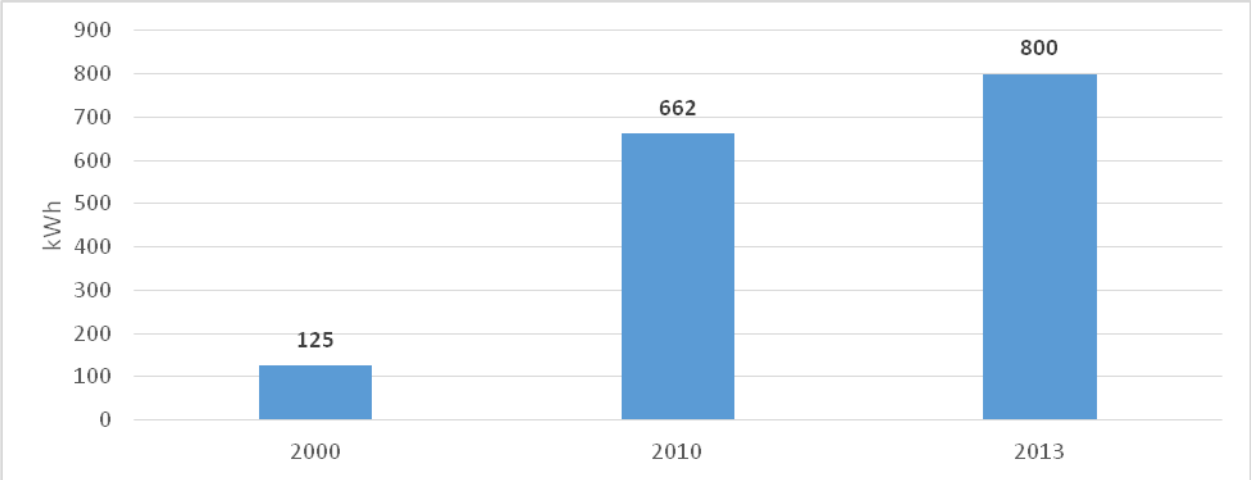
II. THE GROWING IMPORTANCE OF HOUSEHOLD DIGITAL DEVICES

As shown in the top graph of Figure 1, the amount of electricity consumed by household digital devices increased more than five-fold between 2000 and 2010. Our estimate of the 2013 national average consumption of 800 kWh for household digital devices is based on the weighted average of the presence of those devices in households. That is, we multiply estimates of the number of households across the nation with the device by the average usage per household and divide by the total number of households.

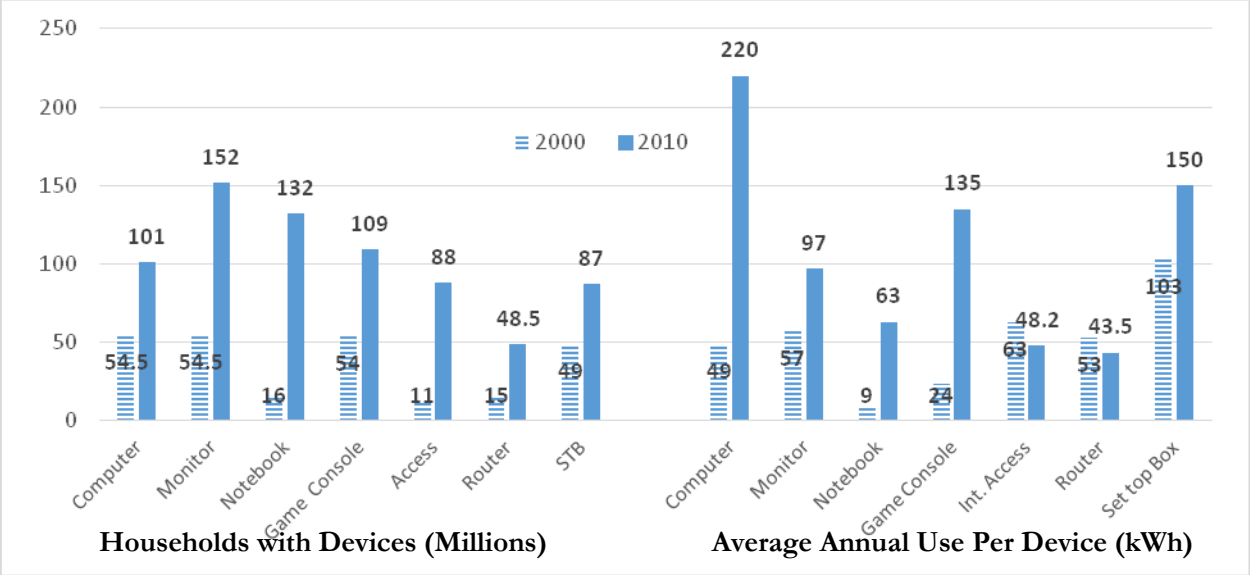
The increase in electricity use of these devices is driven both by increased penetration of the devices into households and increased use of those devices by households, as shown in the bottom graph of Figure 1. More households have more devices that they use more often for longer periods of time to accomplish tasks that consume more energy. Keeping in mind that in 2010 there were fewer than 120 million households, it is clear that these devices were not only approaching full saturation, but that some households had more than one device. Thus, in thinking about future levels of penetration, it may be more appropriate to think about some of these devices as personal rather than household.[12]

