THE GEORGE WASHINGTON UNIVERSITY

WASHINGTON, DC

Working Paper[1]

September 2, 2015

Whose Benefits Are They, Anyway?

Examining the Benefits of Energy Efficiency Rules 2007 - 2014

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Abstract

The Energy Policy and Conservation Act authorizes the Department of Energy (DOE) to establish energy efficiency standards for consumer appliances that are both technologically feasible and economically justified, while also resulting in a "significant conservation of energy." To justify its regulations, DOE relies almost entirely on two specific types of regulatory benefits: the cost savings consumers are estimated to enjoy over the life of a more energy efficient appliance, and international benefits associated with reducing the impacts of climate change. To explore these benefits, this paper first examines the composition of benefits from energy efficiency regulations as reported by the Department of Energy over the past 10 years. It then examines arguments for and against inclusion of these benefits in regulatory impact analysis, including whether attributing large private benefits to energy efficiency rules is consistent with standard economic assumptions of consumer sovereignty, and the appropriateness of including international benefits in domestic rulemakings.

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Introduction

In the past decade, government agencies have greatly increased the number of regulations establishing energy efficiency standards for household and commercial appliances. For example, in 2014, federal regulations setting energy efficiency standards accounted for $7.65 billion in annualized regulatory benefits.[3]

Because these regulations target common household appliances, they affect nearly all households. The Department of Energy (DOE) has recently finalized energy conservation standards for residential dishwashers,[4] microwaves,[5] clothes washers,[6] furnaces, and air conditioners,[7] appliances that most households rely on for everyday tasks. Each of these regulations increases the price of appliances in return for reducing long-term energy usage and energy bills.

Due to the scope of these rules, it is important to examine the rationale that regulators use to justify them. In the past decade especially, federal regulators have cited behavioral economics and "consumer irrationality" to justify standards that limit the amount of electricity and water that appliances can use. Because they comprise such a large proportion of overall regulatory benefits—and because they affect all households—these rules, and their justification, merit a closer look.

First, this paper examines the statutory authority underpinning DOE energy efficiency standards, and the market failures that these rules purportedly address. Second, it assesses the composition of the benefits that DOE claims result from its rules finalized between 2007 and 2014, and explains the ramifications of including private benefits and benefits to citizens of other countries in a traditional benefit-cost analysis. Third, it concludes with recommendations to policymakers who promote energy efficiency standards and analysts who seek to understand the role of consumer choice in constructing policies to reduce energy use.

[3] Author calculation based on annualized benefit numbers reported in DOE final rules. Numbers are reported in 2010$. See *Appendix B* for detailed benefit information on final rules, and see *Appendix C* for annual benefit information on included rules.

[4] 77 FR 31917

[5] 78 FR 36315

[6] 77 FR 32307

[7] 76 FR 37407

Statutory Authority

The Energy Policy and Conservation Act of 1975 (EPCA) authorizes DOE to establish energy conservation standards for consumer appliances that are both technologically feasible and economically justified, while also resulting in a "significant conservation of energy."[8] EPCA requires DOE to establish energy and water efficiency standards for twenty different categories of covered consumer products, including refrigerators, freezers, furnaces, dishwashers, clothes dryers, televisions, faucets, and lamps.[9]

In addition to this wide range of explicitly covered appliances, EPCA also gives DOE the authority to establish energy conservation standards for "[a]ny other type of consumer product which the Secretary classifies as a covered product under subsection (b)."[10] This subsection of the Act allows the Secretary broad discretion in classifying consumer products as a "covered product" if he or she determines that:

> (A) classifying products of such type as covered products is necessary or appropriate to carry out the purposes of this Act, and
>
> (B) average annual per-household energy use by products of such type is likely to exceed 100 kilowatt-hours (or its Btu equivalent) per year.[11]

Since energy use is a function of water use in many appliances (e.g., clothes or dish washers), the statute gives the Department authority to regulate energy and water usage of a wide swath of products used every day in nearly every American household.

The EPCA also delegates authority to DOE to establish energy conservation standards for twelve classes of commercial appliances, including commercial ice machines, air conditioners, heating equipment, walk-in coolers and freezers, and commercial clothes washers.[12] Beyond these explicitly covered products, DOE also has authority to regulate "[a]ny other type of industrial equipment which the Secretary classifies as covered equipment under section 341(b)."

The number of energy efficiency standards promulgated by the federal government has increased rapidly since passage of the Energy Independence and Security Act of 2007 (EISA), which amended the EPCA to increase Corporate Average Fuel Economy (CAFE) standards and

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[8] 42 U.S.C. 6295(o)(3)(B) and 6313(d)(4) (http://www.gpo.gov/fdsys/pkg/USCODE-2013-title42/html/USCODE-2013-title42-chap77-subchapIII-partA-sec6295.htm)

[9] Energy Policy and Conservation Act, as amended, §322 (http://legcounsel.house.gov/Comps/EPCA.pdf)

[10] Energy Policy and Conservation Act, as amended, §322(a) (http://legcounsel.house.gov/Comps/EPCA.pdf)

[11] Energy Policy and Conservation Act, as amended, §322(b) (http://legcounsel.house.gov/Comps/EPCA.pdf)

[12] Energy Policy and Conservation Act, as amended, §340 (http://legcounsel.house.gov/Comps/EPCA.pdf)

efficiency standards for energy-using durables. Figure 1 below shows the number of significant energy efficiency rules finalized by DOE from 1987 – 2014.

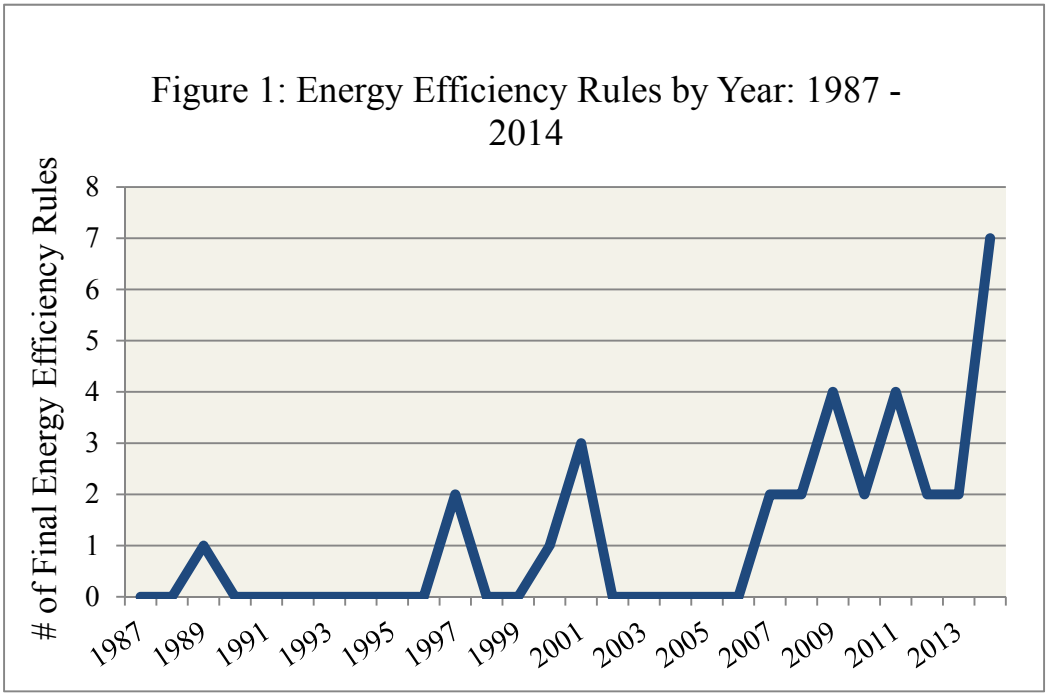

Figure 1 displays counts of energy efficiency rules finalized by the Department of Energy each year between 1987 and 2014. This figure measures only significant rules reviewed by the Office of Information and Regulatory Affairs.

Source: Mannix & Dudley, "The Limits of Irrationality as the Rationale for Regulation." *Journal of Policy Analysis and Management*, Summer 2015.

The semiannual Unified Agenda, published by the Office of Management and Budget (OMB), lists ongoing and upcoming regulations planned by agencies for the year ahead. The Spring 2015 Unified Agenda listed four energy efficiency standards from DOE in the prerule stage, twenty-one standards in the proposed rule stage, and ten in the final rule stage,[13] indicating that federal regulators do not plan to slow the promulgation of energy efficiency rules any time soon.

Market Failure

In 1993, President Clinton signed Executive Order 12866, which laid out the principles of regulation that underpin the current American regulatory system. These principles have been upheld by every president since, and were recently reinforced by President Obama's Executive

[13] These counts do not include test procedures for energy efficiency which, while integral to the promulgation of energy efficiency rules, do not in themselves establish energy conservation standards.

Order 13563. When regulating energy efficiency, DOE is required by Section 1(a) of Executive Order 12866 to identify the problem that it is attempting to solve with its regulation:

> Federal agencies should promulgate only such regulations as are required by law, are necessary to interpret the law, or are made necessary by compelling public need, such as material failures of private markets to protect or improve the health and safety of the public, the environment, or the well-being of the American people.[14]

The language of EO 12866 clearly indicates that an agency should not promulgate a regulation that is not made necessary by a failure of private markets or other compelling public need unless it is statutorily required. DOE is required by statute to issue energy efficiency standards for many residential and commercial appliances. As directed by EO 12866, in a recent rule DOE identified several problems that its efficiency rules are intended to address:

> The problems these proposed standards address are as follows:
>
> (1) There is a lack of consumer information and/or information processing capability about energy efficiency opportunities in the home appliance market.
>
> (2) There is asymmetric information (one party to a transaction has more and better information than the other) and/or high transactions costs (costs of gathering information and effecting exchanges of goods and services).
>
> (3) There are external benefits resulting from improved energy efficiency of residential furnace fans that are not captured by the users of such equipment. These benefits include externalities related to environmental protection and energy security that are not reflected in energy prices, such as reduced emissions of greenhouse gases.[15]

The types of market failure that typically are used to justify government intervention fall into one of the following categories: externalities, monopoly power, and asymmetric information. DOE's claim is that two types of market failure could potentially be addressed by setting energy efficiency standards for commercial and residential equipment.

