U.S. Department of Energy
Building Technologies Program

RE: Notice of Proposed Rulemaking for)
Energy Conservation Standards for) EERE-2014–BT–STD–0031
Residential Furnaces;)

JOINT COMMENTS OF THE CONSUMER FEDERATION OF AMERICA, NATIONAL CONSUMER LAW CENTER, MASSACHUSETTS UNION OF PUBLIC HOUSING TENANTS AND TEXAS RATEPAYERS' ORGANIZATION TO SAVE ENERGY

JULY 10, 2015

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EXECUTIVE SUMMARY

The Consumer Federation of America, National Consumers Law Center, Massachusetts Union Of Public Housing Tenants and Texas Ratepayers' Organization to Save Energy (Joint Commenters) are pleased to provide comments for the Department of Energy's Notice of Proposed Rulemaking on energy conservation standards for residential furnaces (Docket Number: EERE-2014-BT-STD-0031 RIN: 1904-AD20.)

The joint commenters support a minimum efficiency standard for furnaces set at an Annual Fuel Utilization Efficiency (AFUE) of at least 92% and believe that it is clearly in the consumer and national interest. Joint Commenters further propose that DOE set the standard at 95% AFUE, since DOE's own analysis shows that this yields greater net benefits for consumers, but we propose exempting units of 50,000 BTU capacity or less to address concerns about burdens to low income households, small or well-insulated units where installation of 95% AFUE units may not be cost-justified, as well as some single family attached units.

Among the key findings of the report that lead support this recommendation are the following:

- The reductions in expenditures for fuel use are larger than the costs of the fuel saving technologies – about twice as large.
- The payback period is less than half the life of the appliance.
- Many more consumers enjoy net benefits than bear net costs.
- The individuals who benefit have much larger gains than the losses of the individuals who do not.
- All of the conclusions about consumer benefits in the aggregate apply to low income consumers as well.
- As large as the consumer pocketbook benefits are, we believe that the DOE has underestimated the net pocketbook benefits by overestimating the costs and underestimating the benefits.
- The consumer pocketbook savings are augmented by other indirect and external benefits. (e.g. environmental, public health and macroeconomic)

The comments explain why the market does not on its own provide cost-effective, efficient furnaces and why performance standards are well-suited to address the many important market imperfection that lead to underinvestment in furnace efficiency. The comments conclude that DOE's regulatory actions are critical to correct the market imperfections identified in these comments, and to ensure that consumers reap the billions of dollars in savings that will arise from setting an appropriate efficiency standard.

We provide a detailed analysis of the consumer pocketbook impacts of higher furnace efficiency and find that the net benefits exceed the incremental costs and that the number of winners exceed the number of losers by a wide margin. The comments point out the harm of not having had any real improvement in the furnace standards for over 20 years (almost $13 billion over the life of the lower-efficiency furnaces that have been installed) as well as the consumer and macroeconomic benefits of setting a standard of at least 92 AFUE(approximately $20 billion). Moving the level to 95% AFUE as the level, with the lower level for small furnaces increase the net pocketbook benefits by $5 billion.

Low income consumers will benefit more than other groups, as generally speaking, they occupy older housing with less efficient furnaces, and they are also more likely to be renters. This renter segment is subject to severe split incentives. Landlords do not pay heating bills and tend to keep first costs down. Therefore, they are more likely to underinvest in energy efficiency. Low income households would benefit greatly through lower energy bills resulting from a higher minimum efficiency furnace standard. Landlord choices should be limited to higher efficiency models.

In addition, our extensive review of the academic literature on efficiency standards shows that regulator predictions of costs in prior standards dockets have been consistently higher than the actual cost increases associated with efficiency standards and industry predictions have been even wider of the mark. Innovation, competition and 'learning' over time brings down the cost of the product, and DOE thus routinely underestimates the net benefits of increased efficiency.

Our analysis of the performances of various appliances and past standards using multiple regression techniques to control for underlying trends and differences between appliances demonstrates that

- The implementation of standards improved the efficiency of the consumer durables.
- Furnaces have been far less efficient than they should have been, since, as we have noted, DOE has set weak standards.
- After the initial implementation of a standard, the improvement levels off, suggesting that if engineering-economic analysis indicates that improvements in efficiency would benefit consumers, the standards should be strengthened on an ongoing basis.
- While the efficiency was increasing, the cost of the durables was not and there was no reduction in the quality or traits of the products.

The Department of Energy should issue a strong final rule increasing the efficiency of gas furnaces as soon as possible to stem the economic harm consumers have been subject to through unnecessarily high energy bills.

I. INTRODUCTION AND OVERVIEW

A. JOINT CONSUMER COMMENTERS

The Consumer Federation of America,[1] National Consumer Law Center,[2] Massachusetts Union Of Public Housing Tenants [3] and Texas Ratepayers' Organization to Save Energy[4] (hereafter Joint Consumer Commenters), applaud the Department of Energy for presenting a thorough analysis of the costs and benefits of increasing minimum efficiency level for gas

[1] The Consumer Federation of America is an association of more than 250 nonprofit consumer groups that was established in 1968 to advance the consumer interest through research, advocacy, and education.

[2] The National Consumer Law Center is a non-profit organization with a broad mission of seeking economic justice in the marketplace for low-income households. NCLC has a particular focus on making sure that low-income consumers can obtain the essential amounts of energy they need, and that their homes and appliances are as efficient as reasonably possible

[3] MUPHT is a membership organization that represents the interests of the tens of thousands of families that reside in publicly-owned as well as privately-owned but publicly-subsidized housing (collectively, "public housing") in Massachusetts. By law, families residing in public housing must have incomes below specified limits, and the overwhelming majority of MUPHT's members live on annual incomes well below the median income in Massachusetts. MUPHT is the oldest statewide association of public housing tenants in the United States and is formally recognized by the Massachusetts Department of Housing and Community Development as the representative of the state's low-income public housing tenants. MUPHT has also partnered with the federal Department of Housing and Urban Development on a broad range of housing and utility issues, including determining the scope of utility costs that tenants are required to pay.

[4] Texas Ratepayers' Organization to Save Energy (Texas ROSE) is a 501(c) (3) non-profit membership organization that represents the interests of millions of Texas families, many of them low-income, on a broad range of energy and utility issues. The stated goals of Texas ROSE include assuring that energy conservation programs and benefits are made available to all classes of customers, especially low-income customers and renters; promoting energy conservation; and making sure energy supplies are affordable for low-income consumers. Texas ROSE has for many years advocated for energy conservation and energy efficiency programs and policies that help low-income households obtain necessary amounts of electricity and natural gas for appliances, home heating and other household uses. Texas ROSE was an intervenor-plaintiff in NRDC v. Abraham, 355 F.3d 179 (2nd Cir. 2004), a successful suit to require an increase in the efficiency standards for central air conditioners, and a plaintiff in Natural Resources Defense Council et al. v. Samuel W. Bodman, #05-CV-7808 (S.D.N.Y., complaint filed Sept. 7, 2005), in which the plaintiffs challenged the Department of Energy's failure to comply with statutory deadlines for strengthening federal appliance efficiency standards and were able to enter into a Consent Judgment with DOE. Texas ROSE was also one of a large group of organizations and consumer groups, including the Massachusetts Union of Public Housing Tenants, that have jointly filed comments in the Department of Energy furnace and boiler rulemaking dockets over the past decade.

furnaces and for choosing the 92% Annual Fuel Utilization Efficiency (AFUE) as the focal point of its analysis.

The Joint Consumer Commenters have participated in dozens, if not hundreds, of efficiency rulemakings, regulatory negotiations, and legislative hearings involving large and small energy using consumer durables, ranging from automobiles to air conditioners, furnaces, water heaters, computers, and lightbulbs.[5] We have participated in the ongoing rulemaking and its immediate predecessor dealing with gas furnaces for over a decade.[6]

Our technical expertise is not in the design and construction of these consumer durables, it is in the design and implementation of minimum energy standards. We believe that knowing how to build an effective standard is at least as important to arriving at a successful outcome as knowing how to build a furnace. Moreover, although we do not claim expertise in the technical design of consumer durables, we do claim expertise in the economic analysis of technologies. This analysis combines a review of the technical economic studies, prepared by others, and

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[5] The CFA website (http://www.consumerfed.org/issues/energy) lists over 100 pieces of legislative testimony and regulatory comments in home energy and motor vehicles, most of which involve energy use and efficiency standards. The NCLC website (http://www.nclc.org/issues/appliance-efficiency-standards.html) lists a dozen comments, letters and lawsuits involving appliance efficiency standards.

[6] Comments Of The National Consumer Law Center, Consumer Federation Of America and Massachusetts Union Of Public Housing Tenants Re: Energy Conservation Standards For Residential Furnaces And Boilers, Docket No. EE-RM/Std-01-350/RIN 1904-AA78, November 10, 2004; Charles Harak, Esq, Comments of The National Consumer Law Center, Re: Energy Conservation Standards Boilers and Furnaces, Docket EE-RM/STD-01-350 AA78), October 30, 2006; Supplemental Comments of the National Consumer Law Center, Consumer Federation of America, Massachusetts Union of Public Housing Tenants, National Association of State Community Service Programs, Texas Legal Services Center, Texas Ratepayers' Organization to Save Energy, and Virginia Citizens Consumer Council, Re: Energy Conservation Standards For Residential Furnaces And Boilers, Docket No. EE-RM/STD-Ol-350/RIN 1904-AA 78, submitted February 26, 2007; Comments of the Consumer Federation of America, NCLC and numerous other groups, United States Department Of Energy, Energy Conservation Program: Docket No. EERE-2014-BT-STD-0049, Procedures, Interpretations, and Policies for Consideration of New or Revised Energy Conservation Standards for Consumer Products via regulations.gov, December 30, 2014; Letter from Consumer Federation of America (CFA) and the National Consumer Law Center (NCLC) to The Honorable Lisa Murkowski and The Honorable Maria Cantwell, April 29, 2015.

evidence on the market performance of appliances and devices to determine whether there are significant potential consumer savings that would result from a higher standard.[7]

B. APPROACH

We approach the setting of standards from a uniquely consumer point of view, always starting from a basic question:

- Will a standard save consumers money?

If there appears to be potential savings, we ask:

- Why is there an efficiency gap that appears to impose unnecessary costs on consumers?

If we find market imperfections that prevent the gap from being closed and cost savings from being realized, we then ask:

- Why is a standard an appropriate policy and how can the standard be best designed to achieve the goal of lowering consumer cost?

[7] In addition to the key documents in this proceeding – Department of Energy, Energy Conservation Program for Consumer Products: Energy Conservation Standards for Residential Furnaces; Proposed Rule, Federal Register, 10 CFR Part 430, (Vol. 80 Thursday, No. 48 March 12, 2015, Part III (hereafter DOE NOPR, 2015) and the Technical Support Document: Energy Efficiency Program For Consumer Products And Commercial And Industrial Equipment: Residential Furnaces, February 10, 2015 (hereafter DOE TSD, 2015), we have also reviewed a number of other analyses, including Lekov, A., G, et al. *Cost and Energy Consumption of Energy Efficiency Design Options for Residential Furnaces and Boilers*, Lawrence Berkeley National Laboratory. Berkeley, CA. Report No. LBNL-52762, 2003; Lutz, James, et al., *Modeling Energy Consumption of Residential Furnaces and Boilers in U.S. Homes*, Lawrence Berkeley National Laboratory, Environmental Energy Technologies Division, February 2004; Lekov, Alex, et al., Electricity and Natural Gas Efficiency Improvements for Residential Gas Furnaces in the U.S., Lawrence Berkeley National Laboratory, Berkeley, California, LBL 59745, 2006; Lekov, et al., Alex B. *Economics of Residential Gas Furnaces and Water Heaters in United States New Construction Market*, Lawrence Berkeley National Laboratory, Environmental Energy Technologies Division, LBNL-2828E, October 2009; Alex Lekov, et al., *Economics of Condensing Gas Furnaces and Water Heaters Potential in Residential Single Family Homes,* Lawrence Berkeley National Laboratory, EE Summer Study 2010; Lekov Alex B., et al., "Economics of residential gas furnaces and water heaters in US new construction market," *Energy Efficiency* (2010) 3; Brand, I. and W. Rose, *Measure Guideline: High Efficiency Natural Gas Furnaces*, U.S. Department of Energy, EERE, October 2012

Throughout the analysis, we pay particular attention to the impact of energy expenditures on low and lower middle income households, who typically spend a much larger part of their income on energy.[8]

C. FINDINGS AND RECOMMENDATIONS

Home heating is one of the largest single expenditures in the household budget of American families.[9] The gas products covered by the proposed rule are the number one choice of heating technology among all households.[10] The standards governing natural gas furnaces have been in place for almost a quarter of a century with no meaningful increase in the standard. A minuscule increase in 2007 only added insult to injury for consumers.[11] A meaningful increase in the standard is now more than a decade late. The failure to address a significant and obvious failure in the furnace market with a new rule at an appropriately consumer-friendly level is long overdue.

Based on our experience and close attention to the record in this proceeding, we conclude that after more than a decade of failure to properly exercise its authority, the Department of Energy (DOE) has finally put on the table overwhelming evidence that an increase in the standard to 92% or more is well-justified. A minimum standard set at an Annual Fuel Utilization Efficiency (AFUE) of at least 92% is clearly in the consumer and national interest.

