CHAPTER 12. MANUFACTURER IMPACT ANALYSIS

12.1 INTRODUCTION 12-1
12.2 METHODOLOGY 12-1
12.2.1 Phase I: Industry Profile 12-2
12.2.2 Phase II: Industry Cash-Flow Analysis and Interview Guide 12-2
12.2.2.1 Industry Cash-Flow Analysis 12-2
12.2.2.2 Interview Guide 12-3
12.2.3 Phase III: Subgroup Analysis 12-3
12.2.3.1 Manufacturing Interviews 12-3
12.2.3.2 Revised Industry Cash-Flow Analysis 12-3
12.2.3.3 Manufacturer Subgroup Analysis 12-4
12.2.3.4 Small-Business Manufacturer 12-4
12.2.3.5 Manufacturing Capacity Impact 12-4
12.2.3.6 Employment Impact 12-5
12.2.3.7 Cumulative Regulatory Burden 12-5
12.3 MANUFACTURER IMPACT ANALYSIS KEY ISSUES 12-5
12.3.1 Impact on Dishwasher Performance 12-5
12.3.2 Issues with Test Procedures 12-6
12.3.3 Increased Competition 12-6
12.3.4 Concern over Cumulative Regulatory Burden 12-7
12.4 GRIM INPUTS AND ASSUMPTIONS 12-7
12.4.1 Overview of the GRIM 12-7
12.4.2 Sources for GRIM Inputs 12-8
12.4.2.1 Corporate Annual Reports 12-8
12.4.2.2 Standard and Poor Credit Ratings 12-8
12.4.2.3 Shipment Model 12-8
12.4.2.4 Engineering Analysis 12-9
12.4.2.5 Manufacturer Interviews 12-9
12.4.3 Financial Parameters 12-9
12.4.4 Corporate Discount Rate 12-10
12.4.5 Trial Standard Levels 12-12
12.4.6 NIA Shipment Forecast 12-12
12.4.6.1 Base-Case Shipments Forecast 12-13
12.4.6.2 Standards-Case Shipments Forecast 12-13
12.4.7 Production Costs 12-13
12.4.8 Conversion Costs 12-15
12.4.8.1 Residential Dishwasher Product and Capital Conversion Costs 12-15
12.4.9 Markup Scenarios 12-17
12.4.9.1 Flat Markup Scenario 12-18
12.4.9.2 Preservation of Operating Profit 12-18
12.5 INDUSTRY FINANCIAL IMPACTS 12-19
12.5.1 Introduction 12-19
12.5.2 Residential Dishwasher Industry Financial Impacts 12-20
12.6 IMPACTS ON SMALL RESIDENTIAL DISHWASHER MANUFACTURERS 12-22

12.7 OTHER IMPACTS 12-23
12.7.1 Employment 12-23
12.7.2 Production Capacity 12-25
12.7.3 Cumulative Regulatory Burden 12-26
12.7.3.1 DOE Regulations for Other Products Produced by Residential Dishwasher Manufacturers 12-26
12.7.3.2 Other Regulations That Could Impact Residential Dishwasher Manufacturers 12-29
12.8 CONCLUSION 12-30
12.8.1 Residential Dishwashers 12-30

LIST OF TABLES

Table 12.2.1 SBA and NAICS Classification of Small Businesses Potentially Affected by This Rulemaking 12-4
Table 12.4.1 GRIM Financial Parameters based on 2003–2010 Weighted Company Financial Data 12-10
Table 12.4.2 Cost of Equity Calculation 12-11
Table 12.4.3 Cost of Debt Calculation 12-12
Table 12.4.4 Trial Standard Levels for Residential Dishwashers 12-12
Table 12.4.5 Total Base-Case 2018 NIA Shipments in the Reference NIA Shipment Scenario 12-13
Table 12.4.6 Base-Case Distribution of Efficiencies for Residential Dishwashers in 2018 12-13
Table 12.4.7 MPC Breakdown for Standard Dishwashers 12-14
Table 12.4.8 MPC Breakdown for Compact Dishwashers 12-15
Table 12.4.9 Product and Capital Conversion Costs for Standard Dishwashers by TSL 12-16
Table 12.4.10 Product and Capital Conversion Costs for Compact Dishwashers by TSL 12-17
Table 12.4.11 Flat Markups for Standard Dishwashers 12-18
Table 12.4.12 Preservation of Operating Profit Markups for Standard Dishwashers . 12-18
Table 12.4.13 Flat Markups for Compact Dishwashers 12-19
Table 12.4.14 Preservation of Operating Profit Markups for Compact Dishwashers . 12-19
Table 12.5.1 Manufacturer Impact Analysis for Residential Dishwashers – Flat Markup Scenario 12-21
Table 12.5.2 Manufacturer Impact Analysis for Residential Dishwashers – Preservation of Operating Profit Markup Scenario 12-21
Table 12.7.1 Total Domestic Residential Dishwasher Production Workers in 2018* 12-24
Table 12.7.2 Other DOE and Federal Actions Affecting the Residential Dishwasher Industry 12-27
Table 12.7.3 DOE Regulations on Products For Which Residential Dishwasher Manufacturers Hold Significant Market Share 12-29
Table 12.7.4 Other Covered Products 12-29

LIST OF FIGURES

Figure 12.4.1 Using the GRIM to Calculate Cash Flow 12-7
Figure 12.5.1 Annual Industry Net Cash Flows for Residential Dishwashers (Flat Markup Scenario) 12-21
Figure 12.5.2 Annual Industry Net Cash Flows for Residential Dishwashers (Preservation of Operating Profit Markup Scenario) 12-22
Figure 12.7.1 Total Residential Dishwasher Industry Domestic Employment by Year .. 12-25

CHAPTER 12. MANUFACTURER IMPACT ANALYSIS

12.1 INTRODUCTION

In determining whether a 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. 6295(o)(2)(B)(i)) The statute 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 more stringent energy conservation standards on manufacturers of residential dishwashers, and assessed the impact of such standards on direct 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 adapted for each product in this rulemaking. 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), which is the sum of discounted industry cash-flow over the analysis period. The model estimates the financial impact of more stringent energy conservation standards by comparing changes in INPV between a base case and the various trial standard levels (TSLs) in the standards case. The qualitative part of the MIA addresses product characteristics, manufacturer characteristics, market and product trends, as well as the impact of standards on subgroups of manufacturers.

12.2 METHODOLOGY

DOE conducted the MIA in three phases. Phase I, "Industry Profile," consisted of preliminary research directed at characterizing the residential dishwasher industry. This research involved collecting data on market share, sales volumes and trends, pricing, employment, and the industry financial structure.

In Phase II, "Industry Cash Flow," DOE created a GRIM to model the economic impact of amended energy conservation standards on the residential dishwasher industry as a whole. The DOE also developed a manufacturer interview guide to gather additional information in Phase III on the potential impacts on manufacturers.

In Phase III, "Subgroup Impact Analysis," DOE interviewed manufacturers representing over 80 percent of the residential dishwasher market. Interviewees included manufacturers with various market shares and product focus, providing a representative cross-section of the industry. During interviews, DOE discussed financial topics specific to each manufacturer and obtained each manufacturer's view of the industry. The interviews provided DOE with valuable information for evaluating the impacts of amended energy conservation standards on manufacturer cash flows, investments, and employment.

12.2.1 Phase I: Industry Profile

In Phase I of the MIA, DOE prepared a profile of the residential dishwasher industry that built upon the market and technology assessment prepared for this rulemaking. (See chapter 3 of the direct final rule Technical Support Document (TSD)). Before initiating the detailed impact studies, DOE collected information on the present and past market structure and characteristics of the industry, tracking trends in market share, product attributes, product shipments, manufacturer markups, and the cost structure for various manufacturers.

The profile also included a top-down analysis of manufacturers in the industry using Security and Exchange Commission (SEC) 10–K filings,[a] Standard & Poor (S&P) stock reports,[b] and corporate annual reports released by both public and privately held companies. DOE used this and other publicly available information to derive preliminary financial inputs for the GRIM (*e.g.* revenues; cost of goods sold; depreciation; selling, general and administrative expenses (SG&A); and research and development (R&D) expenses).