FIGURE 1: THE INCREASING IMPACT OF DIGITAL DEVICES ON HOUSEHOLD ELECTRICITY USE

Weighted Average Annual Consumption of Households Digital Devices



Penetration and Use of Computers, Game Consoles and Network Connectivity Devices

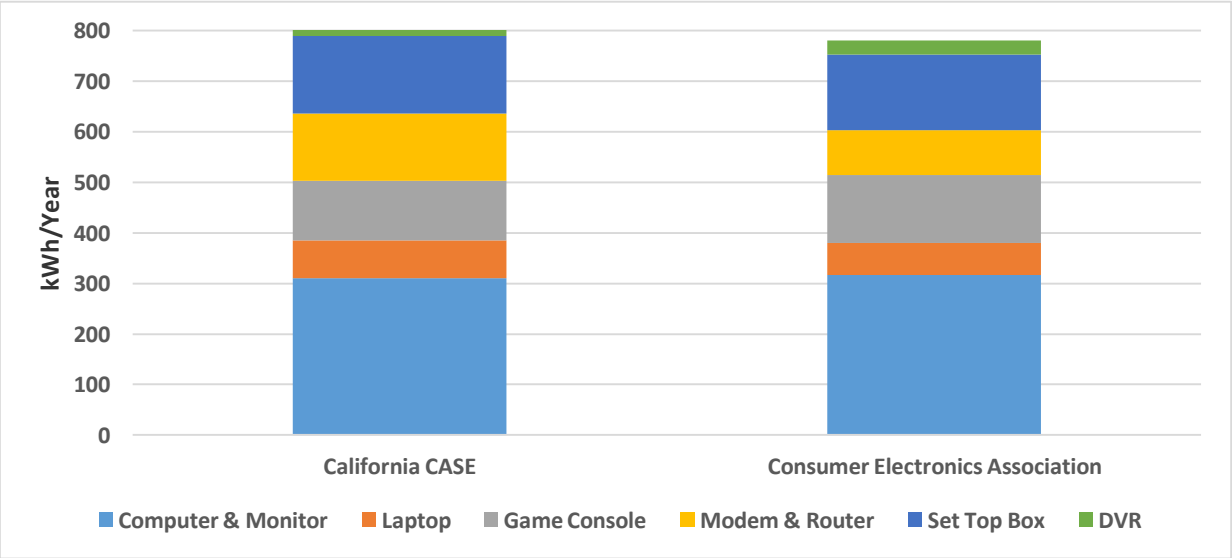


Source: Bryan Urban, Verena Tiefenbeck and Kurt Roth, *Energy Consumption of Consumer Electronics in U.S., Households: Final Report to the Consumer Electronics Association (CEA),* Fraunhofer Center for Sustainable Energy Systems, December 2011. 2013 assumes one-third the average annual rate of growth since 2010 as occurred in 2000 to 2010. This reflects a slowing of growth in computer ownership and subscriptions to multichannel video service, with continued strong growth in broadband connectivity and gaming. Weighted average household use calculated with 110 million households in 2010, 120 in 2010 and 121 in 2013.