First, energy used to power appliances results in some greenhouse gas emissions. Because the social cost of greenhouse gas emissions may not be fully represented in the price of energy, these emissions are externalities which regulatory policies could address. By this reasoning, as DOE notes in its third point above, increasing energy efficiency creates external benefits that are not otherwise internalized by consumers or businesses.

[14] Exec. Order No. 12866, Regulatory Planning and Review, §1(a).
[15] 78 FR 64132

However, DOE's energy efficiency standards do not ultimately address this market failure. As examined later in this paper, the environmental benefits of these rules are so small relative to the private benefits, and relative to the upfront costs, that reduced externalities alone do not justify the standards. While reducing carbon emissions may be a worthwhile goal for regulation, these rules only tangentially reduce carbon emissions, and primarily focus on reduced energy expenditures by consumers[16] and businesses.

Second, DOE argues that consumers and businesses are currently choosing appliances with higher long-term energy costs than other available appliances, which may indicate that they do not have sufficient information about the energy cost savings that higher-efficiency products make possible. DOE presumes that these choices result from an information asymmetry in which consumers and businesses do not have the relevant information to purchase the appliances that suit their needs. This asymmetric information, if it exists, could be remedied by improved labeling or other types of consumer education campaigns.

However, these rules do not address information asymmetry in the marketplace by promoting labeling requirements or other standards that could improve the quality of information available to consumers, even though EPCA grants the Department broad authority to require labeling of energy-using products:

> (6) AUTHORITY TO INCLUDE ADDITIONAL PRODUCT CATEGORIES.—The Commission may, by regulation, require labeling or other disclosures in accordance with this subsection for any consumer product not specified in this subsection or section 322 if the Commission determines that labeling for the product is likely to assist consumers in making purchasing decisions.[17]

Despite this authority, and the relatively low cost of implementing labeling requirements, DOE does not rely heavily on labeling or other disclosures that would communicate potential energy savings to consumers. Instead, these rules ban products from the marketplace, which restricts choice rather than improving information.

While it does not fall into the category of a traditional market failure, the Department also intends for its rules to address consumers' lack of "information processing capability," as DOE notes in the rule text cited above. It is clear from the text of DOE's rules that the Department believes consumers are not adequately equipped to trade off upfront price increases against long-term energy savings. Overcoming this presumed consumer cognitive failure is the primary focus

[16] Miller, Sofie E. 2015. "One Discount Rate Fits All? The Regressive Effects of DOE's Energy Efficiency Rule." *Policy Perspectives* 22:40-54. http://www.policy-perspectives.org/article/view/15110/pdf_21

[17] Energy Policy and Conservation Act, as amended, §324 (http://legcounsel.house.gov/Comps/EPCA.pdf)

of DOE's energy conservation standards, rather than reducing information asymmetry or pollution externalities. By doing so, these rules primarily create "private benefits" to consumers and businesses, rather than public benefits to society at large from reducing externalities or information asymmetries.

The following sections explore how the Department justifies its energy efficiency standards, the massive regulatory benefits that DOE calculates as a result, and the assumptions on which those regulatory benefits are based. We find that the assumptions that DOE uses to formulate its analyses are not representative of the real-world tradeoffs faced by consumers, and modeling techniques that better represent consumer preferences and tradeoffs instead suggest consumers will bear large net costs.

Benefit Composition

DOE relies on two types of regulatory benefits to justify its regulations: private benefits to consumers from reduced energy expenditures, and the international benefit of reductions in emissions of CO_2. Each of these benefit types is explained in the sections below.

Private Benefits

Private benefits constitute the vast majority of benefits used to justify new energy efficiency rules for commercial and residential appliances. These "private" benefits are the cost savings consumers are estimated to enjoy over the life of a more energy efficient appliance. Because this cost saving is a benefit felt exclusively by the private consumer or business, rather than society at large, the benefits that justify DOE's energy efficiency rules are "private benefits" rather than public benefits. This is in contrast to the language of EO 12866, which instructs regulators to promulgate only such rules as are made necessary by "compelling *public* need."

This also differentiates these rules from the majority of federal regulations, which have historically relied on public benefits—such as reduced externalities—for justification. However, our analysis below finds that the private benefits of DOE's efficiency rules dwarf the anticipated public benefits, such that most of these rules would not pass a benefit-cost test if relying on externality benefits alone.

In many cases, consumers already had the option to purchase more efficient, higher-priced appliances prior to regulation, indicating that a lack of energy efficient appliances available in the market is not the impetus for these standards. However, regulators draw on the behavioral economics literature to argue that consumers fail to purchase these high-efficiency appliances due to inadequate information processing capability. In doing so, regulators overlook the

possibility that consumers may have legitimate preferences for less-efficient appliances based on household characteristics or other observable product qualities (such as size, durability, reliability, or noise level).[18] By regulating away the option for consumers to purchase less-efficient appliances, DOE is ostensibly improving consumers' choice structure by removing choices.[19]

Social Cost of Carbon

As recently as 2009, DOE did not factor the benefits of reduced carbon emissions into a complete analysis of its rules. In 2007 and 2008, DOE provided estimates of how many million metric tons of carbon dioxide (CO_2) emissions would be avoided by its rules, but the agency did not monetize these reductions. Beginning in 2009, the Department started providing a range of quantified environmental benefits for CO_2. However, it did not incorporate this range—or a midpoint—into its total benefit estimate. As DOE explains:

> DOE has chosen to continue to report these benefits separately from the net benefits of energy savings. Nothing in EPCA or in the National Environmental Policy Act (NEPA) requires that the economic value of emissions reduction be incorporated in the net present value analysis of energy savings. Unlike energy savings, the economic value of emissions reduction is not priced in the marketplace. However, DOE will consider both values when weighing the benefits and burdens of standards.[20]

In the rule cited above, which was finalized in January of 2009, DOE used $0/ton as a low-end estimate of the benefit of reducing carbon emissions, and $20/ton as a high-end value. Later in 2009, DOE formalized this process by using a social cost of carbon (SCC) to value the CO_2 emissions reductions from its efficiency standards. In a 2011 rule, DOE used an SCC value of $22.1/ton of CO2, using a 3 percent discount rate.[21] In a 2013 final rule, DOE unveiled for the first time an SCC value of $41.4/ton.[22, 23]

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[18] Dudley, Susan E. "Addendum to Public Interest Comment on the Department of Energy's Proposed Clothes Washer Efficiency Standards." Docket No. EE-RM-94-403. http://mercatus.org/sites/default/files/publication/Clothes_Washer_Standards.pdf

[19] See, for example, Hunt Allcott and Cass Sunstein. "Regulating Internalities." *Journal of Policy Analysis and Management*, Vol. 34 Issue 3 698-705.

[20] 74 FR 1114

[21] 76 FR 37413

[22] 78 FR 36315

[23] For additional information, read our comment on DOE's final rule: Dudley, Susan E., Sofie E. Miller, & Brian F. Mannix. "Public Interest Comment on Reconsideration of the Department of Energy's Final Rule: Energy Conservation Standards for Standby Mode and Off Mode for Microwave Ovens." Filed September 6, 2013.

Importantly, the social cost of carbon is calculated using the global value of reducing domestic emissions. While the costs of the standards will be borne by the American consumers and businesses that are directly affected by the rule, the reduction in carbon emissions resulting from DOE's rules is monetized based on its global, rather than domestic, value. That is, the Department weighs not only domestic but international benefits from its rules against entirely domestic costs, which swings the analysis in favor of stricter efficiency standards. Using a global perspective to calculate the benefits of reducing carbon emissions represents a dramatic shift in domestic policy, and there are many attendant problems to be considered with this methodology.[24]

Methodology

Identifying the Rules

To calculate the total benefit DOE attributes to its energy efficiency rules, we first identified final DOE regulations issued between 2004 and 2014 using the Federal Register. To identify rules that establish energy efficiency standards, we searched for "energy conservation program," the program under which DOE promulgates efficiency rules pursuant to the EPCA and EISA. Of the search results, we included in our database those rules that clearly established minimum energy efficiency standards for residential or commercial appliances. While they are also important components of the energy conservation program, rules establishing certification requirements or test procedures for appliance efficiency were not included in this examination because they do not set minimum standards for energy efficiency.

Originally, this search returned 40 energy efficiency standards promulgated by DOE. However, 15 of these final rules did not include sufficient information on benefits and costs for the purposes of this analysis, so they were excluded from consideration. Notably, most of these rules were finalized between 2004 and 2007. Because none of the final rules issued prior to 2007 included information on benefits and costs, the earliest rules examined in this analysis were finalized in 2007. While this research project was originally intended to span a decade of energy efficiency standards, these data limitations constrain this analysis to the seven years between 2007 and 2014. The rules that were excluded from this analysis are listed in Appendix D, and the rules that were included in this analysis are listed in Appendix A.