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[8] The 2013 Consumer Expenditure Survey from the Bureau of Labor Statistics shows that households with income between $5,000 and $10,000 spend four times the national average on natural gas as a percent of their income (2.3% v .6%), while households with income between $30,000 and $40,000) spent twice the national average (1.2%).

[9] In the 2013, Consumer Expenditure Survey, home energy expenditures were almost $2,000 and natural gas accounted for about one fifth of the total.

[10] http://www.eia.gov/todayinenergy/detail.cfm?id=3690.

[11] The increase in the standard in 2007 from 78% to 80% AFUE was minuscule compared to what the economic analysis justified and so paltry that it was more an insult than an improvement. The meaninglessness of the 2007 standard is affirmed by the recognition that 99% of the households would experience "no Impact.) Department of Energy, Energy Conservation Program for Consumer Products: Energy Conservation Standards for Residential Furnaces; Final Rule, Federal Register, 10 CFR Part 430, (Nov. 19, 2007) Part II, p. 65156. (Hereafter, DOE, Final Rule 2007).

- The reductions in expenditures for fuel use are larger than the costs of the fuel saving technologies – about twice as large.

- The payback period is less than half the life of the appliance.

- Many more consumers enjoy net benefits than bear net costs.

- The individuals who benefit have much larger gains than the losses of the individuals who do not.

- All of the conclusions about consumer benefits in the aggregate apply to low income consumers as well.

- As large as the consumer pocketbook benefits are, we believe that the DOE has underestimated the net pocketbook benefits by overestimating the costs and underestimating the benefits.

- The consumer pocketbook savings are augmented by other indirect and external benefits. (e.g. environmental, public health and macroeconomic)

Our support for the standard based on consumer pocketbook analysis is magnified by the fact that a move to a standard above 90% has been well-justified for over a decade.[12] The failure of the DOE to adopt this higher level has resulted in millions of inefficient furnaces wasting billions of consumer dollars.[13] Because furnaces are among the most long-lived of all consumer durables, the waste will continue for decades.

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[12] This is a longstanding weakness of DOE analysis. See Supplemental Comments of the National Consumer Law Center, Consumer Federation of America, Massachusetts Union of Public Housing Tenants, National Association of State Community Service Programs, Texas Legal Services Center Texas Ratepayers' Organization to Save Energy, and Virginia Citizens Consumer Council, *Re: Energy Conservation Standards For Residential Furnaces And Boilers*, Docket No. EE-RM/STD-Ol-350/RIN 1904-AA 78, submitted February 26, 2007, p. 2. (“These commenters note that DOE's proposed 80% AFUE standard runs counter to the central purpose of the appliance standards law, that is, to set standards that are ‘designed to achieve the maximum improvement in energy efficiency ... which the Secretary determines is technologically feasible and economically justified.’ 42 U.S.C. 6295(o) (2) (a).”)

[13] We identified the harms that DOE has imposed on consumers by failing to act responsibly in setting standards over a decade ago. See *Comments Of The National Consumer Law Center, Consumer Federation Of America And Massachusetts Union Of Public Housing Tenants Re: Energy Conservation Standards For Residential Furnaces And Boilers,* Docket No. EE-RM/Std-01-350/RIN 1904-AA78, p. 2, November 10, 2004. “The Consumer Groups believe that DOE can significantly improve the lives of consumers across America by adopting the highest efficiency standards that are technologically possible and economically feasible. They also believe that DOE has the legal

Our support for a standard at 92% AFUE or higher also reflects the fact that the DOE has consistently underestimated the net benefits of standards.[14]

We have urged the DOE to refine the rule by adopting policies that enable it to set the standard at different levels for different circumstances to increase the overall net benefit to consumers and minimize burdens to consumers who might face high installation costs. We have tried to develop a consensus position with the industry to achieve this goal, but, to date, those efforts have been rebuffed. We continue to believe that the DOE can develop an approach to achieve this end, but we are also convinced that the time to act is long past. The DOE must adopt a rule that sets the standard at 92% or higher by next spring to comply with a court order. It can certainly act sooner.

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authority and, indeed, obligation to specify geographically-differentiated standards, so that consumers in colder climates can benefit from higher standards that are economically justified in those cold-weather states. Finally, the Consumer Groups urge the DOE to adopt standards for furnace fans because this, too, will make home heating more affordable for the literally millions of Americans who struggle each winter to pay their heating bills while saving significant amounts of energy**.”**

[14] This is a longstanding weakness of DOE analysis. See Charles Harak, Esq, *Comments Of The National Consumer Law Center Energy Conservation Standards Boilers And Furnaces,* Docket EE-RM/STD-01-350 AA78), October 30, 2006, (p. 1). “We believe that DOE tends to understate the benefits and overstate the costs to low income consumers when considering whether to impose higher appliance standards. To the extent this is so, DOE therefore improperly burdens low-income consumers with higher energy bills.”

II. CONSUMER POCKETBOOK IMPACTS OF HIGHER FURNACE EFFICIENCY

A. NET BENEFITS2

The consumer pocketbook benefits of adopting an AFUE at or above the 90% level and the consumer harm with delay can be seen in several ways. The current analysis shows that, on average, the benefits of a standard set at 92% or above exceed the costs by a substantial margin, i.e. the benefit-cost ratio is 2 (see Exhibit 1). The analysis is based on a 3% discount rate. In other words, the consumer is considered to be a winner if the investment yields a return of more than 3% real. If it yields just 3%, the consumer breaks even.[15]

The economic benefit exists in the two regions of the country analyzed by the DOE, cold (North) and moderate (rest of the country). The net benefits are substantial – consumer pocketbook savings of about $16 billion and total savings in the range of about $20 billion.[16] This is also true for low income consumers, as shown in the lower graph in Exhibit 1.

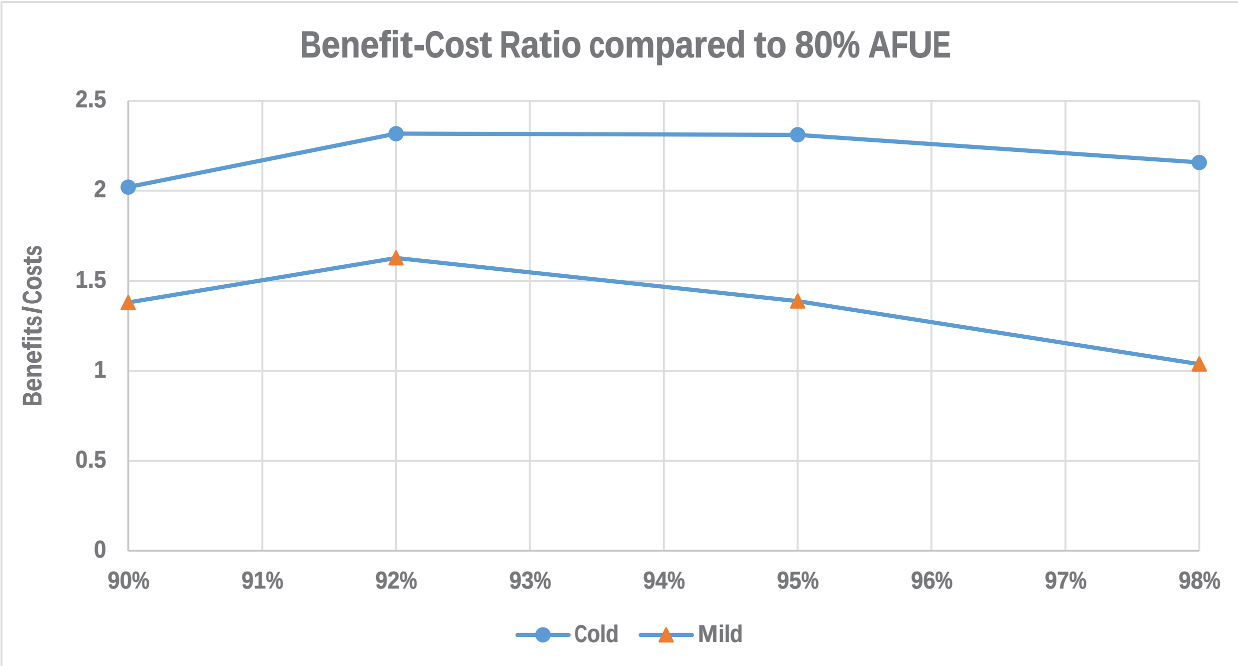
B. WINNERS AND LOSERS

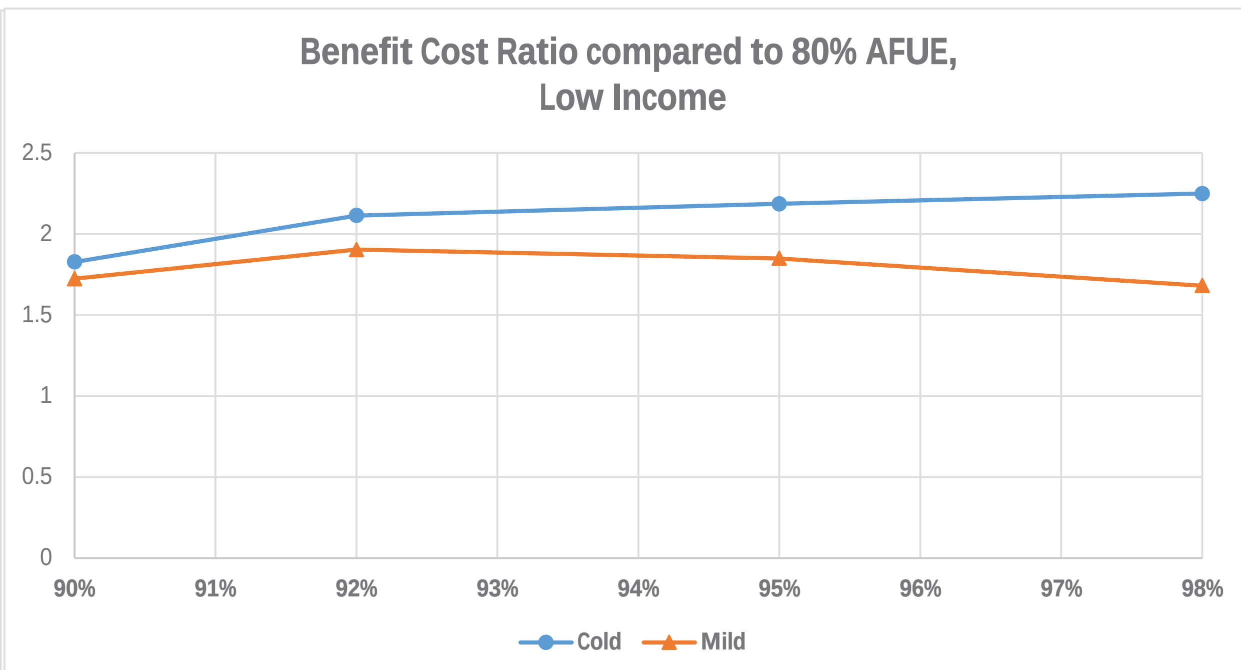
Every efficiency standard will have different impacts on specific consumers. Consequently, there will be some consumers for whom the standards yield benefits that exceed costs, but for some consumers costs will be greater than the benefits they derive. The fact that there can be both winners and losers from the adoption of a standard is always a source of concern to those who represent the consumer interest. However, the obverse is also true. The failure to adopt a standard when market imperfections have led to underinvestment in efficiency imposes unnecessary costs on some consumers. The relevant policy question is: how do those

[15] Throughout this analysis, we present the results for the 3% real discount rate, which we believe represents the opportunity cost of capital for typical households. Investments in efficiency are relatively low risk and 3% real is a lot more than the typical consumer can earn on an insured savings account. These days, 3% is close to what the typical consumer pays for home mortgages, which is where the cost of a furnace is likely to be bundled.

[16] NOPR 2015, 13123.

EXHIBIT 1: NATIONAL BENEFIT-COST RATIOS





Source: U.S. Department of Energy, *Technical Support Document: Energy Efficiency Program For Consumer Products And Commercial And Industrial Equipment: Residential Furnaces,* February 10, 2015, pp. 8-37, 11-3.

who would be helped by the standard compare to those would be hurt by the standard and/or the failure to adopt a standard?

In the case of a gas furnace efficiency standard set at 92% or higher, as shown in Exhibit 2, the winners exceed the losers by a wide margin. We identify two categories of winners:

(1) those who enjoy a direct benefit in terms of pocketbook costs and

(2) those who break even in terms of pocketbook costs (beyond the 3% embedded in the analysis) and enjoy the other indirect benefits of the standard at zero net pocketbook cost.

