CHAPTER 16. REGULATORY IMPACT ANALYSIS

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CHAPTER 16. REGULATORY IMPACT ANALYSIS

16.1 INTRODUCTION

The Department of Energy (DOE) has determined that energy conservation standards for small electric motors 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.

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 five major non-regulatory alternatives to standards as representing feasible policy options to achieve greater energy efficiency for the 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. DOE did not analyze an "early replacement" scenario because it did not find any data supporting an underlying trend toward higher efficiency over time, which suggests that early replacement would not achieve significant energy savings.

Table 16.1.1 Policy Alternatives to National Standards

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

16.2 METHODOLOGY

This section describes the approach DOE used to analyze non-regulatory policies for small electric motors.

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 small electric motors 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 and shipment-weighted average annual energy consumption. 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 in another form (such as additional taxes), and therefore did not include them as a 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 effective date of the policy case (2015) to the year 2045.

- Net present value: The value of net monetary savings from equipment bought in the period from the effective date of the policy case (2015) to the year 2045. 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.

16.2.1 Policy Assumptions

The impacts of non-regulatory policies are by nature uncertain, since they depend on program implementation and marketing efforts and the subsequent consumer behavior response. The projected impacts depend on the assumptions regarding the consumer participation rate, and are therefore 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 U.S. By studying field experience with sample programs of each type, DOE sought to make credible assumptions of their potential market impacts. Section 16.3 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 to the proposed standards that DOE considered would improve the average efficiency of new small electric motors relative to the base case (no new regulatory action). The analysis considered that each alternative policy would induce consumers to purchase units at higher efficiency levels than they would otherwise purchase, reaching the efficiency levels corresponding to 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 efficiency levels corresponding to the proposed standards for polyphase small electric motors are those in TSL 5, as shown in Table 16.2.1. The proposed standards for capacitor-start induction-run (CSIR) and capacitor-start capacitor-run (CSCR) small electric motors are those in TSL 7, as shown in Tables 16.2.2 and 16.2.3.

Table 16.2.1 Proposed Standard Levels* for Polyphase Small Electric Motors (TSL 5)

Motor output power	6 Poles	4 Poles	2 Poles
0.25 Hp / 0.18 kW	77.4	72.7	69.8
0.33 Hp / 0.25 kW	79.1	75.6	73.7
0.5 Hp / 0.37 kW	81.1	80.1	76.0
0.75 Hp / 0.55 kW	84.0	83.5	81.6
1 Hp / 0.75 kW	84.2	85.2	83.6
1.5 Hp / 1.1 kW	85.2	87.1	86.6
2 Hp / 1.5 kW	89.2	88.0	88.2
≥3 Hp / 2.2 kW	90.8	90.0	90.5

* Standard levels are expressed as efficiency (%).

Table 16.2.2 Proposed Standard Levels for CSIR Small Electric Motors (TSL 7)

Motor output power	6 Poles	4 Poles	2 Poles
0.25 Hp / 0.18 kW	65.4	69.8	71.4
0.33 Hp / 0.25 kW	70.7	72.8	74.2
0.5 Hp / 0.37 kW	77.0	77.0	76.3
0.75 Hp / 0.55 kW	81.0	80.9	78.1
1 Hp / 0.75 kW	84.1	82.8	80.0
1.5 Hp / 1.1 kW	87.7	85.5	82.2
2 Hp / 1.5 kW	89.8	86.5	85.0
≥3 Hp / 2.2 kW	92.2	88.9	85.6

* Standard levels are expressed as efficiency (%).

Table 16.2.3 Proposed Standard Levels for CSCR Small Electric Motors (TSL 7)

Motor output power	6 Poles	4 Poles	2 Poles
0.25 Hp / 0.18 kW	63.9	68.3	70.0
0.33 Hp / 0.25 kW	69.2	71.6	72.9
0.5 Hp / 0.37 kW	75.8	76.0	75.1
0.75 Hp / 0.55 kW	79.9	80.3	77.0
1 Hp / 0.75 kW	83.2	82.0	79.0
1.5 Hp / 1.1 kW	87.0	84.9	81.4
2 Hp / 1.5 kW	89.1	86.1	84.2
≥3 Hp / 2.2 kW	91.7	88.5	84.9

* Standard levels are expressed as efficiency (%).

DOE assumed that the non-regulatory policy impacts would last from the effective date for proposed standards for small electric motors—2015—through the end of the analysis period, 2045.

16.2.2 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 to provide incentives, such as bulk government purchases with consumer rebates. 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.

16.3 NON-REGULATORY POLICY ASSUMPTIONS

16.3.1 No New Regulatory Action

The case in which no new regulatory action is taken with regard to small electric motor 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.

16.3.2 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 energy efficient equipment meeting the target level for each product. Tax credits could be offered to consumers who purchase target-level small electric motors. 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 16A 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.