Docket I.D. EERE-BT-PET-0043. http://regulatorystudies.columbian.gwu.edu/sites/regulatorystudies.columbian.gwu.edu/files/downloads/GW_RSC_DOE-EERE-BT-PET-0043.pdf

[24] Ted Gayer & W. Kip Viscusi. "Determining the Proper Scope of Climate Change Benefits." *Working Paper, the George Washington University Regulatory Studies Center*. June 3, 2014.

Counting Costs and Benefits

For each of the included rules, we recorded regulation identification number (RIN), rule title, date of publication, total benefits, total costs, private benefits, benefits from the reduction of CO_2 emissions, and the dollar years in which these data were reported. These raw data are listed in Appendix A of this paper. In each regulation examined, the costs and benefits (and the composition of those benefits) were found in the preamble of the final rule text. After tallying all relevant benefit and cost information from the selected rules, we converted all values to 2010 dollars using the Bureau of Labor Statistics' Consumer Price Index to sum the benefit and cost values. These converted dollar values are listed in Appendix B of this paper.

Due to changes over time in how agencies present their estimated costs and benefits, we use annualized costs and benefits to measure the cumulative effects of these rules. This approach has the strength of consistency over time, as each of the DOE rules examined provided annualized cost and benefit information. One weakness of this approach is that it does not convey the total costs and benefits of DOE's energy efficiency standards, but instead provides an annualized snapshot. However, this approach has the strength of data consistency, and in our judgment is the most reliable way to approach this analysis.

Costs and benefits are reported for two groups of rules. First, we report costs and benefits for all rules issued between 2007 and 2014. Second, we report costs and benefits for all rules issued after August 2009, when the DOE first began using SCC values to calculate regulatory benefits. Because the value of carbon reductions was not consistently monetized in regulatory analyses until August 31, 2009, reporting the cumulative benefit compositions for all rules between 2007 and 2014 slightly under-represents the extent of the rules' environmental impact. To address this concern, we assess the total benefit composition in addition to benefit compositions both pre- and post-policy change.

International Benefits

For some rules,[25] DOE reports both the domestic and international benefits from reducing carbon emissions. In these cases, the domestic benefits expected to result are about 7 – 23% of the worldwide values DOE emphasizes in its proposal. This is because, relying on an integrated assessment model (the FUND model), DOE would expect the direct benefit to the U.S. to be between 7 and 10% of the global benefit of CO_2 reductions. The 23% value is derived assuming

[25] The Department of Energy's Proposed Rule: *Energy Conservation Program: Energy Conservation Standards for Small, Large, and Very Large Air-Cooled Commercial Package Air Conditioning and Heating Equipment*. Proposed Sept. 30, 2014.79 FR 58947.

that benefits to the U.S. are proportional to the domestic share of global GDP, resulting in an overall 7 – 23% range.[26]

For this analysis, we rely on the total worldwide benefits reported in each of DOE's final rule preambles. We used the upper boundary of the FUND model estimates to calculate 10% of the total CO_2 benefits as accruing to the U.S., while the remaining 90% of CO_2 benefits accrue to other nations.

Findings

Benefits and Costs

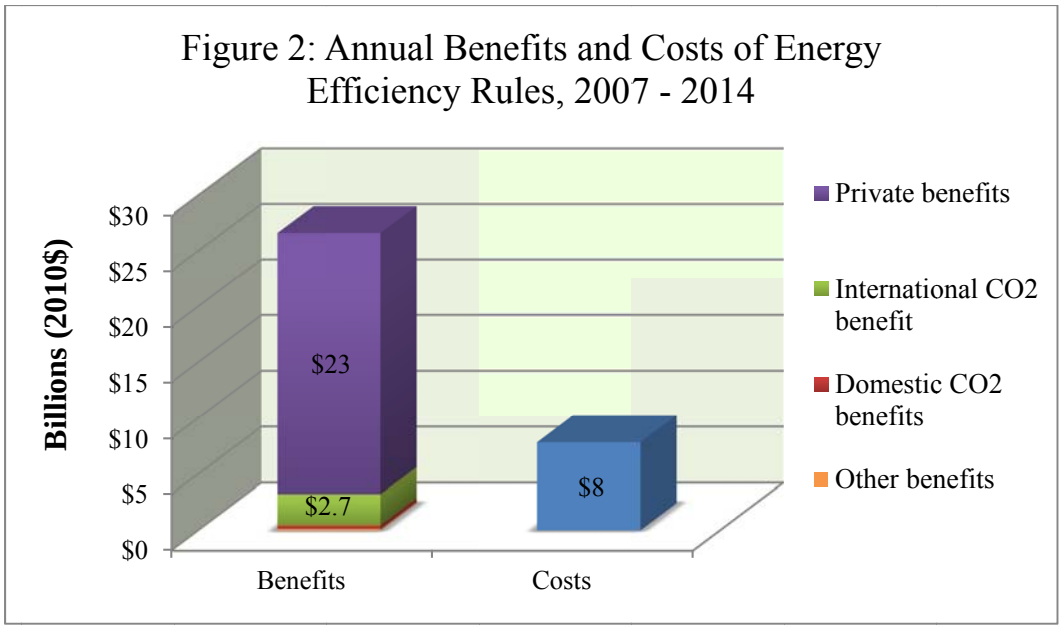
We find that according to DOE estimates, efficiency standards issued between 2007 and 2014 will result in $26.63 billion in annual benefits. $23.4 billion of these benefits are private benefits, and the remaining $3.2 billion are public benefits. The table below lists the composition of benefits DOE reports from its final efficiency rules.

Annual Benefit Composition 2007 – 2014 (2010$)	
Private benefits	$23,420,000,000
Other benefit	$147,860,000
International CO2 benefits	$2,751,000,000
Domestic CO2 benefits	$305,660,000
Total benefits*	**$26,625,700,000**

**Due to rounding, summing the individual benefits above does not add up to the total benefits. To see totals before rounding, visit Appendix B.*

For ease of comparison, these data are also presented in the figure below, and are displayed in contrast to the annualized costs of these rules.

[26] United States Government. Interagency Working Group on Social Cost of Carbon. *Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866*. http://www.epa.gov/OMS/climate/regulations/scc-tsd.pdf

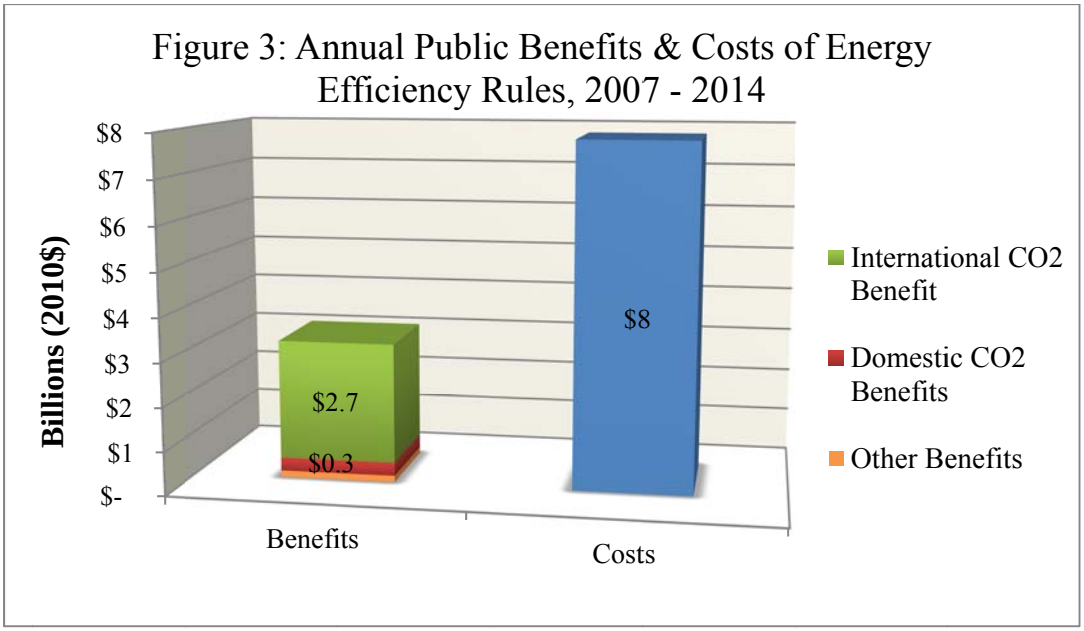


As is clear in the above chart, the reported benefits of these rules greatly outweigh the reported costs. Based on DOE's analyses, consumers can expect $18.8 billion in annual net benefits from efficiency standards. Also based on DOE's analyses, the vast majority of these benefits are private benefits enjoyed by appliance users rather than public benefits to health or the environment.

For the purpose of illustration, the following chart shows how the *public* benefits of DOE's efficiency rules compare to costs. Without the $23 billion in private benefits, the costs of these standards outweigh the public benefits by $4.6 billion (2010$) annually, indicating that these rules are not "made necessary by compelling public need" as directed by Executive Order 12866, nor are they "economically justified" as specified in the Act. Instead, the rules serve primarily to address what DOE might term a private need.

