

CHAPTER 17. REGULATORY IMPACT ANALYSIS

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CHAPTER 17. REGULATORY IMPACT ANALYSIS

17.1 INTRODUCTION

The Department of Energy (DOE) has determined that energy conservation standards for microwave ovens constitute an “economically significant regulatory action” under Executive Order (E.O.) 12866 “Regulatory Planning and Review.” 58 FR 51735 (October 4, 1993). Therefore, DOE’s proposed energy conservation standards require a regulatory impact analysis (RIA), which involves an evaluation of non-regulatory alternatives to the standards. This document evaluates several possible alternatives to the proposed standards and compares the costs and benefits of each to the proposed standards. As described in section 17.2.2 of this report, the proposed standards for microwave ovens are those in TSL 3.

Under the Process Rule (*Procedures for Consideration of New or Revised Energy Conservation Standards for Consumer Products*, 61 FR 36974 (July 15, 1996); 10 CFR Part 430, Subpart C, Appendix A), DOE is committed to continually explore non-regulatory alternatives to standards. This RIA, which DOE has prepared pursuant to E.O. 12866, is subject to review under the Executive Order by the Office of Management and Budget (OMB)’s Office of Information and Regulatory Affairs (OIRA). 58 FR 51735.

DOE identified six major non-regulatory alternatives to standards as representing feasible policy options to achieve consumer product energy efficiency for the appliance products that are the subject of this rulemaking. These are listed in Table 17.1.1. DOE evaluated each alternative in terms of its ability to achieve significant energy savings at a reasonable cost and compared the effectiveness of each one to the effectiveness of the proposed standards.

Table 17.1.1 Policy Alternatives to National Standards

No New Regulatory Action
Consumer Rebates
Consumer Tax Credits
Manufacturer Tax Credits
Voluntary Energy Efficiency Targets
Early Replacement
Bulk Government Purchases

17.2 NON-REGULATORY POLICIES

17.2.1 Methodology

This section describes the approach DOE used to analyze non-regulatory policies for microwave ovens.

To calculate the national energy savings and the net present value (NPV) corresponding to each policy alternative, DOE used its national impact analysis (NIA) spreadsheet models. (See Chapter 10 of the technical support document (TSD) for a description of the NIA spreadsheet models.) To compare each alternative to the proposed standards, DOE quantified the effect of each alternative on the purchase of microwave ovens meeting the *target levels*, which are defined as the efficiency levels in the proposed standards. Once it had made the quantitative assumptions for each alternative policy, DOE made the appropriate revisions to the inputs in the NIA spreadsheet models. The main model inputs that DOE revised were market shares of equipment at target efficiencies, shipment-weighted average annual energy consumption, and equipment replacement rates. The shipments for any given year are comprised of a distribution of efficiency levels. DOE assumed that standards would affect 100 percent of the shipments, while the non-regulatory policies would affect a smaller percentage of the shipments. In each policy case, DOE made particular assumptions about the percentage of shipments impacted by the policy under analysis. DOE then calculated the shipment-weighted average energy consumption and costs using these market shares.

A shift in the market share of higher efficiency units may increase the average installed cost of energy-consuming equipment. Operating costs will generally decrease due to a decline in energy consumption. Therefore, DOE calculated an NPV for non-regulatory alternatives in the same way as it did for the proposed standards. In some scenarios, total installed cost increases are partially mitigated by government rebates or tax credits. However, DOE assumed that credits and rebates would be paid for by consumers in another form (such as additional taxes), and therefore did not include them as a consumer benefit for the purposes of calculating the national NPV. DOE did not consider administrative costs for any of the non-regulatory policies in its analysis. Inclusion of such costs would decrease their NPVs by a small amount.

The key measures of the impact of each alternative are:

- National energy savings in quadrillion Btus (quads): Cumulative national primary energy savings for equipment bought in the period from the compliance date of the policy case (2014) to the year 2043.
- Net present value: The value of net monetary savings from equipment bought in the period from the compliance date of the policy case (2014) to the year 2043. DOE calculated the NPV as the difference between the present value of equipment and operating expenditures (including energy) in the base case and the present value of

expenditures in each alternative policy case. DOE calculated operating expenses (including energy) for the life of the equipment.

17.2.2 Policy Assumptions

The impacts of non-regulatory policies are by nature uncertain, since they depend on program implementation, marketing efforts, and the subsequent consumer behavior response. The projected impacts depend on the assumptions regarding the consumer participation rate and therefore are subject to more uncertainty than the impacts of mandatory standards, which DOE assumes will have full compliance. To increase the robustness of the analysis, DOE conducted a literature review on each non-regulatory policy and consulted with key experts to gather information on similar incentive programs that have already been implemented in the United States. By studying field experience with sample programs of each type, DOE sought to make credible assumptions of their potential market impacts. Section 17.3 below reports the conclusions from this research as they apply to the policy modeling assumptions and includes the corresponding literature citations.

Each of the policy alternatives that DOE considered to the proposed standards would improve the average efficiency of new microwave ovens relative to their base cases (no new regulatory action). The analysis considered that each alternative policy would induce residential or commercial consumers to purchase units at the same efficiency levels as required by the proposed standards, or the *target levels*. In contrast to the proposed standards, however, their market penetration rate in the alternative policy cases may not be 100 percent.

The proposed standards for microwave ovens are those in TSL 3, as shown in Table 17.2.1.

Table 17.2.1 Trial Standard Level 3 for Microwave Ovens

No.	Product Class (PC)	Proposed Energy Conservation Standards
1	Microwave oven with or without thermal elements	Maximum standby power = 1.0 Watt
2	Over-the-range combination ovens	Maximum standby power = 2.2 watts

DOE assumed that the non-regulatory policy impacts would last from the compliance date for proposed standards for microwave ovens—2014—through the end of the analysis period, 2043.

