CHAPTER 12. MANUFACTURER IMPACT ANALYSIS

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CHAPTER 12. MANUFACTURER IMPACT ANALYSIS

12.1 INTRODUCTION

In determining whether an energy conservation standard is economically justified, the U.S. Department of Energy (DOE) is required to consider "the economic impact of the standard on the manufacturers and on the consumers of the products subject to such a standard." (42 U.S.C. 6313(a)(6)(B)(i)) The law also calls for an assessment of the impact of any lessening of competition as determined in writing by the Attorney General. *Id.* DOE conducted a manufacturer impact analysis (MIA) to estimate the financial impact of higher energy conservation standards for standby mode and off mode power on manufacturers of microwave ovens and to assess the impact of such standards on employment and manufacturing capacity. The MIA has both quantitative and qualitative aspects.

The quantitative part of the MIA primarily relies on the Government Regulatory Impact Model (GRIM), an industry-cash-flow model adopted to analyze the impact of standby mode and off mode energy conservation standards on microwave oven manufacturers. The GRIM inputs include information on industry cost structure, shipments, and pricing strategies. The GRIM's key output is the industry net present value (INPV). The model estimates the financial impact of energy conservation standards by comparing changes in INPV between a base case and the various trial standard levels (TSLs). The qualitative part of the MIA addresses factors such as product characteristics, characteristics of particular manufacturers, and market and product trends. It also assesses the impact of standards on subgroups of manufacturers.

12.2 METHODOLOGY

DOE conducted the MIA in three phases. Phase I, "Industry Profile," consisted of preparing an industry characterization for the microwave oven industry, including data on market share, sales volumes and trends, pricing, employment, and financial structure. Phase II, "Industry Cash Flow," focused on the microwave oven industry individually. Two major product categories were identified for this rulemaking:

- Product Class 1: Microwave-Only Ovens and Countertop Combination Microwave Ovens
- Product Class 2: Built-In and Over-the-Range Combination Microwave Ovens.

DOE developed a GRIM to prepare an industry cash flow analysis. Using publicly available information developed in Phase I, DOE adapted the GRIM's generic structure to facilitate analysis of new standby power requirements for microwave oven manufacturers.

In Phase III, "Subgroup Impact Analysis," DOE interviewed three microwave oven manufacturers with varying product focus and market shares, providing a representative cross-section of the industry. During these interviews, DOE discussed financial topics specific to each manufacturer and obtained each manufacturer's view of the industry as a whole. The interviews provided valuable information that DOE used to evaluate the impacts of new standby mode and off mode standards on manufacturers' cash flows, investment requirements, and employment levels. The following subsections describe more specifically the steps DOE took in developing the information on which it based the MIA.

12.2.1 Phase I: Industry Profile

In Phase I of the MIA, DOE prepared a profile of the microwave oven industry that built upon the market and technology assessment prepared for this rulemaking (see chapter 3 of this Technical Support Document (TSD)). Before initiating the detailed impact studies, DOE collected qualitative and quantitative financial information and past and present market data. This included estimated market shares, corporate operating ratios, wages, employment, and financial ratios for several home appliance manufacturers. The industry profile included a top-down cost analysis of microwave oven manufacturers that DOE used to derive cost and preliminary financial inputs for the GRIM (*e.g.*, revenues; material; labor; overhead; depreciation; selling, general and administrative expenses (SG&A); and research and development (R&D) expenses).

DOE also used public information to further calibrate its initial characterization of the microwave oven industry, including Securities and Exchange Commission (SEC) 10–K reports, Standard & Poor's (S&P) stock reports, Dun and Bradstreet (D&B) company profiles, corporate annual reports, and U.S. Census Bureau's 2006 *Annual Survey of Manufactures* (2006 *ASM*). In addition, DOE relied on information from its engineering analysis, life-cycle cost analysis, and analysis of markups to determine product prices to characterize the industry. DOE also interviewed manufacturers of microwave ovens. These preliminary interviews were designed to solicit key concerns, industry structure, and other data points for the subsequent analysis.

12.2.2 Phase II: Industry Cash-Flow Analysis and Interview Guide

In Phase II, DOE performed industry cash-flow analyses and prepared written guidelines for interviewing manufacturers. Phase II focused on the financial impacts of new standby mode and off mode standards on the microwave oven industry. New standards can affect manufacturers in three distinct ways: (1) require additional investment, (2) raise production costs, and (3) impact revenues through higher prices and possibly lower shipments. The analytical tool DOE uses for calculating the financial impacts of energy conservation standards on manufacturers is the GRIM. DOE performed a cash flow analysis by modifying the GRIM for the microwave oven industry to quantify these impacts.

12.2.2.1 Industry Cash-Flow Analysis

The GRIM uses several factors to determine a series of annual cash flows for the time between the announcement of the standard and the compliance year and for several years after implementation. These factors include annual expected revenues; costs of sales; SG&A expenses; taxes; and capital expenditures related to new standards. Inputs to the GRIM include manufacturing costs, shipments forecasts, and prices developed in other analyses. DOE derived the manufacturing costs from the engineering analysis and information provided by the industry, and estimated typical manufacturer markups from public financial reports and interviews with manufacturers. DOE developed alternative markup scenarios for each GRIM based on discussions with manufacturers during the rulemaking. DOE's shipments analysis, presented in chapter 9 of this TSD, provided the basis for the shipments projection under each TSL in each GRIM. The financial parameters were developed using publicly available data of manufacturers of products covered by this rulemaking. The results of the GRIM are compared against base-case projections. The financial impact of new standby mode and off mode standards is the difference between the baseline and the standards-impacted sets of discounted annual cash flows.

12.2.2.2 Interview Guide

During Phase III of the MIA, DOE conducted interviews with manufacturers that cover all or some microwave oven product categories to gather information on the effects of new standby mode and off mode energy conservation standards on revenues and finances, direct employment, capital assets, and on industry competitiveness. Prior to the interviews, DOE distributed a standard interview guide that provided a starting point to identify relevant issues and help identify the impacts of energy conservation standards on individual manufacturers or subgroups of manufacturers. The interview guide covered current organizational characteristics, industry infrastructure, manufacturer cash-flow analysis, a competitive impacts assessment, an employment impacts assessment, and a manufacturing capacity impacts assessment. The interview guides used to conduct the manufacturer interviews are found in appendix 12-A of this TSD.

12.2.3 Phase III: Subgroup Analysis

During the course of the MIA, DOE interviewed manufacturers representing a large percentage of microwave oven sales. Many of these same companies also participated in interviews for the engineering analysis. However, the MIA interviews broadened the discussion from primarily technology-related issues to include business related topics. One objective was to obtain feedback from industry on the approaches used in the GRIM and to isolate key issues and concerns. The following sections summarize the methodology and findings of this assessment.

12.2.3.1 Manufacturer Interviews

The information gathered in Phase I and the cash-flow analysis performed in Phase II are supplemented with information gathered during interviews with manufacturers during Phase III. The interview process has a key role in the manufacturer impact analysis, since it provides an opportunity for interested parties to express their views privately on important issues, allowing confidential or sensitive information to be considered in the rulemaking process.

DOE prepared two different interview guides—one for microwave oven manufacturers dealing with energy factor standards and one for microwave oven manufacturers regarding standby power requirements.[a] DOE used these interviews to tailor the GRIM for microwave oven standby mode and off mode standards. DOE contacted companies from its database of manufacturers, which provided a representation of the industry. DOE interviewed three

[a] DOE published its final rule setting energy factor microwave oven standards on April 8, 2009. Please see *http://www1.eere.energy.gov/buildings/appliance_standards/residential/cooking_products.html.*

microwave oven manufacturers with varying product focus and market shares, providing a representative cross-section of the industry. Interviews were scheduled well in advance in order to provide every opportunity for key individuals to be available for comment. Although a written response to the questionnaire was acceptable, DOE preferred an interactive interview process because it helped clarify responses and provide the opportunity to identify additional issues.

DOE conducted detailed interviews with all manufacturers that agreed to participate to gain insight into the range of potential impacts and how this range varies with each TSL. The resulting qualitative and quantitative information are valuable inputs for the GRIM.

12.2.3.2 Revised Industry Cash-Flow Analysis

In Phase II of the MIA, DOE provided manufacturers with preliminary GRIM input financial figures for review and evaluation. During the interviews, DOE requested comment and suggestions regarding the values selected for the parameters. Upon completion of the interviews, DOE revised its industry cash flow models based on the feedback provided through the interviews. More information on how DOE calculated the parameters for the GRIM is found in section 12.4.3 of this chapter.

12.2.3.3 Manufacturer Subgroup Analysis

Using average cost assumptions to develop an industry cash flow estimate is not adequate for assessing differential impacts among subgroups of manufacturers. Manufacturers exhibiting a cost structure that differs significantly from the industry average could be more negatively affected. Ideally, DOE would consider the impact on every manufacturer individually; however, it typically uses the results of the industry characterization to group manufacturers exhibiting similar characteristics. During the interview process, DOE discussed the potential subgroups and subgroup members that have been identified for the analysis. DOE looked to the manufacturers and other interested parties to suggest what subgroups or characteristics are the most appropriate for the analysis. However, DOE did not identify any subgroups to present INPV impacts separately.

12.2.3.4 Small Business Manufacturer Subgroup

DOE used the small business size standards published on November 5, 2010, as amended, by the Small Business Administration (SBA) to determine whether any small entities would be required to comply with the rule (codified at 13 CFR Part 121). The size standards are listed by North American Industry Classification System (NAICS) code and industry description. DOE used the SBA limits for NAICS code 335221 (Household Cooking Appliance Manufacturing) to determine if any small business manufacturers would be affected by this rulemaking. The SBA bases its small business definition on the total number of employees for a business, its subsidiaries, and its parent companies. Whenever an aggregated business entity has less than the listed number of employees, it is considered a small business. For NAICS code 335221, the SBA size limit is a total of 750 employees.

DOE surveyed the Association of Home Appliance Manufacturers (AHAM) member's directory to identify manufacturers of microwave oven products. DOE also asked stakeholders and AHAM representatives within the industry if they were aware of any other small business manufacturers. DOE then consulted publicly available data, purchased company reports from vendors such as D&B, and contacted manufacturers, where needed, to determine if they meet the SBA's definition of a small business manufacturing facility and have their manufacturing facilities located within the United States. Based on this analysis, DOE did not identify any small business manufacturers of microwave ovens.

12.2.3.5 Manufacturing Capacity Impact

One of the significant outcomes of energy conservation standards could be the consequential obsolescence of existing manufacturing assets, including tooling and investment. The manufacturer interview guide has a series of questions to help identify impacts on manufacturing capacity, specifically capacity utilization and plant location decisions in the United States and North America with and without a standard; the ability of manufacturers to upgrade or remodel existing facilities to accommodate the new requirements due to energy conservation standards; the nature and value of stranded assets, if any; and estimates for any one-time restructuring and other charges, where applicable.

12.2.3.6 Employment Impact

The impact of energy conservation standards on employment is an important consideration in the rulemaking process. To assess how domestic employment patterns might be affected, the interviews explored current employment trends in the microwave oven industry. In addition, the interviews solicited manufacturer views on changes in employment patterns that may result from more stringent standard levels. The employment impacts section of the interview guide focused on current employment levels associated with manufacturers at each of their production facilities, expected future employment levels with and without energy conservation standards for standby mode and off mode, and differences in workforce skills and issues related to the retraining of employees.

12.2.3.7 Cumulative Regulatory Burden

DOE recognizes and seeks to mitigate the overlapping effects on manufacturers due to energy conservation standards and other Federal regulatory actions affecting the same products. DOE analyzed and considered the impact on manufacturers of multiple, product-specific regulatory actions. Based on its own research and discussions with manufacturers, DOE identified several regulations relevant to microwave oven manufacturers including: Federal energy conservation standards for other products manufactured by these manufacturers and other environmental regulations.