The penetration curves do not exactly model the dynamics of a particular equipment market. Therefore, DOE used them in the following way to predict changes in equipment market shares. If the current market share is 0.0%, DOE assumed that the market share would increase to be equal to the difference between the penetration-curve market share at the no-rebate B/C ratio and the penetration-curve with-rebate B/C/ ratio. If the current market share at the target level is greater than zero, DOE used the penetration curve to determine that ratio between the with-rebate and no-rebate market shares, and applied this ratio to the motor market under consideration. DOE limited the effect of the rebate by assuming that it could no increase the market share above the maximum for the corresponding penetration curve. For example, if the current market share were 5% and the penetration curve predicted a no-rebate market share of 3% and a with-rebate market share of 12%, DOE would assume that the rebate would increase the target-level market share by a factor of 4, to 20%.

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, and 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.

16.3.2.1 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.

Polyphase Small Electric Motors

For conventional cooking products, DOE estimated the impact of increasing the benefit/cost (B/C) ratio via a rebate that paid a portion of the incremental installed cost between a unit meeting the baseline efficiency level and a unit meeting the target efficiency level. DOE based the rebate amount on a large sample of utility rebate programs for NEMA Premium-rated polyphase electric motors (three-digit frame series). Since DOE found no rebate programs for small electric motors, DOE chose these larger motors as similar equipment, with similar market dynamics. DOE gathered data on rebate programs for 1 horsepower motors offered by 48 agencies or utilities throughout the country. (See Appendix 16A for a listing of these rebate programs.) The simple average of the rebate amounts in these programs, $26, is roughly 25% of the incremental cost between a 1 HP three-digit frame series motor which meets current efficiency standards for medium motors and a motor which meets NEMA Premium efficiency. NEMA Premium efficiency for medium motors corresponds most closely with TSL 5, the Department's proposed standard level for small polyphase motors. DOE assumed that a rebate program for small polyphase electric motors would offer a similar rebate of $25 for a 4 pole, 1 HP motor, with rebate amounts for other motor speeds and powers scaling in the same fashion as motor cost (see chapter 8 for a discussion of price scaling). 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 (2015–2045).

DOE first calculated the B/C ratio for the target 4-pole 1 HP 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 as lifetime operating cost savings, incremental installed costs without rebates and with rebates, and B/C ratios without rebates and with rebates.

Table 16.3.1 Benefit/Cost Ratios for 4-pole 1 HP Polyphase Motor Rebate Policy Case

	4 pole 1 HP Polyphase
Benefit (Lifetime Operating Cost Savings)	$ 57.90
Incremental Installed Cost (Increased Installed Cost)	$131.23
B/C Ratio with No Rebate	**0.44**
Current Market Share	**0.0%**
Rebate Amount	$25.00
Adjusted Incremental Installed Cost (Increased Installed Cost after Rebate)	$106.23
B/C Ratio for Rebate Policy Case	**0.55**
Penetration Curve Projected Increase in Market Share	**0.4%**

DOE then used the B/C ratios with the penetration curve 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 polyphase small electric motors, DOE selected the "moderate barriers" curve, which has the greatest degree of correspondence (among the curves prepared by Xenergy) between the market share calculated from the B/C ratio of each efficiency level and the current market share for each efficiency level. Figure 17.3.1 shows 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 0.4 percent above the base case market share for polyphase small electric motors.

To calculate the impacts of this policy, DOE adjusted the market shares of polyphase small electric motors at the target efficiencies in its NIA model to represent the policy case scenario. Table 16.3.2 shows the efficiency distribution used.

Table 16.3.2 Polyphase Small Electric Motor Consumer Rebate Efficiency Market Share Impacts

	Baseline	**CSL 1**	**CSL 2**	**CSL 3**	**CSL 4**	**CSL 5**	**CSL 6**	**CSL 7**
Base case	82.0%	4.0%	4.0%	4.0%	6.0%	0.0%	0.0%	0.0%
Rebate case	81.6%	4.0%	4.0%	4.0%	6.0%	0.4%	0.0%	0.0%