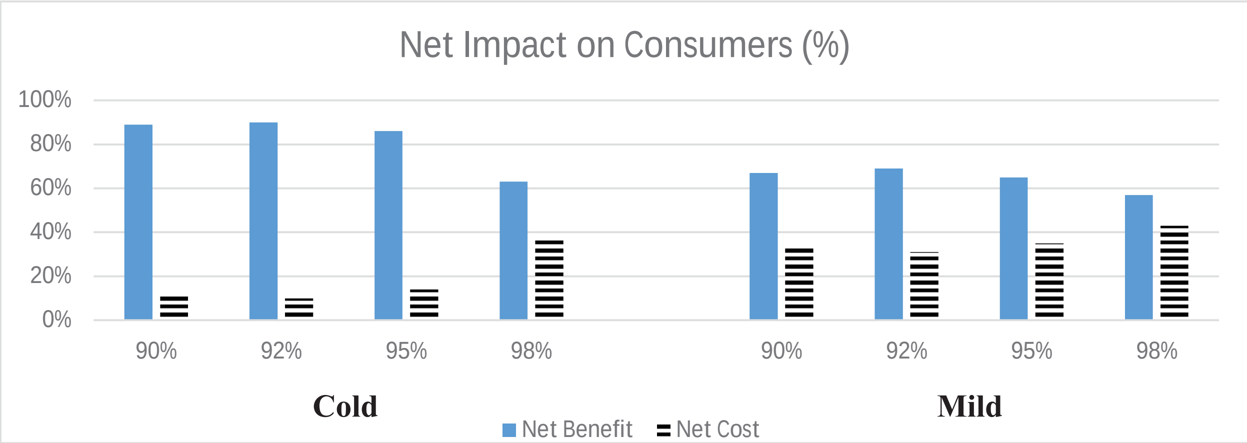
One can even argue that some consumers who suffer small out of pocket losses but receive indirect benefits that are large enough to make them net winners could be considered winners. For this analysis we do not claim those consumers as net beneficiaries of the rule.

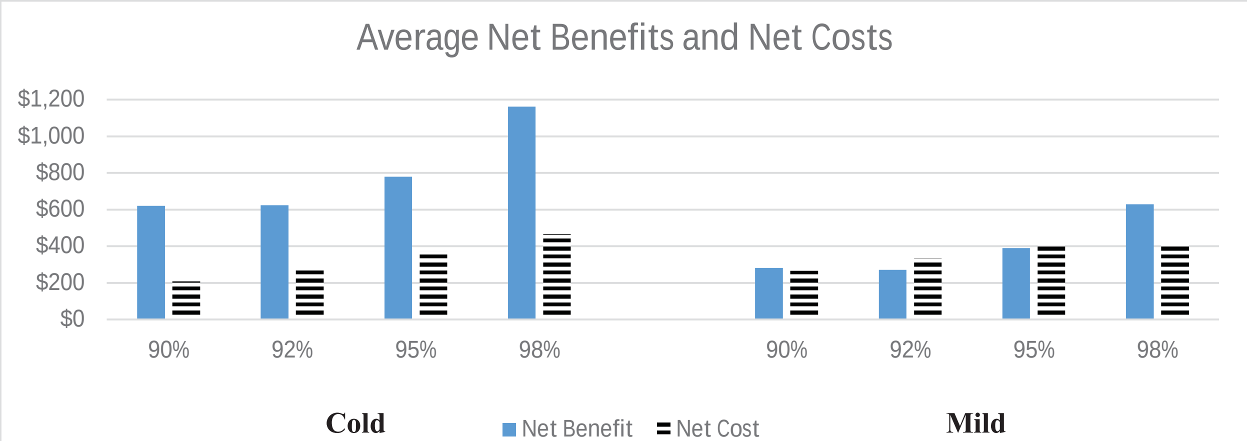
The upper graph in Exhibit 2 identifies the percentage of households that are net winners from the higher efficiency furnace. The Exhibit shows that the number of net losers is much smaller than the number of net winners in all circumstances. Generally, winners outnumber losers by 3 or 4 to 1. As shown in middle graph of Exhibit 2, the economic analysis also shows that the winners gain more per household, on average, than the losers lose.

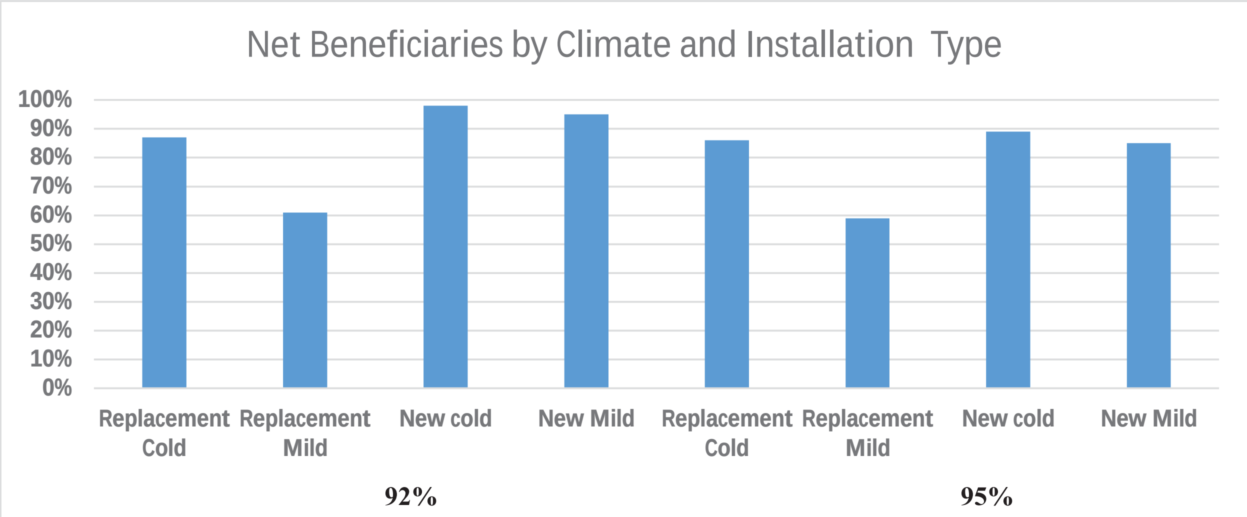
Winners also substantially outnumber losers in both types of installation, replacement and new construction, as shown in the bottom graph of Exhibit 2. In all cases, the majority of households are winners.

The winners and losers analysis provides evidence to support our concern about the impact on some groups of consumers. While winners outnumber losers in both cold and mild climates, the margin is much smaller in the mild climates. If the DOE could tailor the rule to specific circumstances, it could reduce the number of losers and increase the overall net benefit. That is the approach we urge the DOE to continue to explore. But under no circumstances

EXHIBIT 2: CONSUMERS WITH NET BENEFITS AND NET COSTS: NATIONAL AVERAGE PERCENTAGES AND DOLLAR AMOUNTS







Source: U.S. Department of Energy, *Technical Support Document: Energy Efficiency Program For Consumer Products And Commercial And Industrial Equipment: Residential Furnaces,* February 10, 2015, pp. 8-37, 8-38; Energy Conservation Standards for Residential Furnaces; Proposed Rule, Federal Register, 10 CFR Part 430, (Vol. 80 Thursday, No. 48 March 12, 2015, Part III

should it allow this concern to delay the rule. If the DOE solved the problem of targeting along the lines discussed below, the total net pocketbook benefit to consumers would be about 10% higher, bringing the pocketbook savings to over $19 billion. [17]

Having reduced the problem of net losses in certain circumstances, DOE could raise the standard in other circumstances. Because some circumstances in which there are winners would be exempted from the higher level, the approximately $5 billion increase in consumer benefit from moving to 95% AFUE would not be realized, [18] but the net increase of the two effects would certainly be well in excess of $5 billion.

As shown in Exhibit 3, the conclusions reached about the benefits to consumers in general also apply to low income households. If anything, the fact that stands out for low income households is that the net dollar benefits are slightly larger and the net dollar costs slightly lower. This may reflect the fact that low income households have lower efficiency furnaces to start with, so the energy savings from a higher standard are larger. There are other reasons that the standards are likely to benefit low income households more, or certainly ensure that they fare at least as well as others, which will be identified in the discussion of market imperfections below.

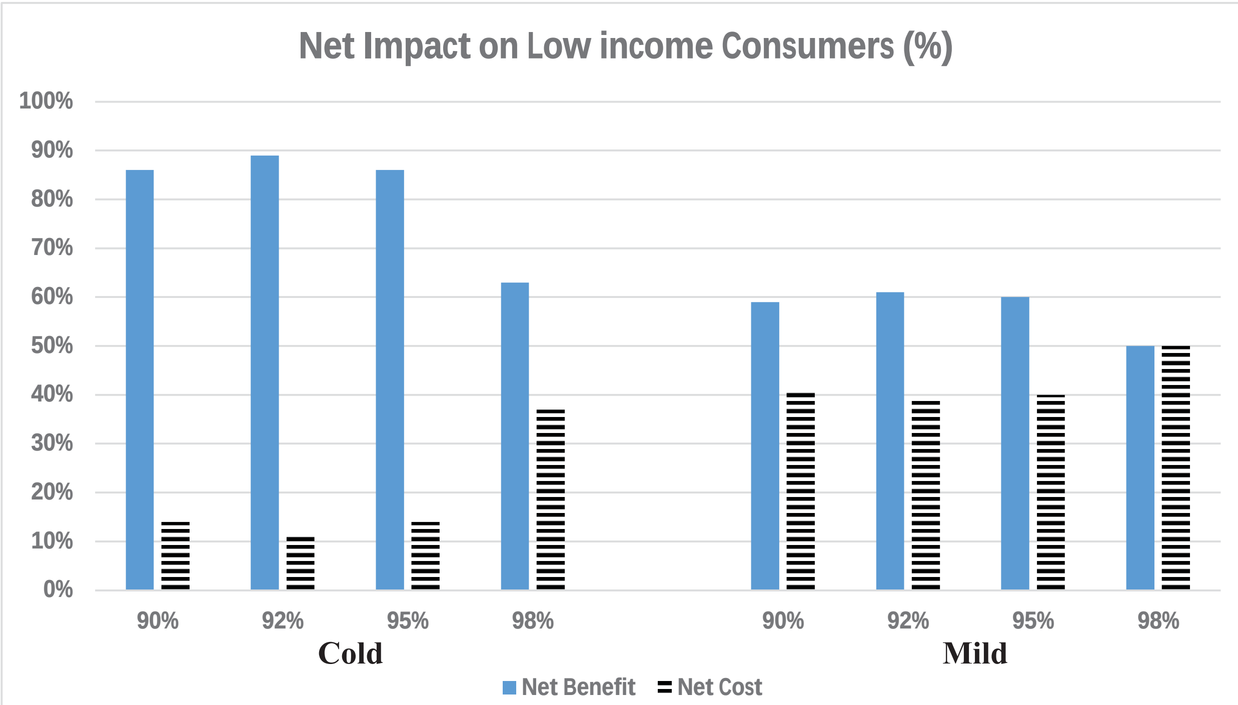
C. The Harm of Inaction

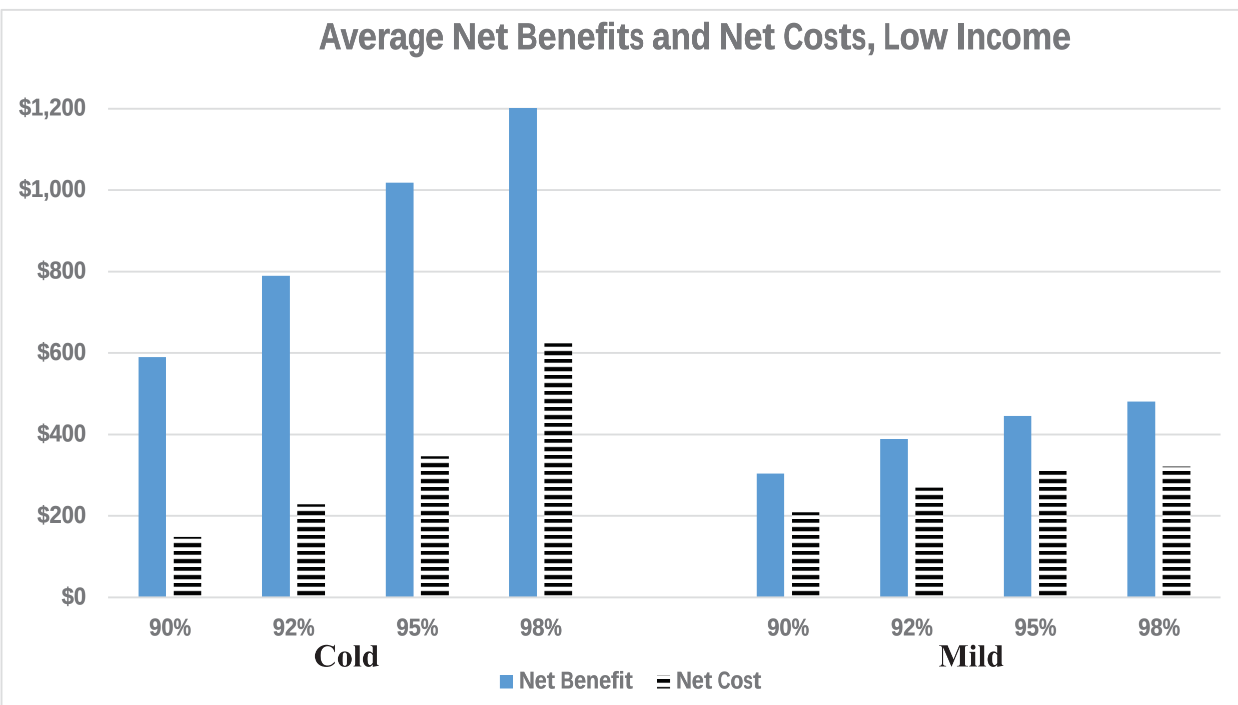
Given the history of the standard setting in the furnace market, we must underscore the importance of taking action to increase the standard. Failing to act would deny between three-

[17] The shift from 92% to 95% increases consumer pocketbook benefits by $5billion, but the 95% standard applies to less than 100% of the households. Assuming the net losers are eliminated in mild climates, one-third of those with net costs would be eliminated, saving about $370 of net costs per household. (TSD 2015, p. 3-38). This would apply to roughly 16% of total shipments. (TSD 2015, p. 7-3). Over twenty years, that is about 8 million units shipped, bringing the total reduction in net costs to almost $3 billion.