12.3 MANUFACTURER IMPACT ANALYSIS KEY ISSUES

Each MIA starts by asking: "What are the key issues for your company regarding the energy conservation standard rulemaking?" This open question initiates dialogue with the manufacturers, enabling them to identify the issues that they feel DOE should explore and discuss further during the interview. The following section describes key issues mentioned for all product categories under review. Manufacturers indicated that, for the most part, the risks associated with these issues increase with more stringent TSLs.

12.3.1 Consumer Utility

All manufacturers of microwave ovens are concerned that amendments to the microwave oven test procedure could reduce consumer utility. For example, one manufacturer stated that it is not aware of cooking sensors that do not require standby power and thus, depending on the level chosen by DOE, a new standby power requirement could lead to the elimination of cooking sensors from its products. However, multiple manufacturers stated that they already use or are in the process of adopting no-standby cooking sensors. Another potential impact on consumer utility related to cooking sensors mentioned by manufacturers was waiting for sensors to activate or a hard off switch causing microwave ovens to have a delayed start.

On a related note, manufacturers stated that lower standby power could impact display and control choices which would also affect consumer utility. Finally, manufacturers indicated some other features that add consumer utility (*i.e.*, a clock or nightlight) also could be impacted by standby mode and off ode standards since these features consume standby power.

12.3.2 Profitability

Manufacturers of microwave ovens stated that standby mode and off mode standards have the potential to hurt profitability. Manufacturers typically earn a premium on higher-end models while low-end models are extremely commoditized. The premium on high-end products would be squeezed if standards eliminated product differentiators (such as larger, premium displays) or forced high-end features to lower end models (such as cooking sensors). Manufacturers indicated that standards have the potential to eliminate remaining U.S. production due to already tight margins, especially if standards impact consumer utility.

12.4 GRIM INPUTS AND ASSUMPTIONS

The GRIM serves as the main tool for assessing the impact on industry due standby mode and off mode energy conservation standards. DOE relies on several sources to obtain inputs for the GRIM. Data and assumptions from these sources are then feed into an accounting model that details the cash flow on a baseline basis, as well as calculates the impacts on manufacturers due to energy conservation standards

12.4.1 Overview of the GRIM

The basic structure of the GRIM, illustrated in Figure 12.4.1, is an annual cash flow analysis that uses manufacturer prices, manufacturing costs, shipments, and industry financial information as inputs, and accepts a set of regulatory conditions such as changes in costs, investments, and associated margins. The GRIM spreadsheet uses a number of inputs to arrive at a series of annual cash flows, beginning with the base year of the analysis, 2011, and continuing explicitly through 2043. The model calculates the INPV by summing the stream of annual discounted cash flows during this period and adding a terminal value.[1]

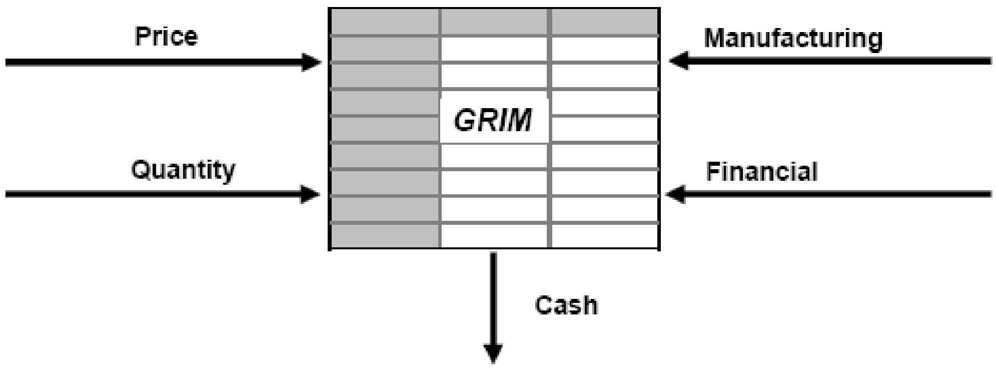

Figure 12.4.1 Using the GRIM to Calculate Cash Flow

The GRIM projects cash flows using standard accounting principles and compares changes in INPV between the base case scenario and the standard case scenario, evaluating changes induced by the energy conservation standards. The difference in INPV between the base case and the standard case(s) represents the estimated financial impact of the energy conservation standard on manufacturers. Appendix 12-B provides more technical details and user information for the GRIM.

12.4.2 Sources GRIM Inputs

The GRIM uses several different sources for data inputs in determining the cash flows for the industry, including corporate annual reports, company profiles, Census data, credit ratings, the shipments model, the engineering analysis, and the manufacturer interviews.

12.4.2.1 Corporate Annual Reports

Corporate annual reports to the SEC (10-Ks) provided many of the financial inputs to the GRIM.[2] These reports exist for publicly held companies and are freely available to the general public. DOE developed average financial inputs to the GRIM by examining the annual SEC 10-K reports filed by publicly-traded manufacturers primarily engaged in appliance manufacturing and whose combined product range includes microwave ovens. Because these companies are typically diversified, producing a range of different appliances, an industry average was assumed by DOE to be representative for the manufacture of each type of appliance. In determining financial parameters for the industry, DOE weighted corporate financial information contained in the SEC 10-Ks by each company's estimated market share to arrive at industry-weighted averages. DOE used corporate annual reports to derive the following GRIM inputs:

- Tax rate,
- Working capital,
- SG&A,
- R&D expenses,
- Depreciation,
- Capital expenditures, and
- Net property, plant, and equipment (PPE).

DOE also used information from company SEC 10-K reports to calibrate the GRIM's operating profit margin against the industry weighted average.

12.4.2.2 Standard and Poor Credit Ratings

S&P provides independent credit ratings, research, and financial information. S&P reports are available for a nominal fee. DOE relied on S&P reports to determine the industry's average cost of debt for the cost of capital calculation.

12.4.2.3 Dun and Bradstreet Reports

D&B provides independent research regarding company cash flows, revenues, employees, and credit-worthiness. Besides conducting manufacturer interviews, DOE used D&B reports to profile several manufacturers which had the potential to be small businesses.

12.4.2.4 Shipment Model

The GRIM used shipment projections derived from DOE's shipments model in the national impact analysis. The model relied on historical shipments data for microwave oven from AHAM for the supplemental notice of proposed rulemaking (SNOPR) analysis. Chapter 9 of this TSD describes the methodology and analytical model DOE used to forecast shipments.

12.4.2.5 Engineering Analysis

During the engineering analysis, DOE used data submitted from AHAM, manufacturer interviews, and product testing and tear downs to develop manufacturing cost estimates for Product Class 1 (Microwave-Only Ovens and Countertop Combination Microwave Ovens) and Product Class 2 (Built-In and Over-the-Range Combination Microwave Ovens).

12.4.2.6 Manufacturer Interviews

During the course of the MIA, DOE conducted interviews with manufacturers of microwave ovens. During these discussions, DOE obtained information, which it used to determine and verify GRIM input assumptions for each industry. Key topics discussed during the interviews and reflected in the GRIM include:

- Conversion capital costs (one-time investments in property, plant, and equipment);
- Product conversion costs (one-time investments in research, product development, testing, and marketing);
- The portion of the conversion capital expenditures that companies use to replace stranded assets;
- Product cost structure: The portion of the manufacturer production costs related to materials, labor, overhead, and depreciation costs;
- Projected total shipment and shipment distribution mix; and
- Engineering analysis estimated manufacturer production costs.

12.4.3 Financial Parameters

Table 12.4.1 provides financial parameters for three public companies engaged in manufacturing and selling microwave ovens. The values listed are averages over an eight-year period (1999–2006).

Table 12.4.1 GRIM Financial Parameters Based on 1999–2006 Weighted Company Financial Data

Parameter	Industry-Weighted Average	Manufacturer		
		A	B	C
Tax Rate ***(% of Taxable Income)***	33.9	6.6	34.1	34.5
Working Capital ***(% of Revenue)***	2.9	9.6	5.6	2.0
SG&A ***(% of Revenue)***	13.0	12.7	12.3	13.2
R&D ***(% of Revenues)***	2.3	2.3	2.0	2.4
Depreciation ***(% of Revenues)***	3.4	3.9	3.4	3.3
Capital Expenditures ***(% of Revenues)***	3.5	1.9	3.4	3.6
Net Property, Plant, and Equipment ***(% of Revenues)***	19.9	17.3	21.6	19.4

These companies constitute a significant portion of the microwave oven industry. For other companies in the industry, public data is not available and was not used to calculate the parameters. The values used in the GRIM, therefore, represent the industry's weighted average estimates using financial data from three publicly traded manufacturers. During manufacturer interviews, microwave ovens manufacturers were asked to review the parameters listed in Table 12.4.1 and comment on how the parameters related to their specific industry. Where applicable, the parameters were then adjusted for the GRIM.

12.4.4 Corporate Discount Rate

DOE used the weighted-average cost of capital (WACC) for the industry as the discount rate to calculate the INPV. A company's assets are financed by a combination of debt and equity. The WACC is the total cost of debt and equity weighted by their respective proportions in the capital structure of the industry. DOE estimated the WACC for the microwave oven industry based on several representative companies, using the following formula:

WACC = After-Tax Cost of Debt x (Debt Ratio) + Cost of Equity x (Equity Ratio)

The cost of equity is the rate of return that equity investors (including, potentially, the company) expect to earn on a company's stock. These expectations are reflected in the market price of the company's stock. The capital asset pricing model (CAPM) provides one widely used means to estimate the cost of equity. According to the CAPM, the cost of equity (expected return) is:

Cost of Equity = Riskless Rate of Return + β x Risk Premium

where:

Riskless rate of return is the rate of return on a "safe" benchmark investment, typically considered the short-term Treasury Bill (T-Bill) yield.

Risk premium is the difference between the expected return on stocks and the riskless rate.

Beta (β) is the correlation between the movement in the price of the stock and that of the broader market. In this case, Beta equals one if the stock is perfectly correlated with the S&P 500 market index. A Beta lower than one means the stock is less volatile than the market index.

DOE determined that the industry average cost of equity for the microwave oven industry is 17.9 percent as calculated in Table 12.4.2.

Table 12.4.2 Cost of Equity Calculation

Parameter	Industry-Weighted Average *(%)*	Manufacturer		
		A	B	C
(1) Average Beta (2002–2006)	1.31	1.0*	1.77	1.17
(2) Yield on 10 Year T-Bill (1990–2006)	5.9	-	-	-
(3) Market Risk Premium (1926–1999)	9.2	-	-	-
Cost of Equity (2)+[(1)*(3)]	17.9	-	-	-
Equity/Total Capital	37.2	23.7	-49.8	64.6

* Estimated Beta

Bond ratings are a tool to measure default risk and arrive at a cost of debt. Each bond rating is associated with a particular spread. One way of estimating a company's cost of debt is to treat it as a spread (usually expressed in basis points) over the risk-free rate. DOE used this method to calculate the cost of debt for all three manufacturers. S&P had bond ratings for all three manufacturers, so DOE used these ratings to estimate the manufacturers' cost of debt by adding the relevant spread to the risk-free rate.

In practice, investors use a variety of different maturity Treasury bonds to estimate the risk-free rate. DOE used a long-term Treasury bond return (10-year bond return) because it captures long-term inflation expectations and is less volatile than short-term rates. The risk-free rate is estimated to be approximately 6 percent, which is the average 10-year Treasury bond return over the period of 1990 to 2006.