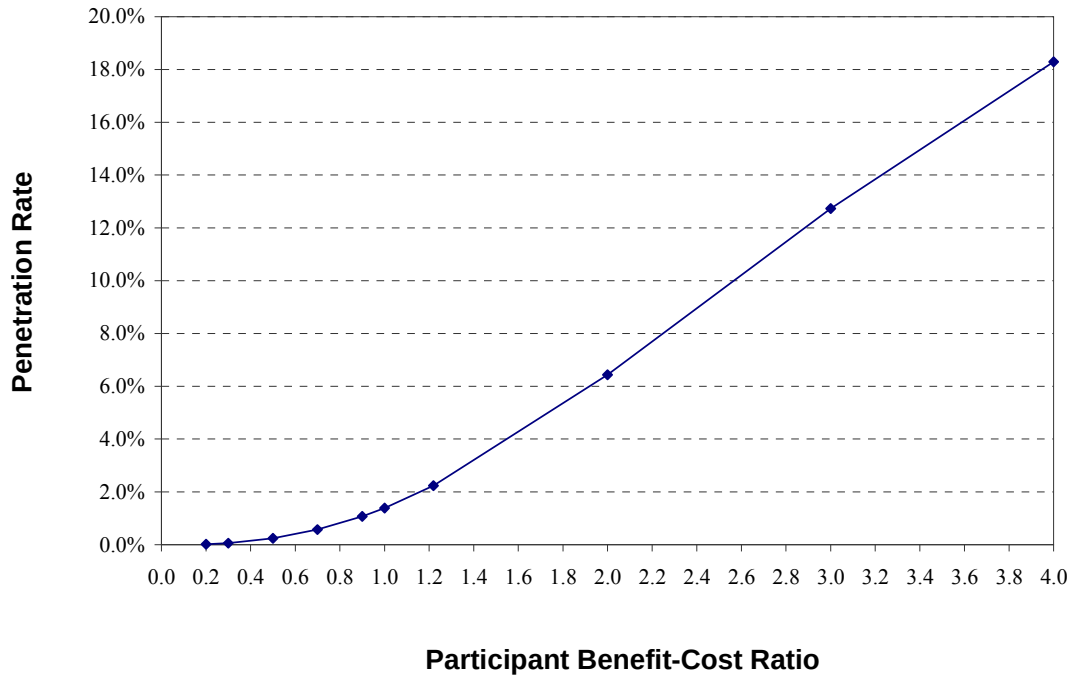

Figure 16.3.1 Market Penetration Curve for Polyphase Small Electric Motors

Capacitor-Start Small Electric Motors

For capacitor-start small electric motors, DOE assumed that the rebate would cover a portion of the incremental cost between a motor meeting the baseline efficiency level and a unit meeting the target efficiency level. DOE assumed that the rebate amount for a 1 HP motor would be equal to the $25 rebate offered for 1 HP polyphase small electric motors (based, in turn, on current rebate programs for three-digit frame series polyphase motors). Similar to polyphase motors, DOE assumed that the rebate amount would scale with the number of poles and power of the motor in the same fashion as motor prices scale. 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 (2015–2045).

DOE first analyzed the impact of rebates at the efficiency levels prescribed by TSL 7. However, for CSIR motors at this efficiency level, a $25 rebate (scaled from a 1 HP motor) had no effect on the efficiency distribution of CSIR motor shipments. Therefore, DOE chose to undertake the remainder of its analysis of policy alternatives with the efficiency levels corresponding to TSL 5.

For each type of capacitor-start motor (induction-run and capacitor-run), DOE first calculated the B/C ratio for the target 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 17.3.3 shows the benefits as lifetime operating cost savings, incremental installed costs without rebates and with rebates, and B/C ratios without rebates and with rebates.

Table 16.3.3 Benefit/Cost Ratios for Capacitor-Start Small Electric Motor Rebate Policy Case

	4-pole 1/2 HP CSIR	**4-pole ¾ HP CSCR**
Benefit (Lifetime Operating Cost Savings)	$109.81	$71.34
Incremental Installed Cost (Increased Installed Cost)	$97.50	$48.90
B/C Ratio with No Rebate	1.13	1.57
Penetration Curve Market Share without Rebate	0.4%	32.6%
Current Market Share at Target Level	**0.0%**	**21.0%**
Rebate Amount	$17.67	$21.65
Adjusted Incremental Installed Cost (Increased Installed Cost after Rebate)	$79.83	$27.25
B/C Ratio for Rebate Policy Case	1.38	2.82
Penetration Curve Market Share with Rebate	0.7%	45.8%
DOE Estimated Market Share with Rebate	**0.3%**	**29.5%**

DOE then used the B/C ratios with the penetration curves shown in Figures 17.3.2 and 17.3.3 to estimate the increased percentage of consumers who would purchase the units that meet the policy target levels if given a rebate incentive. For CSIR motors, DOE chose the "moderate barriers" curve. In the case of CSIR motors, the incremental cost between the baseline and the TSL is substantial, and the benefit-cost ratios of less energy-efficient levels, compared with their market shares, indicate that the "moderate barriers" curve is the best fit. Figure 17.3.6 shows the increase in penetration rates of target-level CSIR 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 0.3 percent. For CSCR motors, DOE chose the "low barriers" curve, because the incremental cost between the baseline and the TSL is small and there is currently substantial market share at or above the target level. Figure 17.3.7 shows the increase in penetration rates of target-level CSCR units as a function of their higher B/C ratios. Using the method discussed above, DOE estimated that the market share of CSCR equipment meeting the policy target due to a rebate policy would increase by 8.5 percent.

