RFF REPORT

Comments on the US Department of Energy's Office of Energy Efficiency and Renewable Energy's Request for Information on Energy Conservation Standards Program Design

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FEBRUARY 2018

RESOURCES FOR THE FUTURE

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1. Introduction

Beginning shortly after the energy crises of the 1970's with the passage of The Energy Policy and Conservation Act of 1975 (EPCA), federal regulators at DOE have been charged with setting minimum energy efficiency standards for an expanding set of appliances and different types of equipment to help reduce the energy demands and costs of using that equipment and promote energy security. In recent years the justification for these appliance and equipment energy conservation standards has expanded to include emissions reductions including emissions of CO_2 that contribute to global warming. In general, these standards are implemented as minimum standards that all appliances in the relevant product category must meet by a certain date. Compliance with the standards is demonstrated using test procedures prescribed in the standards and under a subsequent law passed in 1987 standards are scheduled to be reviewed every six years.

As the DOE looks ahead to the next phase in setting energy conservation standards, they are considering introducing flexibility mechanisms such as tradable performance standards or feebate approaches that could reduce compliance costs or maintain greater consumer choice while achieving important efficiency gains on average. To help in that assessment of future improvements, the Office of Energy Efficiency and Renewable Energy (EERE) has issued a request for information regarding what types of flexibility mechanisms among the relevant options are best suited to the appliance and equipment energy conservation standard setting. They are seeking information regarding impacts of flexible approaches on compliance costs, potential energy savings, incentives for innovation by manufacturers and on consumers. EERE is also seeking suggestions for an initial pilot program that focuses on a flexible approach and for guidance on how to evaluate and learn from such a pilot.

2. Benefits of Flexibility Mechanisms

The request for information outlines some of the more prominent market-based mechanisms for adding flexibility including feebates and credit trading. Feebates offer a way to pay for manufacturers to be rewarded for performance beyond the standard and a way to pay a fee for efficiency performance below the standard if meeting the standard is too costly for the firm. Credit trading allows firms to demonstrate excess performance, in terms of either lifetime energy use below that implied by the standard or some measure of energy use intensity (energy use per unit of energy services), and be rewarded for that performance the form of credits that can be traded across models, with other manufacturers or potentially across appliances. Both of these approaches provide flexibility for manufactures and could increase program benefits by lowering costs or enabling greater efficiency at a given level of cost.

These types of flexibility mechanisms have the potential to address particular types of inefficiencies associated with the current system of appliance specific standards. One such inefficiency is the incentive to meet the standard but not exceed it. With fixed standards, appliances are required to just meet the standard level, but are not rewarded for exceeding the standard even if this could save energy. This minimum threshold approach can result in the bunching of appliances right above the standard cutoff level. This bunching can result in the marginal cost of reducing energy usage varying significantly across models indicating that the same level of average energy efficiency for the fleet of appliances could be achieved at a lower cost. For example, it may be inexpensive to reduce the energy usage of one refrigerator model beyond the minimum efficiency standard, but there are no incentives for the manufacturer to exceed the standard since there are no rewards to this incremental effort.[1] Conversely, other models may be made more expensive by the requirement to meet a common specific standard level.

The effect of inflexible standards on producer behavior has been studied in the car market with fuel-economy standards that are based on secondary attributes of a car such as weight. For example, Japan sets fuel economy targets for specific car models, but lessens those requirements for heavier cars. Research shows that car manufacturers frequently increased the weight of their car models in order to lessen their fuel economy requirements. Car manufacturers also bunched their models right above a standard requirement. These distortions were found to reduce the benefits of the Japanese fuel-economy standards. (Ito and Sallee 2018). This type of response in the car market suggests that bunching or other distortionary behavior may be happening with our current system of rigid appliance standards. For example, the minimum standard for refrigerators is based partially on the size of the unit, which might give manufactures an incentive to increase the size of some units in order to reduce the cost of complying with the standard.