17.2.3 Policy Interactions

DOE calculated the impacts of each regulatory policy separately from those of the other policies. In actual practice, certain policies are often most effective when implemented in combination, such as early replacement with consumer rebates or early replacement with bulk government purchases. DOE attempted to make conservative assumptions to avoid double-counting policy impacts. Therefore, the policy impacts reported below are not additive; the

combined impact of several or all of the policies may not be inferred from adding the results together.

Section 17.3 presents graphs showing market penetration or shipment-weighted efficiency parameters for each of the non-regulatory policy cases for microwave ovens.

17.3 NON-REGULATORY POLICY ASSUMPTIONS

17.3.1 No New Regulatory Action

The case in which no new regulatory action is taken with regard to microwave oven efficiency constitutes the base case scenario described in chapter 10. This case defines the basis of comparison for all other scenarios. By definition, no new regulatory action yields zero energy savings and an NPV of zero dollars.

17.3.2 Financial Incentives Policies

DOE considered scenarios in which the Federal government would provide two types of financial incentives: rebates and tax credits. The government could provide consumers with a rebate for purchasing an energy-efficient appliance meeting the target level for each product. Tax credits could be offered to consumers who purchased target-level microwave ovens. The government could also provide tax credits to manufacturers to offset costs associated with producing such equipment.

DOE's evaluation of consumer rebates used a comprehensive study of the potential for energy efficiency in California performed by Xenergy, Inc., which summarized experience with various utility rebate programs.¹ This analysis method is based on curves that estimate the market penetration of a technology based on its benefit/cost (B/C) ratio. DOE consulted with experts and reviewed several other methods of estimating market penetration of efficient technologies due to consumer rebate programs that were developed since the referenced Xenergy report was published.^{2,3,4,5} However, these methods were based either on other economic parameters (payback period) or on expert surveys predicting penetration of a new technology over time. Therefore, DOE decided to use the penetration curve method based on B/C ratio, which incorporates lifetime operating cost savings and was calibrated with utility rebate program participation results.

Xenergy's information diffusion model estimates market impacts induced by financial incentives for energy-efficient appliances. The basic premise of this model is that information diffusion drives technology adoption. The model is formulated to characterize the influences of both internal and external sources of information on consumer behavior by superimposing two components in the equation, each capturing the effect of one of two different types of information source. The effects of these two types of information diffusion mechanisms are different. *Internal* sources of information influence consumers to purchase new products due

mainly to word-of-mouth from early adopters, while *external* information sources influence consumers to change their adoption decisions as a result of marketing efforts and information coming from outside the consumer group. (Appendix 17A of the TSD contains further details on modeling these influences.)

Xenergy's model combined these two information diffusion mechanisms and generated a set of measure "implementation curves" or *penetration curves*, which Xenergy calibrated using evaluation data from utility rebate programs. Consumer response to rebate incentives appears to be a combination of the two information source types. The penetration curves illustrate the increased penetration (i.e., increased market share) of efficient equipment as a result of consumer response to B/C ratio changes induced by a specific rebate program. The penetration curves are used to depict various diffusion patterns based on perceived barriers to consumer purchase of high-efficiency equipment. There are penetration curves for varying levels of market barriers, from "no barriers" to "extremely high barriers." These curves provide a means to study the impact of changing the B/C ratio, by reducing the initial equipment cost through financial incentives, on the consumer participation rate.

DOE based its estimates of the impacts of consumer tax credits on actual program experience with State tax credits in Oregon. DOE studied State tax credits in Montana as well. DOE also attempted to determine residential consumer participation due to the Federal appliance tax credits, which were mandated by the Energy Policy Act of 2005 (EPACT 2005). For the manufacturer tax credits policy, DOE attempted to investigate manufacturer participation due to the efficient equipment tax credits from EPACT 2005. Both the Federal consumer and manufacturer credits were in effect in 2006 and 2007. Unfortunately, the Internal Revenue Service (IRS) had not yet published data on taxpayer response to either of these tax credits.

DOE also incorporated previous research that had differentiated the impact of tax credits into the "direct price effect," which arises from the incremental equipment cost savings, and the "announcement effect," which is independent of the credit amount.^{6,7} The announcement effect derives from the credibility that a particular technology receives from its inclusion in an incentive program, as well as changes in product marketing strategy, and the resulting modifications in markups and pricing. DOE assumed that the direct price effect and the announcement effect would apply to the consumer tax credit policy, as well as the consumer rebate policy. DOE also assumed that half of the increases in market penetration associated with either policy would be due to the direct price effect and half to the announcement effect.

17.3.2.1 Consumer Rebates

DOE modeled the impact of the consumer rebate policy by determining the increase in market penetration of target-level equipment relative to its market penetration in the base case. DOE assumed that the rebate would cover 100 percent of the incremental installed cost between a microwave meeting the baseline efficiency level and a unit meeting the target efficiency for PC1. It chose this amount because the microwave oven incremental cost was very low (\$2). For PC2, the \$2 amount covers 14.4 percent of increment cost. DOE assumed the rebates would

remain in effect until they had transformed the markets so that the shift in market share of efficient units seen in the first year of the programs would be maintained throughout the forecast period (2014–2043).

DOE first calculated the B/C ratio for the baseline unit without a rebate. It then calculated another B/C ratio for the unit meeting the target level, with a rebate, relative to the baseline unit. Because of the incremental cost reductions due to the rebates, the B/C ratios for the rebate policy unit were larger. Table 17.3.1 shows the benefits, defined as lifetime operating cost savings, incremental installed costs without rebates and with rebates, and B/C ratios without rebates and with rebates.