To calculate the impacts of this policy, DOE adjusted the market shares of capacitor-start motors at the target efficiencies in its NIA model to represent the policy case scenarios. Table 17.3.4 shows the efficiency distributions used. DOE also adjusted the relative shipment-weighted average prices of CSIR and CSCR motors to incorporate the rebate amounts and used its modified logistic market share model to incorporate rebates into its model of the relative market share of CSIR and CSCR motors within each combination of power and number of poles.

Table 16.3.4 Capacitor-Start Small Electric Motor Target-Level Consumer Rebate Efficiency Market Share Impacts

	Baseline	Eff. 1	Eff. 2	Eff. 3	Eff. 4	Eff. 5	Eff. 6	Eff. 7	Eff. 8
CSIR									
Base case	40.0%	7.0%	20.0%	30.0%	2.0%	1.0%	0.0%	0.0%	-
Rebate case	39.7%	7.0%	20.0%	30.0%	2.0%	1.0%	0.3%	0.0%	-
CSCR									
Base case	67.0%	10.0%	2.0%	2.0%	11.0%	3.0%	5.0%	0.0%	0.0%
Rebate case	58.5%	10.0%	2.0%	10.5%	11.0%	3.0%	5.0%	0.0%	0.0%

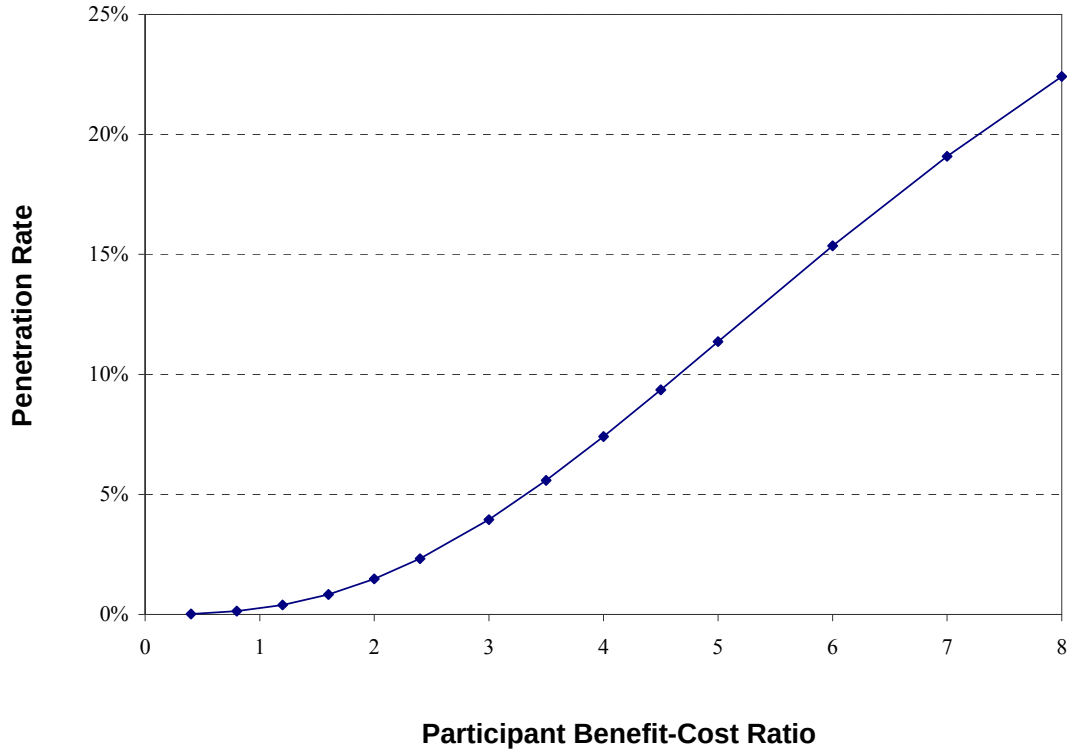

Figure 16.3.2 Market Penetration Curve for CSIR Small Electric Motors

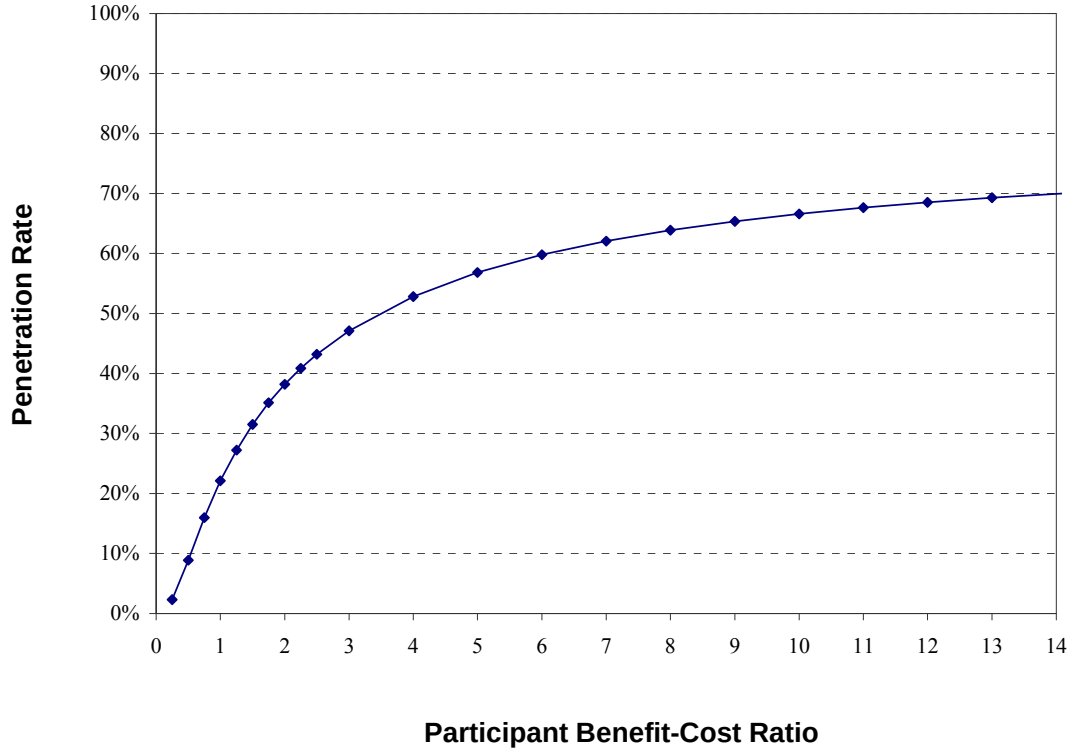

Figure 16.3.3 Market Penetration Curve for CSCR Small Electric Motors

Other Capacitor-Start Rebate Scenarios

DOE analyzed two additional consumer rebate scenarios for capacitor-start motors. The first scenario models the impact of a $25 rebate for 1 HP CSIR motors (as well as scaled rebates for other classes) which meet the efficiency of efficiency level 4, rather than level 6. CSCR rebates in this scenario continue to promote the target efficiency level (level 3). This corresponds to a rebate program targeting capacitor-start TSL 2. This rebate reimburses the consumer for a significantly larger fraction of the incremental cost, resulting in significantly greater utilization of the rebate program. Table 17.3.5 shows the B/C ratios for this scenario.

Table 16.3.5 Benefit/Cost Ratios for Capacitor-Start Small Electric Motors, CSIR Level 4 (TSL 2) Rebate Policy Case

	4-pole 1/2 HP CSIR	4-pole ¾ HP CSCR