One cost of flexible standards is the need to collect data on appliance sales from manufacturers. Currently, appliance manufactures only need to verify that each model they are selling complies with the minimum standard. Under a flexible standard, appliance manufactures would need to report total sales by model and, depending on the form of the standard and the scope of the trading that is allowed, estimated energy usage by model to the program administrator to prove that they are in compliance. The program administrator would then need to calculate average energy usage, which can become a nontrival exercise if the standard has multiple flexibilities. The additional data would be advantageous from a program design perspective since it would provide more information on the appliance market. It does, however, come with administrative costs that must be balanced against the benefits of the program.

Another challenge for DOE associated with implementing flexible standards is that such an approach may not be consistent with the existing statute, which calls for a minimum energy conservation standard and appears to preclude the averaging provisions allowed for in the case of fuel economy standards for vehicles. If this legal requirement is binding, implementation of a flexible approach would require congressional action. One potential way to avoid going back to the congress might be to combine minimum efficiency standards, perhaps based on existing standards, that would apply to all appliances of a particular type with a flexibility mechanism such as a tradable standard or feebate to enable further increases in energy efficiency beyond the minimum requirement. This combined approach would also prevent any backsliding in the stringency of the standards, which is also prohibited in the enabling statute (Chester Energy and Policy 2017).

3. Approaches to Evaluation

To fully understand the costs savings from moving to flexible standards, one would ideally like to know the costs associated with the current approach. The federal government conducts ex ante analyses of expected engineering costs and energy savings benefits of new standards before they are introduced

[1] Energy star does provide credit for exceeding the standards by a fixed amount, but it still creates the same threshold effect at the higher standard level.

(e.g. Energy Conservation Program (2010)), but it is hard to measure the costs of the current inflexible appliance standards empirically. There are no reasonable counterfactual situations without standards against which to compare the existing system because standards are typically implemented simultaneously at the national level. As a result, there is no control group against which to compare the standards policy. Without empirical evidence, economic theory and ex-ante modeling are useful when considering the costs and benefits of introducing flexibility into rigid performance standards.[2]

Economic theory and modeling come together in the development of a policy simulation model of appliance markets for purpose of evaluating the transition from a minimum standard to a crediting standard or other flexible approach. The model simulation option is able to provide empirical outcomes based on theoretically grounded assumptions about aspects of consumer and producer behavior. This approach can be used to evaluate a policy change that has either already taken place or has yet to occur.

Developing and exercising a simulation model involves several steps. The first step is building a theoretical model of the appliance market that represents both consumer and producer behavior. A standard approach is to assume that appliance demand is derived from consumers making decisions based on utility maximization. Individual consumers value attributes of the appliances they buy (e.g., energy efficiency), and make utility maximizing purchase choices based on the bundle of attributes of each product. Consumer behavior is then aggregated to the market level to obtain total sales of each product. Producers in imperfectly competitive markets are typically modeled as making price and attribute decisions for their products to maximize profits subject to any regulatory constraints such as the current minimum energy efficiency standard or an alternative flexible approach. In doing so each producer takes into account consumer demand and the decisions made by other producers when making their own decisions. In equilibrium, all producers are maximizing profits.

The second step is to either calibrate or estimate the model's parameters. This step involves gathering lots of data and access to data can be challenging for both the producer and consumer sides of the market.[3] One parameter that is critical to evaluating energy efficiency standard design is consumer willingness to pay for energy efficiency improvements. This parameter can be calibrated based on estimates from existing studies. Or it can be estimated based on the assumptions of consumer demand and data on appliance sales, transaction prices, and attributes. Houde (2014) is a recent example of an approach taken to estimate willingness to pay with appliance market data.

The third step is to compute a benchmark market equilibrium that represents the status quo without a policy change. This step

[2] Houde and Spurlock (2015) exploit changes in the level of standards overtime and a large proprietary data set of appliance sales to look at the impacts of changes in appliance standards on measures of appliance quality and on prices.

[3] Because consumers register their automobiles for operation on the road, there is abundant data on cars for economic researchers to use in developing such models. No such requirement exists for appliances, so data on appliances must typically come from other, proprietary sources. Having a tradable standard would involve collection of more data from manufacturers that might help with the parameterization of such simulation models. Getting data from producers on costs to them remains a challenge.

requires computing producer decisions based on the calibrated or estimated parameters. The benchmark serves as a comparison to any policy change, so that the simulated effects of a policy change are relative to this benchmark.