Table 17.3.1 Benefit/Cost Ratios for Microwave Oven Proposed Standard and Rebate Policy Case

	PC1	PC2
Benefit (Lifetime Operating Cost Savings)	\$28.40	\$21.77
Incremental Installed Cost (Increased Installed Cost)	\$1.93	\$13.88
B/C Ratio with No Rebate	14.7	1.6
Rebate Amount	\$2.00	\$2.00
Adjusted Incremental Installed Cost (Increased Installed Cost after Rebate)	\$0	\$11.88
B/C Ratio for Rebate Policy Case	Inf.	1.8

DOE then used the B/C ratios with the penetration curves shown in Figure 17.3.1 to estimate the increased percentage of consumers who would purchase the units that meet the policy target levels if given a rebate incentive. For microwave ovens, DOE chose the “no barriers” curve. The incremental cost between the baseline and the TSL is minimal, and there are no product utility issues that would cause barriers to consumer acceptance. Figures 17.3.1 and 17.3.2 show the increase in penetration rates of target-level units as a function of their higher B/C ratios. Using the method discussed above, DOE estimated that the market share of equipment meeting the policy target due to a rebate policy would increase by 7.0 percent for PC1 and 3.9 percent for PC2.

To calculate the impacts of this policy, DOE adjusted the market shares of microwave ovens at the target efficiencies in its NIA model to represent the policy case scenarios.

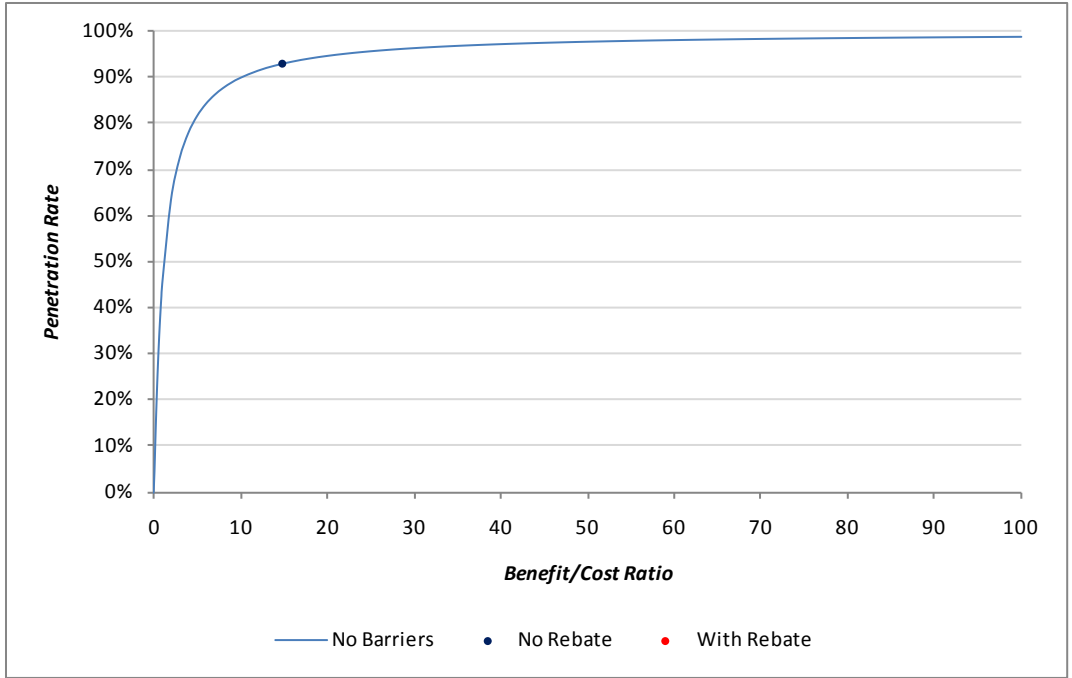


Figure 17.3.1 Market Penetration Curve for Microwave Ovens → PC1

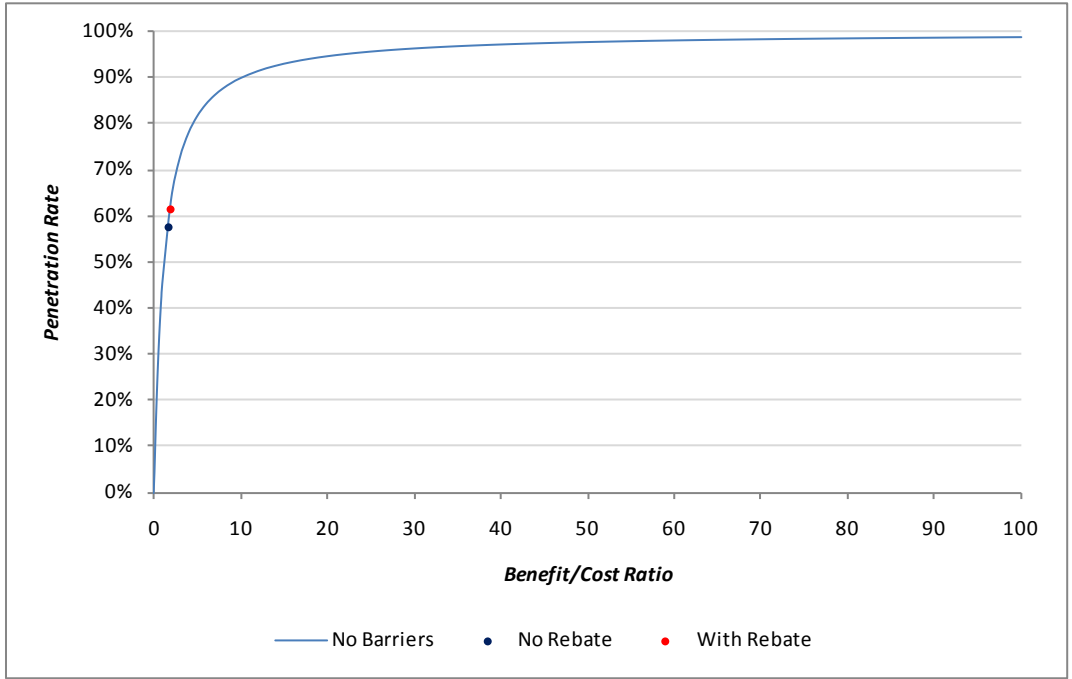


Figure 17.3.2 Market Penetration Curve for Microwave Ovens → PC2

Note that the portion of the penetration curve displayed in Figure 17.3.1 does not display the 100 percent penetration that would result from an “infinite” B/C ratio where the rebate covers the entire incremental measure cost.