Figure 2 presents a second way to describe household digital device electricity consumption. It shows the estimated electricity consumption of a household that has one of each of the devices – a computer with a monitor, a laptop, a modem with a router, a cable set top box and a DVR – and uses those devises at the average level. Given the penetration of these devices, this household would

be the modal or "typical" household. Two estimates are shown, one from the California utilities, one from the Consumer Electronics Association. Both estimates of electricity consumption for this "typical" household, are quite close to 800 kWh. Of course on a national average basis, some households do not have all of these devices, but some have more than one. Therefore, the weighted average seems reasonable.

FIGURE 2: ANNUAL CONSUMPTION OF A HOUSEHOLD WITH ONE OF EACH OF THE DEVICES

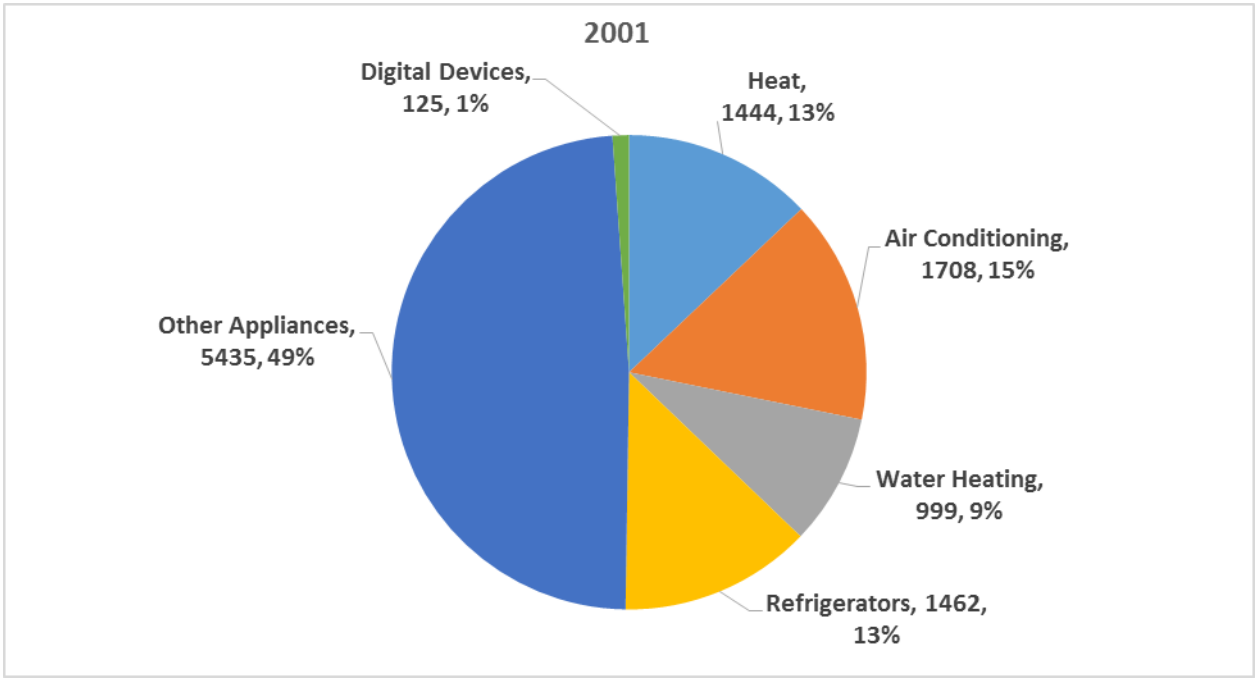


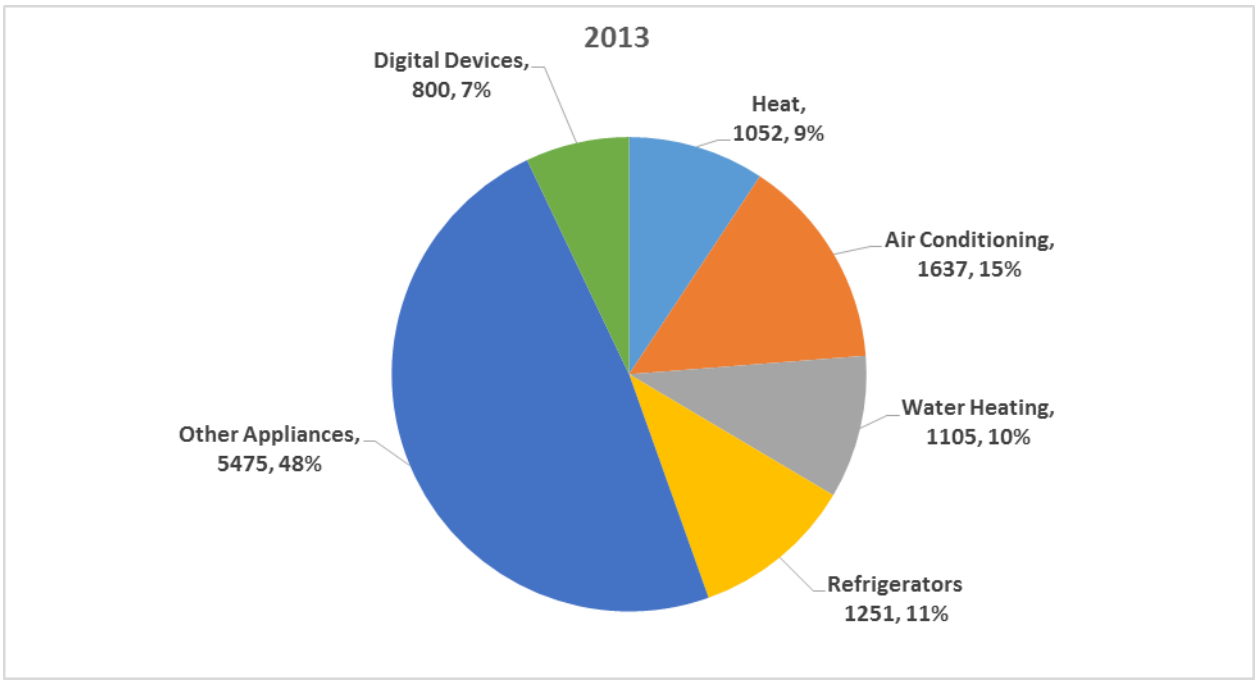
Source: Bryan Urban, Verena Tiefenbeck and Kurt Roth, *Energy Consumption of Consumer Electronics in U.S., Households: Final Report to the Consumer Electronics Association (CEA),* Fraunhofer Center for Sustainable Energy Systems, December 2011. Pacific Gas and Electric et al., Codes and Standards Enhancement (CASE) Initiative for PY 2013, Title 20 Standard Development, docket #12-AAER-2A, July 29, 2013. The IOU CASE Reports cover, Computers, Set Top Boxes, Small Network Equipment and Game Consoles.

As shown in Figure 3, we estimate that on a national average basis, by 2013, household digital devices are not only the fastest growing source of demand for electricity, these consumer electronics devices also consumed about half as much energy as air conditioning and two-thirds as much as home refrigeration.[13] Of course, air conditioning use is concentrated in specific regions while use of these consumer electronic devices is widespread across the country. The widely-dispersed nature of electricity consumption of household digital devices does not mean they should be ignored in consumer, energy or environmental policy. On the contrary, as discussed in Section III of this report, it makes it even more important to address the electricity consumption of household digital devices. Thus, household digital devices are one of the largest household users of electricity that have not been addressed by energy standards. While the rapid growth and dispersed nature of the use of these devices may have kept them off the radar screen of energy policy makers, it is clear that they are now an important driver of electricity consumption that deserves immediate and careful attention from decision makers with responsibility for energy policy.

FIGURE 3: NATIONAL WEIGHTED AVERAGE ELECTRICITY CONSUMPTION KWH/HOUSEHOLD

(Includes all households)