For the cost of debt, S&P's Credit Services provided the average spread of corporate bonds for the three public manufacturers over the period 2002–2006. To this, DOE added the industry-weighted average spread to the average T-Bill yield over the same period. Since proceeds from debt issuance are tax deductible, DOE adjusted the gross cost of debt by the industry average tax rate to determine the net cost of debt for the industry. Table 12.4.3 presents the derivation of the cost of debt. Also shown is the capital structure of the industry, *i.e.* the debt ratio (debt/total capital).

Table 12.4.3 Cost of Debt Calculation

Parameter	Industry-Weighted Average *(%)*	Manufacturer		
		A	B	C
S&P Bond Rating	--	B-	BBB	BBB
(1) Yield on 10 year T-Bill (1990–2002)	5.9	-	-	-
(2) Gross Cost of Debt	8.2	13.9	8.1	8.1
(3) Tax Rate	34	6.6	34.1	34.5
Net Cost of Debt (2)x((1)-(3))	5.4	-	-	-
Debt/Total Capital	62.8	76.3	149.8	35.4

DOE estimated the microwave oven industry' WACC to be approximately 10.1 percent. Subtracting an inflation rate of 2.9 percent between 1990 and 2006, the inflation adjusted WACC, and the corporate discount rate used in the GRIM, is 7.2 percent.

12.4.5 Trial Standard Levels

DOE developed TSLs for microwave oven standby mode and off mode energy conservation standards. The efficiency levels used in the GRIM and other analyses are presented in Table 12.4.4 and Table 12.4.5.

Table 12.4.4 Product Class 1 Standby Power Efficiency Levels and TSLs

Product Class	Efficiency Metric	Baseline	TSL 1	TSL 2	TSL 3	TSL 4
Product Class 1	W	4.00	2.00	1.50	1.00	0.02
	Description	Baseline	FEMP Procurement Efficiency Recommendation	Gap Fill	IEA 1-Watt Program	Max Tech

Table 12.4.5 Product Class 2 Standby Power Efficiency Levels and TSLs

Product Class	Efficiency Metric	Baseline	TSL 1	TSL 2	TSL 3	TSL 4
Product Class 2	W	4.50	3.70	2.70	2.20	0.04
	Description	Baseline	FEMP Procurement Efficiency Recommendation	Gap Fill	IEA 1-Watt Program	Max Tech

12.4.6 NIA-Shipments Forecast

The GRIM estimates manufacturer revenues based on total-unit-shipment forecasts and the distribution of these values by efficiency level. Changes in the efficiency mix at each standard level are a key driver of manufacturer finances. For this analysis, the GRIM used the national impact analysis (NIA) shipments forecasts for microwave ovens from 2011 to 2043.

Only the shipments in 2011 and beyond have an impact on INPV because 2011 is the base year to which future cash flows are summed. Further explanation of approaches and calculations of total shipments can be found in the shipment analysis section of this TSD (chapter 9). Total shipments forecasted in the shipment analysis for all efficiency levels in 2014 are shown in Table 12.4.6 and are further detailed below.

Table 12.4.6 Total NIA-Shipments Forecast in 2014

Product Class	Total Industry Shipments*
Product Class 1	15,004,000
Product Class 2	151,600

* Estimates rounded to the nearest hundred

12.4.6.1 Base Case Shipments Forecast

As part of the shipment analysis, DOE estimated the shipment distribution by efficiency level for Product Class 1 and Product Class 2. Table 12.4.7 and Table 12.4.8 show the base case distributions of shipments by TSL estimated in the NIA for various product classes for 2014.

Table 12.4.7 Base Case Standby Power Distribution of Efficiencies for Product Class 1 in 2014 Estimated in the NIA

Shipments Efficiency Level *(Watts (W))*	Baseline (4.00)	TSL 1 (2.00)	TSL 2 (1.50)	TSL 3 (1.00)	TSL 4 (0.02)
%	46.2	34.6	19.2	0	0

Table 12.4.8 Base Case Standby Power Distribution of Efficiencies for Product Class 2 in 2014 Estimated in the NIA

Shipments Efficiency Level *(W)*	Baseline (4.50)	TSL 1 (3.70)	TSL 2 (2.70)	TSL 3 (2.20)	TSL 4 (0.04)
%	100	0	0	0	0

12.4.6.2 Standards Case Shipments Forecast

To examine the effects of energy conservation standards on shipments, which affect the INPV, DOE used the base case shipments described in the previous section. For the standards case, DOE assumed shipments at lower efficiencies were most likely to roll up into higher efficiency levels in response to more stringent energy conservation standards. This scenario assumes that demand for high efficiency equipment is a function of its price without regards for the standard level. Table 12.4.9 and Table 12.4.10 show the distributions of efficiencies for the various equipment classes in 2014 under the roll-up scenario.

Table 12.4.9 Distribution of Standby Power Product Class 1 Shipments in the Standards Case in 2014 – Rollup Scenario

TSL *(W)*	**Baseline** **4.00**	**TSL 1** **2.00**	**TSL 2** **1.50**	**TSL 3** **1.00**	**TSL 4** **0.02**
Baseline **4.00**	46.2%	34.6%	19.2%	0%	0%
TSL 1 **2.00**		80.8%	19.2%	0%	0%
TSL 2 **1.50**			100%	0%	0%
TSL 3 **1.00**				100%	0%
TSL 4 **0.02**					100%

Table 12.4.10 Distribution of Standby Power Product Class 2 Shipments in the Standards Case in 2014 – Rollup Scenario

TSL *(W)*	**Baseline** **4.50**	**TSL 1** **3.70**	**TSL 2** **2.70**	**TSL 3** **2.20**	**TSL 4** **0.04**
Baseline **4.50**	100%	0%	0%	0%	0%
TSL 1 **3.70**		100%	0%	0%	0%
TSL 2 **2.70**			100%	0%	0%
TSL 3 **2.20**				100%	0%
TSL 4 **0.04**					100%

12.4.6.3 Price Elasticity of Demand Shipments Scenario

In the GRIM, DOE modeled a shipment scenario that considers the impacts of changes in relative prices on consumer demand for each product. As described in chapter 9 of this TSD, the purchase this shipment scenario estimates how the combined effects of increases in purchase price and decreases in operating costs due to energy conservation standards affect shipments. DOE calculated the relative price elasticity of demand over time to determine how shipments would likely change after a standard sets a higher initial purchase price and lower operating costs. Under the "price elasticity scenario," the effects from the increase in product purchase prices offset the effects from decreased operating costs, resulting in a net decrease in shipments. For the INPV impacts described in this chapter, DOE uses the elasticity case for economic growth, though results without the relative price elasticity can also be generated in the GRIM. See chapter 9 of this TSD for more details on the shipment scenarios.

12.4.6.4 Economic Growth Shipments Scenario

In the GRIM, DOE modeled three shipment scenarios that consider the impacts of changes in the overall U.S. economy. These shipment scenarios are based on the Energy Information Administration's (EIA) 2010 *Annual Energy Outlook Report (AEO2010).*[3]

AEO2010 provides three scenarios: the Reference case, the High Economic Growth case, and the Low Economic Growth case. For the INPV impacts described in this chapter, DOE uses the Reference case for economic growth. However, this option is left as an option for the user to select in the GRIM. It is also possible for the user to combine the price elasticity scenario with an economic scenario. See chapter 9 of this TSD for more details on the economic growth shipment scenarios.

12.4.7 Production Costs

Changes in production costs impact revenues and gross profits. As shown in the engineering analysis (chapter 5 of this TSD), products that are more efficient typically cost more to produce than baseline products. For the MIA, DOE used the manufacturing production costs (MPCs) derived in the engineering analysis, with appropriate production volume estimates. For instance, more efficient products sold under existing energy conservation standards are manufactured at lower production volumes than products at the baseline for standby mode power consumption. Enacting more stringent energy conservation standards will increase production volumes for more efficient units.

As described in chapter 5 of this TSD, the costs for Product Class 1 and Product Class 2 were calculated using data supplied by AHAM and product testing and tear-downs. For the SNOPR, DOE updated the manufacturer production costs and prices for Product Class 1 that it estimated in the notice of proposed rulemaking (NOPR) for residential cooking products, including microwave ovens, and commercial clothes washers that it published on October 17, 2008 (73 FR 62034) (hereinafter referred to as the October 2008 NOPR), to 2010$ using the Producer Price Index (PPI). The GRIM included the proportion of costs devoted to labor, materials, overhead, and depreciation that make up the full cost of production or MPCs. DOE estimated the proportion of costs associated with each cost category by using information provided by AHAM[4] and U.S. Census Bureau's Current Industry Reports (*CIR*)[5] and the 2006 *ASM*. Table 12.4.11 and Table 12.4.12 provide the MPC results used in the GRIM for microwave ovens.

Table 12.4.11 Base Case Standby Power Production Costs (2010$) used in the GRIM for Product Class 1

TSL *(W)*	Labor	Material	Overhead	Depreciation	MPC
Baseline (4.00)	$10.63	$101.28	$3.28	$5.16	$120.35
TSL 1 (2.00)	$10.65	$101.51	$3.29	$5.17	$120.62
TSL 2 (1.50)	$10.68	$101.79	$3.30	$5.18	$120.95
TSL 3 (1.00)	$10.74	$102.39	$3.32	$5.21	$121.66
TSL 4 (0.02)	$11.03	$105.13	$3.41	$5.35	$124.92

Table 12.4.12 Base Case Standby Power Production Costs (2010$) used in the GRIM for Product Class 2

TSL *(W)*	Labor	Material	Overhead	Depreciation	MPC
Baseline (4.50)	$22.95	$218.73	$7.09	$11.13	$259.90
TSL 1 (3.70)	$22.95	$218.73	$7.09	$11.13	$259.90
TSL 2 (2.70)	$23.15	$220.66	$7.15	$11.23	$262.19
TSL 3 (2.20)	$23.78	$226.67	$7.35	$11.54	$269.34
TSL 4 (0.04)	$23.41	$223.09	$7.23	$11.36	$265.09

12.4.8 Conversion Costs

Energy conservation standards typically cause manufacturers to incur one-time conversion costs to bring their production facilities and product designs into compliance with new regulations. For the purpose of the MIA, DOE classified these one-time conversion costs into two major groups: (1) capital conversion costs, and (2) product conversion costs. Capital conversion costs are one-time investments in property, plant, and equipment to adapt or change existing production facilities so that new product designs can be fabricated and assembled under the new regulation. Product conversion costs are one-time investments in research, development, testing, and marketing focused on making product designs comply with new energy conservation standards. The following sections describe in greater detail the inputs DOE used in the GRIM.

12.4.8.1 Capital Conversion Costs

DOE evaluated the level of capital investment needed to comply with the energy conservation standards for standby power efficiencies at each TSL. For each TSL, DOE estimated the proportion of the products on the market will have to be redesigned to meet that TSL. The higher the TSL, the greater the proportion products on the market that will require redesign.

DOE used a platform approach to estimate the capital conversion costs. For standby mode and off mode standards, DOE used information submitted during manufacturer interviews, conversations with industry experts, and product catalogs to estimate the percentage of platforms at each TSL that would require minor tooling changes to accommodate more efficient components and the cost of the tooling. DOE then weighted the costs of manufacturers that submitted information to account for the tooling necessary for the platform's of all manufacturers in the industry.

Because the design options for Product Class 1 and Product Class 2 are similar at each TSL, DOE used the same per-platform costs for both product classes. DOE also used the same per platform cost as in the October 2008 NOPR, but converted each cost to 2010$ using the PPI. To segment the total capital conversion costs between Product Class 1 and Product Class 2, DOE used the same split as the shipments in the NIA.