17.3.2.2 Consumer Tax Credits

To analyze this policy, DOE studied taxpayer participation in tax credit programs for energy-efficient appliances that were available at both the Federal and the State levels. DOE analyzed a consumer tax credit program whose credit amounts would be similar to the percentage of equipment costs covered by existing State tax credits. Because tax credits have not been available for microwave ovens, DOE analyzed Oregon's residential tax credit data for an analogous product—dishwashers.

EPACT 2005 included Federal tax credits for consumers who installed efficient air conditioners or heat pumps, gas or oil furnaces, furnace fans, and gas, oil, or electric heat pump water heaters in new or existing homes.⁸ While these credits were available during tax years 2006 and 2007, as mentioned above, the IRS had not published data on the numbers of taxpayers taking these credits. Appendix 17A gives details of the equipment covered and the Federal tax credit amounts for residential appliances.

The States of Oregon and Montana have had consumer tax credits for efficient appliances for several years.^a DOE based most of its estimates on Oregon's experience with this policy. Oregon's Residential Energy Tax Credit (RETC) was created in 1977. The Oregon legislature expanded the RETC program in 1997 to include home appliances and participation in the program increased significantly after they became eligible.^b In response to changes in the appliance market, the RETC program updates its lists of eligible model numbers monthly and makes occasional adjustments to the maximum tax credit dollar amount for each appliance. Oregon offers tax credits on residential refrigerators, clothes washers, and dishwashers.⁹ The tax credit is either an amount noted on the list of qualifying appliances^c or 25 percent of the purchase price of the appliance, whichever is less.

Montana has had an Energy Conservation Installation Credit for residential energy conservation measures since 1998.¹⁰ The tax credit covers a variety of residential energy and water efficiency installations, including ENERGY STAR heating/cooling equipment, water heaters, low-flow showerheads and faucets, and light fixtures and controls. The amount of the credit increased in 2002 from 5 percent of equipment costs (up to \$150) to 25 percent (up to \$500). DOE obtained data from the Montana Department of Revenue (DER) on the numbers of tax credits claimed from 1998 through 2006.¹¹ However the DER did not have data

^a The District of Columbia (Washington D.C.) passed legislation entitled the “Residential Energy Conservation Tax Credit Act Of 2005” for consumer tax credits, but did not appropriate the necessary funding and so the credits did not go into effect.

^b The program added fuel cells in 1999 and high-efficiency heat pump systems, furnaces, and boilers in 2002.

^c These lists change frequently, and generally require units that exceed ENERGY STAR specifications -- for example units that meet Consortium for Energy Efficiency (CEE) specifications.

disaggregated by appliance, so the number of tax credits claimed for large household appliances could not be distinguished from those for plumbing products. DOE analyzed the available data and noted that the number of tax credits claimed increased steadily from 1998 through 2006, which contributed to its assumptions for this policy scenario.

DOE obtained data from the Oregon Department of Energy (ODOE) on the number of efficient appliance tax credits claimed by Oregon residential taxpayers for the years 1998 through 2006, as well as the credits claimed by appliance type for the years 2000 to 2006.¹² DOE also obtained Oregon appliance shipments data for clothes washers and dishwashers for 2006.^{13,14} The number of credits claimed generally increased each year, although there were some fluctuations that ODOE attributed to changes in qualifying models. DOE assumed that a tax credit program would be designed to provide consistent consumer information and slightly adjusted the ODOE data for the years 2003 and 2004 to provide a steady trend line. DOE calculated that the number of clothes washer tax credits claimed comprised 24 percent of the total number of Oregon clothes washer shipments in 2006. However, not all of these high-efficiency clothes washers were likely purchased due to the tax credit program alone. Some taxpayers would have been motivated by utility rebate incentives, and others would be "free riders" who would have purchased efficient appliances without a tax credit or rebate incentive but still claimed the tax credit. To better understand this interaction between tax credits, rebates, and free riders/market impacts, DOE reviewed a report prepared by KEMA on efficient clothes washers in the Northwest. KEMA compared the penetration of "ultra high efficiency" (UHE)^d clothes washers in Oregon and Washington, two neighboring States that have similar utility rebate programs for residential clothes washers.¹⁵ The study attributed the difference in market share of these UHE units (50 percent for Oregon versus 15 percent for Washington) to the Oregon tax credits. DOE estimated that 38 percent of the tax credits claimed (9 percent of total shipments) were actually due to rebates. To estimate the free riders, DOE used the market penetration of the baseline commercial clothes washer units, which was 9.2 percent of total shipments (38 percent of the number of tax credit claims). DOE then estimated that the remaining 24 percent of the Oregon clothes washer tax credits claimed for the years 1998–2005 (or 5.8 percent of total shipments) were attributable to tax credits alone.

Dishwashers

The percentage of total annual dishwasher shipments associated with tax credit claims declined in 2005 and 2006, which ODOE attributed to changes in the listings of eligible models. Observing that clothes washer tax credits claimed generally rose each year between 1998 and 2006, and also that Montana's tax credit claims increased annually during the same period (see below), DOE assumed that the tax credit program for this policy would be designed for increasing annual participation and adjusted the dishwasher percentages for the years 2004 through 2006 to provide a steady trend line. For 2006, the estimated percentage of total shipments associated with tax credit claims was 14 percent. DOE did not find data comparing Oregon and Washington's efficient dishwasher sales. To estimate the portions of these tax credit claims that were likely due to utility rebates and to market impacts, DOE reviewed a report by

^d Units meeting specifications of minimum modified energy factor (MEF) of 2.20 and maximum water factor (WF) of 6.5.