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

Phase II focused on the financial impacts of amended energy conservation standards on the residential dishwasher industry as a whole. Amended energy conservation standards can affect manufacturer cash flows in three distinct ways: (1) by creating a need for increased investment, (2) by raising production costs per unit, and (3) by altering revenue due to higher per-unit prices and/or possible changes in sales volumes. DOE used the GRIM to model these effects in a cash-flow analysis for the residential dishwasher industry. In performing this analysis, DOE used the financial values derived during Phase I and the shipment assumptions from the NIA. In addition to the cash-flow analysis, DOE also prepared a written guide for manufacturer interviews as part of Phase II.

12.2.2.1 Industry Cash-Flow Analysis

The GRIM uses several factors to determine a series of annual cash flows from the announcement year of amended energy conservation standards until several years after the standards' compliance date. INPV is the sum of these annual cash flows discounted by the industry weighted average cost of capital. Inputs to the GRIM include the manufacturing costs, markups, and shipment forecasts developed in other analyses. DOE derived the manufacturing costs from the engineering analysis as presented in chapter 5 of the direct final rule TSD, information provided by the industry, publicly available financial reports, and interviews with manufacturers. DOE developed alternative markup scenarios for each GRIM based on discussions with manufacturers. DOE's shipments analysis, presented in chapter 10 of the direct final rule TSD, provided the basis for the shipment projections. DOE derived the financial parameters using publicly available reports and revised them using information submitted confidentially during manufacturer interviews. DOE used the GRIM to compare INPV in the base case with INPV at various TSLs (the standards cases). The difference in INPV between the base and standards cases represents the financial impact of the amended standard on manufacturers.

[a] Available online at www.sec.gov.
[b] Available online at www2.standardandpoors.com.

12.2.2.2 Interview Guide

During Phase III of the MIA, DOE interviewed manufacturers of residential dishwashers to gather information on the effects of amended energy conservation on revenues and finances, direct employment, capital assets, and industry competitiveness. Before the interviews, DOE distributed an interview guide to representatives of each participating manufacturer. The interview guide provided a starting point to help identify relevant issues and understand the impacts of amended energy conservation standards on individual manufacturers or subgroups of manufacturers. Most of the information DOE received from these meetings is protected by non-disclosure agreements and resides with DOE's contractors. The topics covered as part of these interviews include (1) key issues to this rulemaking; (2) engineering and life cycle cost follow-up; (3) manufacturer markups and profitability; (4) financial parameters; and (5) conversion costs. The interview guide is presented in appendix 12-A.

12.2.3 Phase III: Subgroup Analysis

While conducting the MIA, DOE interviewed a representative cross-section of residential dishwasher manufacturers. The MIA interviews broadened the discussion to include business-related topics. DOE sought to obtain feedback from industry on the approaches used in the GRIM and to isolate key issues and concerns. During interviews, DOE did not identify any manufacturer subgroups that would warrant a subgroup analysis.

12.2.3.1 Manufacturing Interviews

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

DOE used these interviews to tailor the GRIM to reflect the unique financial characteristics of the residential dishwasher manufacturing industry. Companies with various market shares and product focus were interviewed to provide a representation of the industry. Interviews were scheduled well in advance to provide every opportunity for key individuals to be available for comment. Although a written response to the questionnaire was acceptable, DOE sought interactive interviews, which help clarify responses and identify additional issues. The resulting information provides valuable inputs to 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 comments on the values it selected for the parameters. DOE revised its industry cash-flow models based on this feedback. Section 12.4.3 provides more information on how DOE calculated the parameters.

12.2.3.3 Manufacturer Subgroup Analysis

Using average cost assumptions to develop an industry cash flow estimate may not adequately assess differential impacts of amended energy conservation standards on manufacturer subgroups. For example, small businesses, manufacturers of niche products, or companies exhibiting a cost structure that differs significantly from the industry average could be more negatively affected. DOE used the results of the industry characterization to group manufacturers exhibiting similar characteristics. During the interviews, DOE discussed the potential subgroups and subgroup members it identified for the analysis. DOE asked manufacturers and other interested parties to suggest what subgroups or characteristics are the most appropriate to analyze. As discussed below, since DOE identified no small business manufacturers of residential dishwashers, DOE did not conduct a separate subgroup analysis of small business manufacturers.

12.2.3.4 Small-Business Manufacturer

DOE used the Small Business Administration (SBA) small business size standards published on August 22, 2008, as amended, and the North American Industry Classification System (NAICS) code, presented in Table 12.2.1, to determine whether any small entities would be affected by the rulemaking.[c] For the product classes under review, the SBA bases its small business definition on the total number of employees for a business including the total employee count of a parent company and its subsidiaries. An aggregated business entity with fewer employees than the listed limit is considered a small business.

Table 12.2.1 SBA and NAICS Classification of Small Businesses Potentially Affected by This Rulemaking

Industry Description	Revenue Limit	Employee Limit	NAICS
Other Major Household Appliance Manufacturing	N/A	500	335228

DOE used the Association of Home Appliance Manufacturers (AHAM)[1] member directory as well as public certification databases including the Consortium of Energy Efficiency (CEE),[2] California Energy Commission (CEC),[3] and ENERGY STAR[4] to identify manufacturers of residential dishwashers. DOE then checked this list of dishwasher manufacturers against the employee limit for small businesses using reports from vendors such as Dun & Bradstreet. DOE also consulted publicly available data from the Small Business Association (SBA) to determine the presence of any additional small businesses in the industry. Further, DOE asked interested parties and industry representatives if they were aware of other small business manufacturers and checked any companies identified against the small business criteria. During its research, DOE identified no manufacturer of residential dishwashers that meets the small business criteria as specified by the SBA.

12.2.3.5 Manufacturing Capacity Impact

One significant outcome of amended energy conservation standards could be the obsolescence of existing manufacturing assets, including tooling and production equipment. The manufacturer interview guide contains a series of questions to help identify impacts of amended

[c] The size standards are available on the SBA's website at www.sba.gov/content/table-small-business-size-standards

standards on manufacturing capacity, specifically capacity utilization and plant location decisions in the United States and North America, with and without amended standards; the ability of manufacturers to upgrade or remodel existing facilities to accommodate the new requirements; the nature and value of any stranded assets; and estimates for any one-time changes to existing plant, property, and equipment (PPE). DOE's estimates of the one-time capital changes and stranded assets affect the cash flow projections in the GRIM. These estimates can be found in section 12.4.8; DOE's discussion of the capacity impact can be found in section 12.7.2.

12.2.3.6 Employment Impact

The impact of amended energy conservation standards on employment is an important consideration in the rulemaking process. To assess how domestic direct employment patterns might be affected, the interviews explored current employment trends in the residential dishwasher industry. The interviews also solicited manufacturer views on changes in employment patterns that may result from more stringent standards. The employment impacts section of the interview guide focused on current employment levels associated with manufacturers at each production facility, expected future employment levels with and without amended energy conservation standards, and differences in workforce skills and issues related to the retraining of employees. The employment impacts are reported in section 12.7.1.

12.2.3.7 Cumulative Regulatory Burden

DOE seeks to mitigate the overlapping effects on manufacturers due to amended energy conservation standards and other regulatory actions affecting the same products. DOE analyzed the impact on manufacturers of multiple, product-specific regulatory actions. Based on its own research and discussions with manufacturers, DOE identified regulations relevant to residential dishwasher manufacturers, such as other Federal regulations that impact other products made by the same manufacturers. Discussion of the cumulative regulatory burden can be found in section 12.7.3.

12.3 MANUFACTURER IMPACT ANALYSIS KEY ISSUES

Each MIA interview starts by asking: "What are the key issues for your company regarding the energy conservation standard rulemaking?" This question prompts manufacturers to identify the issues they feel DOE should explore and discuss further during the interview. The following section describes key issues manufacturers mentioned for all product classes under review.