[18] DOE, NOPR 2015, p. 13576.

EXHIBIT 3: LOW INCOME CONSUMERS WITH NET BENEFITS AND NET COSTS: PERCENTAGES AND DOLLAR AMOUNTS



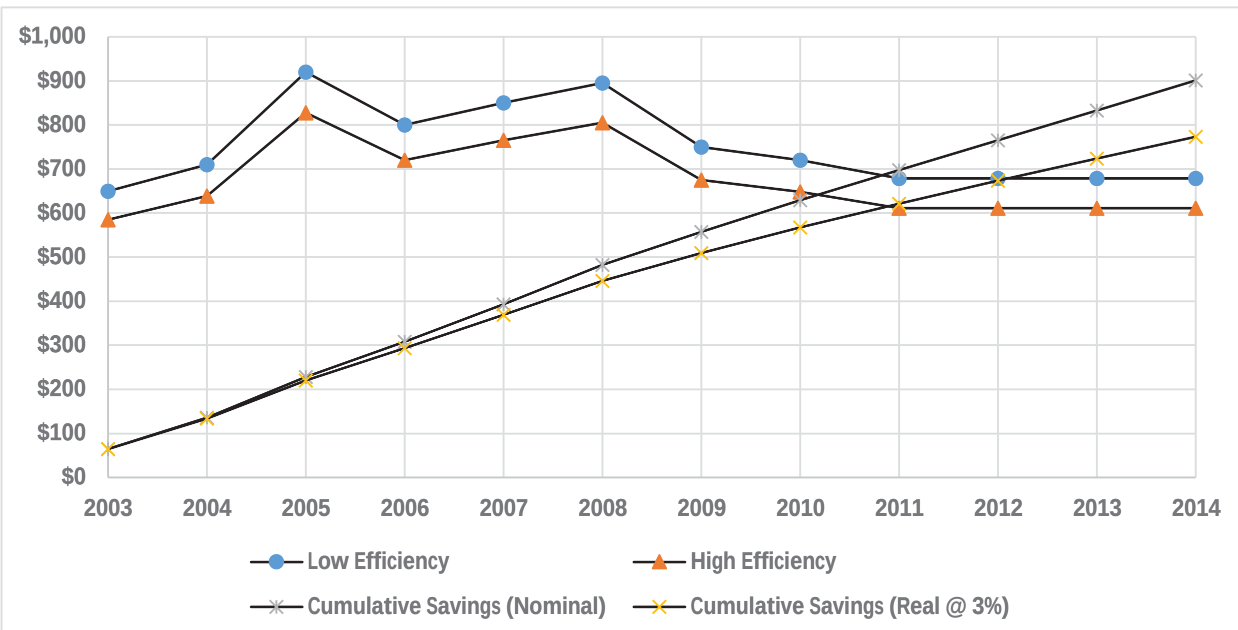


Source: U.S. Department of Energy, *Technical Support Document: Energy Efficiency Program For Consumer Products And Commercial And Industrial Equipment: Residential Furnaces,* February 10, 2015, pp. 8-37, 8-38

quarters and nine-tenths of consumers significant benefits. The correct approach is to deliver the benefits to those consumers, while trying to reduce the burden on those who might bear a cost.

The importance of taking action today can be emphasized by considering the cost of having failed to act in the past. Exhibit 4 shows estimates for household winter natural gas expenditures going back to the winter of 2003-2004. We use this as a starting date since, under the governing statute, the DOE could have put a standard above 90% AFUE in place by that time.[19]

EXHIBIT 4: WINTER HEATING EXPENDITURES AND SAVINGS FROM EARLY ADOPTION OF HIGHER EFFICIENCY



Source: Energy Information Administration

[19] National Appliance Energy Conservation Act of 1987, contemplates a new standard being in place by January 2002. It could have been 90%. DOE was also half a decade late. http://www.gpo.gov/fdsys/pkg/STATUTE-101/pdf/STATUTE-101-Pg103.pdf

We conservatively estimate bill savings at 10% of the winter bill, by assuming a 13% reduction for 75% of the bill. (the heating usage portion) [20] We estimate that the average annual bill would have been about $75 lower over this period. Exhibit 4 includes a cumulative accounting in both nominal and real terms of the savings on energy bills in the backward-looking analysis of the impact of a standard above 90% AFUE. Cumulatively, expenditures were $900 higher in nominal terms and almost $800 higher in real terms than they would have been if a higher standard had been in place beginning in the 2003-2004 heating season.

Although we do not know the incremental cost of higher efficiency throughout the period, all of the evidence suggests that it was much lower than the benefits of reduced energy bills. The evidence in the 2007 proceeding indicates that a 90% standard was economically superior and costs were probably declining over the period due to scale economies and learning effects.[21] However, even assuming that the real cost of a 92% AFUE furnace had been constant over the past decade, the payback in setting the standard higher would have been about five years. Most consumers would already be well ahead of the game, with years of additional savings in the offing.

In short, as a result of the failure of the DOE to act responsibly in setting a standard above 90% AFUE at the earliest possible date, there are already almost 15 million energy wasting furnaces in the marketplace and that number will grow to almost 23 million before the new standard takes effect. The net saving for consumers (i.e. subtracting the cost of the higher efficiency technology from the reduction in energy expenditures), had those furnaces been

[20] The 10% improvement is equal to a 13.3% reduction applied to 75% of the bill. The increase in efficiency in the backward looking analysis could vary as follows: 15.3% (78 to 92% AFUE); 13.3% (78-90%), 13% (80-92%), 11.1% (80-90%),

[21] The net present value of a 90% standard in the 2007, was five times as large as the standards adopted, DOE Final Rule, p. 65163.

subject to higher standards, would have been almost $13 billion over the life of the furnaces. This is a sunk harm that cannot be corrected, but it underscores how important it is to set the standard up to at least 92% as soon as possible.

This backward look at where we could have been if DOE had acted responsibly a decade ago is quite consistent with the DOE analysis of what will happen if it now adopts a standard of 92% or higher. It is time to stop the bleeding of consumers' pocketbooks. Given that furnaces last about 20 years and the standard is projected to have cumulative net savings of $20 billion, each year of delay now imposes $1 billion of unnecessary costs on consumers. Moreover, as the next section shows, the net benefit of adopting a higher standard and the harm of delay are actually much larger than the DOE analysis suggests.

III. FULL ACCOUNTING OF BENEFITS

A. UNDERESTIMATING CONSUMER POCKETBOOK BENEFITS

We believe that the DOE analysis underestimates the magnitude of the pocketbook benefits that are likely to flow from the higher standard in three ways.

- The cost of the standard is overestimated.
- Natural gas price reductions resulting from lower consumption are likely to benefit consumers.
- Reduced volatility in monthly bills is a consumer benefit.

1. Cost of Meeting the Standards

One of the strongest findings of the empirical literature on energy efficiency standards is its support of the theoretical expectation that technological innovation and market processes during the implementation of standards will drive down the cost of improving energy efficiency. A comprehensive review of *Technology Learning in the Energy Sector* found that energy efficiency technologies are particularly sensitive to learning effects and policy.

> For demand-side technologies the experience curve approach also seems applicable to measure autonomous energy efficiency improvements. Interestingly, we do find strong indications that in this case, policy can bend down (at least temporarily) the experience curve and increase the speed with which energy efficiency improvements are implemented.[22]

Analyses that fail to take into account the powerful processes of technological innovation and competition that lower costs will overestimate costs, undervalue innovation, and perpetuate market failure. Detailed analyses of major consumer durables — including air conditioners, and refrigerators — find that technological change and pricing strategies of producers lower the cost of increasing efficiency in response to standards.

1. For the past several decades, the retail price of appliances has been steadily falling while

[22] Junginger, Martin, et al., 2008, *Technological Learning in the Energy Sector,* Universities Utrach and Energy Research Centre of the Netherlands, Kiso, Takashiko, April 2009, *Environmental Policy and Induced Innovation: Evidence from Automobile Fuel Economy Regulation.*,

efficiency has been increasing.

2. Past retail price predictions made by the DOE [U.S. Department of Energy] analysis of efficiency standards, assuming constant price over time, have tended to overestimate retail prices.

3. The average incremental price to increase appliance efficiency has declined over time. DOE technical support documents have typically overestimated the incremental price and retail prices.

4. Changes in retail markups and economies of scale in production of more efficient appliances may have contributed to declines in prices of efficiency appliances.[23]

Figure 5 shows the systematic overestimation by regulators of the cost of efficiency-improving regulations in consumer durables. The cost for household appliance regulations was overestimated by more than 100 percent and the costs for automobiles were overestimated by roughly 50 percent. The cost estimates from industry players were even further off the mark, running three times higher for auto technologies.[24] Broader studies of the cost of environmental regulation find a similar phenomenon, with overestimates of cost outnumbering underestimates by almost five to one. Industry figures are considered a "serious overestimate."[25]

A recent analysis of major appliance standards adopted since 2000 shows a similar, even stronger pattern. Estimated cost increases are far too high, as shown in Exhibit 6. There may be a number of factors, beyond an upward bias in the original estimate and learning in the implementation that produce this result, including pricing and marketing strategies.[26]

While the very high estimates of compliance costs offered by industry can be readily dismissed as self-interested political efforts to avoid regulation, they can also be seen as a worst-

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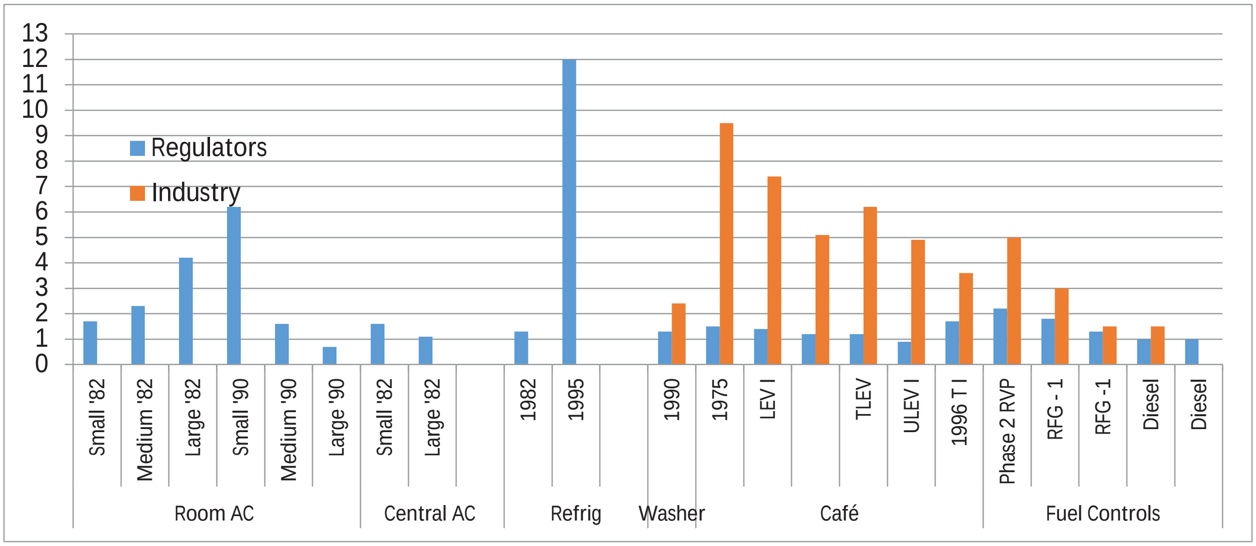
[23] Dale, Larry et al 2009, "Retrospective Evaluation of Appliance Price Trends," *Energy Policy* 37, 2009, p. 1.

[24] Hwang, Roland and Matt Peak, Innovation and Regulation in the Automobile Sector: Lessons Learned and Implications for California's CO_2 Standard, Natural Resources Defense Council, April 2006.

[25] Winston Harrington, Grading Estimates of the Benefits and Costs of Federal Regulation: A Review of Reviews, Resources for the Future, 2006, p. 3; How Accurate Are Regulatory Costs Estimates?, Resources for the Future, March 5, 2010.