Benefit (Lifetime Operating Cost Savings)	$90.15	$71.34
Incremental Installed Cost (Increased Installed Cost)	$35.15	$48.90
B/C Ratio with No Rebate	2.56	1.46
Penetration Curve Market Share without Rebate	2.7%	32.6%
Current Market Share at Target Level	**3.0%**	**21.0%**
Rebate Amount	$17.67	$21.65
Adjusted Incremental Installed Cost (Increased Installed Cost after Rebate)	$17.48	$27.25
B/C Ratio for Rebate Policy Case	5.16	2.62
Penetration Curve Market Share with Rebate	12.0%	45.8%
DOE Estimated Market Share with Rebate	**13.2%**	**29.5%**

DOE then used the B/C ratios with the penetration curves shown in Figures 17.3.2 and 17.3.3 to estimate the increased percentage of consumers who would purchase the units that meet efficiency level 4 if given a rebate incentive. DOE again chose the "high barriers" curve for CSIR motors and the "low barriers" curve for CSCR motors. Using the method discussed above, DOE estimated that the market share of CSIR equipment at efficiency level 4 would increase by 11.2 percent.

Table 16.3.6 Capacitor-Start Small Electric Motor TSL 5 Consumer Rebate Efficiency Market Share Impacts

	Baseline	Eff. 1	Eff. 2	Eff. 3	Eff. 4	Eff. 5	Eff. 6	Eff. 7	Eff. 8
CSIR									
Base case	40.0%	7.0%	20.0%	30.0%	2.0%	1.0%	0.0%	0.0%	-
Rebate case	29.8%	7.0%	20.0%	30.0%	12.2%	1.0%	0.0%	0.0%	-
CSCR									
Base case	67.0%	10.0%	2.0%	2.0%	11.0%	3.0%	5.0%	0.0%	0.0%
Rebate case	58.5%	10.0%	2.0%	10.5%	11.0%	3.0%	5.0%	0.0%	0.0%

DOE's CSIR/CSCR market share model, detailed in section 9.4, indicates that there are significant market barriers to the purchase of CSCR motors, even when it would be cost effective for consumers to do so. DOE therefore analyzed a rebate scenario which targets only CSCR motors. This scenario models the effects of relatively large rebates ($50 for 1 HP motors) for CSCR motors which meet the policy-target efficiency level (efficiency level 3, corresponding to TSL 7), where there is no rebate for CSIR motors. Table 17.3.7 shows the B/C ratios and resulting market share impacts for this scenario.