Itron on utility rebate programs in California, which compared the percentage of free riders in residential clothes washer and dishwasher rebate programs in 2005.¹⁶ Itron found that the market penetration rate of ENERGY STAR dishwashers was much higher than that of ENERGY STAR clothes washers, and the percentage of free riders was greater for dishwasher programs than for clothes washer programs. Also, DOE estimated that the incremental cost from the baseline was much smaller for dishwashers than for clothes washers. Thus, DOE estimated that market impacts (part of which is due to free riders) were responsible for a higher percentage of dishwasher tax credit claims than for residential clothes washer credit claims. DOE estimated that 49 percent of Oregon's dishwasher tax credits claimed, or 6.9 percent of total dishwasher shipments, were due to market impacts. It estimated that utility rebates were responsible for 32 percent of tax credits claimed, or 4.5 percent of total shipments. DOE attributed the remaining 20 percent of tax credits claimed, or 2.8 percent of total shipments, to tax credits. DOE then took 20 percent of the number of Oregon dishwasher tax credits claimed for the years 1998–2005 to estimate the impact attributable to tax credits for those years.

Table 17.3.2 shows the number of Oregon residential tax credits claimed for dishwashers as percentages of total annual shipments that these claims represent for the years 1998–2006. It also shows the percentages of total shipments attributed to the tax credits themselves, to utility rebates, and to other market influences/free riders for 2006, as well as the percentage attributed to tax credits for 1998–2005.

Table 17.3.2 Oregon Tax Credits Claimed for Residential Dishwashers from 1998 to 2006 and their Attribution for 2006

	1998	1999	2000	2001	2002	2003	2004	2005	2006
Tax Credits Claimed	4%	7%	9%	10%	12%	14%	12%	7.5%	7.6%
Tax Credits Claimed, Adjusted	4%	7%	9%	10%	12%	14%	14%	14%	14%
Due to Tax Credits	0.7%	1.4%	1.8%	2.0%	2.4%	2.8%	2.8%	2.8%	2.8%
Due to Rebates	NA	NA	NA	NA	NA	NA	NA	NA	4.5%
Due to Market	NA	NA	NA	NA	NA	NA	NA	NA	6.9%

Microwave Ovens

DOE estimated that, due to consumer tax credits, the market share of target-efficiency microwave ovens would increase by the same percentages shown for dishwashers for the first nine years and remain constant at 2.8 percent thereafter. Table 17.3.3 shows the resulting market share increases.

Table 17.3.3 Oregon Tax Annual Increased Market Shares of Microwave Ovens at Target Efficiency Levels from Consumer Tax Credits

Year of Program	Annual Market Share Increase
2014	0.7%
2015	1.4%
2016	1.8%
2017	2.0%
2018	2.4%
2019	2.8%
2020	2.8%
2021	2.8%
2022	2.8%
2023–2043	2.8%

17.3.2.3 Manufacturer Tax Credits

EPACT 2005 provides Energy Efficient Appliance Credits to manufacturers for production of high-efficiency refrigerators, clothes washers, and dishwashers at the Federal level through the IRS.¹⁷ Manufacturers receive these credits only for the increase in production of qualifying appliances over a three-year rolling baseline. Each manufacturer is limited to a certain amount for all credits under this provision. The credits were available for models produced in 2006 and 2007. Legislation pending in Congress would extend the manufacturer tax credits in modified form through 2010.¹⁸ Appendix 17A gives details of the equipment covered and the Federal tax credit amounts for appliance manufacturers.

DOE assumed that a manufacturer tax credit program would effectively result in a lower price to the consumer by an amount equivalent to that provided by consumer tax credits as described above. Because these tax credits would go directly to manufacturers, DOE assumed that manufacturers would pass on the reduced costs to consumers, causing the direct price effect. However, DOE assumed that the announcement effect would not occur because the program would not be visible to consumers. Because the direct price effect is approximately equivalent to the announcement effect,⁶ DOE estimated that half of the consumers assumed to take advantage of consumer tax credits would purchase more efficient products due to a manufacturer tax credit program. Therefore, DOE reduced the market penetrations attributed to Oregon’s consumer tax credits in the year 2006 for dishwashers by 50 percent and used the resulting market penetrations to represent the impact of manufacturer tax credits for all years of the analysis period. DOE assumed the impact of this policy would be to permanently transform the market so that the market share increase seen in the first year of the program would be maintained throughout the forecast period.

DOE estimated that this policy could increase the market share of efficient microwave ovens by 1.4 percent annually over the base case at the TSL. Because of the small incremental cost between the baseline and TSL for this product, a manufacturer tax credit might be easier to implement than a consumer tax credit for microwave ovens.

17.3.3 Voluntary Energy Efficiency Targets

For microwave ovens DOE assumed that voluntary targets would be achieved through manufacturer participation in a gradual phase-out of production of units below their respective TSLs. DOE assumed that this would be achieved by a program similar to the ENERGY STAR endorsement labeling program conducted by the Environmental Protection Agency (EPA) and DOE. The ENERGY STAR program sets minimum energy efficiency specifications for various products. ENERGY STAR encourages consumer adoption of these products through marketing to promote consumer label recognition, adoption of the specifications by various efficiency incentive programs, and manufacturer production and promotion of ENERGY STAR-compliant appliances. ENERGY STAR prepares projections of market penetration of compliant appliances and estimates the percentage of the sales of those compliant appliances that are attributed to the ENERGY STAR program.