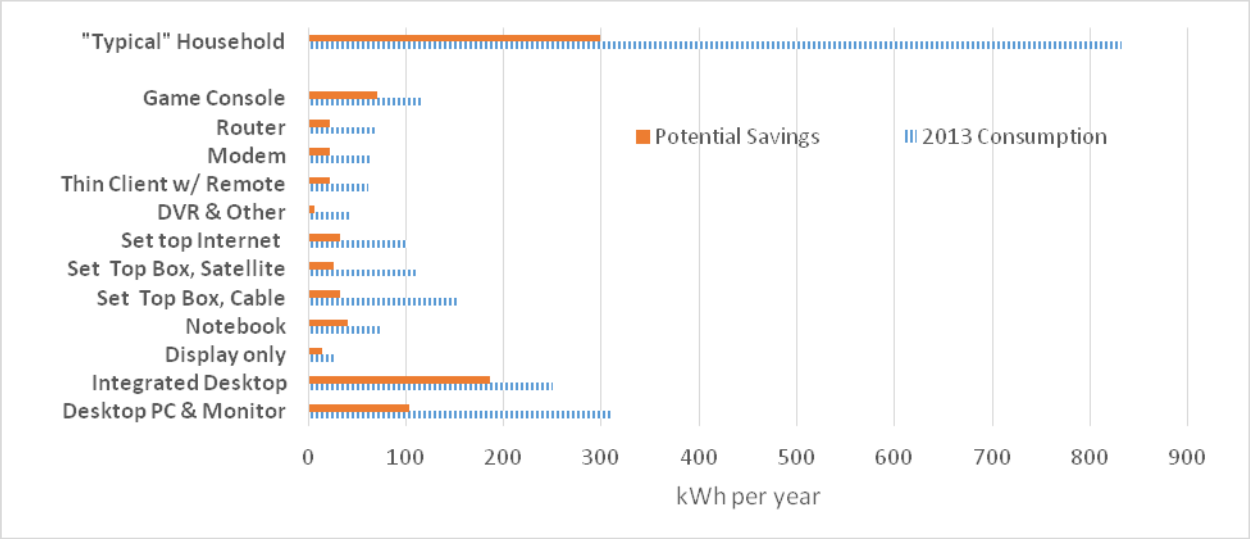
Sources and notes: The estimates of consumption by Household Digital Devices are subtracted from the "other appliance category." The 2009 RECS percentages of electricity consumption are adjusted to 2013, based on total electricity consumption in 2012. Residential Energy Consumption Survey (2001, 2009).

III. The Cost and Benefit of Potential Electricity Savings

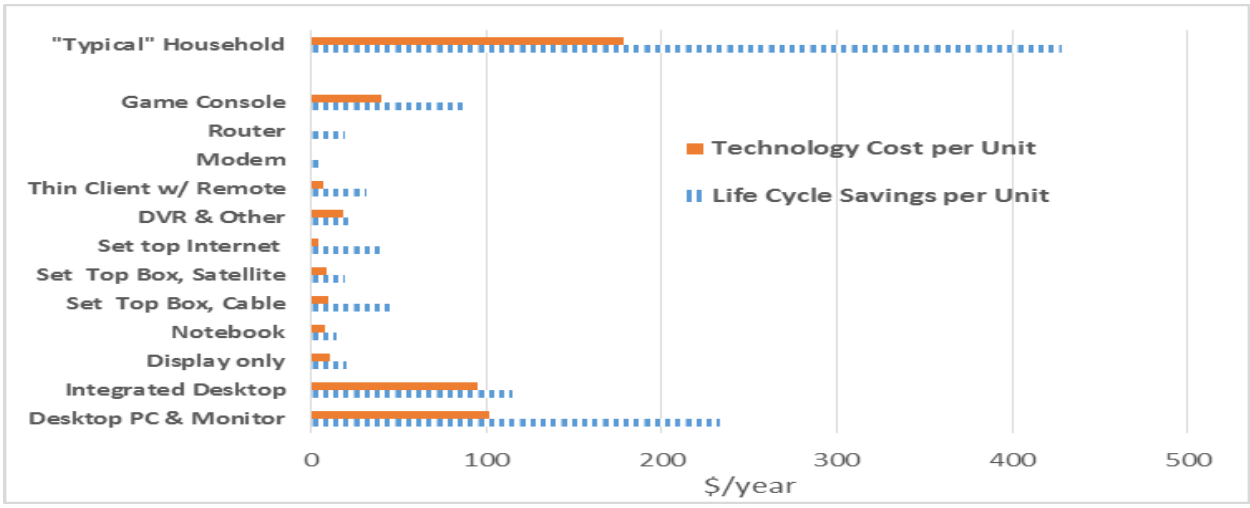
Recent analysis by the California investor-owned utilities (IOUs) demonstrates a substantial potential for electricity savings for these devices at a very attractive cost.[14] As shown in the top graph of Figure 4, the typical household could save almost 300 kWh per year for the "one of each" set of devices. This is a reduction of more than one-third in electricity consumption.[15] We use the