Table 16.3.7 Benefit/Cost Ratios for Capacitor-Start Small Electric Motors, CSCR-only Rebate Policy Case

	4-pole 1/2 HP CSIR	4-pole ¾ HP CSCR
Benefit (Lifetime Operating Cost Savings)	$109.81	$71.34
Incremental Installed Cost (Increased Installed Cost)	$97.50	$48.90
B/C Ratio with No Rebate	1.13	1.57
Penetration Curve Market Share without Rebate	0.4%	32.6%
Current Market Share at Target Level	**0.0%**	**21.0%**
Rebate Amount	$0.00	$21.65
Adjusted Incremental Installed Cost (Increased Installed Cost after Rebate)	$97.50	$27.25
B/C Ratio for Rebate Policy Case	1.13	13.71
Penetration Curve Market Share with Rebate	0.4%	69.8%
DOE Estimated Market Share with Rebate	**0.0%**	**44.9%**

DOE then used the CSCR B/C ratios with the penetration curve shown in Figure 17.3.3 to estimate the increased percentage of consumers who would purchase CSCR motors which meet the target efficiency level. DOE again chose the "low barriers" penetration curve. Using the method discussed above, DOE estimated that the market share of CSCR equipment at efficiency level 3 (the CSCR level of TSL 6) would increase by 23.9 percent. DOE again used its CSIR/CSCR market share model to model the impact of this differential rebate program on CSCR market share within each equipment class. DOE found that this program would increase total shipments of CSCR motors in the analysis period (2015-2045) from 6.9 million in the base case to 11.1 million.

To calculate the impacts of these policies, DOE adjusted the market shares of capacitor-start small electric motors at the relevant efficiencies in its NIA model to represent the policy case scenarios. Table 16.3.8 shows the efficiency distributions used to analyze these rebate policies.

Table 16.3.8 Capacitor-Start Small Electric Motor CSCR-Only Consumer Rebate Efficiency Market Share Impacts

	Baseline	Eff. 1	Eff. 2	Eff. 3	Eff. 4	Eff. 5	Eff. 6	Eff. 7	Eff. 8
CSIR									
Base case	40.0%	7.0%	20.0%	30.0%	2.0%	1.0%	0.0%	0.0%	-
Rebate case	40.0%	7.0%	20.0%	30.0%	2.0%	1.0%	0.0%	0.0%	-
CSCR									
Base case	67.0%	10.0%	2.0%	2.0%	11.0%	3.0%	5.0%	0.0%	0.0%
Rebate case	43.1%	10.0%	2.0%	25.9%	11.0%	3.0%	5.0%	0.0%	0.0%

16.3.2.2 Consumer Tax Credits

Consumer tax credits cover a percentage of the difference in incremental product price between equipment meeting baseline efficiency levels and that with higher efficiencies. Consumer tax credits are considered a viable non-regulatory market transformation program, as shown by the inclusion of Federal consumer tax credits in EPACT 2005 for various residential appliances.

DOE estimated that for both polyphase and capacitor-start small electric motors, the consumer participation rate would be lower than the rate of participation in consumer rebates. Research on tax credits has shown that the time delay to the consumer in receiving a reimbursement through a tax credit, plus the added transaction costs in tax return preparation, make the tax credit incentive less effective than a rebate received at the time of purchase. Based on previous analysis[8], DOE assumed that only 60 percent as many consumers would take advantage of the tax credit as would take advantage of a rebate.

Using a similar approach as for the rebate policy, DOE estimated that the market share of target efficiency level motors would increase due to consumer tax credits over the base case. For all covered motors, these changes in percentage market penetrations are 60 percent of the market penetration changes estimated for the consumer rebate policy.

DOE assumed that the impact of this policy would be to permanently transform the market so that the increased market penetration seen in the first year of the program would be maintained throughout the forecast period. Table 17.3.9 shows the efficiency distributions used in analyzing the impact of this policy.

Table 16.3.9 Small Electric Motor Consumer Tax Credit Efficiency Market Share Impacts

	Baseline	Eff. 1	Eff. 2	Eff. 3	Eff. 4	Eff. 5	Eff. 6	Eff. 7	Eff. 8
Polyphase									
Base case	82.0%	4.0%	4.0%	4.0%	6.0%	0.0%	0.0%	0.0%	-
Consumer Tax Credit	81.8%	4.0%	4.0%	4.0%	6.0%	0.2%	0.0%	0.0%	-
CSIR									
Base case	40.0%	7.0%	20.0%	30.0%	2.0%	1.0%	0.0%	0.0%	-
Consumer Tax Credit	39.8%	7.0%	20.0%	30.0%	2.0%	1.0%	0.2%	0.0%	-
CSCR									
Base case	67.0%	10.0%	2.0%	2.0%	11.0%	3.0%	5.0%	0.0%	0.0%
Consumer Tax Credit	61.9%	10.0%	2.0%	7.1%	11.0%	3.0%	5.0%	0.0%	0.0%

16.3.2.3 Manufacturer Tax Credits

Manufacturer tax credits are considered a viable non-regulatory market transformation program, as shown by the inclusion of Federal tax credits in EPACT 2005 for manufacturers of residential appliances. Similar to consumer tax credits, manufacturer tax credits would effectively result in lower product prices for consumers by an amount that covered part of the incremental price difference between products meeting baseline efficiency levels and those meeting targeted efficiency levels.