Component switches for standby power TSLs do not require major changes to the microwave enclosure or cavity because these design options all have standard hole locations that will not be altered if more efficient components are used. Table 12.4.13 and Table 12.4.14

summarize the breakdown of capital conversion costs by TSL for energy conservation standards for standby mode and off mode. Table 12.4.15 shows the per-platform capital cost assumptions DOE made for the tooling changes required for each platform that did not meet the required efficiency.

Table 12.4.13 Standby Power Capital Conversion Costs for Product Class 1 by TSL

TSL	Total Industry Capital Conversion Costs *(2010$ million)*
Baseline	$0
TSL 1	$3.9
TSL 2	$4.3
TSL 3	$4.7
TSL 4	$7.8

Table 12.4.14 Standby Power Capital Conversion Costs for Product Class 2 by TSL

TSL	Total Industry Capital Conversion Costs *(2010$ million)*
Baseline	$0.0
TSL 1	$0.0
TSL 2	$0.0
TSL 3	$0.0
TSL 4	$0.1

Table 12.4.15 Per Platform Assumptions for Capital Conversion Costs (Product Class 1 and Product Class 2)*

	TSL 1	TSL 2	TSL 3	TSL 4
Per-Platform Tooling Capital Cost Assumption	$150,000	$165,000	$180,000	$300,000

* The platform costs are in 2008$. These are converted to 2010$ when calculating the industry-wide conversion costs.

12.4.8.2 Product Conversion Costs

DOE conducted interviews with manufacturers to better understand the many steps that manufacturers have to take before they can release new or improved products. The magnitude of the required investments varies by manufacturer and the TSL analyzed.

Multiple manufacturers estimated that the time and resources spent on research and development, testing, and certification of products would be significant depending on the design path chosen to achieve higher efficiency.

For Product Class 1 and Product Class 2, DOE estimated the engineering, reliability testing, and product development expenses per platform necessary at each TSL. DOE used the same per-platform cost as in the October 2008 NOPR, but converted each to 2010$ using the PPI. For the SNOPR, DOE also estimated a per-platform cost where it analyzed a power-down design option to achieve the required standby mode and off mode efficiencies. The marketing cost equaled half the estimated engineering expense per platform. For TSL 3, DOE analyzed a power down for only one type of display technology and DOE used the percentage of models with that technology as a weight to calculate the platform market cost. To segment the total product conversion costs between Product Class 1 and Product Class 2, DOE used the same split as the shipments in the NIA. DOE multiplied the estimate of these development costs per platform by its approximation of the number of platforms available in the United States that fell below the required efficiency. For standby power, conversion costs become more expensive at higher TSLs as the complexity of further lowering standby power increases, substantially driving up engineering time and also increasing the testing and product development time. DOE also a per-platform cost where it analyzed a power-down design option to achieve the required standby power level. The marketing cost equaled half the estimated engineering expense per platform. There is a large jump in conversion expenses at TSL 4 because there changes that impact other functions of each platform. Table 12.4.16 and Table 12.4.17 summarize the breakdown of product conversion costs by TSL for PC 1 and PC 2 for standby mode and off mode standards. Table 12.4.18 and Table 12.4.19 show the per-platform product conversion cost assumptions DOE made for each platform that did not meet the required efficiency.

Table 12.4.16 Standby Power Product Conversion Costs for Product Class 1 by TSL

TSL	Total Industry Product Conversion Costs *(2010$ million)*
Baseline	$0
TSL 1	$39.2
TSL 2	$70.5
TSL 3	$89.1
TSL 4	$172.3

Table 12.4.17 Standby Power Product Conversion Costs for Product Class 2 by TSL

TSL	Total Industry Product Conversion Costs *(2010$ million)*
Baseline	$0
TSL 1	$0.4
TSL 2	$0.7
TSL 3	$0.9
TSL 4	$1.7

Table 12.4.18 Per-Platform Assumptions for Product Conversion Costs (Product Class 1)*

	TSL 1 (2.00 W)	TSL 2 (1.500 W)	TSL 3 (1.00 W)	TSL 4 (0.02 W)
Per-Platform Engineering Cost Assumption	$50,000	$100,000	$150,000	$200,000
Per-Platform Reliability Cost Assumption	$50,000	$100,000	$100,000	$200,000
Per-Platform Product Development Expenses Assumption	$25,000	$25,000	$25,000	$50,000
Extraordinary Marketing Expenses per Platform	$0.0	$0.0	$10,000	$100,000

* The platform costs are in 2008$. These are converted to 2010$ when calculating the industry-wide conversion costs.

Table 12.4.19 Per Platform Assumptions for Product Conversion Costs (Product Class 2)*

	TSL 1 (3.70 W)	TSL 2 (2.70 W)	TSL 3 (2.20 W)	TSL 4 (0.04 W)
Per Platform Engineering Cost Assumption	$50,000	$100,000	$150,000	$200,000
Per Platform Reliability Cost Assumption	$50,000	$100,000	$100,000	$200,000
Per Platform Product Development Expenses Assumption	$25,000	$25,000	$25,000	$50,000
Extraordinary Marketing Expenses per Platform	$0.0	$0.0	$0.0	$100,000

* The platform costs are in 2008$. These are converted to 2010$ when calculating the industry-wide conversion costs.

12.4.9 Markups

To understand how baseline and more efficient products are differentiated, DOE reviewed manufacturer catalogs and utilized information gathered from manufacturers. To estimate the prices at which manufacturers sell their products, DOE applied markups to the production costs it had developed earlier. DOE used markup scenarios to bound the range of expected product prices following energy conservation standards. For each product class, DOE used the markup scenarios that best characterized the prevailing markups and described the range of market responses as a result of energy conservation standards for standby mode and off mode.

DOE analyzed two distinct markup scenarios: (1) preservation-of-gross-margin-percentage, and (2) preservation of gross margin (in absolute dollars).

12.4.9.1 Preservation of Gross Margin Percentage

The gross margin is defined as revenues less costs of goods sold. Under the preservation of gross margin percentage scenario in the GRIM, DOE applied a single uniform "gross margin percentage" markup to MPCs across all efficiency levels. As production costs increase by efficiency level, this scenario implies that the absolute dollar markup will increase also. DOE used a manufacturer markup of 1.26, which includes SG&A expenses; R&D expenses; interest; and profit. This markup is consistent with the manufacturer markup DOE assumed in the base case for the GRIM. Most manufacturers stated it is optimistic to assume that they could maintain their gross margin percentages despite production cost increases due to new standby mode and off mode standards. Therefore, DOE assumes that this scenario represents a high bound to industry profitability under an energy conservation standard.

12.4.9.2 Preservation of Gross Margin in Absolute Dollars

The implicit assumption behind the "preservation of gross margin in absolute dollars" markup scenario is that the industry will lower its markups in response to the standards to maintain only its gross margin (in absolute dollars). This means the percentage difference between MPC and selling price will decrease in the standards case compared to the base case and the gross margin percentage will be lower. The industry would do so by passing through part of the increase in production costs while increased R&D and SG&A lower profit. DOE implemented this scenario in the GRIM by lowering the production cost markups for each TSL to yield approximately the same gross margin in dollars in the standards cases in the year after standards are effective (2015) as is yielded in the base case. Table 12.4.20 and Table 12.4.21 show the manufacturer markups for Product Class 1 and Product Class 2 under the Preservation of Gross Margin in Absolute Dollars markup scenario.

Table 12.4.20 Product Class 1 Preservation of Gross Margin in Absolute Dollars Manufacturer Markups

	Baseline (4.00 W)	TSL 1 (2.00 W)	TSL 2 (1.500 W)	TSL 3 (1.00 W)	TSL 4 (0.02 W)
Baseline (4.00 W)	1.2600	-	-	-	-
El 1 (2.00 W)	1.2600	1.2597	-	-	-
EL 2 (1.500 W)	1.2600	1.2600	1.2593	-	-
EL 3 (1.00 W)	1.2600	1.2600	1.2600	1.2581	-
EL 4 (0.02 W)	1.2600	1.2600	1.2600	1.2600	1.2526

Table 12.4.21 Product Class 2 Preservation of Gross Margin in Absolute Dollars Manufacturer Markups

	Baseline (4.50 W)	TSL 1 (3.70 W)	TSL 2 (2.70 W)	TSL 3 (2.20 W)	TSL 4 (0.04 W)
Baseline (4.50 W)	1.2600	-	-	-	-
EL 1 (3.70 W)	1.2600	1.2600	-	-	-
EL 2 (2.70 W)	1.2600	1.2600	1.2581	-	-
EL 3 (2.20 W)	1.2600	1.2600	1.2600	1.2526	-
EL 4 (0.04 W)	1.2600	1.2600	1.2600	1.2600	1.2559

12.5 MICROWAVE OVEN INDUSTRY FINANCIAL IMPACTS

Using the inputs and assumptions described in the previous sections, the GRIM produced indicators of financial impacts on the microwave oven industry. The following sections detail additional inputs and assumptions for microwave ovens. The main results of the MIA are also reported in this section. The MIA results consist of two key financial metrics: INPV and annual cash flows.

12.5.1 Impacts on Industry Net Present Value

The INPV measures the industry value and is used in the MIA to compare the economic impacts of different TSLs. For the microwave oven industry, the GRIM estimated cash flows between 2011and 2043, consistent with the forecast period used in the national impact analysis (chapter 10 of this TSD).

In the MIA, DOE compares the INPV of the base case (no new standby mode and off mode standards) to that of each TSL. The difference between the base case INPV and a standards case INPV is an estimate of the economic impacts that implementing that particular TSL would have on the entire industry. For the microwave oven industry, DOE examined the two markup scenarios described in the manufacturer markup section above. Table 12.5.1 through Table 12.5.6 provide the INPV estimates for the microwave oven industry under the different scenarios.

Table 12.5.1 Product Class 1 Manufacturer Impact Analysis Under the Preservation of Gross Margin Percentage Markup Scenario

Preservation of Gross Margin Percentage Markup Scenario							
	Units	**Base Case**	**Trial Standard Level**			
			1	**2**	**3**	**4**
INPV	***(2010$ millions)***	1,103.4	1,076.6	1,058.6	1,050.6	1,013.9
Change in INPV	***(2010$ millions)***	-	(26.8)	(44.9)	(52.8)	(89.6)
	(%)	-	(2.4)	(4.1)	(4.8)	(8.1)

Table 12.5.2 Product Class 1 Manufacturer Impact Analysis Under the Preservation of Gross Margin in Absolute Dollars Markup Scenario

Preservation of Gross Margin in Absolute Dollars Markup Scenario						
	Units	**Base Case**	**Trial Standard Level**			
			1	**2**	**3**	**4**
INPV	***(2010$ millions)***	1,103.4	1,074.4	1,051.8	1,031.6	939.5
Change in INPV	***(2010$ millions)***	-	(29.0)	(51.7)	(71.9)	(163.9)
	(%)	-	(2.6)	(4.7)	(6.5)	(14.9)

Table 12.5.3 Product Class 2 Manufacturer Impact Analysis Under the Preservation of Gross Margin Percentage Markup Scenario

Preservation of Gross Margin Percentage Markup Scenario						
	Units	**Base Case**	**Trial Standard Level**			
			1	**2**	**3**	**4**
INPV	***(2010$ millions)***	24.0	23.8	23.7	23.9	23.2
Change in INPV	***(2010$ millions)***	-	(0.3)	(0.4)	(0.1)	(0.9)
	(%)	-	(1.2)	(1.5)	(0.3)	(3.6)

Table 12.5.4 Product Class 2 Manufacturer Impact Analysis Under the Preservation of Gross Margin in Absolute Dollars Markup Scenario