Several reports have analyzed the impacts of ENERGY STAR programs for specific products, which are generally based on a combination of information dissemination and utility or agency rebates. These studies base their analysis on the ENERGY STAR statewide data on percentages of each appliance's shipments that meet the ENERGY STAR specifications. These analyses have generally concluded that the market penetration of ENERGY STAR-qualifying appliances is higher in regions or States where such promotional programs have been active.^{15,16,19,20,21}

There has been no ENERGY STAR program for microwave ovens. Because of the low incremental costs and the small overall operating cost savings opportunity at the TSL, DOE assumed that an ENERGY STAR effort for this product would focus on an information program. DOE assumed that such a voluntary program would induce similar market penetration behavior as that of televisions with cathode ray tube (CRT) screens, for which there was an ENERGY STAR specification, as energy savings for both products are achieved by reducing standby power. DOE used estimates of the increased market penetration due to the ENERGY STAR program for CRT televisions during its first six years (1998–2003), applying those percentage increases to microwaves for the first six years of the analysis period, from 2014 through 2019. Beginning in 2004, televisions with liquid crystal display (LCD) screens dominated the market, so DOE did not use the ENERGY STAR forecast for televisions from 2004 on. Instead, it calculated the average market penetration of all consumer electronics products in 2003—58 percent—and assumed this level could eventually be achieved by a voluntary program for microwave ovens.²² Thus DOE estimated that, from 2019 through 2023, the market penetration of microwave ovens meeting the TSL would increase an additional 1.7 percentage points per year, reaching 58 percent by 2023. After 2023 DOE assumed that market penetration would remain at that level through the remainder of the forecast. Table 17.3.4 shows the annual projected market share increases of the targeted units due to the programs resulting from this voluntary efficiency targets policy.

Table 17.3.4 Annual Increased Market Shares of Microwave Ovens at Target Efficiency Level from Voluntary Efficiency Targets

Year of Program	Microwave Ovens*
2014	15%
2015	37%
2016	44%
2017	43%
2018	42%
2019	47%
2020	49%
2021	52%
2022	55%
2023–2043	58%

* Percentages in each column refer to shares of the eligible market.

17.3.4 Early Replacement

Early replacement refers to the replacement of microwave ovens before the end of their useful lives. The purpose of this policy is to replace old, inefficient equipment with higher-efficiency units. The economic feasibility of early replacement depends on the vintage of the unit being replaced, the cost for the new equipment, and the energy cost savings.

There has been limited experience with early replacement programs for appliances in the United States. However, DOE studied several reports to inform its analysis of this policy. One report detailed the Connecticut Appliance Retirement Program (ARP) conducted in 2004.²³ Another was an electric energy efficiency potentials study performed for the State of Vermont in 2006.²⁴ DOE had also performed an earlier study on Federal potential for early retirement of appliances under EPACK 1992.

The Connecticut ARP was conducted from June through December 2004 by Nexus Market Research, Inc. and RLW Analytics, Inc. for Northeast Utilities–Connecticut Light and Power and the United Illuminating Company’s State programs. The ARP was intended to assist utility customers in Connecticut to overcome barriers to recycling room air conditioners (RACs), secondary refrigerators, and freezers. The program picked up used appliances at customers’ homes or at turn-in events, paid participants to retire their units, and educated customers about the costs of running older appliances. In addition, the program paid incentives to consumers to replace their RACs with ENERGY STAR-qualified units. DOE considered the RAC program to most closely resemble the early replacement policy scenario, as these consumers were replacing primary units rather than retiring second units. Nexus’ report on ARP results estimated the number of RACs retired by program participants, the percentage of those replaced with an ENERGY STAR model, and the number of RACs replaced by non-participants during the program duration, using program data and surveys. According to their analysis, about seven percent of all RACs retired during the program were retired through the ARP, and 63 percent of those were replaced with an ENERGY STAR model. This meant that the program directly

resulted in early replacement with a more efficient unit of about four percent of the total eligible RAC population. DOE assumed that this type of program most likely eliminates second ownership of the RAC, thus shortening its useful service life.

In 2006, GDS Associates, Inc. conducted an electricity and peak demand potentials study for energy efficiency and fuel conversion measures for the State of Vermont. GDS developed a special “early retirement” scenario with all residential appliances replaced during the four-year period from 2006 to 2009, and analyzed similar early replacements in the commercial sector. They estimated achievable market penetrations assuming that consumers would receive a financial incentive equal to 50 percent of the incremental cost of the measure in most programs. GDS assumed an 80 percent penetration limit for the program. It estimated a maximum achievable annual program participant level of two percent of applicable single-family or multifamily homes in 2005.

DOE also reviewed a study it conducted in the 1990s, under EPACT 1992, which analyzed the feasibility of a Federal program to promote early replacement of appliances.²⁵ This study identified policy options for early replacement that included a direct national early replacement program, replacement of appliances owned by the Federal government, promotion through equipment manufacturers, consumer incentives, incentives to utilities, and building regulations.^e

For this analysis, DOE considered a program that targets the units in the stock that have efficiency levels lower than the policy target efficiency level and encourages their early replacement with products at the target level. The program affects a portion of units in the stock in 2014 that would be replaced at the end of their useful or service life (at the “natural” replacement rate) without the effects of this policy, but are replaced sooner as a result of the policy. Shipments in 2014 and beyond are not affected by this program and remain at base case efficiency levels.

Based on their average service lives, 11 percent of microwaves are replaced annually; these are their natural replacement rates. For this policy study, DOE assumed that an additional percentage of microwave ovens in the existing stock in 2014, the first year of the analysis period, would be replaced by models meeting the target levels. For each product, DOE modeled this policy by replacing four percent per year of the units in the stock in addition to those being replaced at the end of their service lives (using the estimated percentage from the Connecticut study, because it was based on actual program experience). DOE assumed that these early replacement programs would last as long as it took to completely replace all of the eligible

^e The analysis concluded that, while cost-effective opportunities for early replacement exist, a widespread Federal early replacement program was not economically justified. Because premature retirement means that a unit may be replaced by an appliance less efficient than the eventual replacement would probably have been, energy savings would be smaller than anticipated. Early replacement programs could increase sales volatility in the long run by encouraging a temporary increase in production followed by a lull in demand. Early replacement could be economical in localities with high energy cost conditions or environmental constraints, when replacement appliances are much more efficient than existing stock, or when a major technology breakthrough has recently occurred, creating the need for a ready market.

microwave ovens that were in the stock in the year that the program began (2014). After the 2014 stock had been completely replaced, there would be no additional impacts from this policy.