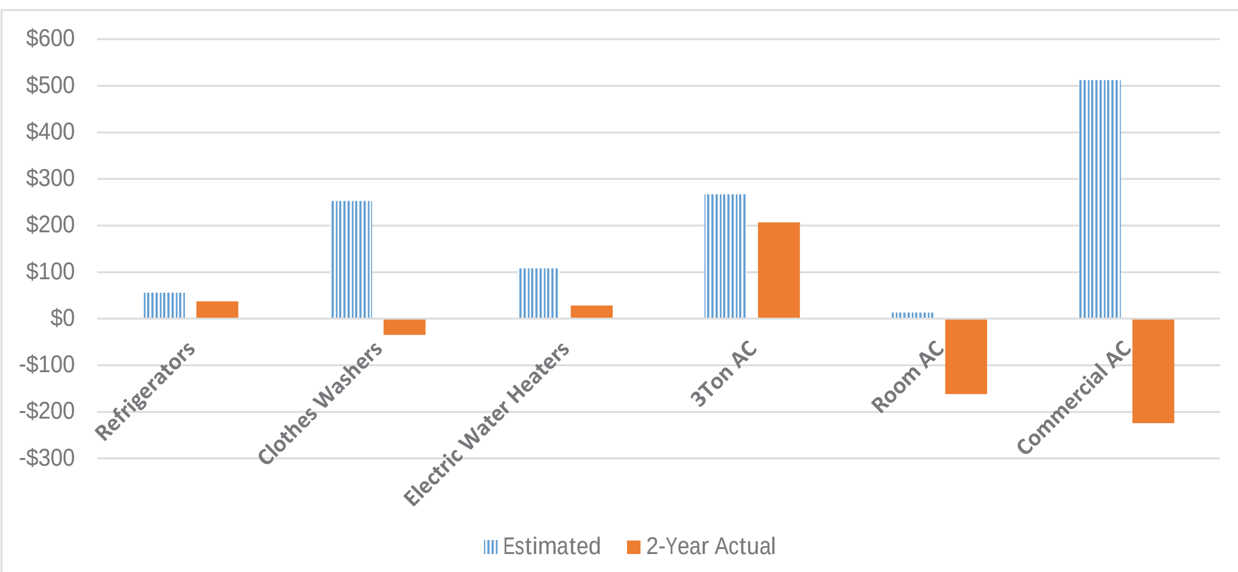
[26] Nadel, Steven and Andrew deLaski, *Appliance Standards: Comparing Predicted and Observed Prices,* American Council for An Energy Efficient Economy, July 2013.

EXHIBIT 5: RATIO OF ESTIMATED COST TO ACTUAL COST BY SOURCE



Sources: Winston Harrington, Richard Morgenstern, and Peter Nelson, "On the Accuracy of Regulatory Cost Estimates," *Journal of Policy Analysis and Management* 19(2) 2000, *How Accurate Are Regulatory Costs Estimates?,* Resources for the Future, March 5, 2010; Winston Harrington, *Grading Estimates of the Benefits and Costs of Federal Regulation: A Review of Reviews,* Resources for the Future, 2006; Roland Hwang and Matt Peak, *Innovation and Regulation in the Automobile Sector: Lessons Learned and Implications for California's CO_2 Standard,* Natural Resources Defense Council, April 2006; Larry Dale, et al., "Retrospective Evaluation of Appliance Price Trends," *Energy Policy* 37, 2009.

EXHIBIT 6: ESTIMATED AND ACTUAL COST INCREASES ASSOCIATED WITH RECENT STANDARDS FOR MAJOR APPLIANCES



Source: Nade, Steven I and Andrew Delaski, *Appliance Standards: Comparing Predicted and Observed Prices,* American Council for an Energy Efficient Economy and Appliance Standards Awareness Project, July 2013.

case scenario in which the manufacturers take the most irrational approach to compliance under an assumption that there is no possibility of technological progress or strategic response. Consistent with the empirical record on cost, a simulation of the cost of the 2008 increase in fuel economy standards found that a technologically static response was three times more costly than a technologically astute response. [27] There is no reason to believe that the supply-side of the furnace market will not perform as the supply-side of the other appliance markets have, responding to the standard with cost-cutting innovation and competition.

2. Price Effects

Increasing the efficiency of gas furnaces, a major user of the fuel, will reduce demand. Basic economics suggest that reducing demand puts downward pressure on the price. This observation is so fundamental to economic analysis that there should be no debate about it and empirical evidence supports the theory, but the DOE analysis fails to take it into account. [28]

Moreover, with a nonrenewable resource like natural gas, the importance of demand is magnified because of the limitation on the resource. The reserve to production ratio is the key driver of price, as shown in Exhibit 7. The reserve to production ratio can be increased with either an increase in reserves (as has recently happened as a result of new technology), or a decrease in consumption.

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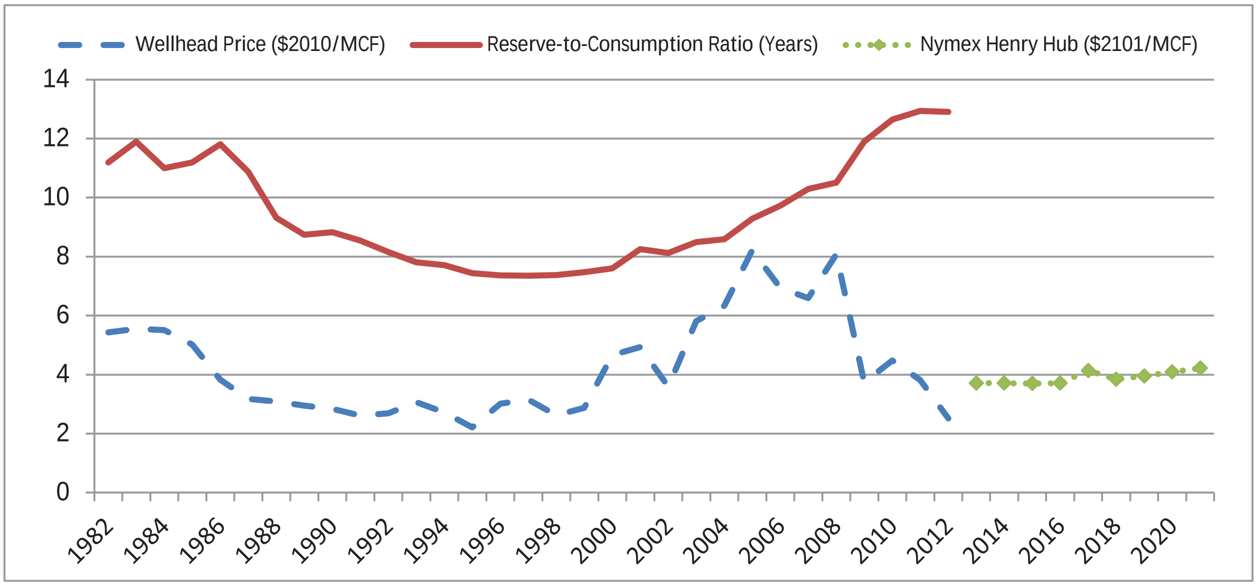
[27] Whitefoot, Kate, Meredith Fowler and Steven Skerlos, 2012, Product Design Response to Industrial Policy: Evaluating Fuel Economy Standards Using an Engineering Model of Endogenous Product Design, Energy Institute at Haas, May, pp. 1-5.'

[28] This is a longstanding weakness of DOE analysis. See Supplemental Comments of the National Consumer Law Center, Consumer Federation of America, Massachusetts Union of Public Housing Tenants, National Association of State Community Service Programs, Texas Legal Services Center Texas Ratepayers' Organization to Save Energy, and Virginia Citizens Consumer Council, *Re: Energy Conservation Standards For Residential Furnaces And Boilers*, Docket No. EE-RM/STD-Ol-350/RIN 1904-AA 78, submitted February 26, 2007, p. 2

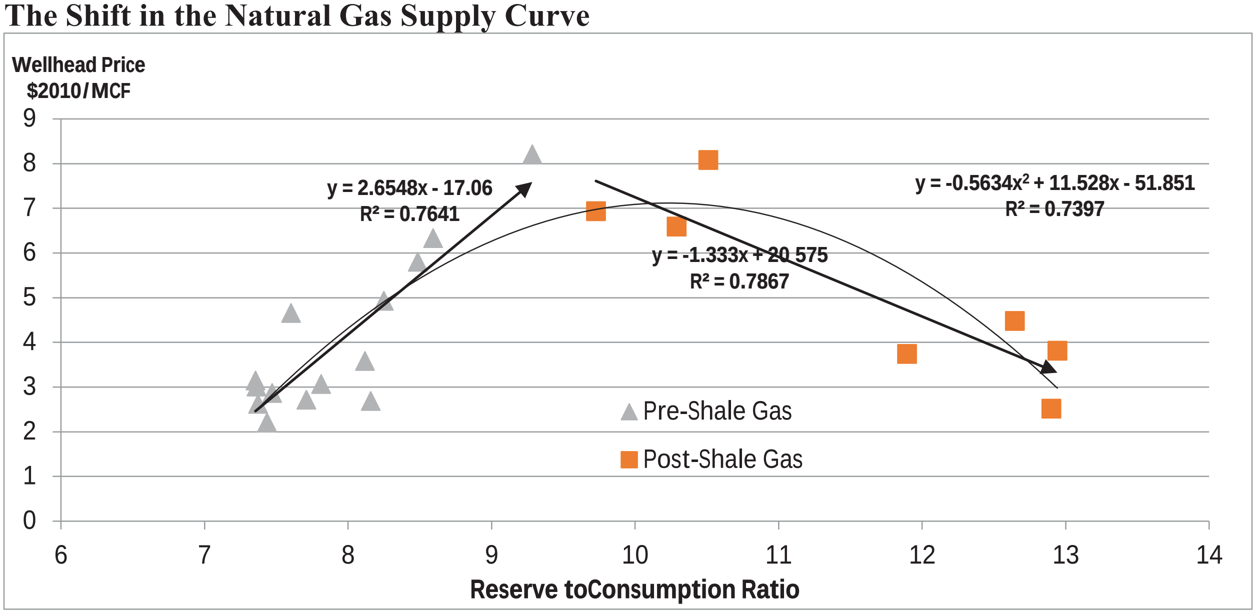
Exhibit 7 presents the natural gas price history since the decision was made to deregulate wellhead prices in the early 1980s. The correlation between reserves, consumption and price is clear. Moreover, there appears to be a sharp break at a ratio around 10 (when reserves exceed 10 years of consumption).

EXHIBIT 7: THE SHALE GAS REVOLUTION TRANSFORMS NATURAL GAS SUPPLY FUNDAMENTALS

Reserves Drive Prices on a Forward Looking Basis



The Shift in the Natural Gas Supply Curve



Sources: EIA, Natural Gas Data; Nymex Henry Hub.

Given the size of the residential gas heating market and the magnitude of the reduction in demand, the reduction in price for natural gas could easily raise the consumer pocketbook benefits significantly. Moreover, the benefit accrues to all uses of gas, not just heating. The total savings could mount to a billion dollars per year over the life of the more efficient furnaces.[29]

3. Reduced Volatility

Higher efficiency standards deliver a second consumer pocketbook benefit associated with the price of natural gas that has not been included in the DOE estimate. Natural gas wellhead prices have been volatile over the past decade (as shown in upper graphs of Exhibit 4 above). The result is a significant fluctuation in monthly bills as the price changes are passed through to consumers. This volatility makes it harder for households to manage their monthly budgets, particularly low and middle income households for whom natural gas expenditures take a significant percentage of income. By consuming less gas, the burden of volatility is dampened. The average bill over the 12 year period, shown in Exhibit 4 above, would have been reduced by about $75 and the standard deviation would have declined by about $9.

B. Other Benefits

While the DOE analysis quantifies several of the environmental and public health benefits of higher fuel efficiency, it does not take account of the single largest external benefit of lower energy bills – the macroeconomic benefit of stimulating the economy. When consumers

[29] EIA data puts residential natural gas at a little over one-fifth of total natural gas consumption and heating at about 60% of residential use. A reductions in demand of 13%, as assumed above would put the reduction due to the standard at about 1.5% of total demand. The linear estimate of the price elasticity in Exhibit 7 is -1.33, which a price reduction of 2%. Given the size of the natural gas well-head market, the value would be in excess of $1 billion.

spend less on energy, they have more to spend on other things. Expenditures on the other things tend to have higher economic multipliers, so economic growth is accelerated.[30]

The macroeconomic impact of energy policy has taken on great significance in the current round of decision making. Every policy is evaluated for its ability to stimulate growth and create jobs. Assessing the macroeconomic impact of policy choice generally relies on complex models of the economy. Economically beneficial energy efficiency investments yield net savings; the reduction in energy costs exceeds the increase in technology costs. Such investments have three effects from the point of view of the economy. The increase in economic activity resulting from spending on new technology and the increase in consumer disposable income flows through the economy, raising the income of the producers of the additional products that are purchased and increasing employment.

- The inclusion of energy efficient technologies in energy using durables increases the output of the firms that produce the technology.
- To the extent that the energy-using products are consumer durables, they increase the disposable income that households have to do other things, such as buy other goods and services.

[30] Consumer Federation of America, Performance Standards. *Energy Efficiency Performance Standards:* The Cornerstone of Consumer-Friendly Energy Policy, October 2013. (hereafter Performance Standards)

IV. MARKET IMPERFECTIONS AND PERFORMANCE STANDARDS

The engineering-economic analysis provides the first pillar on which the case for standards rests. The demonstration of potential savings leads to the next set of questions. Why have these economically beneficial investments not been made and why is a performance standard an effective response? We answer these questions with both a conceptual framework and empirical evidence.

A. Market Imperfections as the Cause of Consumer Harm in the Market for Gas Furnaces

A well-designed performance standard that raises the efficiency of gas furnaces will deliver benefits to consumers and the nation because it addresses important market imperfections that are difficult to correct with other policies. Our extensive analysis of several literatures and hundreds of studies has identified five broad categories and three dozen specific market imperfections.[31] The upper graph of Exhibit 9 identifies the broad categories and specific types of market failures that our analysis shows performance standards are adept at addressing. We described the specific market imperfections that affect the energy consumption of gas furnaces in the lower section of Exhibit 9.

The numerous, varied and significant market imperfections mean that weak, single purpose policies, like information programs, will not be effective. Stronger policies, like price increases (e.g. a gas guzzler tax), do not address many of the imperfections. Simply raising the price of natural gas may impose a great deal of cost on uses that do not suffer market imperfections, while the market imperfections in other markets sectors diminishes the impact of prices.