Preservation of Gross Margin in Absolute Dollars Markup Scenario						
	Units	**Base Case**	**Trial Standard Level**			
			1	**2**	**3**	**4**
INPV	***(2010$ millions)***	24.0	23.8	23.3	22.3	22.3
Change in INPV	***(2010$ millions)***	-	(0.3)	(0.8)	(1.7)	(1.8)
	(%)	-	(1.2)	(3.1)	(7.1)	(7.3)

Table 12.5.5 Manufacturer Impact Analysis Under the Preservation of Gross Margin Percentage Markup Scenario for Product Class 1 and 2 Combined

Preservation of Gross Margin Percentage Markup Scenario						
	Units	**Base Case**	**Trial Standard Level**			
			1	**2**	**3**	**4**
INPV	***(2010$ millions)***	1,127.5	1,100.4	1,082.2	1,074.5	1,037.0
Change in INPV	***(2010$ millions)***	-	(27.1)	(45.2)	(52.9)	(90.4)
	(%)	-	(2.4)	(4.0)	(4.7)	(8.0)

Table 12.5.6 Manufacturer Impact Analysis Under the Preservation of Gross Margin in Absolute Dollars Markup Scenario for Product Class 1 and 2 Combined

Preservation of Gross Margin in Absolute Dollars Markup Scenario						
	Units	Base Case	Trial Standard Level			
			1	2	3	4
INPV	*(2010$ millions)*	1,127.5	1,098.2	1,075.0	1,053.9	961.8
Change in INPV	*(2010$ millions)*	-	(29.3)	(52.4)	(73.6)	(165.7)
	(%)	-	(2.6)	(4.6)	(6.5)	(14.7)

12.5.2 Impacts on Annual Cash Flow

To get an idea of the behavior of annual net cash flows, DOE reports the annual net or free cash flows from 2010 through 2043 for the different TSL levels. Figure 12.5.1 through Figure 12.5.6 present the annual net cash flows for the base case and each of the four standby mode and off mode TSLs for the microwave oven industry assuming the different markup scenarios.

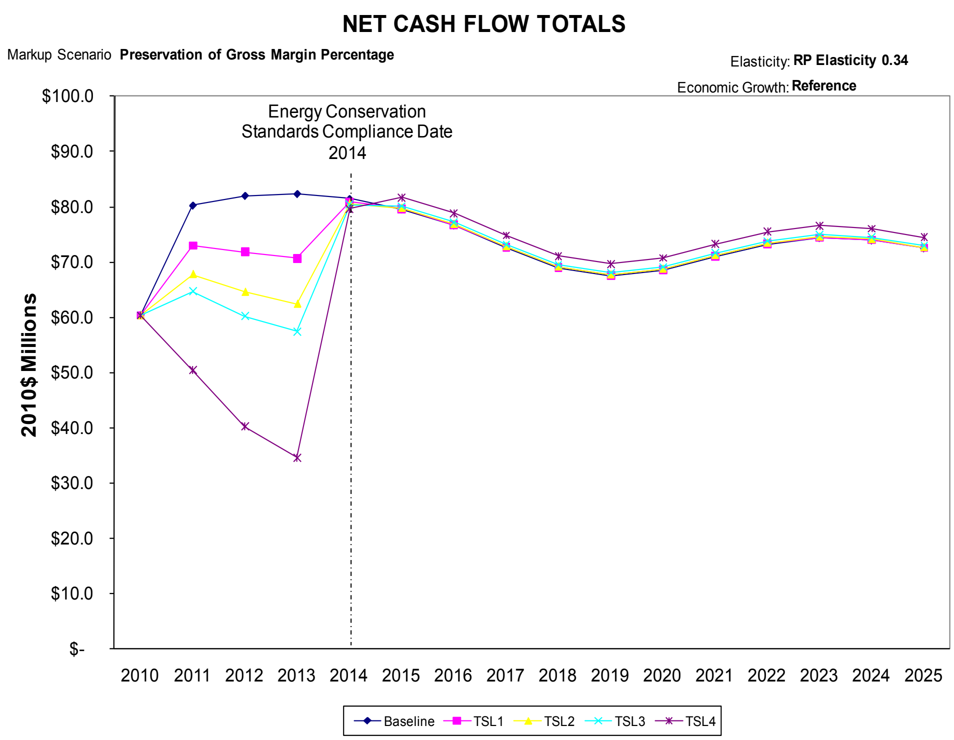

Figure 12.5.1 Annual Net Cash Flows for Product Class 1 (Preservation of Gross Margin Percentage Markup Scenario)

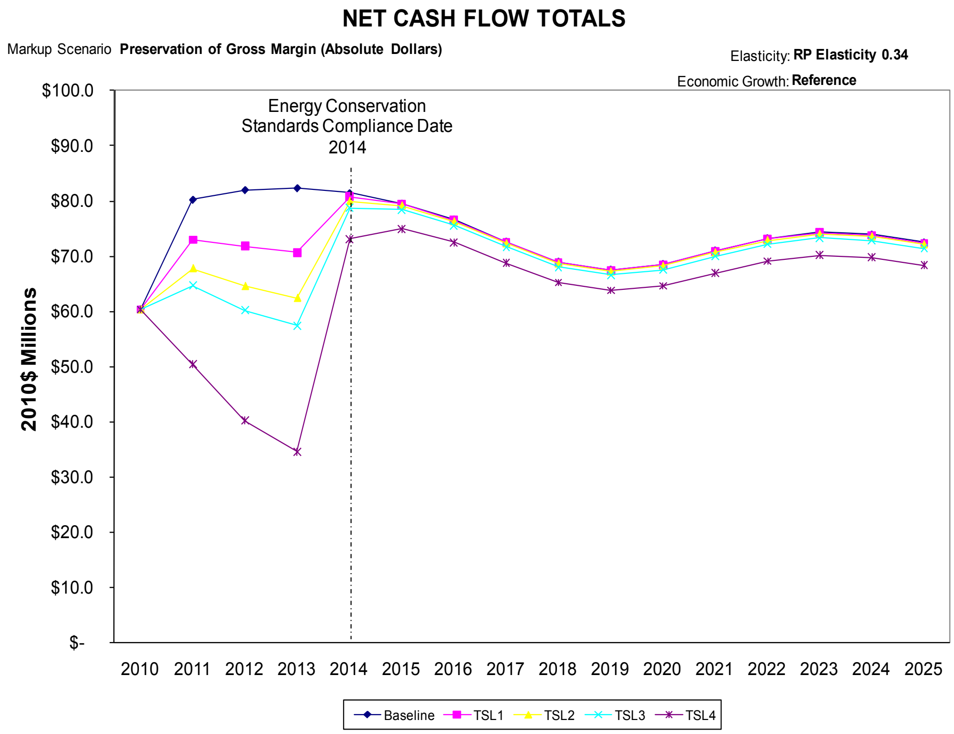

Figure 12.5.2 Annual Net Cash Flows Product Class 1 (Preservation of Gross Margin in Absolute Dollars Markup Scenario)

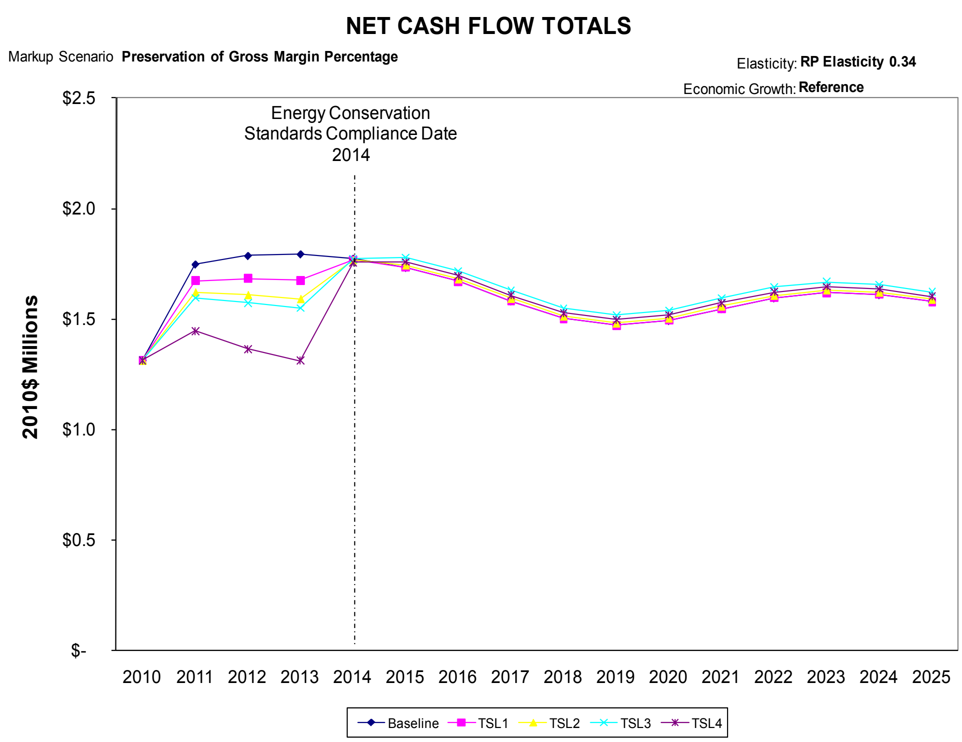

Figure 12.5.3 Annual Net Cash Flows for Product Class 2 (Preservation of Gross Margin Percentage Markup Scenario)

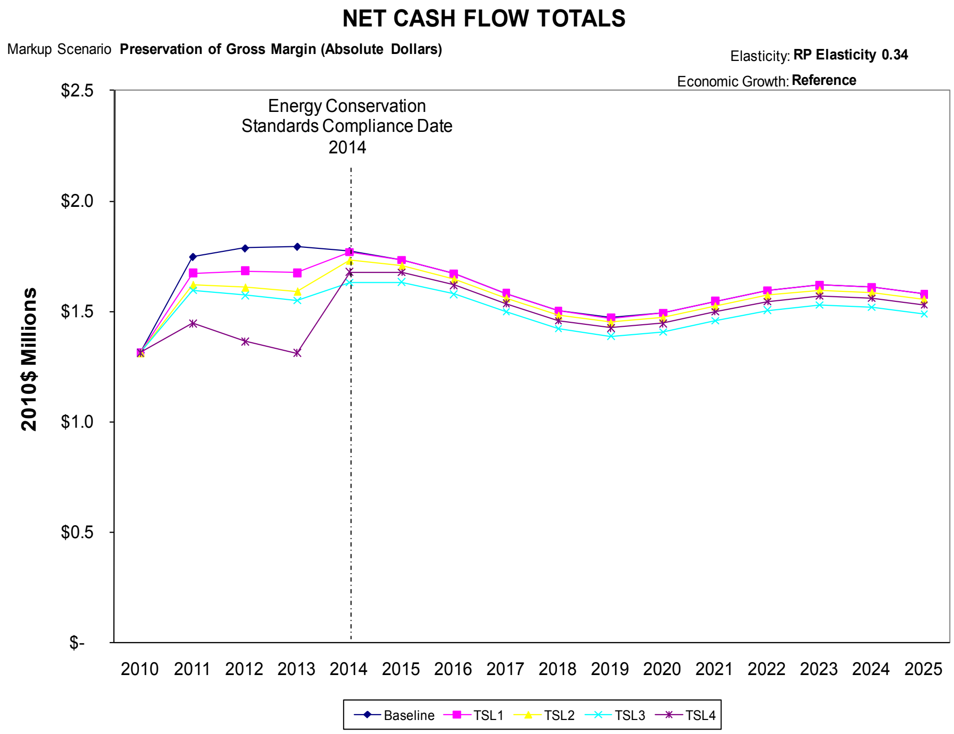

Figure 12.5.4 Annual Net Cash Flows Product Class 2 (Preservation of Gross Margin in Absolute Dollars Markup Scenario)