The next largest category of regulatory benefits is international benefits from CO_2 reductions, which provide $2.75 billion in annual benefits. If we limit standing to residents of the U.S., the costs of these standards outweighs the public benefits by $7.38 billion annually.[27]

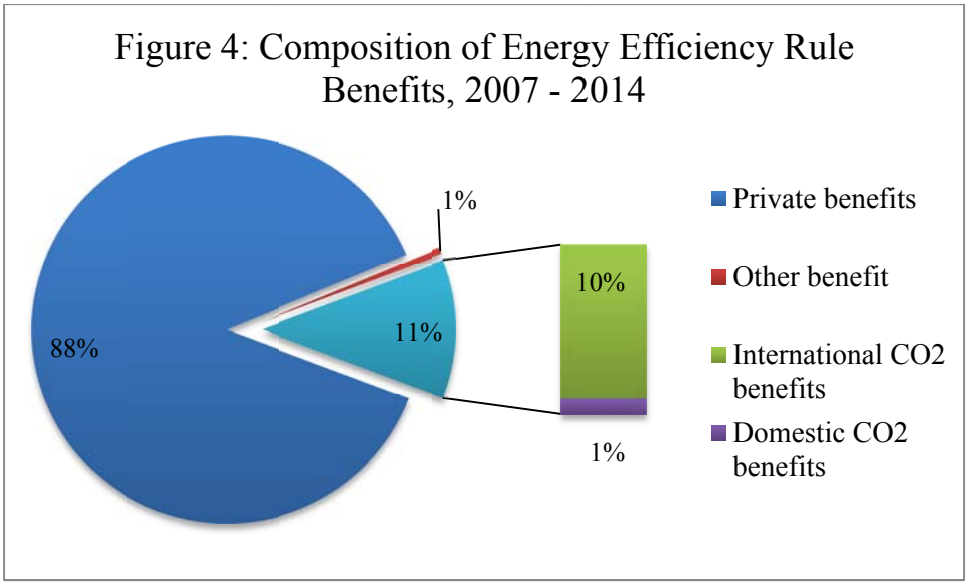
[27] Domestic benefits are estimated to be 10% of the international benefits reported. See the *Methodology* section of this paper for more information on how these values were calculated.



These analyses are highly sensitive to the scope and prevalence of the private benefits—and, to a lesser extent, international benefits—that DOE chooses to include in its analyses. Because of the outsized role of these benefits, careful attention should be paid to the economic theory underpinning them.

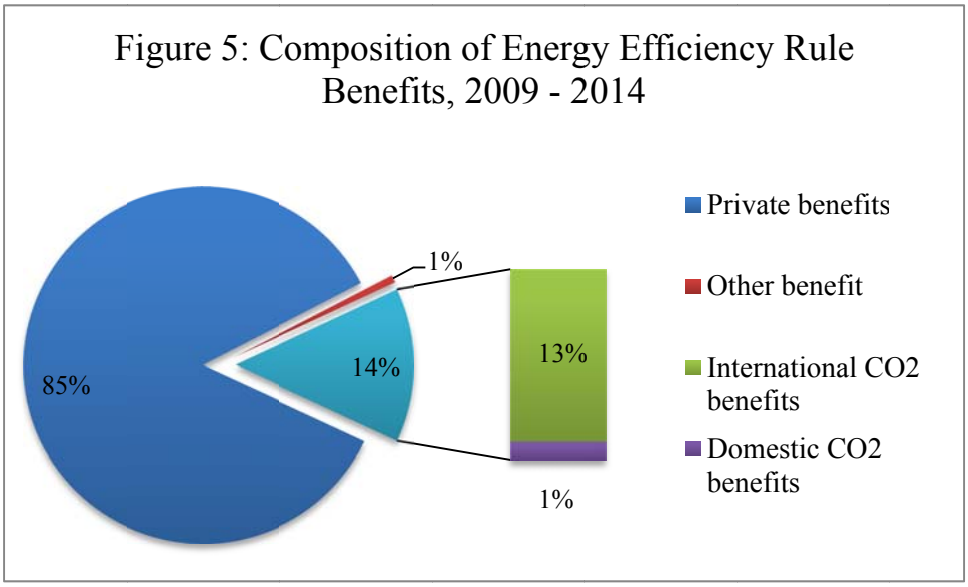
2007 – 2014

The below chart displays in percentage terms the composition of regulatory benefits from all DOE efficiency standards included in this analysis. Private benefits are the largest portion, comprising 88% of all regulatory benefits. Benefits from reducing CO_2 emissions are the next largest portion, at 11% of total benefits. However, as can be noted in the chart, 90% of these CO_2 benefits are benefits to residents of other countries.



2009 – 2014

DOE did not include monetized benefits of carbon reduction in its rules until August 2009. To reflect this different treatment the below chart examines the composition of regulatory benefits for rules issued after August 2009.



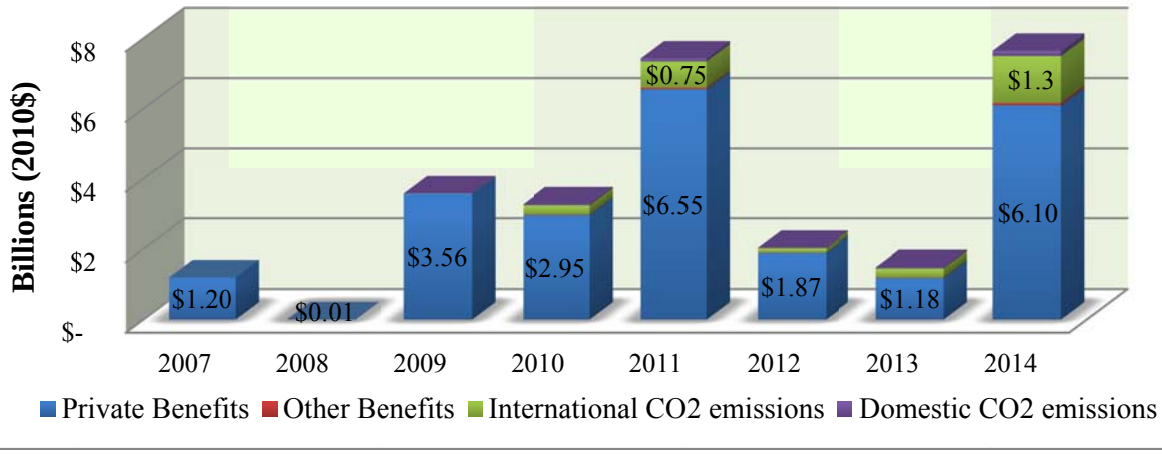
As can be seen above, the outsized role of private benefits in DOE's efficiency standards during the 2007 – 2014 time period is not primarily due to the omission of SCC benefits in early rulemakings. Even after DOE began to monetize the value of reducing carbon and NO_x emissions, private benefits still constituted the vast majority—85 percent—of the benefits of

energy efficiency standards. However, the benefit composition was still somewhat affected. Narrowing the scope of this analysis to only rules that include environmental benefits decreases the concentration of private benefits by three percentage points, from 88 percent to 85 percent of total benefits.

Annual Data

One way to view changes over time in regulatory benefits is through totaling the benefits of all efficiency rules issued per year. The below chart shows annual snapshots of DOE's estimated regulatory benefits for rules issued in each year from 2007 to 2014. The year with the lowest total benefits from energy efficiency rules was 2008, with only $6.8 million in annualized benefits (100% of which were private benefits). 2014 was the year with the highest total at $7.65 billion in annualized benefits, 79.7% of which—$6.1 billion—were private benefits. However, the year with the highest private benefit tally was 2011, with $6.55 billion in annualized private benefits (88.2% of total annualized benefits).

Figure 6: Annual Benefit Composition, 2007 - 2014



Further detail on the costs and benefits of regulations issued by year can be found in Appendix C.

Over time, the share of both international and domestic benefits from CO_2 reductions has increased consistently, rising from 0% of total benefits in 2007 and 2008 to 19% in 2014. These fluctuations generally match increases in value assigned to the SCC, although other factors are at play as well. For instance, there is also significant fluctuation in the share of private benefits, not only year to year but from rulemaking to rulemaking.

Of those rules issued post-SCC, the rule with the highest composition of private benefits is an efficiency standard for residential dishwashers published in May 2012, in which private benefits accounted for 94% of total benefits.[28] The rule with the lowest composition of private benefits was a standard for metal halide lamps published in February 2014, with only 69% of total benefits made up by private benefits.[29] For more information on the benefit composition of individual efficiency rules, turn to Appendix B.

Do Private Benefits Belong in Analyses of Energy Efficiency Rules?

Standard economic analysis of regulations relies on the concept of consumer sovereignty, and traditionally treats market participants as if they are rational actors. This allows regulators to measure potential consumer and producer surplus and infer the social value of regulatory policies. However, the private benefits we examine in this paper are a departure from the norms that have traditionally governed benefit-cost analysis.

By eliminating the option to purchase low efficiency appliances, DOE believes that its energy conservation standards create significant private benefits. But this claim is difficult to reconcile with the standard economic definition of regulatory benefits: the surplus "willingness to pay" remaining after the regulation's winners fully compensate all of the losers. As Mannix and Dudley ask in a recent article:

> How much is the average consumer willing to pay in order to be prohibited from buying, for example, an incandescent light bulb? After all, prior to the regulation, not buying the incandescent bulb is free. Why would anyone pay to have that choice imposed on them?[30]

If it were true that consumers are willing to pay to have their options restricted it would mean that, absent choice-constricting regulation, consumers are missing out on billions of dollars of benefits annually. As Gayer and Viscusi note in a recent paper:

> How can it be that consumers are leaving billions of potential economic gains on the table by not buying the most energy-efficient cars, clothes dryers, air conditioners, and light bulbs? . . . If the savings are this great, why is it that a very

[28] Energy Conservation Program: Energy Conservation Standards for Residential Dishwashers. Direct Final Rule published May 30, 2012. 77 FR 31917.