12.3.1 Impact on Dishwasher Performance

All manufacturers interviewed expressed concerns about the potential impacts of amended standards on product performance, citing several adverse and possibly severe consequences of standards above those agreed upon in a joint petition submitted by interested parties to DOE ("Joint Petition").[d] For higher efficiency standards, the performance metrics

[d] "Agreement on Minimum Federal Efficiency Standards, Smart Appliances, Federal Incentives and Related Matters for Specified Appliances," DOE Docket No. EERE–2011–BT–STD–0060, Comment 1.

manufacturers expect to be most severely impacted include wash performance, drying performance, cycle time, and the noise levels reached in operation. In considering these metrics, manufacturers anticipate negative reactions ranging from small but meaningful changes in consumer behavior to higher rates of service calls and returns. For efficiency standards well above those proposed in the Joint Petition, manufacturers foresee blanket rejection of poorly performing products in the market. In considering impacts to wash performance, manufacturers cited an increase in unnecessary rinsing or washing of dishes prior to loading the dishwasher, switching to a more aggressive cycle, and running multiple cycles when dishes are not adequately cleaned in a single cycle as the most likely changes in consumer behavior. Manufacturers went on to suggest that any of these changes would result in an increase in both energy and water consumption over that used by a dishwasher deemed by consumers to currently provide satisfactory performance.

While manufacturers suggested that the efficiency level specified in the Joint Petition would not likely have a substantial negative impact on wash performance, they noted that standards above this level would certainly result in a notable decrease in performance. To mitigate the impact of future standards on product performance, several manufacturers recommend the adoption of a performance metric into the test procedure and standard.

12.3.2 Issues with Test Procedures

Manufacturers raised concerns over the current DOE dishwasher test procedure and the multitude of additional dishwasher test procedures in the field today. Several manufacturers suggested that the current DOE test procedure does not accurately capture the energy used by dishwashers in the field. These manufacturers cite the single cycle specification and lack of performance metrics in the test procedure as providing an easy avenue for circumvention of the standards. In the scenario described, manufacturers may optimize a particular cycle to perform well on the DOE test procedure with the implicit understanding that this cycle will not meet customer expectations and thus will not be used in the field as customers opt for a different, more energy-intensive cycle.

Other manufacturers, however, raised concerns over expanding the test procedure to include multiple cycles, citing the additional test burden. Some manufacturers raised concerns over how DOE would implement a performance test, noting that numerous dishwasher performance test procedures already exist—including those developed by AHAM, the International Electrotechnical Commission (IEC), and Consumer Reports—and that results for each of these test procedures would by optimized by a different wash cycle algorithm and product attributes.

12.3.3 Increased Competition

Manufacturers of both baseline and high efficiency products anticipate an increase in competition stemming from amended standards. Manufacturers whose market share largely comprises products currently below amended standards expect to see either the removal of features from higher efficiency units as a means to cut costs to maintain a low-cost minimally compliant product, or the disappearance of entry-level models as manufacturers are forced to add other features and cost in line with current higher efficiency products. If the latter approach

prevails, manufacturers of higher efficiency products expect to see increased competition as manufacturers which previously focused on low efficiency products move into their target segment of the market.

12.3.4 Concern over Cumulative Regulatory Burden

Several manufacturers noted that dishwashers are but one of a suite of appliances they produce and that the cumulative burden of R&D to meet standards, capital expenditure and retraining of staff to produce products at the new standards, and product testing to certify compliance of new products represent a significant burden when accounted for across their various product lines. Manufacturers suggest that the ability to establish standards in a coordinated fashion by such vehicles as a joint petition and adequate notice of DOE's plans for amended standards are both necessary elements in mitigating the cumulative burden and aligning changes in efficiency regulations with the product development cycle.

12.4 GRIM INPUTS AND ASSUMPTIONS

The GRIM serves as the main tool for assessing the impacts on industry due to amended energy conservation standards. DOE relies on several sources to obtain inputs for the GRIM. Data and assumptions from these sources are then fed into an accounting model that calculates the industry cash flow both with and without amended 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, 2012, and continuing to 2047. The model calculates the INPV by summing the stream of annual discounted cash flows during this period.[5]

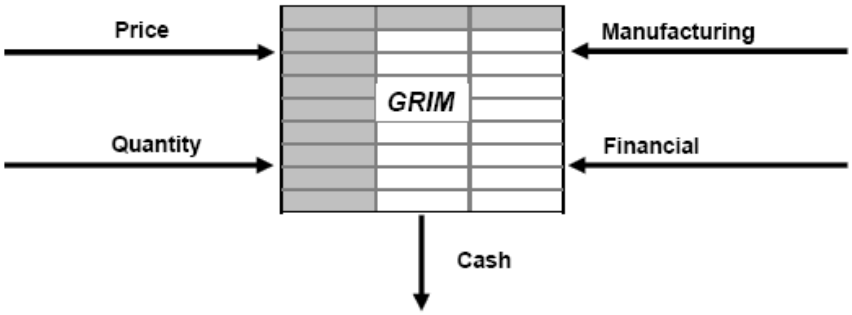

Figure 12.4.1 Using the GRIM to Calculate Cash Flow

The GRIM projects cash flows using standard accounting principles and compares changes in INPV between the base-case and the standard-case scenario induced by amended

energy conservation standards. The difference in INPV between the base case and the standard case(s) represents the estimated financial impact of the amended energy conservation standards on manufacturers. Appendix 12-B provides more technical details and user information for the GRIM.

12.4.2 Sources for GRIM Inputs

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

12.4.2.1 Corporate Annual Reports

Corporate annual reports for publicly held companies are freely available to the general public through the SEC as filings of Form 10-K. Additionally, some privately held companies publish annual financial reports on their corporate websites. DOE developed initial financial inputs to the GRIM by examining the publicly available annual reports of companies primarily engaged in the manufacture of home appliances whose combined product range includes residential dishwashers. As these companies do not provide detailed information about their individual product lines, DOE used the aggregate financial information at the corporate level in developing its initial estimates of the financial parameters to be used in the GRIM. In doing so, DOE assumes that the industry-average figures calculated for these companies were representative of manufacturing for residential dishwashers. These figures were later revised using feedback from interviews to be representative of manufacturing for each product. DOE used corporate annual reports to derive the following initial inputs to the GRIM:

- Tax rate;
- Working capital;
- SG&A;
- R&D;
- Depreciation;
- Capital expenditures; and
- Net PPE.

12.4.2.2 Standard and Poor Credit Ratings

S&P provides independent credit ratings, research, and financial information. DOE relied on S&P reports to determine the industry's average cost of debt when calculating the weighted-average cost of capital.

12.4.2.3 Shipment Model

The GRIM used shipment projections derived from DOE's shipments model in the national impact analysis (NIA). The model relied on historical shipments data for residential dishwashers. Chapter 10 of the direct final rule TSD describes the methodology and analytical model DOE used to forecast shipments.

12.4.2.4 Engineering Analysis

DOE conducted the engineering analyses for this rulemaking using the efficiency-level approach, combined with the cost-assessment approach, to develop a cost for each efficiency level for residential dishwashers. During this analysis, DOE used a manufacturing cost model to develop manufacturer production cost (MPC) estimates for residential dishwashers. The analysis yielded the labor, materials, overhead, and total production costs for products at each efficiency level. The engineering analysis also estimated a manufacturer markup to determine the manufacturer selling price (MSP) for each product at every efficiency level. Chapter 5 of the direct final rule TSD describes the engineering analysis in detail.

12.4.2.5 Manufacturer Interviews

As part of the MIA, DOE conducted interviews with a representative cross-section of manufacturers. Through these discussions, DOE obtained information to determine and verify GRIM input assumptions. Key topics discussed during the interviews and reflected in the GRIM include:

- Capital conversion costs (one-time investments in PPE);
- Product conversion costs (one-time investments in research, product development, testing, and marketing);
- Product cost structure, or the portion of the MPCs related to materials, labor, overhead, and depreciation costs;
- Projected total shipment and shipment distribution mix; and
- MPCs estimated in the engineering analysis.

12.4.3 Financial Parameters

In the manufacturer interviews, DOE used the financial parameters from 2003 to 2010 for four appliance manufacturers with a combined market share of over 90 percent as a starting point for determining the residential dishwasher industry financial parameters. The industry financial parameters were determined by weighting each manufacturer's individual financial parameters by their respective market share, and correcting for the fraction of the market that was not represented. Table 12.4.1 below shows the data used to determine the initial financial parameter estimates.