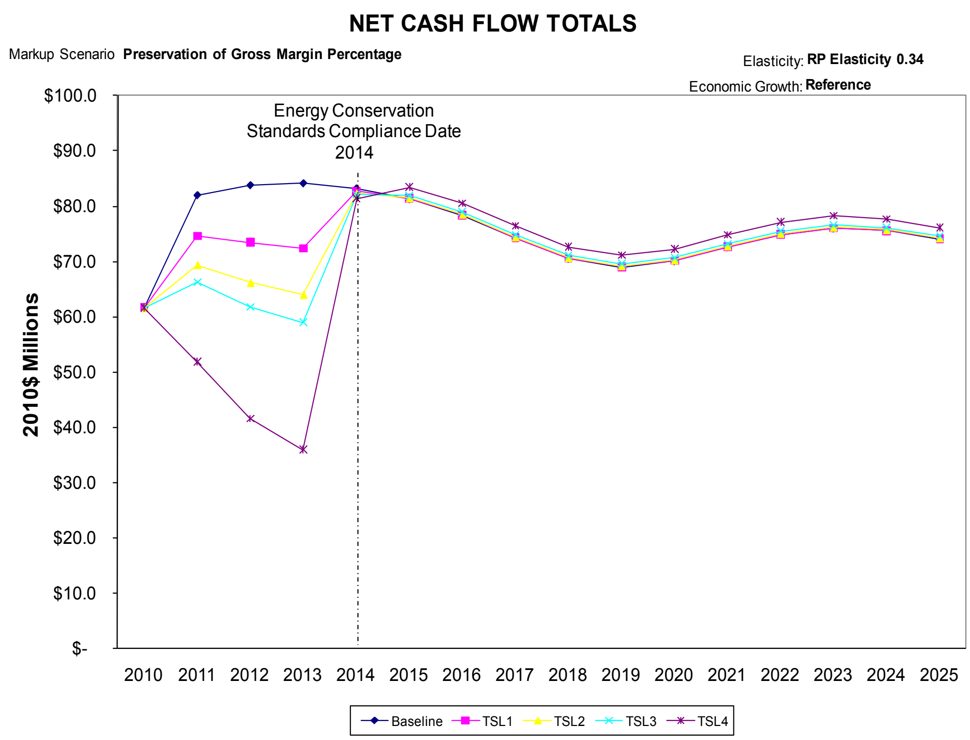

Figure 12.5.5 Annual Net Cash Flows for Product Class 1 and Product Class 2 Combined (Preservation of Gross Margin Percentage Markup Scenario)

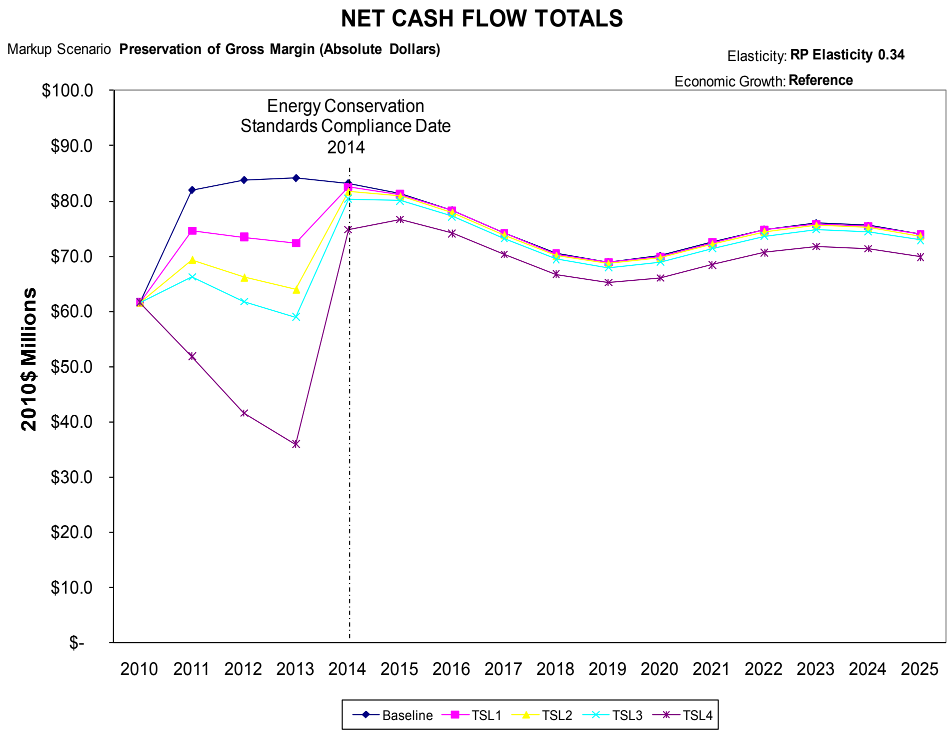

Figure 12.5.6 Annual Net Cash Flows for Product Class 1 and Product Class 2 Combined (Preservation of Gross Margin in Absolute Dollars Markup Scenario)

Prior to the compliance date of the energy conservation standard, cash flows are driven by the level of capital and product conversion costs and the proportion of these investments spent each year. After the standard announcement date in 2011, industry cash flows begin to decline as companies use their financial resources to prepare for the new standard. The more stringent the energy conservation standard, the greater the impact on industry cash flows in the years prior to the compliance date. In the years before the compliance date of the standard, capital investments and product conversion costs depress cash flows from operations. Since the capital and conversion costs are the same regardless of the markup scenario, the impacts in the years prior to the compliance date of the standards are the same in both markup scenarios for these years. Since DOE assumed that standards compliant microwave ovens would be based on existing products, no capital assets are stranded due to standards. Consequently, there is not a one-time injection of cash in the compliance year of the standards from a write-down.

The markup scenario has a large impact on cash flows in the year the compliance year of the standard. The preservation of gross margin percentage markup scenario immediately restores the original cash flow. Higher selling prices increase operating profit and increase cash flow due to a higher depreciation expense. Since depreciation is a non-cash expense, it does not require an outflow of cash but does lower operating profit. Therefore, this expense gets added back to cash flow.

For the preservation of gross margin in absolute dollars the impact on operating profit and the need to boost working capital in 2014 are not significant for standby power because the incremental manufacturing costs are low for all TSLs. Therefore, cash flow increases in 2014 for standby mode and off mode standards. After 2014, higher TSLs have a positive impact on cash flows relative to the base case if manufacturers are able to fully pass along costs to consumers (the preservation of gross margin percentage markup scenario) and lower cash flow relative to the base case if manufacturers can only recover a portion of their increased costs (the preservation of gross margin in absolute dollars markup scenario).

The magnitude of the positive cash flow impact under the preservation of gross margin percentage scenario and the negative cash flow impact under the preservation of gross margin in absolute dollars scenario depends on the incremental cost of standards-compliant products. The higher the relative cost, the larger the impact on operating revenue and cash flow in the years following the compliance date of the standard.

12.6 OTHER IMPACTS

12.6.1 Employment

12.6.1.1 Methodology

To quantitatively assess the impacts of energy conservation standards on microwave oven manufacturing employment, DOE used the GRIM to estimate the domestic labor expenditures and number of employees in the base case and at each TSL. DOE used statistical data from the Census Bureau's 2006 *ASM* and 2006 *CIR*, the results of the engineering analysis, and interviews with manufacturers to estimate the inputs necessary to calculate industry-wide labor expenditures and domestic employment levels.

DOE constructed the industry cost structure using publicly available information from the 2006 *ASM* and SEC 10-K reports filed by publicly owned manufacturers. The labor percentage of the industry cost structure is calculated by dividing total production worker wages by the total value of shipments. For microwave ovens, DOE used the same industry cost structure constructed from 2006 *ASM* data classified under NAICS 335221 (household cooking appliance manufacturing). The labor percentage and other components of the industry cost structure for microwave ovens are shown in Figure 12.6.1 below.

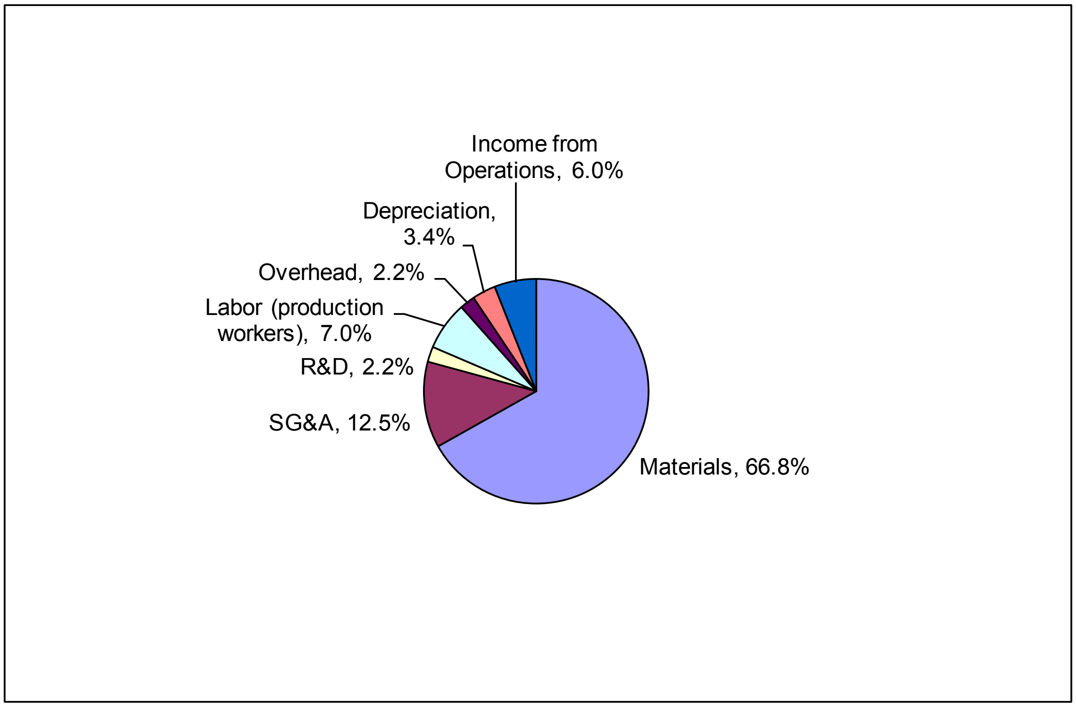

Figure 12.6.1 Microwave Oven Industry Cost Structure

To determine the total annual labor expenditure on production labor, the value of production labor in the industry cost structure was converted to a percentage of the cost of goods sold (COGS). In the GRIM, the labor expenditures in each year are calculated by multiplying the COGS or MPCs by the labor percentage of COGS. As a result, higher TSLs have greater direct labor costs because more efficient products have higher MPCs.

To calculate the annual domestic labor expenditures, DOE used the 2006 *CIR* to estimate the percentage of domestic production in each industry. DOE estimated that 4 percent of microwave ovens are manufactured and sold in the United States.

DOE multiplied the total annual labor expenditures in the GRIM by the percentage of U.S. production for domestic consumption to calculate domestic labor expenditures for production labor in each industry. The domestic annual labor expenditures in the GRIM were converted to domestic production employment levels by dividing production labor expenditures by the annual payment per production worker (production worker hours times the labor rate found in the 2006 *ASM*).[b] The number of non-production employees was calculated by multiplying the number of production workers by the ratio of non-production workers to production workers calculated using the employment data in the 2006 *ASM*.