[29] Energy Conservation Program: Energy Conservation Standards for Metal Halide Lamp Fixtures. Final Rule published February 10, 2014. 79 FR 7745.

[30] Mannix, Brian F., and Susan E. Dudley. 2015. "The Limits of Irrationality as a Rationale for Regulation." *Journal of Policy Analysis and Management* Vol. 34, No. 3, page 707.

> basic informational approach cannot remedy this seemingly stunning example of completely irrational behavior? It should be quite simple to rectify decisions that are this flawed. Rather than accept the implications that consumers and firms are acting so starkly against their economic interest, a more plausible explanation is that there is something incorrect in the assumptions being made in the regulatory impact analyses.[31]

Revealed Preference

Because consumers are faced with a tradeoff between upfront costs and long-term savings when they purchase energy-using durables, these purchases provide a direct example of how consumers and businesses value present versus future consumption. Instead of taking these revealed preferences as indications of legitimate preferences, DOE argues that they reveal behavioral biases that could be resolved through regulation. In a recent final rule, DOE notes that:

> the economics literature provides a wide-ranging discussion of how consumers trade off upfront costs and energy savings in the absence of government intervention. Much of this literature attempts to explain why consumers appear to undervalue energy efficiency improvements. There is evidence that consumers undervalue future energy savings as a result of: (1) A lack of information; (2) a lack of sufficient salience of the long-term or aggregate benefits; (3) a lack of sufficient savings to warrant delaying or altering purchases; (4) excessive focus on the short term, in the form of inconsistent weighting of future energy cost savings relative to available returns on other investments; (5) computational or other difficulties associated with the evaluation of relevant tradeoffs; and (6) a divergence in incentives (for example, renter versus owner or builder versus purchaser). Other literature indicates that with less than perfect foresight and a high degree of uncertainty about the future, consumers may trade off at a higher than expected rate between current consumption and uncertain future energy cost savings. This undervaluation suggests that regulation that promotes energy efficiency can produce significant net private gains (as well as producing social gains by, for example, reducing pollution).[32]

[31] Gayer, Ted, and Kip Viscusi. 2013 "Overriding consumer preferences with energy regulations." *Journal of Regulatory Economics* 43:248–264.

[32] 79 FR 38198

DOE presumes that its own valuation for energy efficiency is the correct one, and that consumers should make product choices based on energy savings as DOE projects and values them. The fact that consumers do not currently choose to buy efficient appliances, instead of revealing consumers' preferences for other product attributes, reveals to the Department only that consumers must "undervalue" efficiency.

Limiting Choice

In many cases, DOE's regulations do not provide consumers with new choices. Often, products meeting DOE's efficiency standards are already available in the market. As DOE states:

> DOE has concluded that the standards in this rule represent the maximum improvement in energy efficiency that is technologically feasible and economically justified, and would result in the significant conservation of energy. DOE further notes that products achieving these standard levels are already commercially available for all of the product classes covered by today's proposal.[33]

Instead of increasing product options, the efficiency standards examined in this paper typically reduce the types of products available by mandating an efficiency threshold. If, as the DOE frequently notes in its rules, appliances already meeting these efficiency standards are typically already being produced in the market, then consumers already have the option to invest in high-efficiency appliances. However, the fact that consumers choose not to purchase efficient appliances indicates that they do not value these attributes as much as the Department does.

Discounting Benefits

Because consumers receive the benefit of reduced energy or water bills over the entire estimated lifetimes of their appliances, DOE must discount these benefits to make them comparable with the upfront costs resulting from the standards. Benefits expected in the future are diminished in this calculation because people generally prefer present consumption to future consumption; that is, they have positive time preferences.[34] Discounting benefits and costs allows comparison between values occurring in different time periods by converting values to a common unit of

[33] 76 FR 37414

[34] Office of Management and Budget (OMB). 2003. "Circular A-4: Regulatory Analysis."

measurement.[35] In its analyses, DOE compares discounted benefits to discounted costs to calculate the net present value of its standards.

A very low discount rate implies that present consumption is not valued much more than future consumption, whereas a very high discount rate implies that future consumption has little value relative to present consumption. The appropriate rate by which to discount future benefits is not certain, and assuming a discount rate that is too high or too low can mischaracterize consumption preferences over time. This further complicates the calculation because a rule's total expected benefits can vary dramatically depending on the discount rate used to compare them to total expected costs. Using an inaccurate discount rate could jeopardize the economic justification of DOE's energy conservation standards.

Furthermore, consumer time preferences are far from homogenous, and can differ to such an extent that DOE's analyses may not reflect actual household effects. For example, a recent working paper from the National Bureau of Economic Research (NBER) finds that different consumer groups have vastly different discount rates for purchases of energy efficient appliances. Newell & Siikamäki find that race, education, and other household characteristics can significantly influence consumer discount rates. This is crucial because "the profitability of EE [energy efficient] investments depends fundamentally on the rate at which individuals discount future energy savings relative to the required upfront investment."[36]

In Circular A-4, the Office of Management and Budget (OMB) recommends that agencies use a default discount rates of 3 and 7 percent when measuring the benefits of public investments and regulations. While a 7 percent discount rate is appropriate because it approximates the opportunity cost of capital,[37] the 3 percent rate represents the "social rate of time preference." This discount rate approximates average saving rates using the real rate of return on long-term government debt, such as 10-year Treasury notes, and thus can act as a proxy of how consumers value future consumption against current consumption.

When benefits for DOE's efficiency rules are discounted at 3 and 7 percent, its rules result in large net private benefits for consumers. For example, using discount rates of 3 and 7 percent puts the annualized benefits of its recent furnace fans rule at $2.17 billion and $1.45 billion, respectively, a range of $720 million. This large range indicates that the discount rate used in

[35] Office of Management and Budget (OMB). 1992. "Circular A-94: Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs." Page 4.

[36] Newell, Richard G. & Juha V. Siikamäki. 2015. "Individual Time Preferences and Energy Efficiency." *National Bureau of Economic Research*. Working Paper 20969. http://www.nber.org/papers/w20969

[37] Office of Management and Budget (OMB). 2003. "Circular A-4: Regulatory Analysis." Page 33.

DOE's assessment is critically important in calculating the anticipated benefits of the regulation and in determining whether the regulation is economically justified, as required by the statute.[38]

OMB's guidance on discounting may be appropriate when evaluating government expenditures, where the typical practice is to "use a low, risk-free, discount rate because no single expenditure is likely to be more than a small part of the government's budget. But this is not true of automobiles and appliances purchased by consumers, who have budget constraints and an aversion to risks, and thus experience real costs that do not get captured by an artificially low discount rate."[39] Consumers' actual discount rates are not homogenous, either across the population or across purchase types, and more variation in DOE's assessed benefits can be seen when using actual consumer discount rates for home appliance purchases.[40]

Many studies of implicit consumer discount rates use the purchase of energy-using durables (such as air conditioners, dishwashers, and refrigerators) to measure consumer time preferences. This is because these appliances have upfront costs that customers can potentially offset with long-term energy savings, and consumers and businesses often have many available options with varying costs and levels of energy efficiency among which to choose.

Based on field studies in the literature, Frederick et al. find implicit discount rates of between 17 and 300 percent for energy-using durables.[41] The variance is so wide that DOE's use (and OMB's recommendation) of 3 and 7 percent seem unprepared to measure actual consumer benefits from energy efficiency standards. The advantage of using field studies to measure discount rates is that they examine actual marketplace behavior, and are therefore more applicable to consumer revealed preferences for energy-using durables.

This is in contrast to OMB's approach, which uses the real rate of return on long-term government debt, such as 10-year Treasury notes, to approximate consumer discount rates. While a 10 year Treasury note's interest rate is useful for analysis, it is not directly useful for understanding the tradeoffs that consumers make when purchasing durable energy-using goods. In their regression analysis, Newell & Siikamäki find that

[38] Miller, Sofie E. 2015. "One Discount Rate Fits All? The Regressive Effects of DOE's Energy Efficiency Rule." *Policy Perspectives* 22:40-54 http://www.policy-perspectives.org/article/view/15110

[39] Mannix, Brian F., and Susan E. Dudley. 2015. "The Limits of Irrationality as a Rationale for Regulation." *Journal of Policy Analysis and Management* Vol. 34, No. 3,

[40] Miller, Sofie E. 2015. "One Discount Rate Fits All? The Regressive Effects of DOE's Energy Efficiency Rule." *Policy Perspectives* 22:40-54 http://www.policy-perspectives.org/article/view/15110

[41] Frederick, Shane, George Loewenstein, and Ted O'Donoghue. 2002. "Time Discounting and Time Preference: A Critical Review." *Journal of Economic Literature* 40 (2):384

> individual discount rates exhibit considerable heterogeneity and systematically influence household willingness to pay (WTP) for EE [energy efficiency], as measured through product choices, required payback periods, and EE tax credit claims. The relationship is statistically significant, empirically robust, and not confounded by the characteristics of the homeowner, household, and their home.[42]

DOE tallies the benefits of its energy efficiency standards by treating consumers as a homogenous group, but this does not reflect reality. If consumers do not value the appliance attributes that DOE is mandating, these rules impose huge net costs on consumers rather than benefits. Using a low discount rate to set standards effectively forces consumers to accept a very low rate of return on their investments in appliances. Many consumers, for a variety of reasons, may be in a position to earn much higher returns on other investments – such as education, or even meals, for their children. Yet DOE ignores these opportunity costs and estimates large benefits from depriving consumers of those superior investments.

Do International Benefits Belong in Analyses of Energy Efficiency Rules?