Figure 4: The Cost and Benefits of Improving the Efficiency of Household Digital Devices

Current Electricity Consumption and Potential Reductions



Life Cycle Costs and Benefits of Reducing Electricity Consumption



Source: Pacific Gas and Electric et al., Codes and Standards Enhancement (CASE) Initiative for PY 2013, Title 20 Standard Development, docket #12-AAER-2A, July 29, 2013. The IOU CASE Reports cover, Computers, Set Top Boxes, Small Network Equipment and Game Consoles.

estimates prepared by the California IOUs since they are recent and provide a consistent analytic approach across appliances that is clearly defined and documented. A review of other estimates of potential energy savings and technology costs shows that these estimates are quite reasonable, even a bit on the cautious side.[16]

The bottom graph of Figure 4 shows that for the "typical" households, the cost of achieving these improvements in energy efficiency would be much smaller than the value of the electricity saved. For each of the individual devices, the benefits exceed the costs. Using a 3% discount rate, the benefits are 2.4 times larger than the cost. [17]

In short, the proposal submitted to the California Energy Commission by the IOUs for this important group of consumer durables passes the consumer pocketbook test with flying colors.

IV. THE IMPORTANT ROLE OF STANDARDS

The strongly positive cost benefit analysis that supports including energy saving technologies in these household digital devices, always raises the question:

- Why hasn't the marketplace driven this result?

The answer to this question is well-known:

- The market for energy efficiency suffers from numerous obstacles, barriers and imperfections that inhibit the investment in energy efficiency technologies.

We have examined the debate over the "efficiency gap" – the gap caused by the failure to make economically beneficial energy efficiency investments – and the role of performance standards as a policy response to close it in great detail in a recent report.[18] Many of the obstacles to investment in energy efficiency that we have identified apply to household digital devices. The electricity consumption of these devices is a particularly difficult problem for the marketplace to solve.

- The electricity consumption of these devices is not visible to consumers. The devices are purchased for their functionalities, which, given the dramatic increase in penetration and use, are highly desirable. The level of electricity consumption is not an attribute of the product to which consumers will pay much attention (a shrouded attribute problem).
- Even if consumers are paying attention to energy use, it would be difficult for them to determine how much energy the devices use and the impact of reducing consumption. The information is either not readily available (information problems) and/or the transaction cost of obtaining it is high (transaction cost problems) and/or the calculations are difficult for consumers to make given uncertainties about consumption and prices (behavioral and information problems).

- The manufacturers of the products make the key decisions about energy consumption and the bundle of attributes that will be made available in the market, thereby constraining the range of energy consumption levels the consumer has to choose from (principal agent problems).
- The manufacturers tend to focus on the primary product attributes and the first cost of the device, ignoring the life cycle cost (i.e. the total of acquisition and operating costs) since they do not pay the electricity bills. The manufacturers' interests are separate and different from the consumers' interests (split incentives problem).
- Ultimately, the benefit of reducing energy consumption has value beyond the benefit that each individual directly enjoys from reduced energy consumption (a public goods problem).

These characteristics make it highly unlikely that the marketplace will overcome these obstacles on its own to stimulate investment in energy efficiency increasing technologies. Simply providing consumers with more information about electricity consumption of the devices does not overcome the underlying problem on the demand side or the supply side.

Therefore, standards can play an important role. They address all four of the barriers identified.

- Standards put a floor under the level of energy consumption, without dictating which technologies can be utilized.
- Consumers do not have to master the economics of the level of energy consumption of the device.
- Because all manufacturers must abide by the same rule, there is less risk of adding the cost of the energy savings technology to the product.
- Producers who are better at adding technology at lower cost may benefit.
- Competition can be stimulated around the standard and may even go beyond it as the standard raises awareness.

Thus, the barriers are overcome to the level of the standard.

California's role in moving the nation forward in setting standards for these devices is also appropriate for a number of reasons.

- California is a large enough market to get the attention of the product manufacturers.
- Not only is the California economy large even on a global scale, but Silicon Valley in Northern California has a special place in the digital revolution, so it is likely to get the broad attention of policy makers.
- Given the experience of the past quarter of a century, there is a great deal of experience with this type of standards setting process in California.