Table 12.4.1 GRIM Financial Parameters based on 2003–2010 Weighted Company Financial Data

Parameter	Industry-Weighted Average	Manufacturer			
		A	B	C	D
Tax Rate *(% of Taxable Income)*	33.3	42.6	25.4	14.0	30.7
Working Capital *(% of Revenue)*	7.0	11.9	20.7	3.8	3.9
SG&A *(% of Revenue)*	13.3	17.8	24.3	13.1	10.4
R&D *(% of Revenues)*	2.3	1.8	2.8	2.8	2.4
Depreciation *(% of Revenues)*	3.1	2.8	3.4	2.2	3.1
Capital Expenditures *(% of Revenues)*	3.2	3.1	4.2	2.6	3.2
Net Property, Plant, and Equipment *(% of Revenues)*	16.7	14.4	16.3	20.9	17.6

During interviews, manufacturers were asked to provide their own figures for the parameters listed in Table 12.4.1. DOE adjusted the tax rate, depreciation and capital expenditures according to the manufacturers' feedback.

12.4.4 Corporate Discount Rate

A company's assets are financed by a combination of debt and equity, and the weighted-average cost of capital (WACC) represents the minimum rate of return necessary to cover the debt and equity obligations manufacturers use to finance operations. The WACC is the total cost of debt and equity weighted by their respective proportions in the capital structure of the company.

DOE estimated the WACC for residential dishwasher 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 = Risk-free Rate of Return + β x Risk Premium

where:

Risk-free rate of return is the rate of return on a "safe" benchmark investment, typically considered the short-term Treasury Bill (T-Bill) yield. In practice, investors use a variety of different maturity T-Bills to estimate the risk-free rate. DOE used the 10-year T-Bill 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 5.2 percent, which is the average 10-year T-Bill return between 1928 and 2010.

Risk premium is the difference between the expected return on stocks and the risk-free rate of return. DOE used the average annual return on the S&P 500 between 1928 and 2010 as the expected return on stocks to arrive at an estimated market risk premium of 6.1 percent.

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. Values for Beta are only available for publicly traded companies.

DOE used the capital asset pricing model to calculate the cost of equity for three publicly traded dishwasher manufacturers whose combined market share is over 90 percent. DOE determined that the industry-average cost of equity for the residential dishwasher industry is 16.7 percent (see Table 12.4.2).

Table 12.4.2 Cost of Equity Calculation

Parameter	Industry-Weighted Average %	Manufacturer			
		A	B	C	D
(1) Average Beta	1.9	1.5	n/a	1.7	2.0
(2) Yield on 10-Year T-Bill (1928-2010)	5.2	-	-	-	-
(3) Market Risk Premium (1928-2010)	6.1	-	-	-	-
Cost of Equity (2)+[(1)*(3)]	16.7	14.4	n/a	15.5	17.5
Equity/Total Capital	68.6	71.0	86.5	92.7	65.8

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 three manufacturers by using S&P ratings and adding the relevant spread to the risk-free rate.

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. DOE determined that the after-tax industry-average cost of debt for the residential dishwasher industry is 4.5 percent. Table 12.4.3 presents the derivation of the cost of debt and 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	D
S&P Bond Rating	--	BBB	A	AA	BBB
(1) Yield on 10-Year T-Bill (1928-2010)	5.2	-	-	-	-
(2) Gross Cost of Debt	6.8	6.8	6.2	5.9	6.8
(3) Tax Rate	33.3	42.6	25.4	14.0	30.7
Net Cost of Debt [(2) x ((1)-(3))]	4.5	-	-	-	-
Debt/Total Capital	31.4	29.0	13.5	7.3	34.2

Correcting for an inflation rate of 3.1 percent over the analysis period, DOE's calculated value for the residential dishwasher industry's inflation-adjusted WACC and the initial estimate of the discount rate is 8.1 percent. DOE adjusted this figure to 8.5 percent for the GRIM based on feedback received during manufacturer interviews.

12.4.5 Trial Standard Levels

DOE developed TSLs to analyze the impact on manufacturers of amended energy efficiency standards for two product classes of residential dishwashers—standard dishwashers and compact dishwashers. Table 12.4.4 presents the TSLs and the corresponding product class efficiency levels based on estimated annual energy use (EAEU) and water consumption (WC) according to the current test procedure (10 CFR part 430, subpart B, appendix C).

TSL 4 represents the maximum technologically feasible ("max-tech") improvements in energy efficiency for residential dishwashers. TSL 3 consists of the next efficiency level below the max-tech level for standard dishwashers, and the max-tech level for compacts. The efficiency levels in TSL 2 correspond to the efficiency levels recommended in the Joint Petition. TSL 1 consists of the first efficiency levels considered above the baseline.

Table 12.4.4 Trial Standard Levels for Residential Dishwashers

Product Class		Baseline	TSL 1	TSL 2	TSL 3	TSL 4
Standard Dishwashers	**Efficiency Level**	Baseline	EL 1	EL 2	EL 4	EL 5
	EAEU *(%)*	355	324	307	234	180
	WC *(gal/cycle)*	6.5	5.8	5.0	3.8	1.6
Compact Dishwashers	**Efficiency Level**	Baseline	EL 1	EL 1	EL 2	EL 2
	EAEU *(%)*	260	222	222	154	154
	WC *(gal/cycle)*	4.5	3.5	3.5	2.1	2.1

12.4.6 NIA Shipment 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

residential dishwasher shipment data from the NIA. Chapter 10 of the direct final rule TSD explains DOE's calculations of total shipments in detail. Table 12.4.5 shows total shipments forecasts for residential dishwashers in 2018.

Table 12.4.5 Total Base-Case 2018 NIA Shipments in the Reference NIA Shipment Scenario

Product Class	Total Industry Shipments
Standard Dishwashers	7,942,499
Compact Dishwashers	11,261

12.4.6.1 Base-Case Shipments Forecast

As part of the shipment analysis, DOE estimated the shipment distribution by efficiency level for residential dishwashers. DOE held the base-case energy efficiency distribution constant throughout the forecast period. Table 12.4.6 shows the base-case distributions of shipments by efficiency level estimated in the NIA for the residential dishwasher product classes.

Table 12.4.6 Base-Case Distribution of Efficiencies for Residential Dishwashers in 2018

Product Class		Baseline	EL 1	EL 2	EL 3	EL 4	EL 5
Standard Dishwashers	EAEU	355	324	307	295	234	180
	% of the Market at EL	3.8	25.2	32.7	18.5	10.8	9.0
Compact Dishwashers	EAEU	260	222	154			
	% of the Market at EL	25.0	25.0	50.0			

12.4.6.2 Standards-Case Shipments Forecast

To examine the impact of amended energy conservation standards on shipments, which in turn affects the INPV, DOE used the base-case shipments described in the previous section as a point of comparison for shipments forecast in the standards case. For each TSL described in the standards case, DOE used the shipments forecasts developed in the NIA for residential dishwashers. DOE used a roll-up scenario to determine efficiency distributions for the standards case. In this scenario, products that fall below the amended energy conservation standards are assumed to "roll-up" to the new standards on the compliance date and thereafter.

As in the shipments analysis, DOE assumed there was relative price elasticity of -0.34 in the residential dishwasher market, meaning that amended energy conservation standards that increase the first cost of residential dishwashers would result in lower total shipments.

12.4.7 Production Costs

Changes in the MPCs of residential dishwashers can affect revenues, gross margins, and cash flow of the industry, making these product cost data key GRIM inputs for DOE's analysis.

In the engineering analysis, DOE created separate cost curves for standard and compact product classes using data from tear-downs to develop both the baseline MPCs and the incremental costs that correspond to the proposed design options. Generally, manufacturing higher efficiency products is more costly than manufacturing baseline products due to the use of more complex components and higher-cost raw materials.

The cost model disaggregated the MPCs at each efficiency level into material, labor, overhead, and depreciation. For materials, DOE used the incremental component and raw material costs that correspond to the proposed design options at each EL. For labor, DOE estimated the labor contribution at each EL by examining how the proposed design options may influence manufacturing and assembly practices. For depreciation, DOE used a depreciation value that is consistent with historical information in SEC 10-Ks. The remainder of total overhead was allocated to factory overhead.

Later, manufacturers validated these estimates and assumptions during interviews. DOE used the resulting MPCs and cost breakdowns as described in section 12.4.2.4 above, and further detailed in chapter 5 of the direct final rule TSD, for each efficiency level analyzed in the GRIM analysis.

The MSP is comprised of production costs (the direct manufacturing costs or MPCs), non-production costs (indirect costs like SG&A), and profit. DOE calculated the MSPs for residential dishwashers by multiplying the MPCs by the appropriate manufacturer markup for that product. Table 12.4.7 and Table 12.4.8 show the production cost estimates used in the GRIM for the representative product classes for residential dishwashers.