[b] 2006 *ASM* labor rates and production hours per year per employee are very similar to figures reported in the engineering analysis. DOE used 2006 ASM figures to ensure a consistent set of publicly available data is used for the manufacturing employment analysis.

The domestic annual labor expenditures and employment levels were calculated for the base case and at each TSL. The impacts on domestic employment due to standards can be assessed by comparing the employment results in the base case to the results at each TSL. In the GRIM, the employment results represent domestic production workers that are impacted by this rulemaking. Workers involved in manufacturing or supporting products for exports would not be impacted and are not included as part of the labor impacts.

The domestic industry labor expenditure for microwave oven production workers in 2014 is approximately $5 million. Using the $13.84 wage rate and 1,940 production hours per year per employee found in the 2006 *ASM*, the GRIM estimates there are approximately 203 production employees involved in manufacturing microwave ovens covered by this rulemaking in the United States (total COGS in 2014 times the production labor percentage of COGS times the percentage of domestic production). In addition, DOE estimates that 27 indirect employees in the United States support microwave oven production. The employment spreadsheet of the microwave oven GRIM shows the annual domestic employment impacts due to amended energy conservation standards in further detail.

Table 12.6.1 illustrates the impact of new standby mode and off mode standards on employment levels at each TSL for the microwave oven industry calculated by the GRIM.

Table 12.6.1 Industry Estimated Employment Impacts in 2014 for Product Classes 1 and 2 Combined

Trial Standard Level	Base Case	TSL 1	TSL 2	TSL 3	TSL 4
Total Number of Domestic Microwave Oven Production Employees in 2014	203	204	204	205	209
Change in Total Number of Domestic Microwave Oven Production Employees in 2014 Due to Standards	-	0.1%	0.3%	0.7%	2.6%
Total Number of Domestic Microwave Oven Non-Production Employees in 2014	27	27	27	27	27
Total Number of Domestic Microwave Oven Employees in 2014	230	230	231	232	236

Figure 12.6.2 shows annual domestic employment levels for each TSL calculated in the GRIM for standby mode and off mode standards.

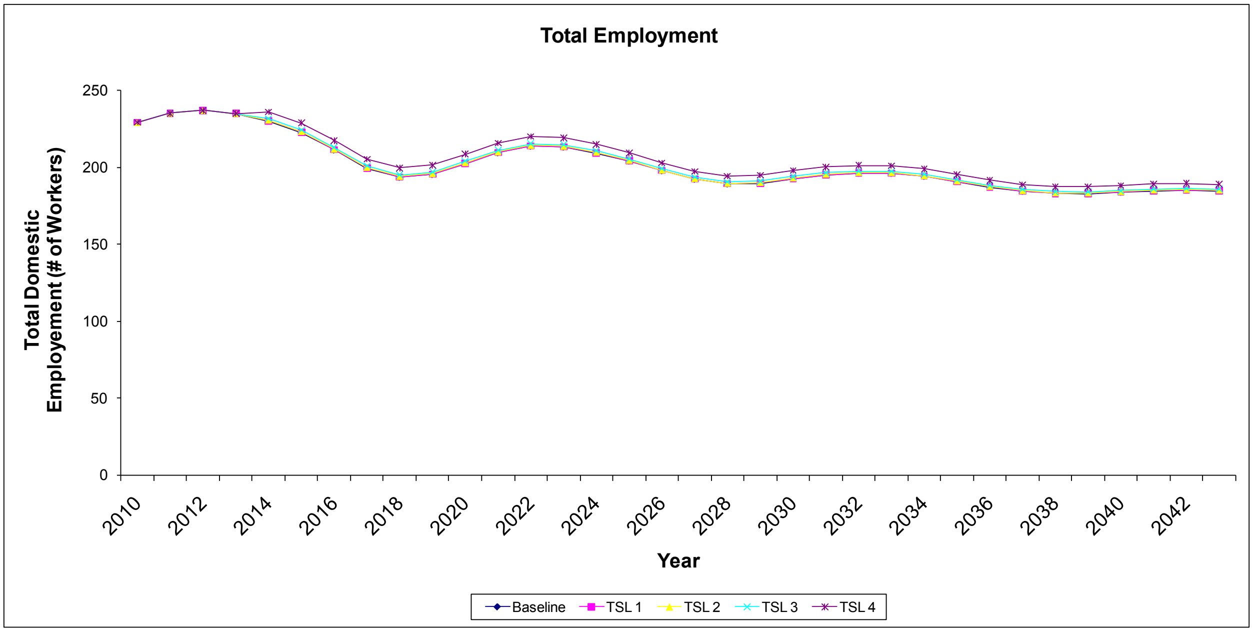

Figure 12.6.2 Total Microwave Ovens Industry Domestic Employment by Year for Product Classes 1 and 2 Combined.

Approximately 96 percent of microwave ovens sold in the United States are imported. Because most microwave ovens are produced abroad, any standby power requirements for microwave ovens have a larger impact on labor in other countries. American companies are all still impacted by the product conversion costs, capital conversion costs, and higher MPCs. However, the impacts of standards on domestic employment would be small.

From the engineering analysis, higher TSLs correspond to switches to more efficient components for standby mode and off mode standards. Because many components are sourced for both large and small manufacturers, labor is more a function of units shipped, not production costs as calculated in the GRIM. However, since shipments are expected to increase gradually over time in the shipments model, employment levels for manufacturers of microwave ovens would still increase at all TSLs.

For all standby power efficiency levels, the GRIM calculates an increase in domestic employment due to energy conservation standards because production labor expenditures are assumed to be a fixed percentage of COGS and MPCs increase with more efficient products. For all TSLs, the GRIM employment results agree with the bottoms up analysis in the engineering. However, the incremental costs for more efficient components at all TSLs are relatively small. Consequently, in response to standards, domestic manufacturers would most likely not alter employment levels much because inserting a more efficient component does not necessarily require more labor.

The employment conclusions ignore the possible relocation of domestic jobs to lower-labor-cost countries, which may occur independently of new standards or may be influenced by the level of investments required by new standards. Since most microwave ovens are already imported and the employment impacts in the GRIM are small, the actual impacts on domestic employment would be mostly impacted if any manufacturer decided to shift remaining domestic production to lower-cost-countries.

12.6.2 Production Capacity

According to many oven manufacturers, energy conservation standards will not significantly affect production capacity. As with conventional cooking products, any necessary microwave oven redesigns involve component switches that will not change the fundamental assembly of the equipment. However, manufacturers anticipate minor changes to tooling at all TSLs for more efficient standby power. For all efficiency levels for standby mode and off mode standards, the most significant conversion costs are the research and development, testing, and certification of products with more-efficient components, which does not affect production line capacity. Thus, DOE believes manufacturers will be able to maintain manufacturing capacity levels and continue to meet market demand under energy conservation standards.

12.6.3 Cumulative Regulatory Burden

While any one regulation may not impose a significant burden on manufacturers, the combined effects of several impending regulations may have serious consequences for some manufacturers, groups of manufacturers, or an entire industry. Assessing the impact of a single regulation may overlook this cumulative regulatory burden. For the cumulative regulatory burden analysis, DOE describes other significant product-specific regulations that could affect microwave oven manufacturers that will take effect 3 years before or 3 years after the compliance date of the amended energy conservation standards for these products[c].

Companies which produce a wide range of regulated products may be faced with more capital and product development expenditures than competitors with a narrower scope of products. Regulatory burdens can prompt companies to exit the market or reduce their product offerings, potentially reducing competition.

In addition to the energy conservation regulations on microwave oven standby mode and off mode. several other Federal regulations and pending regulations apply to these products and other equipment produced by the same manufacturers. DOE recognizes that each regulation can significantly impact manufacturers' financial operations. The following sections provide a qualitative discussion of some of these regulations and standards.

12.6.3.1 Standby Power Requirements

Section 310 of the Energy Independence and Security Act of 2007 (EISA 2007) amends Section 325 of the Energy Policy and Conservation Act (EPCA) to require DOE to regulate standby mode and off mode energy consumption as part of an energy conservation standard for all covered products, including residential ranges and ovens and microwave ovens, for which a final rule is adopted after July 10, 2010. For this rulemaking, EISA 2007 specifies that the test

[c] The compliance date for energy conservation standards for microwave oven standby mode and off mode is 3 years from the date of publication of the final rule.

procedure for residential ranges and ovens and microwave ovens be amended to include measurement of standby mode and off mode energy consumption, taking into consideration the most current version of International Electrotechnical Commission's (IEC) Standard 62301, "Household electrical appliances – Measurement of standby power" (IEC Standard 62301).

Besides today's standard which sets a minimum standby mode and off mode requirement, manufacturers stated a concerned with EISA 2007 is the requirement that all covered products measure standby power and off mode. Manufacturers stated that this requirement will impose a heavy burden on their testing facilities going forward. In addition, because the test procedure change will affect all covered products, manufacturers expressed a concern that this had the potential to create many overlapping regulatory compliance costs in the future.

12.6.3.2 Additional Federal Energy Conservation Standards

Besides the energy conservation regulations on microwave ovens, several other Federal regulations and pending regulations apply to other products and equipment produced by the same manufacturers. DOE recognizes that each regulation can significantly impact manufacturers' financial operations. Multiple regulations affecting the same manufacturer can quickly strain manufacturers' profits and possibly cause an exit from the market. Table 12.6.2 lists the Federal regulations that could also affect manufacturers of the microwave oven industry in the 3 years leading up to and the 3 years preceding the compliance date of the amended energy conservation standards for these products. It must be noted that while the list of products is long, the amount of cumulative burden on any particular firm is extremely variable since the product scope of each company is different.

Table 12.6.2 Other DOE and Federal Actions Affecting Microwave Oven Manufacturers

Regulation	Approximate Compliance Date*	Number of Impacted Companies from the Market and Technology Assessment (MTA) (See chapter 3)	Estimated Total Industry Conversion Costs
ASHRAE Products	2012	0	N/A
Packaged Terminal Air Conditioners and Packaged Terminal Heat Pumps	2012	2	$17.3 million (2007$)[d]
Cooking Products	2012	9	$22.6 million (2006$)[e]
Residential Boilers	2012	1	N/A†
General Service Fluorescent Lamps and Incandescent Reflector Lamps	2012	0	$363.1 million (2008$)[f]
Dehumidifiers	2012	3	N/A†††
Beverage Vending Machines	2012	0	$14.5 million (2008$)[g]
Commercial Clothes Washers	2013	1	$20.4 million (2008$)[h]
Direct Heating Equipment	2013	0	$5.39 million (2009$)[i]
Residential Pool Heaters	2013	0	$0.3 million (2009$)[j]
Battery Chargers and External Power Supplies	2013*	5	N/A††
Residential Refrigerators and Freezers	2014*	9	N/A††
Room Air Conditioners	2014*	N/A	N/A††
Residential Clothes Dryers	2014*	5	N/A††
Fluorescent Lamp Ballasts	2014*	0	N/A††

[d] Estimated industry conversion expenses were published in the TSD for the October 2008 packaged terminal air conditioners and packaged terminal heat pumps final rule. 73 FR 58772. The TSD for the 2008 packaged terminal air conditioners and packaged terminal heat pumps final rule can be found at *http://www1.eere.energy.gov/buildings/appliance_standards/commercial/ptacs_pthps_final_tsd.html*.

[e] Estimated industry conversion expenses were published in the TSD for the April 2009 residential cooking products final rule. 74 FR 16040. The TSD for the 2009 residential cooking products final rule can be found at *http://www1.eere.energy.gov/buildings/appliance_standards/residential/cooking_products_final_rule_tsd.html*.

[f] Estimated industry conversion expenses were published in the TSD for the July 2009 general service fluorescent lamps and incandescent reflector lamps final rule. 74 FR 34080. The TSD for the 2009 lamps final rule can be found at *http://www1.eere.energy.gov/buildings/appliance_standards/residential/incandescent_lamps_standards_final_rule_tsd.html*.