Standard benefit-cost analysis considers the benefits that accrue to people in the jurisdiction where the costs of the policy are borne. [43] For domestic regulatory policy, this has largely meant that agencies have only considered the costs and benefits felt by U.S. residents when conducting regulatory impact analyses. In the case of DOE energy efficiency rules, this would limit DOE to considering benefits to U.S. residents who purchase higher-priced appliances—however, DOE is not relying on the principles of standards benefit-cost analysis in its rulemakings. As examined above, 90% of the benefits of CO_2 emissions reductions—and 10% of total regulatory benefits of these rules—accrue to residents of other countries.

The regulatory philosophy outlined in EO 12866 specifies that rules are made necessary by public need, and the public need in question is that of the "American people" rather than public needs of the world at large.

> Federal agencies should promulgate only such regulations as are required by law, are necessary to interpret the law, or are made necessary by compelling public need, *such as material failures of private markets to protect or improve the health*

[42] Newell, Richard G. & Juha V. Siikamäki. 2015. "Individual Time Preferences and Energy Efficiency." *National Bureau of Economic Research*. Working Paper 20969. http://www.nber.org/papers/w20969

[43] Ted Gayer & W. Kip Viscusi. "Determining the Proper Scope of Climate Change Benefits." *Working Paper, the George Washington University Regulatory Studies Center*. June 3, 2014. Page 3.

> *and safety of the public, the environment, or the well-being of the American people*.[44] (emphasis added)

Gayer and Viscusi note that Executive Order 12866 is focused on how the American regulatory system is meant to serve the American people.[45] However, this is not the only indication that agencies receive on who deserves "standing" in a benefit-cost analysis. The focus on costs and benefits to the American people has been outlined more explicitly than in EO 12866, specifically in the Office of Management and Budget's (OMB) Circular A-4, which provides the heads of executive branch agencies with important guidance on how to conduct regulatory analysis. This guidance is reformulated in OMB's Regulatory Impact Analysis Primer, which states:

> The analysis should focus on benefits and costs that accrue to citizens and residents of the United States. Where the agency chooses to evaluate a regulation that is likely to have effects beyond the borders of the United States, these effects should be reported separately.[46]

DOE's tendency to rely on worldwide benefits for CO_2 reduction violates the directive in OMB Circular A-4, reinforced in the Regulatory Impact Analysis Primer. However, DOE's reliance on benefits that accrue to foreign countries is a recent development.

Taking a Global Perspective

In its initial rulemakings incorporating a range of CO_2 benefit estimates, DOE stated the importance of using a domestic value of carbon. For example, the Department's 2009 final rule establishing efficiency standards for commercial freezer equipment emphasizes this approach:

> As DOE considers a monetary value for CO_2 emission reductions, the value should, if possible, be restricted to a representation of those costs and benefits likely to be experienced in the United States. DOE explained in the August 2008 NOPR that it expects such values would be lower than comparable global values; however, there currently are no consensus estimates for the U.S. benefits likely to result from CO_2 emission reductions. However, it is appropriate to use U.S. benefit values, where available, and not world benefit values, in its analysis.[47]

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[44] Exec. Order No. 12866, Regulatory Planning and Review, §1(a).

[45] Ted Gayer & W. Kip Viscusi. "Determining the Proper Scope of Climate Change Benefits." *Working Paper, the George Washington University Regulatory Studies Center*. June 3, 2014. Page 6.

[46] United States. Office of Management and Budget. Circular A-4, "Regulatory Impact Analysis: A Primer" (August 15, 2011) [Washington, D.C.]

[47] 74 FR 1132

Since finalizing this rule in 2009, DOE changed is stance toward incorporating international benefits into analysis of domestic regulatory policy. In its 2011 direct final rule prescribing efficiency standards for residential furnaces and air conditioners, DOE only listed global benefit totals in the preamble of the rule:

> At the time of the preparation of this notice, the most recent interagency estimates of the potential global benefits resulting from reduced CO_2 emissions in 2010, expressed in 2009$, were $4.9, $22.1, $36.3, and $67.1 per metric ton avoided. For emission reductions that occur in later years, these values grow in real terms over time. Additionally, the interagency group determined that a range of values from 7 percent to 23 percent should be used to adjust the global SCC to calculate domestic effects, *although preference is given to consideration of the global benefits of reducing CO_2 emissions*.[48] (emphasis added)

While the Department is able to calculate domestic benefits from the reduction of carbon emissions expected to result from this rule, it monetizes benefits based on the global value. The domestic benefits of carbon emissions were instead reported in chapter 16 of the Department's technical support document, rather than in the preamble to the rule itself.[49] This is opposite to OMB's guidance, which instructs agencies to report beyond-border effects separately.[50]

This change in approach requires some explanation, which DOE provided in a 2013 technical support document for its proposed commercial refrigeration standards:

> Because of the distinctive nature of the climate change problem, we center our current attention on a global measure of SCC. This approach is the same as that taken for the interim values, but it otherwise represents a departure from past practices, which tended to put greater emphasis on a domestic measure of SCC (limited to impacts of climate change experienced within U.S. borders). As a matter of law, consideration of both global and domestic values is generally permissible; the relevant statutory provisions are usually ambiguous and allow selection of either measure.[51]

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[48] 76 FR 37412

[49] Technical Support Document for the Proposed Rule, *Energy Conservation Program: Energy Conservation Standards for Residential Furnaces and Residential Central Air Conditioners and Heat Pumps*. Chapter 16: "Monetization of Emission Reduction Benefits."

[50] United States. Office of Management and Budget. Circular A-4, "Regulatory Impact Analysis: A Primer" (August 15, 2011) [Washington, D.C.]

[51] Technical Support Document for the Proposed Rule, *Energy Conservation Program: Energy Conservation Standards for Commercial Refrigeration Equipment*. Page 14A-11.

However, the question at hand is whether including global benefits is good policy, not whether it fits within an ambiguous statutory construction.[52] Gayer and Viscusi argue that limiting standing to the jurisdiction bearing the costs of regulation is more likely to generate optimal policy outcomes. They find that "there is an evident mismatch if the implementation of regulations is guided by global preferences whereas the laws governing regulatory policies are based on domestic preferences."[53]

While the costs of the DOEs standards are borne by the American consumers and businesses that are directly affected by the rule, the reduction in carbon emissions resulting from these rules is monetized based on its global, rather than domestic, value. That is, the Department weighs not only domestic but international benefits from this rule against entirely domestic costs, which swings the analysis in favor of stricter efficiency standards. With this in mind, it should be no surprise that "imposing a global perspective on benefits will increase the apparent desirability of the policy but will overstate the actual benefits to the American people."[54]

Conclusion

Agencies increasingly rely on private benefits and benefits to residents of other countries to justify regulations, despite their inconsistency with standard benefit-cost accounting. The Department of Energy routinely justifies regulations based almost entirely on the basis of these benefits, which, taken together, compose 98% of all benefits from the Department's energy efficiency standards.

As this analysis finds, private benefits comprise 88% of all regulatory benefits for energy efficiency regulations issued between 2007 and 2014. These benefits are the costs that DOE estimates consumers save long-term by purchasing more expensive, more energy efficient appliances than they otherwise would because the rule will reduce the number of options available in the market. However, these benefits are based on faulty assumptions about consumers and their preferences. If DOE's assumptions are incorrect, then consumers experience large net costs by having fewer available options that represent their diverse preferences.

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[52] Although, as Gayer & Viscusi note, statutes are not as ambiguous on this matter as agencies seem to suppose. "Determining the Proper Scope of Climate Change Benefits." *Working Paper, the George Washington University Regulatory Studies Center*. June 3, 2014. Pages 6-9.

[53] Ted Gayer & W. Kip Viscusi. "Determining the Proper Scope of Climate Change Benefits." *Working Paper, the George Washington University Regulatory Studies Center*. June 3, 2014. Page 9.

[54] Ted Gayer & W. Kip Viscusi. "Determining the Proper Scope of Climate Change Benefits." *Working Paper, the George Washington University Regulatory Studies Center*. June 3, 2014. Page 11.

Instead of increasing product options, the efficiency standards examined in this paper typically reduce the types of products available by mandating an efficiency threshold. If, as DOE frequently notes in its rules, appliances meeting these efficiency standards are typically already being produced, then consumers already have the option to invest in high-efficiency appliances. However, the fact that consumers choose not to purchase efficient appliances indicates that they do not value these attributes as much as the Department does. If consumers do not value the appliance attributes that DOE is mandating, these rules impose huge net costs on consumers rather than benefits.

Benefits from reducing CO_2 emissions comprise another 11% of total benefits from energy efficiency rules. However, DOE expects a full 90% of these CO_2 benefits will accrue to residents of other countries. Inclusion of these global benefits is inconsistent with traditional regulatory analysis for domestic policy decisions, and swings the Department's analysis in favor of stricter efficiency standards.

According to DOE estimates, efficiency standards issued between 2007 and 2014 will result in $26.63 billion in annual benefits. $23.4 billion of these benefits are private benefits, and the remaining $3.2 billion are public benefits. The reported benefits of these rules greatly outweigh the reported costs. Based on DOE's analyses, consumers can expect $18.8 billion in annual net benefits from efficiency standards. Also based on DOE's analyses, the vast majority of these benefits are private benefits enjoyed by appliance users rather than public benefits to health or the environment.