Table 12.4.7 MPC Breakdown for Standard Dishwashers

EL	EAEU *(kWh/year)*	Labor	Material	Overhead	Depreciation	MPC	Mfr. Markup	MSP
Baseline	355	$34.24	$119.92	$24.99	$11.84	$190.98	1.24	$236.82
EL 1	324	$36.16	$135.44	$24.68	$12.97	$209.25	1.24	$259.47
EL 2	307	$38.47	$144.01	$26.51	$13.81	$222.80	1.24	$276.27
EL 3	295	$37.25	$180.29	$26.54	$16.13	$260.21	1.24	$322.66
EL 4	234	$38.46	$183.76	$27.44	$16.50	$266.16	1.24	$330.04
EL 5	180	$39.62	$188.04	$29.29	$16.98	$273.93	1.24	$339.68

Table 12.4.8 MPC Breakdown for Compact Dishwashers

EL	EAEU *(kWh/year)*	Labor	Material	Overhead	Depreciation	MPC	Mfr. Markup	MSP
Baseline	260	$27.30	$129.07	$17.83	$11.51	$185.72	1.24	$230.29
EL 1	222	$27.16	$130.37	$17.61	$11.58	$186.72	1.24	$231.53
EL 2	154	$26.93	$140.22	$18.41	$12.27	$197.83	1.24	$245.31

12.4.8 Conversion Costs

Amended 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 MIA, DOE classified these one-time conversion costs into two major groups: capital conversion costs and product conversion costs. Capital conversion costs are investments in property, plant, and equipment to adapt or change existing production facilities so that new product designs can be fabricated and assembled. Product conversion costs are investments in research, development, testing, marketing, and other non-capitalized costs focused on making product designs comply with the amended energy conservation standard. These one-time conversion costs are separate and do not directly impact the manufacturer production cost as described in chapter 5 of the direct final rule TSD. The following sections describe the inputs DOE used in the GRIM in greater detail.

12.4.8.1 Residential Dishwasher Product and Capital Conversion Costs

DOE based its conversion cost estimates that would be required to meet each TSL on confidential information received during manufacturer interviews. For standard dishwashers, DOE matched manufacturers' descriptions of proposed changes to PPE and investments in R&D to the corresponding design options at each efficiency level. DOE then aggregated the total industry capital and product conversion costs for each TSL, and divided the total by 0.81, the cumulative market share represented by manufacturers which provided this information. DOE also reviewed public information in the CEC, ENERGY STAR, CEE product databases as well as manufacturer websites to understand which products manufacturers would upgrade at each efficiency level. For compact dishwashers, DOE used capital and product conversion costs that correspond to similar design options for the standard product class, and scaled these figures by the relative number of product platforms currently available on the market. DOE estimated the number of standard and compact platforms using publicly available information from manufacturer websites and product databases as well as insights gained in the engineering analysis.

Table 12.4.9 and Table 12.4.10 show DOE's estimates of the product and capital conversion costs necessary for both residential dishwasher product classes at each TSL.

Table 12.4.9 Product and Capital Conversion Costs for Standard Dishwashers by TSL

TSL (EL)	EAEU *(kWh/year)*	Design Options Considered	Product Conversion Costs *(2010$ millions)*	Capital Conversion Costs *(2010$ millions)*
Baseline	355		0.0	0.0
TSL 1 (EL 1)	324	Electronic controls Multiple Spray Arms Improved Water Filters Separate Drain Pump	24.5	40.1
TSL 2 (EL 2)	307	Electronic controls Improved Control Strategies Soil Sensing Multiple Spray Arms Improved Water Filters Hydraulic System Optimization Separate Drain Pump 3-Phase Variable-Speed Motor Tub Insulation Switch Mode Power Supply	31.6	53.7
TSL 3 (EL 4)	234	Electronic controls Improved Control Strategies Soil Sensing Temperature Sensor Humidity Sensor Flow Meter Multiple Spray Arms Water Diverter Assembly Improved Water Filters Separate Drain Pump Hydraulic System Optimization Flow-Through Water Heater 3-Phase Variable-Speed Motor Switch Mode Power Supply Tub Insulation Condensation Drying	62.2	188.3
TSL 4 (EL 5)	180	Electronic controls Improved Control Strategies Soil Sensing Temperature Sensor Humidity Sensor Flow Meter Multiple Spray Arms Water Diverter Assembly Improved Water Filters Hydraulic System Optimization Separate Drain Pump In-Pump Water Heater 3-Phase Variable-Speed Motor Switch Mode Power Supply Tub Insulation Condensation Drying Eliminate Vent Fan	72.4	219.1

Table 12.4.10 Product and Capital Conversion Costs for Compact Dishwashers by TSL

TSL (EL)	EAEU *(kWh/year)*	Design Options Considered	Product Conversion Costs *(2010$ millions)*	Capital Conversion Costs *(2010$ millions)*
Baseline	260		0.0	0.0
TSL 1 (EL 1)	222	Optimized Control Systems	3.3	5.3
TSL 2 (EL 1)	222	Optimized Control Systems	3.3	5.3
TSL 3 (EL 2)	154	Optimized Control Systems Permanent Magnet Motor Heater Incorporated into Base of Tub Reduced Sump Volume	4.2	7.2
TSL 4 (EL 2)	154	Optimized Control Systems Permanent Magnet Motor Heater Incorporated into Base of Tub Reduced Sump Volume	4.2	7.2

12.4.9 Markup Scenarios

MSP is equal to MPC times a manufacturer markup. The MSP includes direct manufacturing production costs (*i.e.*, labor, material, and overhead estimated in DOE's MPCs) and all non-production costs (*i.e.*, SG&A, R&D, and interest), along with profit.

DOE used several standards case markup scenarios to represent the uncertainty about the impacts of amended energy conservation standards on prices and profitability. In the base case, DOE used the same baseline markups calculated in the engineering analysis for all product classes. In the standards case, DOE modeled two markup scenarios to represent the uncertainty about the potential impacts on prices and profitability following the implementation of amended energy conservation standards: (1) a flat markup scenario, and (2) a preservation of operating profit markup scenario. Modifying these markups from the base case to the standards cases yields different sets of impacts on manufacturers by changing industry revenue and cash flow.

To calculate the baseline manufacturer markup, DOE evaluated publicly available financial information for manufacturers of major household appliances whose product offerings include residential dishwashers. During manufacturer interviews, DOE received feedback supporting the calculated 1.24 baseline manufacturer markup. For both GRIM markup scenarios, DOE assumed a predominantly flat markup structure, placing no premium on higher efficiency products. This assumption is informed by a market structure in which over 96 percent of products currently adhere to ENERGY STAR standards, leaving little to no room for differentiation by efficiency level alone, and was further supported by manufacturer interviews.

12.4.9.1 Flat Markup Scenario

The flat markup scenario assumes that the baseline markup of 1.24 is maintained for all products in the standards case. This represents the upper bound of industry profitability as manufacturers are able to fully pass through additional costs due to standards to their customers in this scenario.

12.4.9.2 Preservation of Operating Profit

DOE also modeled the preservation of operating profit markup scenario to estimate a lower bound of profitability for the industry. This is similar to the flat markup scenario with the exception that in the standards case, minimally compliant products lose a fraction of the baseline markup. The lower markup for minimally compliant products is derived by matching the industry operating profits in the year standards go into effect with those of the same year in the base case. This scenario represents a more substantial impact to the dishwasher industry as manufacturers vie to maintain the lowest possible prices for entry level products while securing the same level of operating profit they saw prior to amended standards.

Table 12.4.11 through Table 12.4.14 list the products DOE analyzed with the corresponding markups at each TSL for residential dishwashers.