[g] Estimated industry conversion expenses were published in the TSD for the August 2009 beverage vending machines final rule. 74 FR 44914. The TSD for the 2009 beverage vending machines final rule can be found at *http://www1.eere.energy.gov/buildings/appliance_standards/commercial/beverage_machines_final_rule_tsd.html*.

[h] Estimated industry conversion expenses were published in the TSD for the January 2010 commercial clothes washers final rule. 75 FR 1122. The TSD for the 2010 commercial clothes washers final rule can be found at *http://www1.eere.energy.gov/buildings/appliance_standards/commercial/clothes_washers_ecs_final_rule_tsd.html*.

[i] Estimated industry conversion expenses were published in the TSD for the April 2010 heating products final rule. 75 FR 20112. The TSD for the 2010 heating products final rule can be found at *http://www1.eere.energy.gov/buildings/appliance_standards/residential/heating_products_fr_tsd.html*.

[j] Estimated industry conversion expenses were published in the TSD for the April 2010 heating products final rule. 75 FR 20112. The TSD for the 2010 heating products final rule can be found at *http://www1.eere.energy.gov/buildings/appliance_standards/residential/heating_products_fr_tsd.html*.

Walk-In Freezers and Coolers	2015*	0	N/A††
Metal Halide Lamp Fixtures	2015*	0	N/A††
Residential Clothes Washers	2015*	7	N/A††
Small Electric Motors	2015	0	$51.2 million (2009$)[k]
Residential Water Heaters	2015	2	$95.9 million (2009$)[l]
Commercial Electric Motors	2015*	0	N/A††
Residential Furnaces	2015*	0	N/A††
Commercial Distribution Transformers	2016*	0	N/A††
Commercial Refrigeration Equipment	2016*	0	N/A††
Residential Central Air Conditioners	2016*	1	N/A††

*The dates listed are an approximation. The exact dates are pending final DOE action.
† Energy conservation standards and compliance dates for residential boilers can be found at 10 CFR 430.32(e)(2)(ii)-(iv).
†† For energy conservation standards for rulemakings awaiting DOE final action, DOE does not have a finalized estimated total industry conversion cost.
††† For minimum performance requirements prescribed by the Energy Independence and Security Act of 2007 (EISA 2007), DOE did not estimate total industry conversion costs because an MIA was not completed as part of a rulemaking. Pub. L. 110-140. EISA 2007 made numerous amendments to the Energy Policy and Conservation Act (EPCA) of 1975, Pub. L. 94-163, (42 U.S.C. 6291–6309), which established an energy conservation program for major household appliances and industrial and commercial equipment.

Additional investments necessary to meet these potential standards could have significant impacts on manufacturers of the covered products. However, DOE has limited data on the importance of these other regulated products for manufacturers of microwave ovens. Differences in market shares and manufacturing processes of other regulated products for each manufacturer could cause varying degrees of burdens on these manufacturers. Therefore, DOE only estimated the cost of compliance to meet other energy conservation standards for regulated products if DOE had published a final rule.

12.6.3.3 Restriction of Hazardous Substance Directive

According to manufacturers, the Restriction of Hazardous Substance Directive[m] (RoHS) will have some global impact on manufacturing of electrical and electronic equipment. Under the directive, all manufacturers are banned from placing on the European Union (EU) market new electrical and electronic equipment containing more than agreed-upon levels of lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyl and polybrominated diphenyl ether

[k] Estimated industry conversion expenses were published in the TSD for the March 2010 small motors final rule. 75 FR 10874. The TSD for the 2010 small motors final rule can be found at *http://www1.eere.energy.gov/buildings/appliance_standards/commercial/sem_finalrule_tsd.html*.
[l] Estimated industry conversion expenses were published in the TSD for the April 2010 heating products final rule. 75 FR 20112. The TSD for the 2010 heating products final rule can be found at *http://www1.eere.energy.gov/buildings/appliance_standards/residential/heating_products_fr_tsd.html*.
[m] Further information about RoHS can be found at *http://eur-lex.europa.eu/LexUriServ/site/en/oj/2003/l_037/l_03720030213en00190023.pdf*

flame retardants. Although there is no Federal regulation on RoHS, California has passed SB 20: Electronic Waste Recycling Act of 2003. Under this law, California limits the amount of hazards substances included in the RoHS directive that can be sold in California.

In addition, several northeastern states have placed a ban on any product that contains more than 1 ounce of mercury (a substance listed in RoHS). This primarily affects mercury-based gas valves found in commercial and residential conventional cooking products. Manufacturers of conventional cooking products have said that these bans and RoHS will have some impacts in the way the electronic components in the cooktops and ovens are incorporated into the design. Currently, these manufacturers have electronic components in the cooktop and oven designs that contain substances banned by the RoHS and mercury limit passed by northeastern states. However, manufacturers do not anticipate these restrictions will significantly impact the cooking products industry as a whole.

A significant worry to manufacturers is the uncertainty about the future of RoHS. One manufacturer stated that California's resumption of the RoHS initiative demonstrates the ease with which any state could selectively choose to ban its products. One manufacturer stated that there are number of exemptions found in RoHS which must be periodically renewed by the EU. Manufacturers use a number of these exempted substances in their products and are not sure if the exemptions will be renewed. Lastly, confirming RoHS-compliance will place additional testing burdens on manufacturers.

Most manufacturers interviewed for this rulemaking are already compliant with the RoHS directive. The most significant cumulative regulatory burden for gas cooking appliance manufacturers is a state-by-state restriction on mercury[n], which affects the gas valves used in their appliances. Most gas cooking appliance manufacturers have already eliminated mercury switches or already have plans in place to do so. However, all appliance manufacturers are concerned about potential restrictions of other hazardous substances in the future, such as fire protection materials, which could be costly to remove from existing products.

12.6.3.4 International Energy Conservation Standards

Canada does set energy conservation standards for cooking products. However, these standards are less stringent than those of the United States. Manufacturers stated their concern that Canada will begin to regulate products at the provincial level. Unlike the United States, Canada doesn't have Federal pre-emption clauses for efficiency standards so province-by-province standards could create a patchwork of standards and result in even greater testing costs.

DOE surveyed foreign regulatory and non-regulatory programs, identifying Korea's e-standby program, Australia's standby program, and Japan's Top Runner Program. All of them aim to meet or exceed the goals of the International Energy Agency (IEA)'s One-Watt program

[n] For example, the Interstate Mercury Education & Reduction Clearinghouse (IMERC) is a coalition of Northeast states coordinating the banning of products containing mercury, see *http://www.newmoa.org/prevention/mercury/imerc.cfm*.

to lower standby power consumption below 1 watt (W) for microwave ovens.[o] Korea's e-standby program currently has a voluntary labeling program for microwave ovens with less than 1 W of standby power. The program is currently transitioning to a mandatory 1 W maximum standby limit by the year 2010. Australia has plans to implement a mandatory 1 W standard by the year 2012. In accordance with Japan's Top Runner Program, Japanese appliance manufacturers made a voluntary declaration to reduce standby power consumption of microwave ovens without a timer as close to 0 W as possible and that of microwave ovens with a timer to 1 W or lower.

12.7 CONCLUSIONS

The following sections summarize the different impacts for the scenarios DOE believes are most likely to capture the range of impacts on microwave oven manufacturers as a result of energy conservation standards for standby mode and off mode. DOE also notes that while these scenarios bound the range of most plausible impacts on manufacturers, there potentially could be circumstances which cause manufacturers to experience impacts outside of this range.

To assess the lower end of the range of potential impacts for the microwave oven industry, DOE considered the scenario reflecting the preservation of gross margin percentage. As production cost increases with efficiency, this scenario implies manufacturers will be able to maintain gross margins as a percentage of revenues. To assess the higher end of the range of potential impacts for the microwave oven industry, DOE considered the scenario reflecting preservation of gross margin in absolute dollars. Under this scenario, DOE assumed that the industry can maintain its gross margins in absolute dollars after the standard compliance date. The industry would do so by passing through its increased costs to customers without increasing its gross margin in absolute dollars.

TSL 1 represents an improvement in standby power from the baseline level of 4.0 W to 2.0 W for Product Class 1 and an improvement in standby power from the baseline level of 4.5 W to 3.7 W for Product Class 2. At TSL 1, the impact on INPV and cash flow varies depending on the manufacturers' ability to pass on increases in MPCs to their customers. DOE estimated the impacts in INPV at TSL 1 to range -$27.1 million to -$29.3 million, or a change in INPV of -2.4 percent to -2.6 percent. At this level, the industry cash flow decreases by approximately 14.0 percent, to $72.3 million, compared to the base-case value of $84.2 million in the year leading up to the standards.

TSL 2 represents an improvement in standby power from the baseline level of 4.0 W to 1.5 W for Product Class 1 and an improvement in standby power from the baseline level of 4.5 W to 2.7 W for Product Class 2. At TSL 2, the impact on INPV and cash flow would be similar to TSL 1 and depend on whether manufacturers can fully recover the increases in MPCs from their customers. DOE estimated the impacts in INPV at TSL 2 to range from -$45.2 million to -$52.4 million, or a change in INPV of -4.0 percent to -4.6 percent. At this level, the industry cash

[o] IEA Energy Information Centre, Standby Power Use and the IEA "1-Watt Plan" *http://www.iea.org/textbase/subjectqueries/standby.asp*

flow decreases by approximately 24.0 percent, to $64.0 million, compared to the base-case value of $84.2 million in the year leading up to the standards.

TSL 3 represents an improvement in standby power from the baseline level of 4.0 W to 1.0 W for Product Class 1 and an improvement in standby power from the baseline level of 4.5 W to 2.2 W for Product Class 2. At TSL 3, the impact on INPV and cash flow continues to vary depending on the manufacturers and their ability to pass on increases in MPCs to their customers. DOE estimated the impacts in INPV at TSL 3 to range from approximately -$52.9 million to -$73.6 million, or a change in INPV of -4.7 percent to -6.5 percent. At this level, the industry cash flow decreases by approximately 29.9 percent, to $59.0 million, compared to the base-case value of $84.2 million in the year leading up to the standards.

TSL 4 represents an improvement in standby power from the baseline level of 4.0 W to 0.02 W for Product Class 1 and an improvement in standby power from the baseline level of 4.5 W to 0.04 W for Product Class 2. At TSL 4, DOE estimated the impacts in INPV to range from approximately -$90.4 million to -$165.7 million, or a change in INPV of -8.0 percent to -14.7 percent. At this level, the industry cash flow decreases by approximately 57.3 percent, to $35.9 million, compared to the base-case value of $84.2 million in the year leading up to the standards. At higher TSLs, manufacturers have a harder time fully passing on larger increases in MPCs to their customers. At TSL 4, the conversion costs are higher than the other TSLs because the design of all microwave platforms must be more significantly altered.

For new standby mode and off mode energy conservation standards, conversion costs increase at higher TSLs as the complexity of further lowering standby power increases, substantially driving up engineering time and also increasing the testing and product development time. If the increased production costs are fully passed on to consumers (the preservation of gross margin percentage scenario), the operating revenue from higher prices is still not enough to overcome the negative impacts from the substantial conversion costs. The incremental costs are small for each TSL, meaning the positive impact on cash flows is small compared to the conversion costs required to achieve these efficiencies. As a result of the small incremental costs and large conversion expenses, INPV is negative for all TSLs under the preservation of gross margin percentage scenario. If the incremental costs are not fully passed along to customers (the preservation of gross margin in absolute dollars scenario), the negative impacts on INPV are amplified at each TSL.

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