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[31] Consumer Federation of America, Performance Standards.

EXHIBIT 9: IMPERFECTIONS ADDRESSED BY STANDARDS: HIGHLIGHTING FACTORS AFFECTING DIGITAL DEVICES

SOCIETAL FAILURES	STRUCTURAL PROBLEMS	ENDEMIC FLAWS	TRANSACTION COSTS	BEHAVIORAL FACTORS
Externalities Public Goods Coordination Information	Scale/ fragmentation Bundling Utility profit incentives Installer skill	Agency – split incentives Lack of Capital	Sunk Costs Risk Uncertainty Imperfect Information	Motivation Calculation/ Discounting

The Gas Consumption of Furnaces is a Particularly Difficult Problem for the Marketplace to Solve.

Externalities: Ultimately, the benefit of reducing energy consumption has value beyond the benefit that each individual directly enjoys from reduced energy consumption (environmental, public health, and market processes like consumption externalities, learning by doing, coordination and network effects, a public goods problem).

Market Structure: Market characteristics can reduce the incentive to invest in economically beneficial technologies. Utilities profit from increased sales and have little incentive to promote conservation. The housing market, and therefore the furnace market, is fragmented. Financial practices reduce the appropriability of gains from efficiency investments. Quality installation of high efficiency products is challenging.

Agency: The builders and landlords make the key decisions about energy consumption by choosing the durables 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. The supply-side interests are separate and different from the consumers' interests (split incentives problem).

Bundling and Access to Capital: Owners and landlords tend to focus on the primary product attributes and the first cost of the consumer durable, ignoring the life cycle cost (i.e. the total of acquisition and operating costs) since they do not pay the energy bills.

Risk: Moving efficiency into mass market products runs the risk of being underpriced by inefficient products. Learning new installations is challenging.

Imperfect Information: Installers lack information and skills with higher technologies in some situations. Consumers do not know how to calculate the economic benefit of long-lived durables or judge the quality of the installation.

Motivation/Calculation: Consumers frequently make replacement decisions under severe time constraints. 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 based on long-term price predictions. The information is either not readily available or the transaction cost of obtaining it is high (information and transaction cost problems).

Source: Categories, Consumer Federation of America, Performance Standards. *Energy Efficiency Performance Standards:* The Cornerstone of Consumer-Friendly Energy Policy, October 2013

B. LOW INCOME CONSUMERS

The analysis of market imperfections also reinforces the conclusion that low income households will not be disproportionately harmed by raising the standard. If anything, they will benefit more than other groups.

While low income consumers occupy older housing with less efficient furnaces, they are also more likely to be renters, so the low income segment suffers from a severe split incentives problems.[32] Landlords do not pay heating bills and they tend to keep first costs down. Therefore, they are more likely to underinvest in energy efficiency. Low income households would benefit more from a standard that makes the landlords do the right thing.

Landlords may also not be able to pass the costs of the more efficient appliances through to consumers. Their ability to do so may be restricted by the fact that the cost increase would apply to a small part of the rental market. There may also be rent eligibility formulas that limit the ability to increase rents to cover the costs of the more efficient equipment, or simply, raising the rent will make their rentals less competitive.

In addition, landlords may also realize that the incremental cost increase of a more efficient furnace spread out over the life of the product amounts to just a few dollars per month.

C. Well-designed Performance Standards

Exhibit 10 identifies the characteristics associated with effective standards. The key point about performance standards is they establish a minimum level of efficiency but they do not dictate the technology. We generally prefer performance standards because they command, but they do not control.

Our analysis shows that performance standards work best when they address clear market imperfections which lead to market failure. They work best when they are technology-neutral,

[32] Erica Myers, "Asymmetric Information in residential Rental Markets: Implications for the energy efficiency gap." Energy Institute Haas School of Business, University of California, Working Paper WP 246, February 2015, cited in Building Technologies Office, Impact of Standards on Low Income Renters, eere.energy.gov, Larry Dale, Transcript of the Public Meeting, Energy Conservation Standards for Residential Furnaces, April 13, 2015, pp. 9-14.

product neutral and pro-competitive. Producers can design and deploy products to meet the standard as they see fit. They will do so by choosing the least cost approach available to them. Different manufacturers will have different skill sets or different product lines and choose different technologies. Well-designed performance standards give market certainty to stimulate adoption of cost effective energy saving technologies. Standards must also be reasonable in relationship to what can be technologically accomplished. If they go too far, impose costs that are too large or require technologies that cannot be developed or delivered in the necessary time frame that can do harm, rather than good.

EXHIBIT 10: MARKET IMPERFECTIONS AND PERFORMANCE STANDARDS

Key Design Features of Effective Performance Standards

Technology-neutral: Taking a technology neutral approach to the long term standard unleashes competition around the standard that ensures that consumers get a wide range of choices at that lowest cost possible, given the level of the standard.

Product-Neutral: Attribute-based standards accommodate consumer preferences and allow producers flexibility in meeting the overall standard.

Procompetitive: All of the above characteristics make the standards pro-competitive. Producers have strong incentives to compete around the standard to achieve them in the least cost manner, while targeting the market segments they prefer to serve.

Long-Term: Setting an increasingly rigorous standard over a number of years that covers several redesign periods fosters and supports a long-term perspective. The long term view lowers the risk and allows producers to retool their plants and provides time to re-educate the consumer.

Responsive to industry needs: Recognizing the need to keep the target levels in touch with reality the goals should be progressive and moderately aggressive, set at a level that is clearly beneficial and achievable.

Responsive to consumer needs: The approach to standards should be consumer-friendly and facilitate compliance. The attribute-based approach ensures that the standards do not require radical changes in the available products or the product features that will be available to consumers.

Source: Consumer Federation of America, Performance Standards. *Energy Efficiency Performance Standards:* The Cornerstone of Consumer-Friendly Energy Policy, October 2013

We believe the proposed standards possess these characteristics. The levels of efficiency and products are widely available in the market. The lead time is more than adequate. The one unique characteristic of the standard is that the higher levels require a different technology (condensing furnaces) because the non-condensing furnaces simply cannot perform much better.

The physics of the furnace require shifting to a new technology to achieve efficiencies above 90%. Manufacturers can implement the technology in different ways, however.

D. THE TRACK RECORD OF APPLIANCE ENERGY PERFORMANCE STANDARDS

1. Impact on Efficiency

The track record of efficiency standards for household consumer durables is excellent and the performance of the furnace market is quite deficient with respect to energy efficiency. Exhibit 11 shows the record of five consumer durables since the late 1980s. Data on the efficiency of these devices has been compiled since then and it covers the period in which natural gas prices were deregulated. Efficiency is measured as the decline in energy use compared to the base year, which is set equal to 1.

Examining the trends for individual consumer durables in Exhibit 11 suggests three important observations.

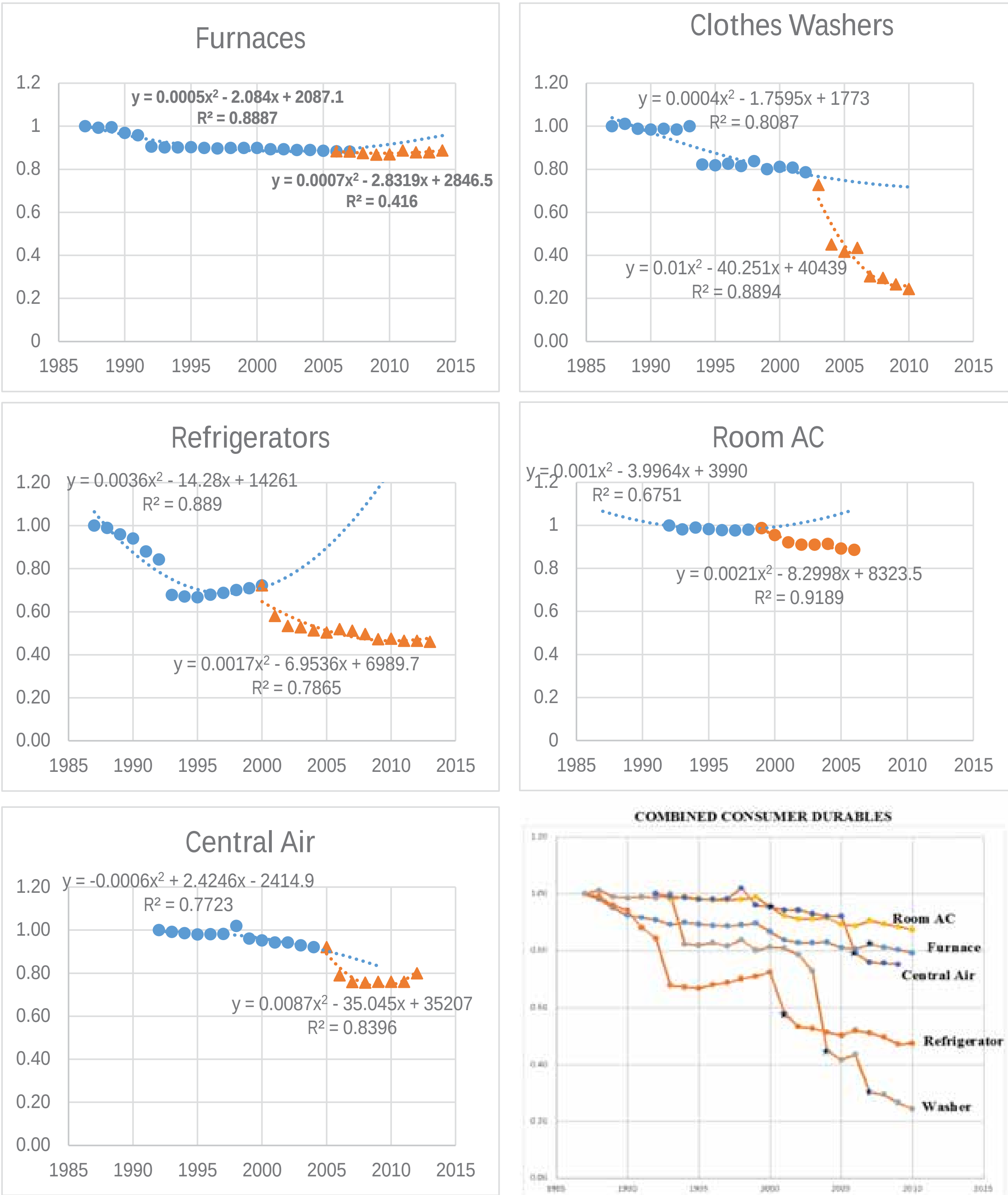
First, the implementation of standards improved the efficiency of the consumer durables.

Second, furnaces have been far less efficient than they should have been, since, as we have noted, DOE has set weak standards.

Third, after the initial implementation of a standard, the improvement levels off, suggesting that if engineering-economic analysis indicates that improvements in efficiency would benefit consumers, the standards should be strengthened on an ongoing basis.

Exhibit 12 shows the results of econometric analysis of the data underlying Exhibit 11. It shows that what is obvious to the naked eye in the bivariate relationships in Exhibit 11 (stricter standards as set by DOE lead to measurable improvements in appliance efficiency) are statistically valid when rigorous controls are introduced into multivariate regression analysis.

EXHIBIT 11: APPLIANCE EFFICIENCY STANDARDS AND TRENDS (BASE YEAR EFFICIENCY = 1; ▲ = NEW STANDARD)



Source: Nadel, Steven and Andrew deLaski, *Appliance Standards: Comparing Predicted and Observed Prices,* American Council for An Energy Efficient Economy, July 2013; Steven Nadel, Neal Elliott, and Therese Langer *Energy Efficiency in the United States:35 Years and Counting,* June 2015

We have built this analysis in the typical way that multivariate regression analysis is conducted. The dependent variable is energy consumption with the base year set equal to 1. Later years had lower values.

We measure the trend of efficiency improvements by including the year as trend term.

EXHIBIT 12: MULTIVARIATE ANALYSIS OF STANDARDS

Variable	Statistic	5-years before/after			All Year			
		1	2	3	4	5	6	
Standard	β	-.1637	-.1386	-.1086	-.2260	-.1079	-.0803	-
	Std. Err.	(..0485)	(.0587)	(.0382)	(.0366)	(.0414)	(.0227)	
	p <	.000	.023	.007	.000	.010	.001	
Trend	β	NA	-.0053	-.0111	NA	- .0107	-.0135	
	Std. Err.		(.0081)	(.008)		(.0026)	(.0019)	
	p <		.51	.176		.000	.000	
Refrig	β	NA	NA	-.2775	NA	NA	-.2242	
	Std. Err.			(.0382)			(.0289)	
	p <			.000			.000	
Washer	β	NA	NA	-.2889	NA	NA	-.2144	
	Std. Err.			(.0561)			(.0391)	
	p <			.000			.000	
RoomAC	β	NA	NA	.0478	NA	NA	-.0895	
	Std. Err.			(.0642)			(.0321)	
	p <			.383			.009	
CAC	β	NA	NA	-.0050	NA	NA	.0383	
	Std. Err.			(.0292)			(.0260)	
	p <			.864			.143	
R^2	.20	.21		.85	.29	.36	.75	

Statistics Beta coefficient and robust standard errors.

We introduce a variable to represent the adoption of a standard. This variable (known as a dummy variable) takes the value of 1 in every year when the standard was in place and a value of zero when it was not. A negative number means that the years in which the standard was in force had lower levels of energy consumption.