Table 12.4.11 Flat Markups for Standard Dishwashers

EL (EAEU)	Markups by TSL				
	Baseline	TSL 1	TSL 2	TSL 3	TSL 4
Baseline (355)	1.240				
EL 1 (324)	1.240	1.240			
EL 2 (307)	1.240	1.240	1.240		
EL 3 (295)	1.240	1.240	1.240		
EL 4 (234)	1.240	1.240	1.240	1.240	
EL 5 (180)	1.240	1.240	1.240	1.240	1.240

Table 12.4.12 Preservation of Operating Profit Markups for Standard Dishwashers

EL (EAEU)	Markups by TSL				
	Baseline	TSL 1	TSL 2	TSL 3	TSL 4
Baseline (355)	1.240				
EL 1 (324)	1.240	1.239			
EL 2 (307)	1.240	1.240	1.238		
EL 3 (295)	1.240	1.240	1.240	1.240	
EL 4 (234)	1.240	1.240	1.240	1.240	1.233
EL 5 (180)	1.240	1.240	1.240	1.240	1.240

Table 12.4.13 Flat Markups for Compact Dishwashers

EL (EAEU)	Markups by TSL				
	Baseline	TSL 1	TSL 2	TSL 3	TSL 4
Baseline (260)	1.240				
EL 1 (222)	1.240	1.240	1.240		
EL 2 (154)	1.240	1.240	1.240	1.240	1.240

Table 12.4.14 Preservation of Operating Profit Markups for Compact Dishwashers

EL (EAEU)	Markups by TSL				
	Baseline	TSL 1	TSL 2	TSL 3	TSL 4
Baseline (260)	1.240				
EL 1 (222)	1.240	1.240	1.240		
EL 2 (154)	1.240	1.240	1.240	1.238	1.238

12.5 INDUSTRY FINANCIAL IMPACTS

Using the inputs and scenarios described in the previous sections, DOE used the GRIM to estimate the financial impacts on the residential dishwasher industry. The MIA uses two key financial metrics: INPV and annual cash flows. The main results of the MIA are reported in this section.

12.5.1 Introduction

The INPV measures the industry value and is used in the MIA to compare the economic impacts of different TSLs in the standards case. The INPV is different from DOE's NPV, which is applied to the U.S. economy. The INPV is specific to the dishwasher manufacturing industry, and is the sum of all net cash flows discounted at the industry's cost of capital. The GRIM for the residential dishwasher industry models cash flows from 2012 to 2047. This timeframe models both the short-term impacts on the industry from the announcement of the standard until the compliance date, and a long-term assessment over the 30-year analysis period immediately thereafter.

In the MIA, DOE compares the INPV of the base case (no amended energy conservation standards) to that of each TSL in the standards case. The difference between the base case and a standards case INPV is an estimate of the economic impacts that implementing that particular TSL would have on the industry. For the residential dishwasher industry, DOE examined the two markup scenarios described above: the flat markup scenario and the preservation of operating profit markup scenario. While INPV is useful for evaluating the long-term effects of amended energy conservation standards, short-term changes in cash flow are also important indicators of the industry's financial situation. For example, a large investment over one or two years could strain the industry's access to capital. Consequently, the sharp drop in financial performance could cause investors to flee, even if recovery is possible. Thus, a short-term disturbance can

have long-term effects that the INPV cannot capture. To get an idea of the behavior of annual net cash flows, Figure 12.5.1 and Figure 12.5.2 below present the annual net or free cash flows from 2012 through 2027 for the base case and each TSL in the standards case.

Annual cash flows are discounted to the base year, 2011. Between 2012 and the 2018 compliance date for TSL 1, TSL 3, and TSL 4 (2013 for TSL 2), cash flows are driven by the level of conversion costs and the proportion of these investments spent every year. After the standard announcement date (*i.e.*, the publication date of the final rule), industry cash flows begin to decline as companies use their financial resources to prepare for the amended energy conservation standard. The more stringent the amended energy conservation standard, the greater the impact on industry cash flows in the years leading up to the compliance date, as product conversion costs lower cash inflows from operations and capital conversion costs increase cash outflows for capital expenditures.

Free cash flow in the year the amended energy conservation standards take effect is driven by two competing factors. In addition to capital and product conversion costs, amended energy conservation standards could create stranded assets, *i.e.*, tooling and equipment that would have enjoyed longer use if the energy conservation standard had not made them obsolete. In this year, manufacturers write down the remaining book value of existing tooling and equipment whose value is affected by the amended energy conservation standard. This one time write down acts as a tax shield that alleviates decreases in cash flow from operations in the year of the write-down. In this year, there is also an increase in working capital that reduces cash flow from operations. A large increase in working capital can be attributed to more costly production components and materials, higher inventory carrying to sell more expensive products, and higher accounts receivable for more expensive products. Depending on these two competing factors, cash flow can either be positively or negatively affected in the year the standard takes effect.

In the years following the compliance date of the standard, the impact on cash flow depends on the operating revenue. More stringent TSLs typically have a positive impact on cash flows relative to the base case under the flat markup scenario because manufacturers are able to earner higher operating profit at each TSL in the standards case, which increases cash flow from operations. There is very little impact on cash flow from operations under the preservation of operating profit scenario because this scenario is calibrated to have the same operating income in the standards case at each TSL as the base case as in the year after the standard takes effect. In this scenario production costs increase, but operating profit remains approximately equal to the base case, effectively decreasing profit margins as a percentage of revenue.

12.5.2 Residential Dishwasher Industry Financial Impacts

Table 12.5.1 and Table 12.5.2 provide the INPV estimates for the residential dishwashers. Figure 12.5.1 and Figure 12.5.2 present the annual net cash flows for residential dishwashers for each of the different markup scenarios.

Table 12.5.1 Manufacturer Impact Analysis for Residential Dishwashers – Flat Markup Scenario

		Base Case	Trial Standard Level			
			1	2	3	4
INPV	*(2010$ millions)*	637.5	593.2	563.6	508.6	491.9
Change in INPV	*(2010$ millions)*	-	(44.3)	(73.9)	(128.9)	(145.6)
	(%)	-	(7.0%)	(11.6%)	(20.2%)	(22.8%)

*For tables in section 12.5, values in parenthesis indicate negative numbers

Table 12.5.2 Manufacturer Impact Analysis for Residential Dishwashers – Preservation of Operating Profit Markup Scenario

		Base Case	Trial Standard Level			
			1	2	3	4
INPV	*(2010$ millions)*	637.5	592.2	552.9	463.1	434.8
Change in INPV	*(2010$ millions)*	-	(45.3)	(84.6)	(174.4)	(202.7)
	(%)	-	(7.1%)	(13.3%)	(27.4%)	(31.8%)

*For tables in section 12.5, values in parenthesis indicate negative numbers

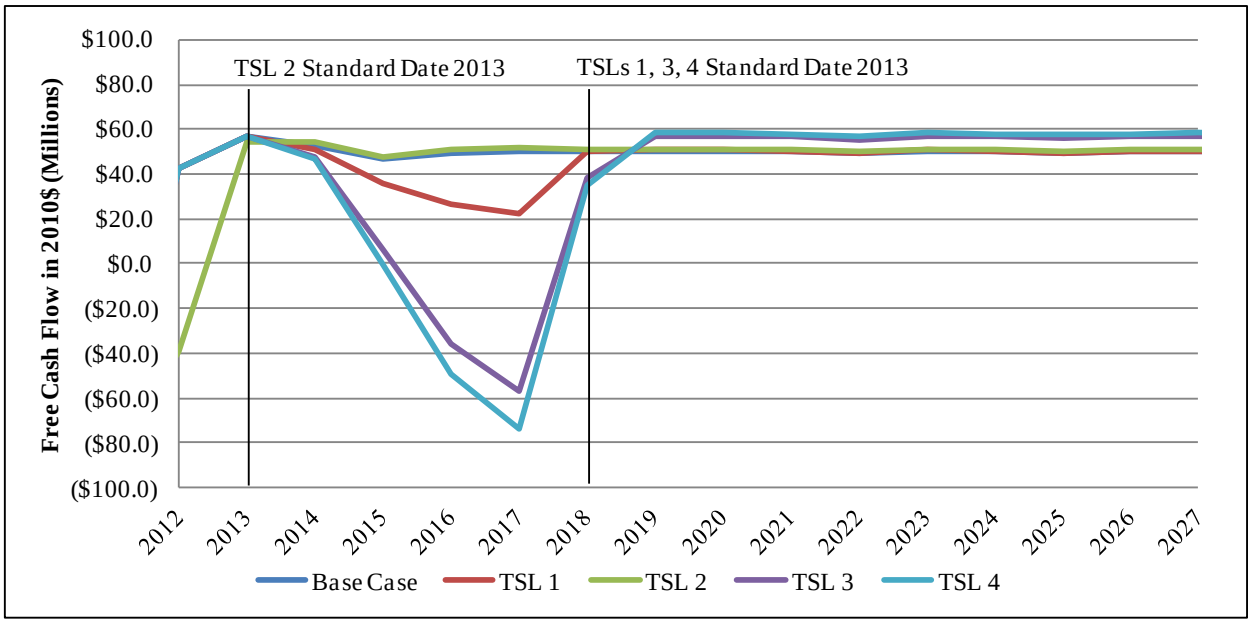

Figure 12.5.1 Annual Industry Net Cash Flows for Residential Dishwashers (Flat Markup Scenario)