However, without the $23 billion in private benefits, the costs of these standards outweigh the public benefits by $4.6 billion (2010$) annually, indicating that these rules are not "made necessary by compelling public need" as directed by Executive Order 12866. Instead, the rules serve primarily to address consumers' and businesses' private "need" to have restricted product choice. These analyses are highly sensitive to the scope and prevalence of the private benefits—and, to a lesser extent, international benefits—that DOE chooses to include in its analyses. A different set of assumptions that rely on consumers' revealed preferences and more traditional domestic policy considerations indicates that these rules result instead in large net costs for consumers and businesses.

Appendix A

DOE Energy Efficiency Regulations and Cumulative Totals, 2007 – 2014								
RIN	Title	Date published	Benefits (annualized, 3% discount rate)	Costs (annualized, 3% discount rate)	Private benefits (annualized)	CO2 reduction benefits (annualized)	Dollar Year	Private benefit % of total
1904-AB08	Energy Conservation Program for Commercial Equipment: Distribution Transformers Energy Conservation Standards; Final Rule	10/12/2007	$904,000,000	$460,000,000	$904,000,000	238 million tons of CO2 avoided in 2010-2038	2006$	100%
1904-AA78	Energy Conservation Program for Consumer Products: Energy Conservation Standards for Residential Furnaces and Boilers	11/19/2007	$204,000,000	$40,000,000	$204,000,000	7.8 million tons of CO2 avoided in 2015-2038	2006$	100%
1904-AB44	Energy Conservation Program for Commercial and Industrial Equipment: Packaged Terminal Air Conditioner and Packaged Terminal Heat Pump Energy Conservation Standards	10/7/2008	$6,500,000	$4,100,000	$6,500,000	1.06 million tons of CO2 avoided in 2012-2042	2007$	100%
1904-AB59	Energy Conservation Program for Commercial and Industrial Equipment: Energy Conservation Standards for Commercial Ice-Cream Freezers; Self-Contained Commercial Refrigerators, Commercial Freezers, and Commercial Refrigerator-Freezers Without Doors; and Remote Condensing Commercial Refrigerators, Commercial Freezers, and Commercial Refrigerator-Freezers	1/9/2009	$253,000,000	$81,000,000	$253,000,000	$0 and $955 million (NPV 2012-2042)	2007$	100%
1904-AB49	Energy Conservation Program: Energy Conservation Standards for Certain Consumer Products (Dishwashers, Dehumidifiers, Microwave Ovens, and Electric and Gas Kitchen Ranges and Ovens) and for Certain Commercial and Industrial Equipment (Commercial Clothes Washers)	4/8/2009	$85,000,000	$28,000,000	$85,000,000	$0 to $241 million (NPV 2012-2042)	2006$	100%

1904-AA92	Energy Conservation Program: Energy Conservation Standards and Test Procedures for General Service Fluorescent Lamps and Incandescent Reflector Lamps	7/14/2009	$3,116,000,000	$531,000,000	$3,116,000,000	$7.6 to $20.6 billion (NPV 2012-2042)	2008$	100%
1904-AB58	Energy Conservation Program: Energy Conservation Standards for Refrigerated Bottled or Canned Beverage Vending Machines	8/31/2009	$59,400,000	$23,100,000	$49,100,000	$10,300,000	2008$; 2007$ used for SCC benefits	83%
1904-AB93	Energy Conservation Program: Energy Conservation Standards for Certain Consumer Products (Dishwashers, Dehumidifiers, Microwave Ovens, and Electric and Gas Kitchen Ranges and Ovens) and for Certain Commercial and Industrial Equipment (Commercial Clothes Washers)	1/8/2010	$79,000,000	$22,700,000	$72,800,000	$5,900,000	2008$	92%
1904-AB70	Energy Conservation Program: Energy Conservation Standards for Small Electric Motors	3/9/2010	$1,111,970,000	$263,700,000	$989,500,000	$115,600,000	2009$	89%
1904-AA90	Energy Conservation Program: Energy Conservation Standards for Residential Water Heaters, Direct Heating Equipment, and Pool Heaters	4/16/2010	$2,020,500,000	$1,249,300,000	$1,842,700,000	$168,600,000	2009$	91%
1904-AC06	Energy Conservation Program: Energy Conservation Standards for Residential Furnaces and Residential Central Air Conditioners and Heat Pumps[55]	6/27/2011	$1,747,850,000	$714,600,000	$1,566,800,000	$170,400,000	2009$	90%
1904-AA89	Energy Conservation Program: Energy Conservation Standards for Residential Clothes Dryers and Room Air Conditioners	8/24/2011	$442,200,000	$166,400,000	$395,300,000	$44,500,000	2009$	89%

[55] This rule includes two efficiency standards for appliances. Benefits and costs are calculated separately for the two standards, and were summed from tables I.3 and I.4 of the final rule for this analysis (76 FR 37413 – 76 FR 37414). Values from table I.4 were added to midpoint values from the ranges in table I.3.

1904-AB79	Energy Conservation Program: Energy Conservation Standards for Residential Refrigerators, Refrigerator-Freezers, and Freezers	9/15/2011	$3,703,000,000	$1,303,500,000	$3,160,000,000	$515,000,000	2009$	85%
1904-AB50	Energy Efficiency Standards for Fluorescent Lamp Ballasts	11/14/2011	$1,438,000,000	$385,000,000	$1,344,000,000	$92,000,000	2010$	93%
1904-AC64	Energy Conservation Program: Energy Conservation Standards for Residential Dishwashers	5/30/2012	$70,000,000	$44,000,000	$66,000,000	$3,900,000	2010$	94%
1904-AB90	Energy Conservation Standards for Residential Clothes Washers	5/31/2012	$1,958,000,000	$212,000,000	$1,808,000,000	$142,000,000	2010$	92%
1904-AC04	Energy Conservation Program: Energy Conservation Standards for Distribution Transformers	4/18/2013	$1,233,000,000	$282,000,000	$983,000,000	$237,000,000	2011$	80%
1904-AC07	Energy Conservation Program: Energy Conservation Standards for Standby Mode and Off Mode for Microwave Ovens	6/17/2013	$294,000,000	$66,400,000	$234,000,000	$58,400,000	2011$	80%
1904-AC00	Energy Conservation Program: Energy Conservation Standards for Metal Halide Lamp Fixtures	2/10/2014	$131,000,000	$40,000,000	$91,000,000	$38,000,000	2012$	69%
1904-AB57	Energy Conservation Program: Energy Conservation Standards for External Power Supplies	2/10/2014	$428,000,000	$162,000,000	$350,000,000	$77,000,000	2012$	82%
1904-AC19	Energy Conservation Program: Energy Conservation Standards for Commercial Refrigeration Equipment	3/28/2014	$1,152,000,000	$264,000,000	$900,000,000	$246,000,000	2012$	78%
1904-AC28	Energy Conservation Program: Energy Conservation Standards for Commercial and Industrial Electric Motors	5/29/2014	$2,696,000,000	$621,000,000	$2,048,000,000	$614,000,000	2013$	76%
1904-AB86	Energy Conservation Program: Energy Conservation Standards for Walk-In Coolers and Freezers	6/3/2014	$1,371,000,000	$528,000,000	$1,064,000,000	$287,000,000	2013$	78%
1904-AC22	Energy Conservation Program for Consumer Products: Energy Conservation Standards for Residential Furnace Fans	7/3/2014	$2,328,000,000	$355,000,000	$2,010,000,000	$312,000,000	2013$	86%
1904-AC77	Energy Conservation Program: Energy Conservation Standards for Commercial Clothes Washers	12/15/2014	$38,000,000	$30,000	$30,000,000	$7,000,000	2013$	79%

Total Benefit Composition	**$26,869,420,000**	**$7,846,830,000**	**$23,572,700,000**	**$3,144,600,000**	**87.73%**
	Total Benefits	Total Cost	Total Private Benefits	Total CO_2 Benefits	Private Benefits as % of Total

Appendix B

DOE Energy Efficiency Regulations and Cumulative Totals, 2007 – 2014 (2010$)							
RIN	Title	Date published	Benefits (annualized, 3% discount rate)	Costs (annualized, 3% discount rate)	Private benefits (annualized)	CO_2 reduction benefits (annualized)	Private benefit % of total
1904-AB08	Energy Conservation Program for Commercial Equipment: Distribution Transformers Energy Conservation Standards; Final Rule	10/12/2007	$977,790,790	$497,548,410	$977,790,790	238 million tons of CO_2 avoided in 2010-2038	100%
1904-AA78	Energy Conservation Program for Consumer Products: Energy Conservation Standards for Residential Furnaces and Boilers	11/19/2007	$220,651,900	$43,265,080	$220,651,900	7.8 million tons of CO_2 avoided in 2015-2038	100%
1904-AB44	Energy Conservation Program for Commercial and Industrial Equipment: Packaged Terminal Air Conditioner and Packaged Terminal Heat Pump Energy Conservation Standards	10/7/2008	$6,835,876	$4,311,860	$6,835,876	1.06 million tons of CO_2 avoided in 2012-2042	100%
1904-AB59	Energy Conservation Program for Commercial and Industrial Equipment: Energy Conservation Standards for Commercial Ice-Cream Freezers; Self-Contained Commercial Refrigerators, Commercial Freezers, and Commercial Refrigerator-Freezers Without Doors; and Remote Condensing Commercial Refrigerators, Commercial Freezers, and Commercial Refrigerator-Freezers	1/9/2009	$266,073,290	$85,185,520	$266,073,290	$0 and $1 billion (NPV 2012-2042)	100%