Similarly, the difference between appliances is handled with dummy variables. We include each appliance except furnaces, which shows how the other appliance performed compared to furnaces. Again, a negative number means that the other appliances had lower levels of energy consumption.

The impact of standards is statistically significant and quantitatively meaningful in all cases. The coefficient in column 6 (All Years, All Variables) indicates that the standard lowers the energy consumption by about 8%. This finding is highly statistically significant, with a probability level less than .0001. There is a very high probability that the effect observed is real.

The underlying trend is also statistically significant, suggesting that the efficiency of these consumer durables was improving at the rate of 1.35% per year. Given that the engineering-economic analysis had justified the adoption of standards and that standards were effective in lowering energy consumption, this means the market trend was not sufficient to drive investment in efficiency to the optimal level.

Comparing the models with shorter terms to the all year model is consistent with the earlier observation. The impact of the standard is greater (almost 11% in column 3) because we have eliminated the out years where the effect of the standard has worn off. The impact of the trend is slightly smaller (1.1% per year) but the statistical significance is greatly affected by shortening the period because we truncate the trend.

2. Price

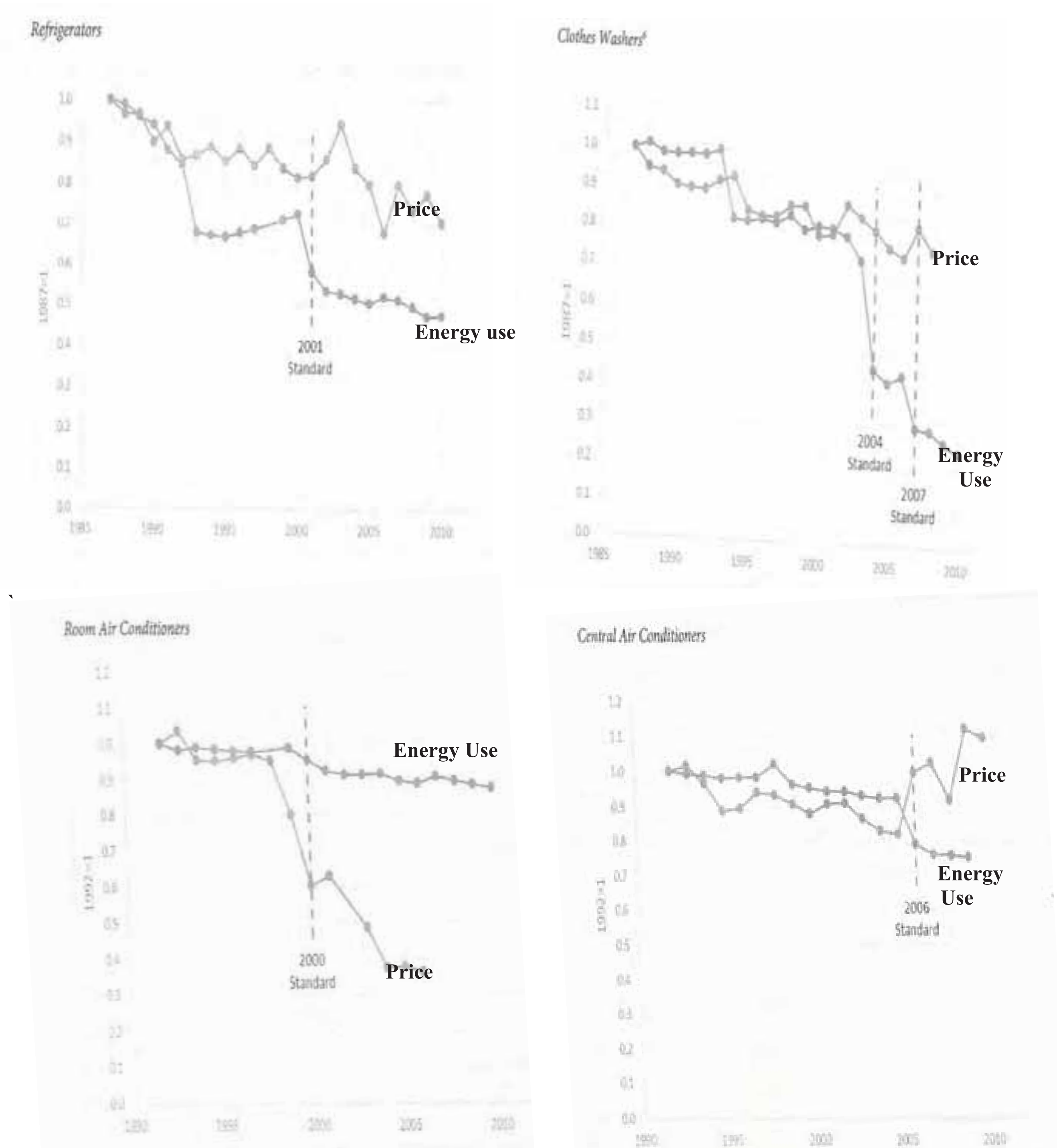
The engineering-economic analysis indicates that although the standards may increase the cost of the consumer durable, the reduction in energy expenditures is larger, resulting in a net benefit to consumers. We have also pointed to evidence that the costs of energy saving technologies tends to be smaller than the *ex ante* analysis suggests because competition and other factors lower the cost. The experience of the implementation of standards for the household consumer durables is consistent with this interpretation.

While the efficiency was increasing, the cost of the durables was not, as shown in Exhibit 13. There are five standards introduce for the four appliances in Exhibit 13. In three of the cases – refrigerators, clothes driers (second standard) and room air conditioners – there was a slight increase with the implementation of the standard, then a return to pre-standard downward trend. In one case – clothes driers (first standard) – there was no apparent change in the pricing pattern. In one case (central air conditioners) there was an upward trend, which may be explained by a surge in metal prices during that period.

We do not mean to suggest that the price increase was too big, compared to the engineering-economic analysis or that the standards lowered costs, although there are theories that would support such a theory (i.e. suppliers take the opportunity of having to upgrade energy efficiency through redesign to make other changes that they might not have made). However, this does indicate that the standards can be implemented without having a major, negative impact on the market. The analysis of consumer durables also shows that there was no reduction in the quality or traits of the products. The functionalities were preserved while efficiency was enhanced at modest cost.[33]

[33] Nadel, Steven and Andrew deLaski, *Appliance Standards: Comparing Predicted and Observed Prices,* American Council for An Energy Efficient Economy, July 2013; Consumer Federation of America, Performance Standards.

EXHIBIT 13: PRICE TRENDS AND STANDARDS



Source: Steven Nadel and Andrew deLaski, *Appliance Standards: Comparing Predicted and Observed Prices,* American Council for An Energy Efficient Economy, July 2013;

V. TIERING THE STANDARD TO INCREASE CONSUMER NET BENEFITS

Over the course of more than a decade, Joint Commenters have advocated steps to regionalize the standard to recognize the wide disparity in heating laods or engage in a waiver process to allow situations with uniquely challenging deployment problems to be exempt from the higher standard. The DOE felt that the former was inconsistent with the statute, the industry complained about the latter. In these comments we provide an anlysis of a different approach, which is clearly legal and meets the needs of consumers and industry. We show that a tiered approahc in which small furnaces (up to 50,000/Btu/hour) remain subject to the current standard addresses many concerns, without undermining the value of the standard. Indeed, with a tiered approach to alleviate negative impacts of the standard, the level of efficiency for the vast majority of furnaces can be raised to 95% AFUE.

A. DEVELOPING A MODEL OF FURNACE SIZE

We use a rule of thumb calculator based on climate zones and house square footage (Exhibit 14). The climate zones used in the rule of thumb map are the American Institute of Architets zones that RECS used in 1978-2005. However, in 2009, the DOE introduced a slightly different climate zone, as shown in the lower graph of Exhibit 14. Since both were included in the RECS 2009 data set, both can be used to estimate recommended furnace sizes.

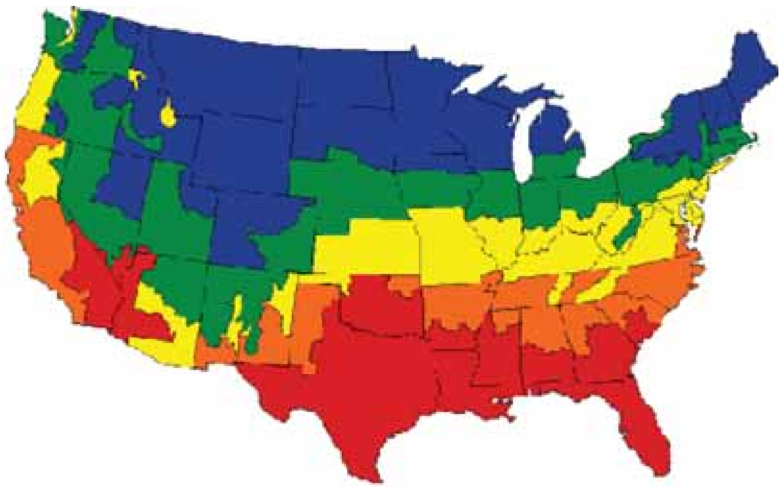
The euqation is: Capacity = Square Footage * Heating Factor/ Efficiency

For the practical purpose of examining the impact of allowing small furnaces to remain at the current standard level, we used the RECS data to estimate the recommended furnace capacity based on the climate zone and the size of the house (AIAZone Value x Total Heated Footage). We used the high level of consumption in the rule of thumb in Exhibit 14, since it is a backward looking analysis.

EXHIBIT 14:

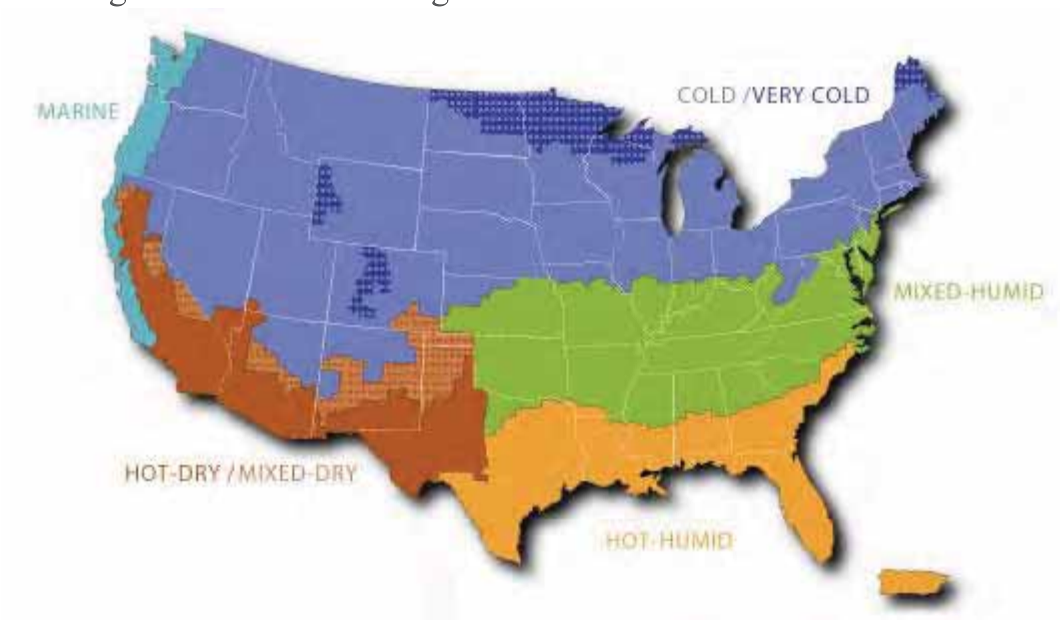
FURNACE SIZING CALCULATOR

Heating Square Footage Range by Climate Zone				
ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5
30 - 35 Btu's per square foot	35 - 40 Btu's per square foot	40 - 45 Btu's per square foot	45 - 50 Btu's per square foot	50 - 60 Btu's per square foot



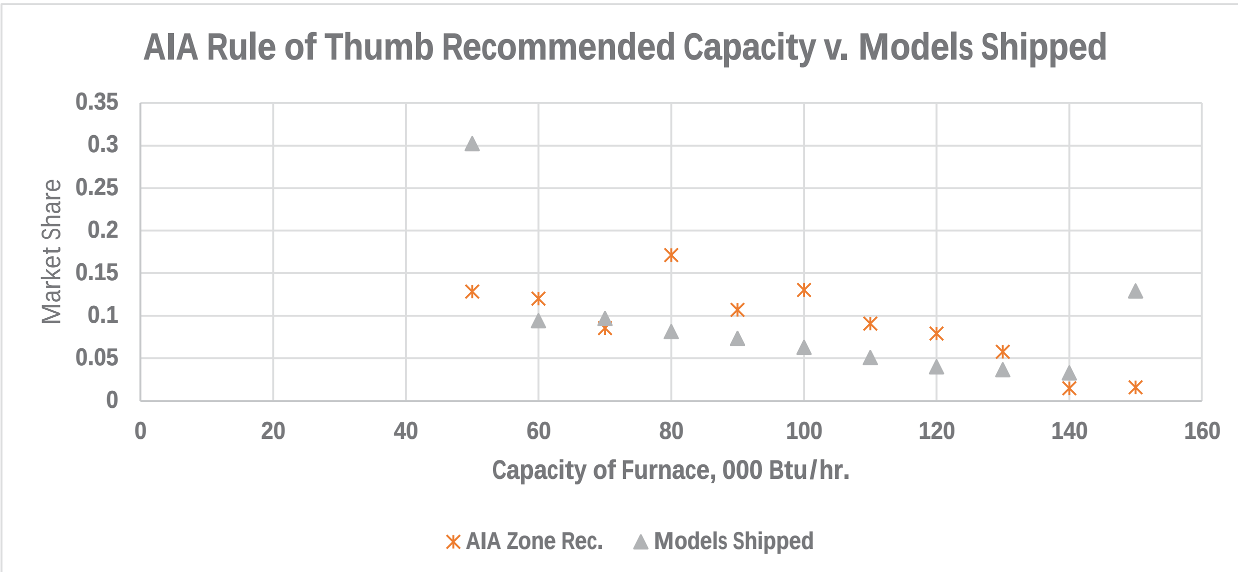
http://www.acdirect.com/gas-heat-learning-center-furnace-sizing-calculator