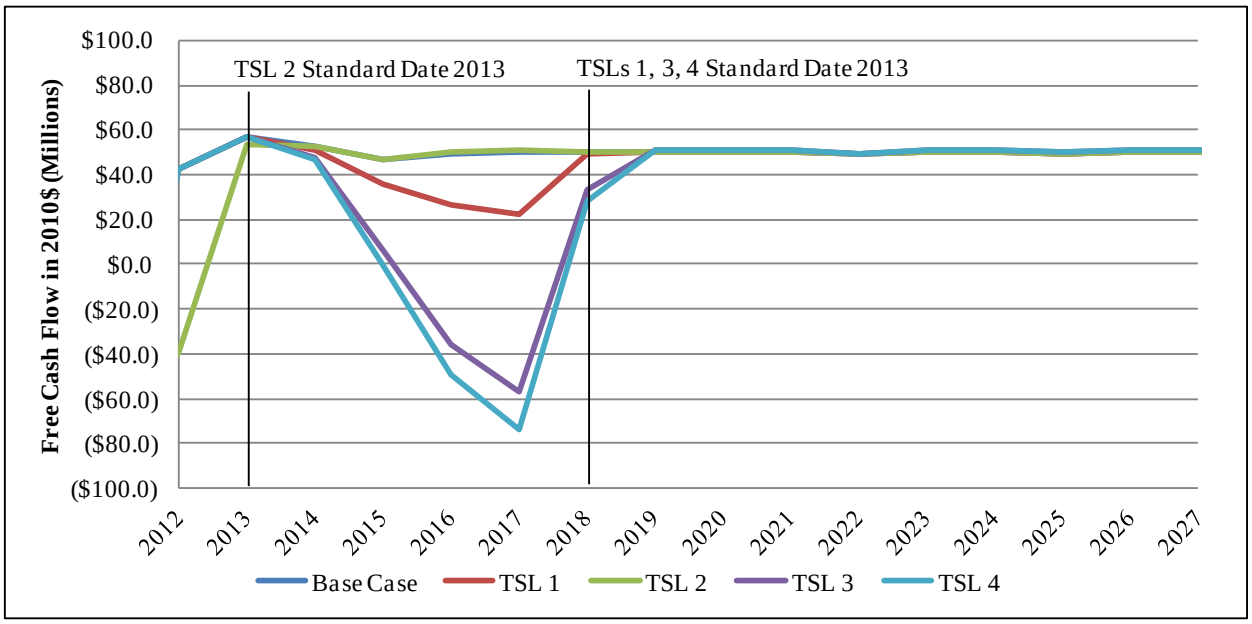

Figure 12.5.2 Annual Industry Net Cash Flows for Residential Dishwashers (Preservation of Operating Profit Markup Scenario)

12.6 IMPACTS ON SMALL RESIDENTIAL DISHWASHER MANUFACTURERS

To estimate the number of small businesses which could be impacted by the amended energy conservation standards, DOE conducted a market survey using all available public information to identify potential small manufacturers. DOE's research included the AHAM membership directory, product databases (CEE, CEC, and ENERGY STAR databases) and individual company websites to find potential small business manufacturers. DOE also asked interested parties and industry representatives if they were aware of any other small business manufacturers during manufacturer interviews and at previous DOE public meetings. DOE reviewed all publicly available data and contacted various companies, as necessary, to determine whether they met the SBA's definition of a small business manufacturer of covered residential dishwashers. DOE screened out companies that did not offer products covered by this rulemaking, did not meet the definition of a "small business," or are foreign owned and operated.

Almost half of residential dishwashers are currently manufactured in the United States by one corporation that accounts for approximately 49 percent of the total market. Together, this manufacturer and 3 other manufacturers that do not meet the definition of a small business manufacturer comprise 99 percent of the residential dishwasher market. The small portion of the remaining residential dishwasher market (approximately 57,000 shipments) is supplied by a combination of approximately 15 international and domestic companies, all of which have small market shares. These companies are either foreign owned and operated or exceed the SBA's employment threshold for consideration as a small business under the appropriate NAICS code. As such, DOE did not identify any small business manufacturers of dishwashers.

Based on the discussion above, DOE certifies that the standards for residential dishwashers set forth in today's rule would not have a significant economic impact on a substantial number of small entities. Accordingly, DOE has not prepared a regulatory flexibility analysis for this rulemaking. DOE will transmit this certification to the SBA as required by 5 U.S.C. 605(b).

12.7 OTHER IMPACTS

12.7.1 Employment

For residential dishwashers, DOE used the GRIM to estimate the domestic labor expenditures and number of domestic production workers in the base case and at each TSL from 2012 to 2047. DOE used the labor content of each product and the manufacturing production costs from the engineering analysis to estimate the total annual labor expenditures associated with residential dishwashers sold in the United States. Using statistical data from the most recent U.S. Census Bureau's 2009 *Annual Survey of Manufactures* (*ASM*), and interviews with manufacturers, DOE estimates that 95 percent of residential dishwashers sold in the United States are manufactured domestically and hence that portion of total labor expenditures is attributable to domestic labor. Labor expenditures for the manufacture of a product are a function of the labor intensity of the product, the sales volume, and an assumption that wages in real terms remain constant.

Using the GRIM, DOE forecasts the domestic labor expenditure for residential dishwasher production labor in 2018 will be approximately $248.7 million. Using the $27.03 hourly wage rate including fringe benefits and 2,003 production hours per year per employee found in the 2009 *ASM*, DOE estimates there will be approximately 4,593 domestic production workers involved in manufacturing residential dishwashers in 2018, the year in which amended standards would go into effect for TSL 1, TSL 3, and TSL 4. In addition, DOE estimates that 1,120 non-production employees in the United States will support residential dishwasher production.[e] The employment spreadsheet of the residential dishwasher GRIM shows the annual domestic employment impacts in further detail.

---

[e] As defined in the 2009 *ASM*, production workers number include "workers (up through the line-supervisor level) engaged in fabricating, processing, assembling, inspecting, receiving, storing, handling, packing, warehousing, shipping (but not delivering), maintenance, repair, janitorial and guard services, product development, auxiliary production for plant's own use (*e.g.*, power plant), recordkeeping, and other services closely associated with these production operations at the establishment covered by the report. Employees above the working-supervisor level are excluded from this item." Non-production workers are defined as "employees of the manufacturing establishment including those engaged in factory supervision above the line-supervisor level. It includes sales (including driver-salespersons), sales delivery (highway truck drivers and their helpers), advertising, credit, collection, installation and servicing of own products, clerical and routine office functions, executive, purchasing, financing, legal, personnel (including cafeteria, medical, etc.), professional, and technical employees. Also included are employees on the payroll of the manufacturing establishment engaged in the construction of major additions or alterations utilized as a separate work force."

The production worker estimates in this section only cover workers up to the line-supervisor level who are directly involved in fabricating and assembling a product within an Original Equipment Manufacturer (OEM) facility. Workers performing services that are closely associated with production operations, such as material handling with a forklift, are also included as production labor. DOE's estimates account only for production workers who manufacture the specific products covered by this rulemaking.

Table 12.7.1 depicts the potential levels of production employment that could result following amended energy conservation standards as calculated by the GRIM. This potential increase reflects the scenario in which manufacturers continue to produce the same scope of covered products in domestic facilities and domestic production is not shifted to lower-labor-cost countries. If all existing production were moved outside of the United States, the expected impact to domestic manufacturing employment would be a loss of 4,593 jobs, the equivalent of the total base case employment. Because there is a risk of manufacturers evaluating sourcing decisions in response to amended energy conservation standards, the expected impact to domestic production employment falls between the potential increases as shown in Table 12.7.1, and the levels of job loss associated with the total collapse of the domestic dishwasher manufacturing industry. The discussion below includes a qualitative evaluation of the likelihood of negative domestic production employment impacts at the various TSLs. Table 12.7.1 illustrates the potential impacts of amended energy conservation standards on domestic production employment levels at each TSL for the residential dishwasher market.