DOE assumed that this incentive policy would help reimburse manufacturers for retooling costs. Because these tax credits would go to manufacturers instead of consumers, DOE assumed that manufacturers would pass on the reduced costs. Since 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. Using this information, DOE calculated the percentage by which market penetration of target efficient level motors would increase due to manufacturer tax credits over the base case.

DOE assumed that the impact of this policy would be to permanently transform the market so that the increased market penetration seen in the first year of the program would be maintained throughout the forecast period. Table 17.3.10 shows the efficiency distributions used in analyzing the impact of this policy.

Table 16.3.10 Small Electric Motor Manufacturer Tax Credit Efficiency Market Share Impacts

	Baseline	Eff. 1	Eff. 2	Eff. 3	Eff. 4	Eff. 5	Eff. 6	Eff. 7	Eff. 8
Polyphase									
Base case	82.0%	4.0%	4.0%	4.0%	6.0%	0.0%	0.0%	0.0%	-
Manufacturer Tax Credit	81.9%	4.0%	4.0%	4.0%	6.0%	0.1%	0.0%	0.0%	-
CSIR									
Base case	40.0%	7.0%	20.0%	30.0%	2.0%	1.0%	0.0%	0.0%	-
Manufacturer Tax Credit	39.9%	7.0%	20.0%	30.0%	2.0%	1.0%	0.1%	0.0%	-
CSCR									
Base case	67.0%	10.0%	2.0%	2.0%	11.0%	3.0%	5.0%	0.0%	0.0%
Manufacturer Tax Credit	64.5%	10.0%	2.0%	4.6%	11.0%	3.0%	5.0%	0.0%	0.0%

16.3.3 Voluntary Energy Efficiency Targets

For all categories of small electric motors, DOE assumed that the market behavior in the context of voluntary targets would be similar to market behavior related to the voluntary NEMA Premium program for three-digit frame series polyphase motors. Current market share for

NEMA Premium motors is roughly 25%. However, DOE assumed that 20% of this market share can be attributed to promotion, labeling, and other non-financial incentives, and 5% may be attributed to current rebate programs for such motors. DOE assumed that a voluntary program for small electric motors would achieve a 20% market share in the target efficiency levels for polyphase and CSIR motors. Current CSCR market share in the target level and above is 21%. DOE assumed that a voluntary program similar to NEMA Premium would increase this share by 10%, to 31%. Table 17.3.11 shows the efficiency distributions DOE assumed would result from a voluntary efficiency program. DOE assumed that these levels would be achieved in 2015 and remain constant throughout the analysis period.

Table 16.3.11 Small Electric Motor Voluntary Efficiency Target Market Share Impacts

	Baseline	**Eff. 1**	**Eff. 2**	**Eff. 3**	**Eff. 4**	**Eff. 5**	**Eff. 6**	**Eff. 7**	**Eff. 8**
Polyphase									
Base case	82.0%	4.0%	4.0%	4.0%	6.0%	0.0%	0.0%	0.0%	-
Voluntary Effic. Targets	62.0%	4.0%	4.0%	4.0%	6.0%	20.0%	0.0%	0.0%	-
CSIR									
Base case	40.0%	7.0%	20.0%	30.0%	2.0%	1.0%	0.0%	0.0%	-
Voluntary Effic. Targets	20.0%	7.0%	20.0%	30.0%	2.0%	1.0%	0.0%	20.0%	-
CSCR									
Base case	67.0%	10.0%	2.0%	2.0%	11.0%	3.0%	5.0%	0.0%	0.0%
Voluntary Effic. Targets	57.0%	10.0%	2.0%	12.0%	11.0%	3.0%	5.0%	0.0%	0.0%

16.3.4 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.[9,10]

DOE analyzed only commercial-sector motor applications for government purchases. Direct government involvement in the industrial sector is very small. While direct government administration of housing is significant, residential applications of covered small electric motors are very small, and government purchases in this sector are unlikely to have a significant impact. DOE used the 2003 Commercial Building Energy Consumption Survey to determine the fraction of commercial floor space owned by government agencies, 23.7%, and assumed that government purchases an equivalent fraction of small electric motors in commercial applications. DOE then assumed that 80% of government purchases of small electric motors in commercial applications would meet the target efficiency level. For polyphase motors, such a program could increase market share for target-level equipment by 7.7%, while for capacitor-start motors it could increase the market share by 7.4%. Table 17.3.12 shows the resulting efficiency distributions, which DOE assumed would remain constant throughout the analysis period.