The fourth step is to simulate a policy change. For evaluating a crediting standard, this would involve replacing the minimum standard with a crediting standard in the producer profit maximization problems, and recalculating producer decisions based on the new set of producer problems. These new decisions yield a new vector of appliance sales and attributes, as well as measures of consumer welfare and producer profits. The simulated effects of the policy change are obtained by taking the difference between the simulated outcomes and the benchmark outcomes.

Although these steps require a substantial amount of effort to complete, the value from this approach cannot be understated. A key benefit is that many different simulations can be performed to assess the relative efficacy of each approach. For example, one simulation could be of a feebate policy, and a direct comparison can be made between a feebate and a crediting standard. Another simulation could be allowing manufacturers to trade credits with one another. These comparisons are made available from the flexibility of the model simulation approach.

4. Lessons from Flexible Efficiency Standards for Vehicles

Other sectors, especially transportation, have been regulated with flexible standards. Currently, light, medium, and heavy duty vehicles must meet both fuel economy and greenhouse gas (GHG) standards. Corporate average fuel economy (CAFE) standards for light duty vehicles require vehicle manufacturers to sell vehicles that achieve an average fuel economy. A parallel GHG standard has been in place since 2012, where a manufacturer's fleet must achieve an average per-vehicle level of emissions less than or equal to a specified GHG requirement. Certain vehicles in the manufacturer's fleet may fall below the CAFE standard as long as other vehicles are above the standard so that the average fuel economy meets the standard. This provision provides manufacturers with flexibility to sell a variety of vehicles to meet heterogeneous consumer demand. The standards are differentiated by two body type categories (cars and light trucks), and since 2012 they have been defined by vehicle footprint, which is the area between a vehicle's wheels. These features further provide manufacturers flexibility to meeting the standards. The standards currently provide many additional forms of flexibility, most of which have been motivated to help reduce compliance costs to manufacturers.

New forms of flexibility since 2012 are crediting provisions. These provisions award credits to manufacturers for over compliance. The credits can be banked for future years; they can be traded across fleets within the same manufacturer; or they can be traded among different manufacturers. Leard and McConnell (2017) review these provisions, focusing on the efficacy of the credit trading provisions. They find that the volume of credit trading was initially small, but has increased dramatically in the last few years. It appears that it has taken manufacturers time to become accustomed to credit trading. This is useful experience for analyzing the potential efficacy of a possible credit trading provision for other standards: a long time window may be necessary to determine the potential for credit trading to reduce compliance costs.

For any policy considering incorporating credit trading, several possible pitfalls should be addressed in the policy design. One pitfall is the supply of nonadditional credits. These are credits that are granted to manufacturers for products that were historically above the standard, and therefore do not represent additional behavior to meet the standard. With credit trading, these credits reduce the energy savings and emissions reductions induced by the standard. In the context of CAFE standards, a few large manufacturers that had historically exceeded the standards were able to bank a large supply of credits, some of which were sold to under compliant manufacturers. Expiration dates and trading restrictions are able to limit the effects of nonadditional credits, and setting standards that are sufficiently stringent for each manufacturer may be warranted to maintain the integrity of the standards.

5. Feebates

An alternative to a flexible standard design is a feebate. Similar to a standard, a feebate sets an average target for energy efficiency, typically referred to as a pivot point. Unlike a standard, manufacturers that are under compliant in a feebate regime are penalized with a fee, while those that are over compliant are rewarded with a rebate. The fee and rebate are proportional for the level of under or over compliance, and these values are predefined, similar to a tax. Although feebates are not a popular policy in the United States, other countries have experience with this design (Roth 2013).