The policy would create a jump in shipments of equipment meeting target efficiency levels relative to the base case in the early years of the program as shown in Figure 17.3.3. As a result, more high efficiency units meeting the policy targets would be quickly brought into the equipment stock, leading to an immediate gain in the market share of efficient units compared to the base case. However, unlike the other policy cases discussed, the efficient unit market share would drop back down to the levels in the base case as the eligible market is depleted.

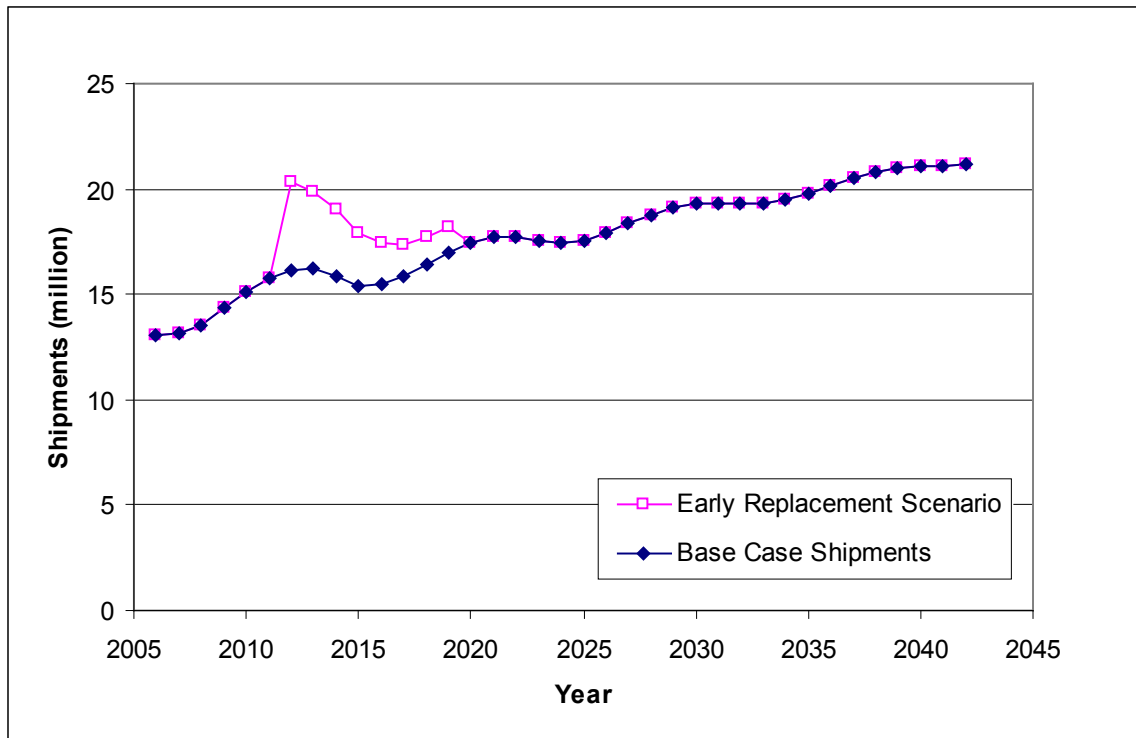


Figure 17.3.3 Early Replacement Shipments Projections for Microwave Ovens

17.3.5 Bulk Government Purchases

DOE assumed that a bulk government purchase policy would encourage Federal, State, and local governments to purchase equipment meeting the target efficiency levels. Aggregating public sector demand could provide a market signal to manufacturers and vendors that some of their largest customers sought suppliers with products that met an efficiency target at favorable prices. This program also could induce “market pull” impacts through manufacturers and vendors achieving economies of scale for high-efficiency products.

While there have been several bulk government purchasing initiatives at the Federal, State, and municipal levels, most of these programs have not tracked data on number of purchases or degree of compliance with procurement specifications. In many cases, procurement

programs are decentralized, being part of larger State or regional initiatives. At the Federal level, the Federal Energy Management Program (FEMP) has performed studies of savings potential for its procurement specifications for appliances and other equipment on which DOE based its assumptions for this policy. Yet FEMP does not track purchasing data, due to the complexity of the purchasing systems, number of vendors, etc. There is evidence of increasing interest and activity in “green purchasing” on the State, county, and municipal levels. While many of these programs target office equipment, the existence of a growing infrastructure for efficient purchasing specifications indicates that such impacts that DOE attributed to bulk government purchasing programs are feasible.^{26,27}

For microwave ovens, DOE assumed that government agencies, such as the Department of Housing and Urban Development (HUD), would administer such a program. At the Federal level, this program could be incorporated into the existing FEMP program. FEMP has procurement guidelines for Federal government equipment purchasing, and Federal construction requirements include these guidelines for installing or replacing equipment. **Error! Bookmark not defined.** There are currently no FEMP procurement guidelines for microwave ovens.

DOE assumed that this policy would impact a subset of housing units for which government agencies purchase or influence the purchase of microwave ovens. This subset would consist mainly of public housing and housing on military bases. To represent this subset, DOE considered publicly owned housing identified in the American Housing Survey (AHS) for 2005, which was 2.0 million households, or about 1.6 percent of all U.S. households.²⁸ (Based on the AHS, there are 124.4 million U.S. households.²⁹) According to the 2001 Residential Energy Consumption Survey (RECS 2001), 76 percent of publicly owned households used microwave ovens.³⁰ DOE assumed that the same percentage of publicly owned housing units would operate microwave ovens. Hence, DOE estimated that 1.2 percent of US households are publicly owned households using microwave ovens, and thus constitute the eligible population to which this policy would apply. Of government-owned residential buildings, DOE’s life-cycle cost and payback period analyses estimated that, by the start year of 2014, none had microwave ovens at efficiency levels meeting the amended energy conservation standards.