- The fact that the California IOUs have conducted extensive analysis and proposed a set of standards that achieves significant savings reflects this history and bodes well for the process.

Given the highly positive cost benefit analysis and the demonstration that there are numerous technologies available that could meet or beat the standard, the proposed levels are a good starting point, but just a starting point. In our review of the literature, we identified a number of characteristics that make performance standards effective in responding to the market barriers and imperfections that inhibit investment in efficiency. The proposed initial levels of the standards would capture many of the characteristics.

Technology Neutral: Taking a technology neutral approach to a long term standard unleashes competition around the standard that enables the industry to present consumers with a wide range of choices at that lowest cost possible.

Product Neutral: Performance-based standards are set in ways that accommodate different levels of performance and features. Therefore, the standards accommodate buyer preferences; and do not try to supplant them. Standards level the playing field for efficient devices.

Responsive to industry needs: Establishing a long term performance standard recognizes the need to keep the standards in touch with reality. Standards need to be set at a moderately aggressive level that is clearly beneficial and achievable and can take into account dynamic changes in technology.

Responsive to market needs: Setting standards that are market-friendly facilitates compliance. The standards do not require radical changes in the types or size of equipment the industry produces; so, the full range of choices will be available to the market. These characteristics make standards pro-competitive.

CONCLUSION

Increasing numbers of consumer electronics (digital devices) in the home coupled with higher usage levels have resulted significant growth in energy consumption over the past decade. There is an opportunity to save consumers money on their energy bills through technology neutral, energy saving performance-based standards for these devices. These standards address the failure of the marketplace to incorporate cost-effective energy saving technologies into the products. California has led the nation on energy efficiency standards for vehicles, buildings and appliances and other electronics, such as battery chargers. It can be a leader once again by moving ahead on efficiency standards for consumer electronics and digital devices. Consumers will benefit from California's leadership.

END NOTES

[1] In economics, a **durable good** or a **hard good** is a good that does not quickly wear out, or more specifically, one that yields utility over time rather than being completely consumed in one use…Examples of consumer durable goods include cars, household goods (home appliances, consumer electronics, furniture, etc.), sports equipment, firearms, and toys, http://en.wikipedia.org/wiki/Durable_good

[2] Appliance Standards Awareness Project, "Standards Scene Heating Up," "California Preps for New Rulemaking," "State of the States," *Appliance Standards Unplugged*, July 25, 2013; Mark Cooper and Jack Gillis, *Paying The Freight: The Consumer Benefits Of Increasing The Fuel Economy Of Medium And Heavy Duty Trucks,* Consumer Federation of America, February, 2014.

[3] *Consumer Federation of America, et al., Comments on the Proposed Rule 2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards,* Docket Nos. EPA-HQ-OAR-2010-0799; FRL-9495-2, NHTSA–2010–0131, 2/13/12;; Consumer Federation of America, *CFA Comments to DOE on Equipment Price Forecasting for Refrigerators, Refrigerator-freezers and Freezers,* 03/24/11; Consumer Federation of America, *CFA and NCLC Letter to DOE Regarding Energy Conservation Standards for Residential Furnaces, Central Air Conditioners and Heat Pumps,* 10/17/11; Consumer Federation of America, *Comments to DOE on Set Top Boxes and Network Equipment as a Covered Consumer Product*, 09/22/11; Consumer Federation of America, *CFA Joins Coalition in Comments to DOE on Efficiency Standards for Battery Chargers,* 07/16/12; Cooper, Mark, *Testimony of Dr. Mark Cooper on the American Energy Initiative* before the House Energy and Commerce Committee, 03/17/11.; Cooper, Mark, Testimony on Appliance Efficiency Standards Legislation, 03/10/11; Consumer Federation of America, *Comments to DOE Urging Action to Advance New Lighting Standards,* 05/13/2013.

[4] Consumer Federation of America, 2011, *CFA Appliance Efficiency Report*, 03/08/11; Consumer Federation of America, *National Survey Shows that Most Consumers Support 60 MPG Fuel Economy Standards by 2025,* 09/28/10; *CFA Surveys Reveal Record Public Concern About Gas Prices and Dependence on Oil Imports*, 03/16/11.

[5] A comprehensive review of the economic theory and empirical evidence supporting performance standards can be found in Mark Cooper, *Energy Efficiency Performance Standards: The Cornerstone of Consumer-Friendly Energy Policy*, Consumer Federation of America, 2013.