A major advantage of a feebate design over a standard is that a feebate provides a clear, monetary incentive for manufacturers to improve the energy efficiency of their products. This clarity comes from the fact that the values of the fee and rebates and the level of the pivot point are predefined and publicly available to all manufacturers. These values could be set one year at a time, or over many years to provide more transparency and certainty into the future. In contrast, a nontradable standard does not provide incentives for manufacturers that already over comply. A standard with credit trading does, in theory, provide the same incentives as a feebate, but in practice, this equivalence may not hold if the trading program fails to provide clear incentives to manufacturers. In the context of CAFE and GHG standards for light duty vehicles, activity under the credit trading provisions has been mysterious and not well-known. The EPA publishes credit trades made by manufacturers at a two-year lag, and no credit prices are reported. This provides manufacturers with an outdated and unclear signal regarding the value of increasing the energy efficiency of their products, reducing the efficacy of the provision.[4] This is in sharp contrast with a feebate system, which provides up-to-date and clear signals to manufacturers.

One potentially important disadvantage of a feebate approach is that it may require revenue raising authority on the part of the implementing agency. Revenues raised by the fee could be used to fund the rebate portion of the policy; however, selecting a pivot point, fee, and rebate levels that make the policy revenue neutral would be a challenge. This is because the total fees and rebates allocated over the course of a compliance period – typically a single model year – depend on product sales during the compliance period. In the context of CAFE and GHG standards, vehicle sales vary considerably from year to year due to economic factors and demand changes. More likely than not, a feebate policy would collect excess fees or grant excess rebates in a given compliance period. This would require a provision for what to do with the excess or how to fund the shortfall.

[4] This lack of transparency could be remedied if EPA were to publish more information about trades and transaction prices of credits.

Despite many of the benefits of a feebate system, feebates can be politically challenging to implement because they can require additional authority than the existing statutes provide. Tradeable credit systems are able to add a similar level of flexibly without many of the political complications.

6. Design Features of Tradeable Credit Systems

There are a number of choices that must be made in designing a tradeable credit system. An important initial choice is the scope of the trading program. A program with a wide scope would set an industry wide appliance standard that allowed trading across different types of appliances and across all of the firms in the market. A program with a limited scope might set the standard to just one type of appliance and not allow trading across manufacturers. A wide scope for trading creates more potential gains from trade. For example, if improving the energy efficiency of water heaters is cheaper than for refrigerators, a flexible standard that allows trading can achieve the same level of overall energy savings at a lower cost. This type of flexibility can also introduce complications that can undermine program benefits. Due to some of the potential problems with expansive credit trading programs, we suggest limiting the scope of the standards to be at the appliance category level.

There are a number of reasons why limiting the scope of trading to within a single appliance category is advisable. One key challenge in designing a tradeable credit system is accurately estimating the lifetime energy consumption of an appliance[5]. This is necessary in order to put energy savings from the standard into the same units across different types of appliances. The CAFE program faces a similar challenge with lifetime car usage. For simplicity, the program assumes that all cars are driven 195,264 miles during their life and all trucks drive 225,000 miles. This assumption does not account for the varied lifetime usage of the car and trucks, which means CAFE will over credit some vehicles and under credit others (Jacobsen et al. 2016). Estimating lifetime energy usage becomes more complex in the appliance setting because the uses for appliances can vary more than in transportation. Some appliances, like air conditioners or heaters, have a wide variance of usage over their lifetimes, which makes them hard to compare to other appliances. For example, an air conditioner in Arizona will use much more energy than one in Maine. The challenge of estimating lifetime usage will only become worse when comparing across types of appliances. As a result, allowing for trading across appliance categories will make it harder to set the appropriate standard. It also makes it more likely that a manufacturer will be able to exploit a mismeasured lifetime usage and undermine program savings. For example, if the lifetime usage of an air conditioner is underestimated and the lifetime usage of a refrigerator is overestimated, the manufacture might lower the price of the air conditioner relative to the refrigerator. This would increase air conditioner sales and satisfy the tradeable standard, but it could result in higher lifetime energy use.

[5] This estimation could be further complicated by the possibility that changes to appliances to comply with changes to an efficiency standard could have implications for appliance lifetimes that may be difficult to predict ex ante.

Trading across firms could increase the efficiency of a credit trading program. Much like the CAFE program, it could equalize the marginal cost of efficiency across manufacturers. It is unclear if the potential gains from inter-firm trading would justify the additional costs. It would require a larger program infrastructure to facilitate and verify inter-firm trading. It also introduces the potential for a firm to gain market power in the credit market. Despite these potential benefits, we suggest that a tradeable credit program first be implemented with no inter-firm trading. In future years, inter-firm trading could be introduced once the program has been established at the firm level.