1904-AB49	Energy Conservation Program: Energy Conservation Standards for Certain Consumer Products (Dishwashers, Dehumidifiers, Microwave Ovens, and Electric and Gas Kitchen Ranges and Ovens) and for Certain Commercial and Industrial Equipment (Commercial Clothes Washers)	4/8/2009	$91,938,290	$30,285,560	$91,938,290	$0 to $261 million (NPV 2012-2042)	100%
1904-AA92	Energy Conservation Program: Energy Conservation Standards and Test Procedures for General Service Fluorescent Lamps and Incandescent Reflector Lamps	7/14/2009	$3,155,843,140	$537,789,700	$3,155,843,140	$7.7 to $20.9 billion (NPV 2012-2042)	100%
1904-AB58	Energy Conservation Program: Energy Conservation Standards for Refrigerated Bottled or Canned Beverage Vending Machines	8/31/2009	$60,159,530	$23,395,370	$49,727,820	$10,832,230	83%
1904-AB93	Energy Conservation Program: Energy Conservation Standards for Certain Consumer Products (Dishwashers, Dehumidifiers, Microwave Ovens, and Electric and Gas Kitchen Ranges and Ovens) and for Certain Commercial and Industrial Equipment (Commercial Clothes Washers)	1/8/2010	$80,010,140	$22,990,260	$73,730,870	$5,975,442	92%
1904-AB70	Energy Conservation Program: Energy Conservation Standards for Small Electric Motors	3/9/2010	$1,130,209,380	$268,025,410	$1,005,730,540	$117,496,160	89%
1904-AA90	Energy Conservation Program: Energy Conservation Standards for Residential Water Heaters, Direct Heating Equipment, and Pool Heaters	4/16/2010	$2,053,641,790	$1,269,791,970	$1,872,925,380	$171,365,510	91%
1904-AC06	Energy Conservation Program: Energy Conservation Standards for Residential Furnaces and Residential Central Air Conditioners and Heat Pumps[56]	6/27/2011	$1,776,519,570	$726,321,420	$1,592,499,850	$173,195,030	90%
1904-AA89	Energy Conservation Program: Energy Conservation Standards for Residential Clothes Dryers and Room Air Conditioners	8/24/2011	$449,453,300	$169,129,420	$401,784,010	$45,229,920	89%

[56] This rule includes two efficiency standards for appliances. Benefits and costs are calculated separately for the two standards, and were summed from tables I.3 and I.4 of the final rule for this analysis (76 FR 37413 – 76 FR 37414). Values from table I.4 were added to midpoint values from the ranges in table I.3.

1904-AB79	Energy Conservation Program: Energy Conservation Standards for Residential Refrigerators, Refrigerator-Freezers, and Freezers	9/15/2011	$3,763,739,440	$1,324,881,000	$3,211,832,740	$523,447,420	85%
1904-AB50	Energy Efficiency Standards for Fluorescent Lamp Ballasts	11/14/2011	$1,438,000,000	$385,000,000	$1,344,000,000	$92,000,000	93%
1904-AC64	Energy Conservation Program: Energy Conservation Standards for Residential Dishwashers	5/30/2012	$70,000,000	$44,000,000	$66,000,000	$3,900,000	94%
1904-AB90	Energy Conservation Standards for Residential Clothes Washers	5/31/2012	$1,958,000,000	$212,000,000	$1,808,000,000	$142,000,000	92%
1904-AC04	Energy Conservation Program: Energy Conservation Standards for Distribution Transformers	4/18/2013	$1,195,270,930	$273,370,970	$952,920,780	$229,747,940	80%
1904-AC07	Energy Conservation Program: Energy Conservation Standards for Standby Mode and Off Mode for Microwave Ovens	6/17/2013	$285,003,770	$64,368,200	$226,839,740	$56,612,990	80%
1904-AC00	Energy Conservation Program: Energy Conservation Standards for Metal Halide Lamp Fixtures	2/10/2014	$124,416,740	$37,989,840	$86,426,890	$36,090,350	69%
1904-AB57	Energy Conservation Program: Energy Conservation Standards for External Power Supplies	2/10/2014	$406,491,320	$153,858,860	$332,411,130	$73,130,450	82%
1904-AC19	Energy Conservation Program: Energy Conservation Standards for Commercial Refrigeration Equipment	3/28/2014	$1,094,107,480	$250,732,960	$854,771,470	$233,637,530	78%
1904-AC28	Energy Conservation Program: Energy Conservation Standards for Commercial and Industrial Electric Motors	5/29/2014	$2,523,551,450	$581,277,990	$1,917,000,510	$574,725,740	76%
1904-AB86	Energy Conservation Program: Energy Conservation Standards for Walk-In Coolers and Freezers	6/3/2014	$1,283,304,540	$494,226,690	$995,941,670	$268,642,160	78%
1904-AC22	Energy Conservation Program for Consumer Products: Energy Conservation Standards for Residential Furnace Fans	7/3/2014	$2,179,090,420	$332,292,570	$1,881,431,170	$292,043,050	86%
1904-AC77	Energy Conservation Program: Energy Conservation Standards for Commercial Clothes Washers	12/15/2014	$35,569,350	$28,082	$28,081,060	$6,552,248	79%

Total Benefit Composition	**$26,625,672,436**	**$7,832,067,142**	**$23,421,188,916**	**$3,056,624,170**	**87.96%**
	Total Benefits	Total Cost	Total Private Benefits	Total CO_2 Benefits	Private Benefits as % of Total

Appendix C

DOE Energy Efficiency Regulations Annual Benefit Composition, 2007 – 2014 (2010$)					
Year	**Total Benefit**	**Total Cost**	**Private Benefit**	**CO_2 Reduction Benefit**	**Private Benefit % of Total**
2007	$1,198,442,690	$540,813,490	$1,198,442,690	-	100%
2008	$6,835,876	$4,311,860	$6,835,876	-	100%
2009	$3,574,014,250	$676,656,150	$3,563,582,540	$10,832,230	99.7%
2010	$3,263,861,310	$1,560,807,640	$2,952,386,790	$294,837,112	90.5%
2011	$7,427,712,310	$2,605,331,840	$6,550,116,600	$833,872,370	88.2%
2012	$2,028,000,000	$256,000,000	$1,874,000,000	$145,900,000	92.4%

2013	$1,480,274,700	$337,739,170	$1,179,760,520	$286,360,930	79.7%
2014	$7,646,531,300	$1,850,406,992	$6,096,063,900	$1,484,821,528	79.7%

Appendix D

DOE Energy Efficiency Regulations Lacking Sufficient Analysis for Inclusion (2004 – 2013)				
Agency	RIN	Rule Title	Published Date	Cause for Exclusion
DOE	1904-AB46	Energy Conservation Program for Consumer Products; Central Air Conditioners and Heat Pumps Energy Conservation Standards	8/17/2004	No analysis
DOE	1904-AA95	Energy Efficiency Program for Certain Commercial and Industrial Equipment: Test Procedures and Efficiency Standards for Commercial Water Heaters, Hot Water Supply Boilers and Unfired Hot Water Storage Tanks	10/21/2004	No analysis
DOE	1904-AA96	Energy Efficiency Program for Certain Commercial and Industrial Equipment: Test Procedures and Efficiency Standards for Commercial Warm Air Furnaces; General Provisions for Commercial Heating, Air Conditioning and Water Heating Equipment; Energy Efficiency Provisions for Electric Motors	10/21/2004	No analysis
DOE	1904-AB02	Energy Efficiency Program for Certain Commercial and Industrial Equipment: Test Procedures and Efficiency	10/21/2004	No analysis

		Standards for Commercial Packaged Boilers		
DOE	1904-AA97	Energy Efficiency Program for Certain Commercial and Industrial Equipment: Test Procedures and Efficiency Standards for Commercial Air Conditioners and Heat Pumps	10/21/2004	No analysis
DOE	1904-AB54	Energy Conservation Standards for Certain Consumer Products and Commercial and Industrial Equipment	10/18/2005	No analysis
DOE	1904-AB13	Energy Conservation Standards for New Federal Commercial and Multi-Family High-Rise Residential Buildings and New Federal Low-Rise Residential Buildings	12/4/2006	No analysis
DOE	1904-AB16 1904-AB17 1904-AB44	Energy Efficiency Program for Certain Commercial and Industrial Equipment: Efficiency Standards for Commercial Heating, Air-Conditioning, and Water-Heating Equipment	3/7/2007	No analysis
DOE	1904-AB74	Energy Conservation Standards for Certain Consumer Products and Commercial and Industrial Equipment	3/23/2009	No analysis
DOE	1904-AB83	Energy Conservation Program for Certain Industrial Equipment: Energy Conservation Standards and Test Procedures for Commercial Heating, Air-Conditioning, and Water-Heating Equipment	7/22/2009	Insufficient analysis
DOE	1904-AB85	Energy Conservation Program: Test Procedures for Walk-In Coolers and Walk-In Freezers	4/15/2011	No analysis
DOE	1904-AC41	Energy Efficiency Design Standards for New Federal Commercial and Multi-Family High-Rise Residential Buildings and New Federal Low-Rise Residential Buildings	8/10/2011	No analysis
DOE	1904-AB57	Energy Conservation Program: Energy Conservation Standards for Certain External Power Supplies	9/19/2011	No analysis
DOE	1904-AC56	Energy Conservation Program: Energy Conservation Standards for Direct Heating Equipment	11/18/2011	No analysis

DOE	1904-AC47	Energy Conservation Program for Certain Industrial Equipment: Energy Conservation Standards and Test Procedures for Commercial Heating, Air-Conditioning, and Water-Heating Equipment	5/16/2012	Insufficient analysis
DOE	1904-AD08	Energy Conservation Program: Energy Conservation Standards for Certain Consumer Products and Commercial and Industrial Equipment	10/23/2013	No analysis