[6] These estimates are explained in Mark Cooper and Jack Gillis, *Paying the Freight: The Consumer Benefits of Increasing the Fuel Economy of Medium and Heavy Duty Trucks,* Consumer Federation of America, February, 2014.

[7] Id.

[8] Bureau of Labor Statistics, Consumer Expenditure Survey for 2010, U.S. Energy Information Administration, *Residential Energy Consumption Survey, 2009*, http://www.eia.gov/consumption/residential/data/2009/

[9] U.S. Energy Information Administration, Heating and cooling no longer majority of U.S. home energy use, March 7, 2013, http://www.eia.gov/todayinenergy/detail.cfm?id=10271

10 Mark Cooper, *Energy Efficiency Performance Standards*, 2013, examines the role of California in appliance efficiency and building codes. CFA has recently analyzed the importance of California policy leadership in the light duty vehicle market in *The Zero Emissions Vehicle Program: Clean Cars States Lead in Innovation*, October 24, 2013

[11] CFA has noted the near perfect correlation between reduced gasoline consumption and reduced vehicle carbon emissions, *Comments of the Consumer Federation of America, Environmental Protection Agency and Department of Transportation,* In the Matter of Notice of Upcoming Joint Rulemaking to Docket ID No. EPA-HQ-OAR-0799 Establish 2017 and Later Model Year Light Duty Vehicle GHG Emissions and Docket ID No. NHTSA-2010-0131 CAFE Standards, October 29, 2010.

[12] The analogy here might be the comparison with wireline telephone subscriptions, which topped out at about 170 million (approximately 1.5 per household), while wireless subscriptions now exceed 330 million (more than one per person).

[13] In fact, the relative importance of these devices on household electricity consumption in California is likely to be greater than the national average. California has a moderate climate, which means households use less air conditioning (about on third below the national average) and higher income than the national average, which likely leads to higher penetration and use of digital technologies (e.g. computer penetration is at least 10 percent above the national average). Combining these two factors, household digital devices account for almost three quarters as much electricity consumption as air conditioning for California households.

[14] Pacific Gas and Electric et al., *Codes and Standards Enhancement (CASE) Initiative for PY 2013, Title 20 Standard Development,* Docket #12-AAER-2A, July 29, 2013.

[15] A voluntary agreement has been reached for set top boxes that will achieve some of the potential savings.

[16] A number of studies put the potential for various devices in the range of 30 to 85 percent. Some mix behavioral and technology options, although it is frequently possible to achieve savings that are attributed to behavioral changes with technology where the extent of behavior modification is uncertain. Few of the studies estimate costs but those that do yield results that are similar to the utility studies – see, e.g., Morris E. Jones, Jr., Belle W.Y. Wei, and Donald L. Hung, "Laptop Energy-Savings Opportunities based on User Behaviors," *Energy Efficiency,* 2013 (6); Won Young Park, Amol Phadke, and Nihar Shah, "Efficiency Improvement Opportunities of Personal Computer Monitors: Implications for Market Transformation Programs," *Energy Efficiency,* (2013(6); Eric Hitting, Kimberly A. Mullins and Ines L. Azevedo, "Electricity Consumption and Energy Savings in the United States, Energy Efficiency, March31, 2012; Steven Lanzisera, Bruce Nordman, and Richard E. Brown, "Data Network Equipment Energy Use and Savings Potential in Buildings," *Energy Efficiency,* 2012 (5); Catherine Mercier and Laura Moorfield, *Commercial Office Plug Load Savings and Assessment: Final Report,* Ecova, July 2011; McKinsey Global Energy and Materials, *Unlocking Energy Efficiency in the U.S. Economy,* McKinsey and Company, 2009.

[17] Discount rates have long been a bone of contention in energy policy analysis. CFA views energy efficiency investments, particularly for electricity consuming durables, as very low risk since usage levels are stable and prices are not volatile. To the extent that consumers reduce their savings to acquire these devices and pay their bills, the opportunity cost is low, since the interest rates on low risk savings instruments is quite low. Under current market conditions, 3 percent, which is typically used as a low discount rate, may even be too high.

[18] Mark Cooper, *Energy Efficiency Performance Standards*, 2013.