7. Designing a Pilot

The DOE has suggested that one way to introduce flexibility into the Energy Conservation Standards program would be to conduct a pilot program for a particular appliance and to construct the pilot in a way that it could provide lessons about policy for the future. The RFI seeks guidance on how best to design such a pilot and what appliances to focus on.

A pilot program provides opportunities to roll out tradeable standards in a limited way that can provide insights for future implementation. The suggestion that the initial program scope be limited to within appliance type and within a single firm is a reflection of the complicated dynamics involved in adding flexibility to the current standards program. The larger the scope of the program, the harder it is to measure the impacts of introducing flexible standards. A focused pilot program will provide the ability to directly observe the impacts of the flexible standard without the potential complications that could come from trading across appliances of manufactures.

Unfortunately, there is no specific pilot design that can quantify the full costs and benefits of a tradeable standard. The benefits could include the reduced cost of appliances, a larger selection of models, increased profits for appliance manufacturers, increased innovation in technologies to improve future efficiency, and a range of appliance types that better match consumer demands. The costs of a more flexible standard can include the administrative costs for the government to run the program, the costs to firms to understand and comply with the standards, and the increased potential for firms to exert market power. It is not possible to easily measure all of these costs and benefits, which makes it hard to effectively evaluate the full impacts of the more flexible standard.

Given the difficulty in finding a counterfactual and the challenges in measuring outcomes, we suggest a pilot of a limited rollout of flexible standards for only type of appliance. Refrigerators could be an ideal appliance for the pilot because their usage is relatively constant from user to user and in different regions of the country. There are also many potential gains from trade across refrigerators that have different configurations and features. For example, it could allow manufacturers to produce refrigerators with less insulation to fit in smaller spaces that would not have met current standards in exchange for selling more refrigerators that exceeded the existing standard. Manufactures could be allowed to opt-in to the program, which would provide additional insight on which manufactures found the flexibility appealing.

Limiting the scope of the pilot would help with evaluating the flexible standards. There are a small number of manufacturers in the appliance space that account for a large portion of the market. Running a randomized control trial, where a portion of the refrigerator manufacturers are using tradable standards likely would not have enough power to identify the overall impact. There are also concerns that the impacts of the tradable standards could spill over to those manufacturers that did not participate. If this were to happen, any measured impacts based on a comparison of the two groups would not accurately reflect the impact of the move to flexible standards. There are also important questions of fairness when dealing with the competitive advantage of tradable standards for some companies in a large appliance market.

There may be some ability to learn about impacts of greater flexibility by comparing behavior across types of appliances. For example, if refrigerator/freezer combos are brought under a tradable standard and standalone freezers are not, one could compare across these groups within a given manufacturer. It would be possible to test if the increased flexibility changed how the manufacturer approached their sizing and features. Unfortunately, this type of comparison would offer somewhat limited insights due to the differences between the two appliances. A similar comparison could be made within a manufacturer before and after the standard flexibility is introduced. This approach could provide some insight on if the amount of bunching around standard thresholds changes with the new flexibility. If the bunching is no longer observed, it suggests that the flexible standard might be improving efficiency.

8. Conclusion

Despite the challenges in evaluating the benefits of a flexible standards system, we think that it is a potentially promising approach to standards policy. Economic theory shows that flexibility in a standards program can improve outcomes, and the CAFE program has demonstrated the value of flexibility (Leard and McConnell 2017). We think the best way to minimize some of the potential issues highlighted above is to first roll out the program to a subset of appliances. Depending on interest, firms could be allowed to opt in to the pilot. It will be easier to understand the effects of the flexibility when there are fewer moving policy levers involved with the new standards. The limited pilot also allows a better understanding of the potential costs of the program without the costs and risk of rolling it out to all appliances. A limited rollout will give companies and the regulator time to address any potential problems or complications. Once the pilot is concluded and the impacts are better understood, more appliances can be brought under the flexible standards regime.

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