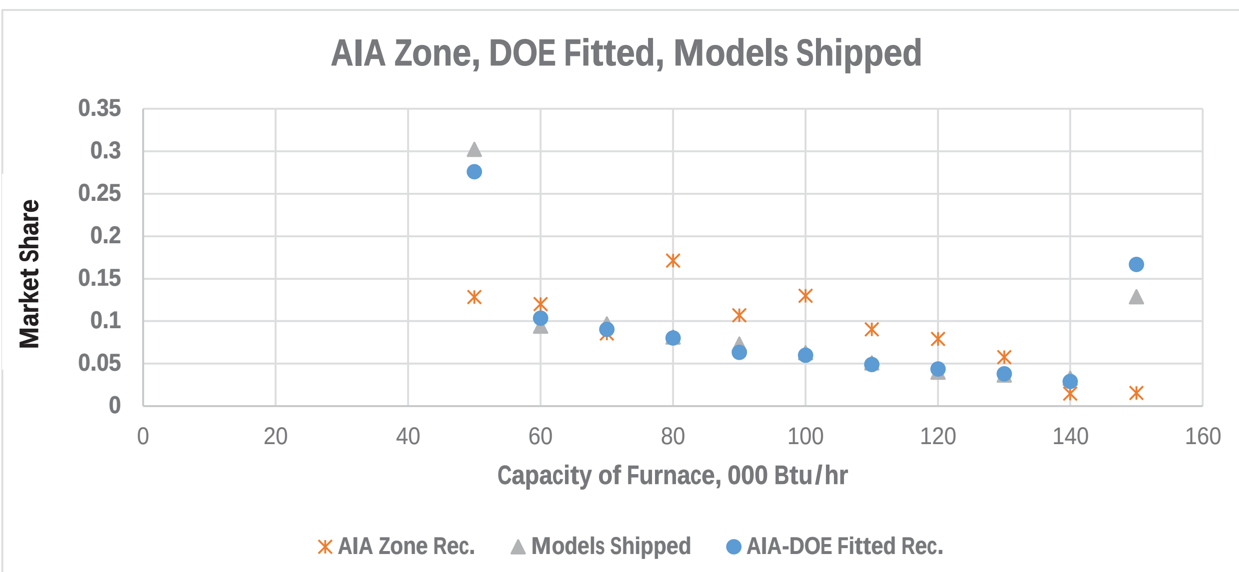
Building America Climate Regions — RECS 2009



The upper graph in Exhibit 15 shows the results. The recommended capacities are "off" in two areas. The rule of thumb applied to the AIA Zones predicts many fewer small furnaces and large furnaces. The former is a serious concern for this analaysis, as we want to estimate the number of furnaces that would be exempt by setting s size threshold. Moreover, because capaocity is correlated with usage and usage is the driver of benefits, the smaller furnaces are likely to be where the consumers who suffer net costs as a result of the rule are likely to be.

Exhibit 15:





Source: RECS 2009, Data.

To evaluate the implications of exempting smaller furnaces, we developed a "fitted" predictor of capacity. The result of that effort is shown in the lower graph of Exhibit 15. It is much closer to the distribution of models shipped. To arrive at this outcome, we took the following approach.

We cross tabulated the AIA and DOE climate categorizations and built an 11 point scale. All cells with fewer than 50 observations were excluded because the small number makes them erratic. The upper graph in Exhibit 16 shows the crosstabulation with the percentages of households in each category used. The lower graph shows the value used for estimating capacity (upper number) and the average consumption of natural gas for heating for all houses in that category.

EXHIBIT 16: CLIMATE ZONE, CAPACITY RECOMMENDATIONS AND AVERAGE GAS USE FOR HEATING (BTU/SqFt) (Percent of Houses Used to Construct the Capacity Rule)

	AIA Zone				
DOE Region	1	2	3	4	5
1	11	27	4		
2				12	3
3					6
4	19	7	1	1	
5				2	4

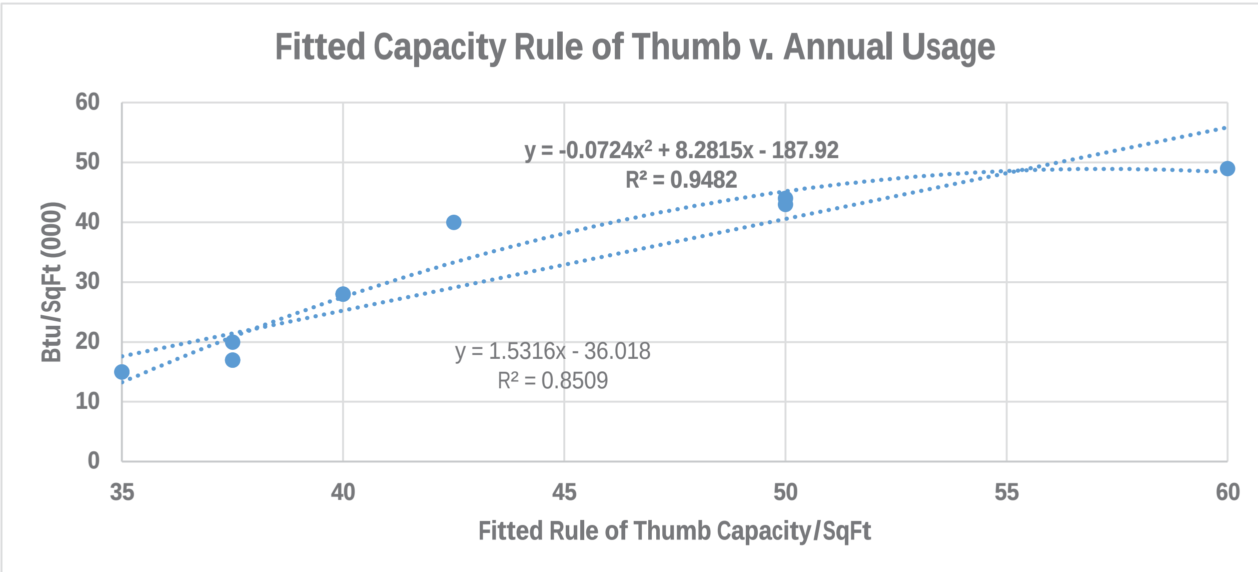
		AIA Zone				
		1	2	3	4	5
DOE Regions						
1	Rule	50	60	50		
	BTU	44	49	43		
2	Rule				37.5	35
	BTU				20	15
3	Rule					37.5
	BTU					17
4	Rule			42.5	40	40
	BTU			40	28	28
5	Rule				37.5	35
	BTU				17	15

AIA
1.Less than 2,000 CDD and greater than 7,000 HDD
2.Less than 2,000 CDD and 5,500 - 7,000 HDD
3.Less than 2,000 CDD and 4,000 - 5,499 HDD
4.Less than 2,000 CDD and less than 4,000 HDD
5. 2,000 CDD or more and less than 4,000 HDD

DOE
1.Very Cold/Cold
2.Hot-Dry/Mixed-Dry
3.Hot-Humid
4.Mixed-Humid
5.Marine

Exhibit 17 shows the correlation between average level of energy consumption per square foot and the capacity recommended per square foot. At this aggregate level, the correlation is strong.

Exhibit 17:



B. Exempting Small Furnaces (up to 50,000/Btu/hr)

Exhibit 18 shows the results of the modeling of the impact of setting a threshold to exempt furnaces from the new standard. We use the weatherized capacity estimator because 2009 was a cold winter and the housing stock is expected to become more weatherized over the next decade. We examine two key factors that have entered into the consideration of tailoring the standard – low income households and attached single family households.

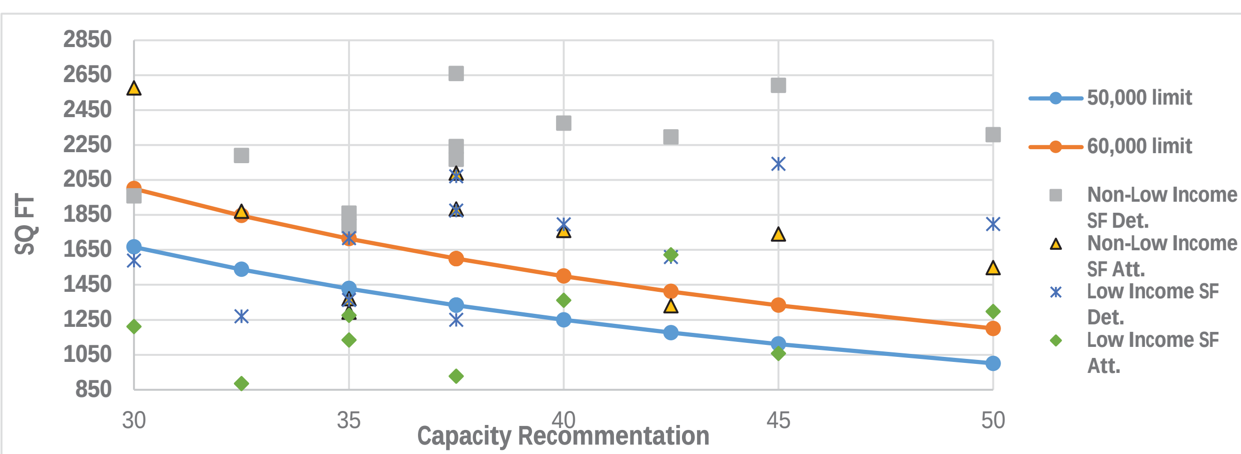
Establishing 50,000/Btu per hour would address concerns about low income households being disadvantaged by a higher standard. It also appears to address some of the concerns about attached single family residences. In mild climates, these are two market segments in which well-insulated houses can meet the need for heating with furnaces up to 50,000 Btu per hour capacity. Setting the threshold higher exempts more houses, but these are not a source of concern in terms of either the impact on occupants who are likely to bear an increase in costs or the cost of installation significant part of the attached single family problem.

C. Conclusion

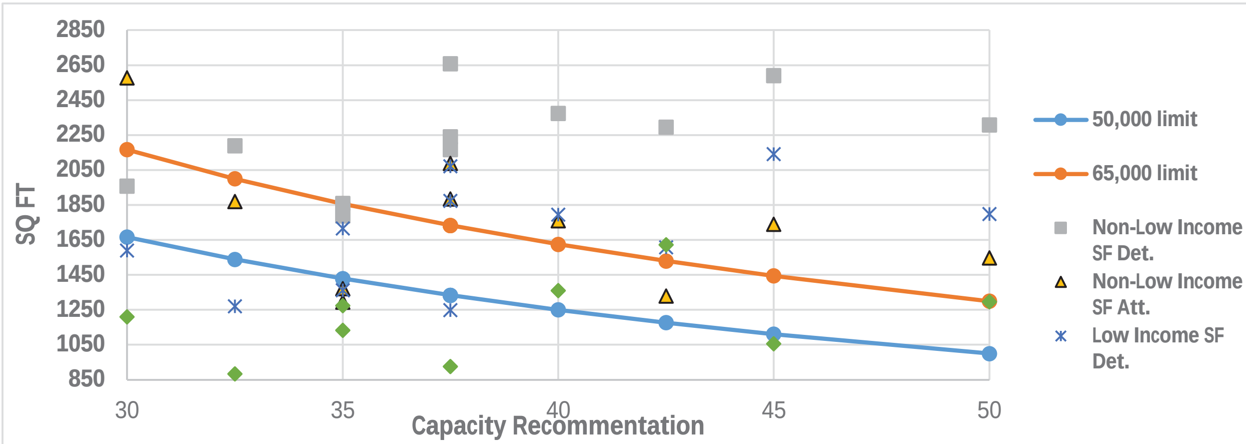
This analysis shows that increasing the minimum efficiency of gas furnace to at least 92% AFUE will benefit consumers and the nation because standards address serious market imperfections in an effective and cost effective manner. The engineering-economic analysis has shown this to be the case for well over a decade and the failure to adopt a 90%+ performance standards has imposed significant, unnecessary costs on consumers and the environment. While that harm cannot be undone, by adopting a higher standard today, future harm can be prevented. The DOE should move expeditiously to adopt such a standard, while it continues to seek approaches that will raise the overall net benefit to consumers by tailoring the standard to specific situations. However, under no circumstances should it delay the standard in pursuit of tailoring. Nor should it adopt an approach to tailoring that jeopardizes the legality of the standard. Failure to adopt a standard at 92% AFUE or higher will impose harm on the vast majority of consumers, harm that will last for decades and cost billions of dollars.

Exhibit 18: Setting Thresholds for Efficiency Tiers

50 –> 60,000 Btu/hr



50 – > 65,000 Btu/hr



50 – > 70,000 Btu/hr