Based on the above percentages, at the end of the first year of the policy case (2014), DOE estimated that eight percent of shipments of government-purchased microwave ovens would be equipment meeting the target levels due to existing bulk government purchase programs. By 2024, DOE estimated that bulk government purchase programs would increase their market share to 80 percent. Thus, DOE modeled the enhanced bulk government purchase program assuming that an annual eight-percent market share increase would be maintained over 10 years starting in 2014. Section 17.4 below presents the resulting efficiency trends for the bulk government purchase policy case for microwave ovens.

17.4 NON-REGULATORY POLICY IMPACTS

Figure 17.4.1 shows the market share impacts (increased penetration rates) for microwave ovens for each policy case. In the base case (i.e., the case without standards or non-regulatory programs), no products are forecasted to meet the target level. All policy cases increase the market share of products meeting the target level, with voluntary energy efficiency targets being the most effective. As a reminder, the proposed standards (not shown in Figure 17.4.2) would result in a 100 percent penetration of products meeting the target level.

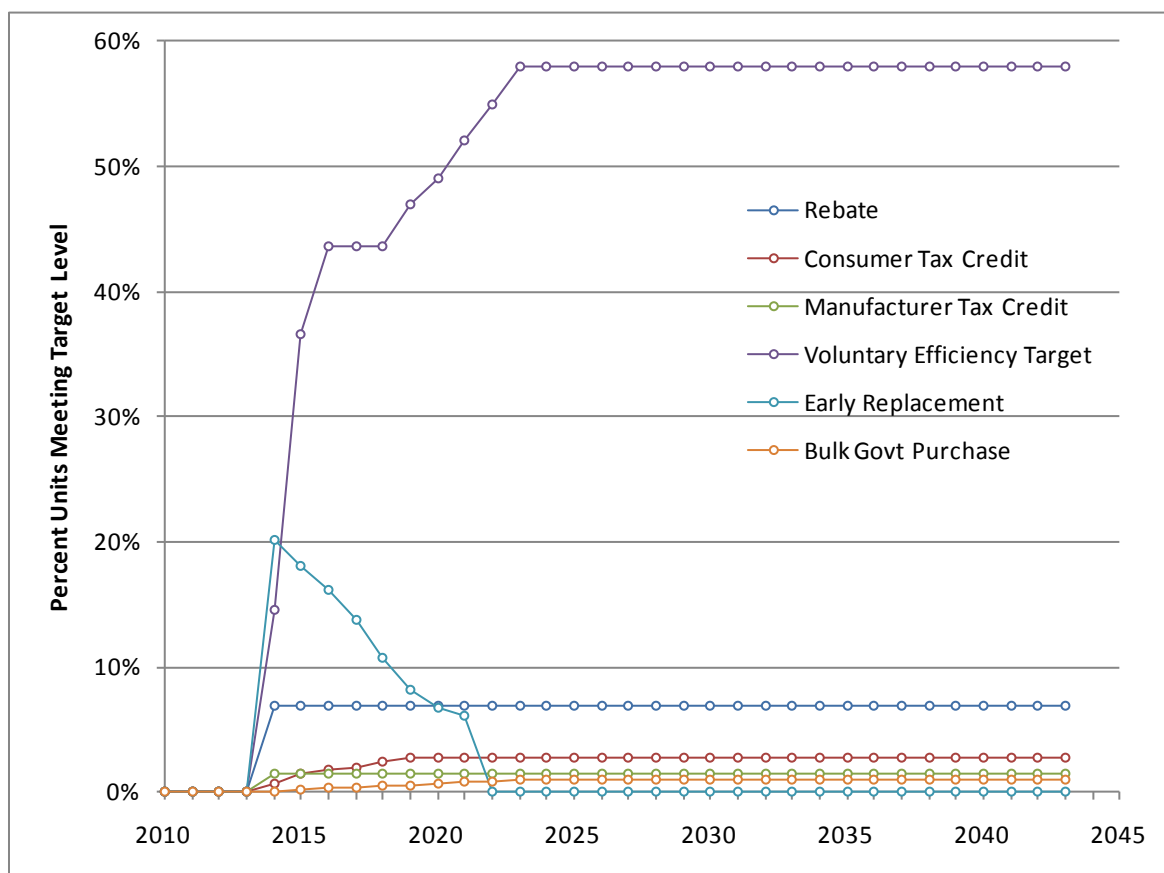


Figure 17.4.1 Penetration Rates of Units Meeting the Target Level for Microwave Ovens

17.5 RESULTS SUMMARY FOR NON-REGULATORY ALTERNATIVES

Table 17.5.1 shows the national energy savings and NPV resulting from the various non-regulatory alternative policy cases, when the efficiency target levels are equal to the proposed standard levels. The case in which no regulatory action is taken with regard to microwave ovens constitutes the base case (or "No Action") scenarios, in which energy savings and NPV are zero by definition. For comparison, the tables include the impacts of the proposed energy

conservation standards. The NPV amounts shown in Table 17.5.1 are based on two discount rates (seven percent and three percent real).

Table 17.5.1 Non-Regulatory Alternatives for Microwave Ovens with Target Levels at TSL 3

Policy Alternatives	Primary Energy Savings (quads)	Net Present Value* (billion 2010\$)	
		7% discount rate	3% discount rate
No New Regulatory Action	0.0	0.0	0.0
Consumer Rebates	0.03	0.13	0.25
Consumer Tax Credits	0.02	0.08	0.15
Manufacturer Tax Credits	0.01	0.04	0.09
Voluntary Energy Efficiency Targets	0.31	1.38	2.80
Early Replacement	0.02	0.11	0.16
Bulk Government Purchases	0.01	0.02	0.05
Proposed Standards At TSL 3	0.41	1.82	3.59

* Net present value (NPV) is the value of a time series of costs and savings. DOE determined the NPV from 2014 to 2043 in billions of 2010\$.

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