Table 16.3.12 Small Electric Motor Bulk Government Purchases Efficiency Market Share Impacts

	Baseline	Eff. 1	Eff. 2	Eff. 3	Eff. 4	Eff. 5	Eff. 6	Eff. 7	Eff. 8
Polyphase									
Base Case	82.0%	4.0%	4.0%	4.0%	6.0%	0.0%	0.0%	0.0%	-
Bulk Gov't Purchases	74.3%	4.0%	4.0%	4.0%	6.0%	7.7%	0.0%	0.0%	-
CSIR									
Base Case	40.0%	7.0%	20.0%	30.0%	2.0%	1.0%	0.0%	0.0%	-
Bulk Gov't Purchases	32.6%	7.0%	20.0%	30.0%	2.0%	1.0%	0.0%	7.4%	-
CSCR									
Base Case	67.0%	10.0%	2.0%	2.0%	11.0%	3.0%	5.0%	0.0%	0.0%
Bulk Gov't Purchases	59.6%	10.0%	2.0%	9.4%	11.0%	3.0%	5.0%	0.0%	0.0%

16.4 RESULTS SUMMARY FOR NON-REGULATORY ALTERNATIVES

Table 17.4.1 summarizes the impact of non-regulatory alternatives on the market share of target-level motors. (The capacitor-start TSL 2 consumer rebate does not change the market share of CSIR motors which meet the requirements of TSL 5 or TSL 7, but does save energy due to the increased market share of efficiency-level-4 CSIR motors.)

Table 16.4.1 Non-Regulatory Alterative Market Share Summary

Policy Alternatives	Market Share at or above Target Level (%)		
	Polyphase	CSIR	CSCR
No New Regulatory Action	0.0	0.0	21.0
Target-Level Consumer Rebates	0.4	0.3	29.5
TSL 2 Consumer Rebates	N/A	13.2*	29.5
CSCR-Only Consumer Rebates	N/A	0.0	44.9
Consumer Tax Credits	0.2	0.2	26.1
Manufacturer Tax Credits	0.1	0.1	23.6
Voluntary Efficiency Targets	20.0	20.0	31.0
Bulk Government Purchases	7.7	7.4	28.4

* Market share at CSIR efficiency level 4 or above (3.0% in the base case)

Tables 16.4.2 and 16.4.3 show 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 for each product (except where noted). The cases in which no regulatory action is taken with regard to small electric motors constitute the base case (or "No Action") scenarios, in which energy savings and NPV are zero by definition. For comparison, the tables also include the impacts of the proposed energy conservation standards. The NPV amounts shown in Tables 16.4.2 and 16.4.3 are based on two discount rates (seven percent and three percent real). The non-regulatory alternatives achieve lower energy savings than the proposed standards and have lower NPV. Table 16.4.3 shows the energy savings and NPV corresponding to a market scenario in which the market share shift between CSIR and CSCR driven by each policy alternative is complete by 2015.

Table 16.4.2 Non-Regulatory Alternatives for Polyphase Small Electric Motors

Policy Alternatives	Primary Energy Savings (quads)	Net Present Value* (billion 2008$)	
		7% discount rate	3% discount rate
No New Regulatory Action	0.0000	0.0000	0.0000
Consumer Rebates	0.0015	0.0005	0.0030
Consumer Tax Credits	0.0009	0.0003	0.0018
Manufacturer Tax Credits	0.0004	0.0001	0.0009
Voluntary Efficiency Targets	0.0716	0.0231	0.1426
Bulk Government Purchases	0.0276	0.0089	0.0549
Proposed Standards at TSL 5	0.3298	0.0598	0.5635

* Net present value (NPV) is the value of a time series of costs and savings. DOE determined the NPV from 2015 to 2065 in billions of 2008$.

Table 16.4.3 Non-Regulatory Alternatives for Capacitor-Start Small Electric Motors

Policy Alternatives	Primary Energy Savings (quads)	Net Present Value* (billion 2008$)	
		7% discount rate	3% discount rate
No New Regulatory Action	0.000	0.000	0.000
Consumer Rebates	0.071	0.245	0.566
TSL 2 Consumer Rebates	0.187	0.517	1.237
CSCR-Only Consumer Rebates	0.130	0.428	0.993
Consumer Tax Credits	0.057	0.206	0.473
Manufacturer Tax Credits	0.047	0.178	0.405
Voluntary Energy Efficiency Targets	0.749	0.331	1.469
Bulk Government Purchases	0.311	-0.016	0.304
Proposed Standards at TSL 7	2.128	5.674	13.586

* Net present value (NPV) is the value of a time series of costs and savings. DOE determined the NPV from 2015 to 2065 in billions of 2008$.

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