Table 12.7.1 Total Domestic Residential Dishwasher Production Workers in 2018*

	Trial Standard Level				
	Base Case	1	2	3	4
Total Number of Domestic Production Workers in 2018 (without changes in production location)	4,593	4,601	4,679	4,658	4,799

* The compliance date for residential dishwashers at TSL 1, TSL 3, and TSL 4 is 2018. At TSL 2, the compliance date is 2013 as specified by the Joint Petition.

Figure 12.7.1 below shows total annual domestic employment levels for each TSL as calculated by the GRIM.

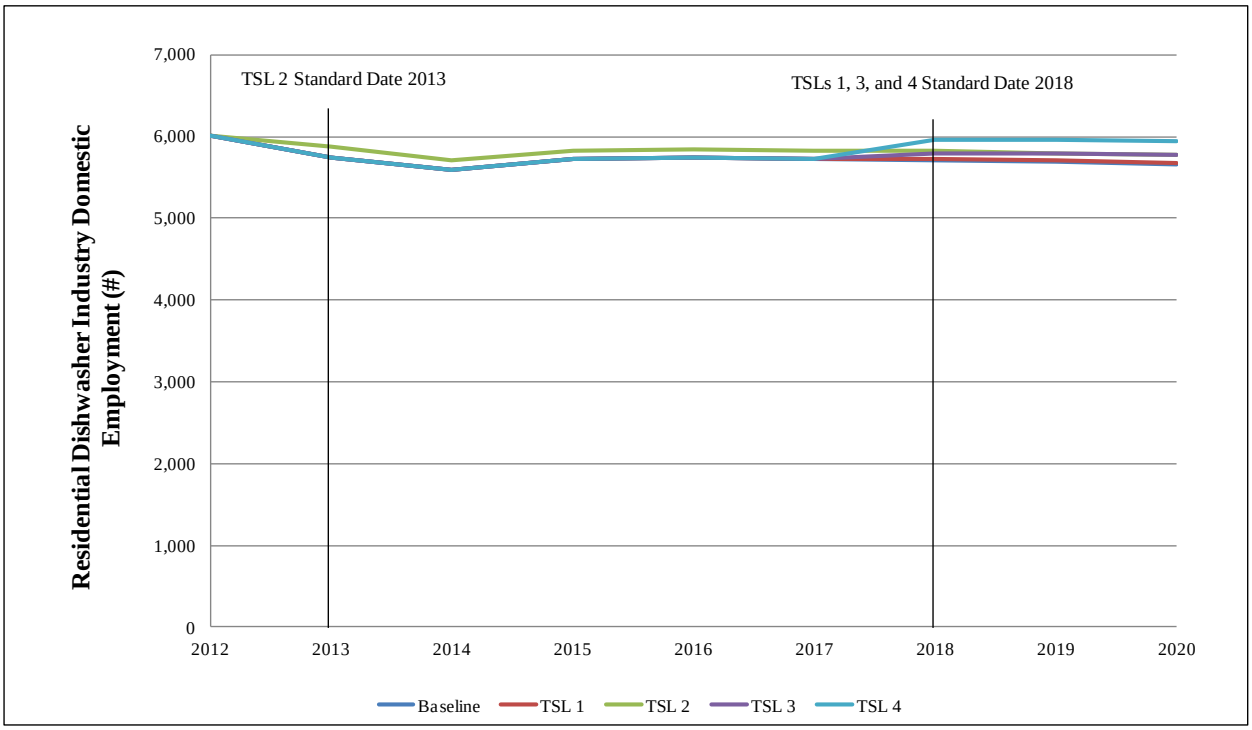

Figure 12.7.1 Total Residential Dishwasher Industry Domestic Employment by Year

All examined TSLs show relatively minor impacts on domestic employment levels relative to total industry employment. At all TSLs, most of the design options analyzed by DOE do not greatly alter the labor content of the final product. For example, longer or more complex wash cycles or improved sump designs involve one-time changes to the final product, but do not significantly change the number of steps required for the final assembly of the dishwasher (which would add labor). Because many manufacturers have recently introduced high efficiency products in the United States that meet or exceed the standards in today's final rule, it is unlikely today's direct final rule would greatly impact the sourcing decisions of these manufacturers. However, at higher TSLs, some of the design options analyzed greatly impact the ability of manufacturers to make product changes within existing platforms. The very large upfront capital costs at these levels could influence the decision of some manufacturers to relocate some or all of the domestic production of these dishwashers to lower labor cost countries.

12.7.2 Production Capacity

Nearly 64 percent of shipments of residential dishwashers already comply with the amended energy conservation standards as agreed upon in the Joint Petition and specified in this rulemaking. Further, every manufacturer that sells standard dishwashers offers products that meet this standard. Since manufacturers would only need to make minor platform changes and or increase the production of existing products by the 2013 compliance date specified by the Joint Petition, the industry would be able to meet the amended energy conservation standards proposed in the Joint Petition without any significant impact to manufacturing capacity.

12.7.3 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. Regulatory burdens can prompt companies to exit the market or reduce their product offerings, potentially reducing competition. Smaller companies in particular can be affected by regulatory costs since these companies have lower sales volumes over which they can amortize the costs of meeting new regulations. Assessing the impact of a single regulation may overlook this cumulative regulatory burden. A proposed standard is not economically justified if it contributes to an unacceptable level of cumulative regulatory burden.

For the cumulative regulatory burden analysis, DOE looks at other significant product-specific regulations that will take effect 3 years before or after the compliance date of the amended energy conservation standards for residential dishwashers.[f] In addition to amended energy conservation regulations, several other Federal regulations apply to residential dishwashers. While this analysis focuses on the impacts on manufacturers born of other Federal requirements, DOE also has described a number of other non-Federal regulations in section 12.7.3.2 because it recognizes that these regulations also impact the products covered by this rulemaking.

12.7.3.1 DOE Regulations for Other Products Produced by Residential Dishwasher Manufacturers

Companies that produce a wide range of regulated products may face more capital and product development expenditures than competitors with a narrower scope of products. Many manufacturers of residential dishwashers also produce other appliances. In addition to the amended energy conservation standards for residential dishwashers, these manufacturers contend with several other Federal regulations and pending regulations that apply to other products. DOE recognizes that each regulation can significantly affect a manufacturer's financial operations. Multiple regulations affecting the same manufacturer can quickly strain manufacturers' profits and possibly cause an exit from the market. Table 12.7.2 lists the other DOE energy conservation standards that could also affect manufacturers of residential dishwashers in the 3 years leading up to and after the compliance date of amended energy conservation standards for these products.

[f] The compliance date for residential dishwashers at TSL 1, TSL 3, and TSL 4 is 2018. At TSL 2, the compliance date is 2013 as specified by the Joint Petition.

Table 12.7.2 Other DOE and Federal Actions Affecting the Residential Dishwasher Industry

Regulation	Approximate Compliance Date*	Number of Impacted Companies from the Market and Technology Assessment (MTA) (See Chapter 3 of the Direct Final Rule TSD)	Estimated Total Industry Conversion Costs
Commercial Distribution Transformers	2010[g]	1	$13.5 (2006$)[h]
Packaged Terminal Air Conditioners and Packaged Terminal Heat Pumps	2012	1	$17.3 million *(2007$)*[i]
Cooking Products	2012	10	$22.6 million *(2006$)*[j]
General Service Fluorescent Lamps and Incandescent Reflector Lamps	2012	1	$363.1 million *(2008$)*[k]
Dehumidifiers	2012	2	N/A†
Commercial Clothes Washers	2013	4	$20.4 million *(2008$)*[l]
Battery Chargers and External Power Supplies	2013*	1	N/A††
Residential Refrigerators and Freezers	2014	11	1,243 million *(2009$)*[m]
ER, BR, and Small Diameter IRLs	2014*	1	N/A††

*The dates listed are an approximation. The exact dates are pending final DOE action.
† 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.
†† For energy conservation standards for rulemakings awaiting DOE final action, DOE does not have a finalized estimated total industry conversion cost.

[g] Standards for commercial distribution transformers with a compliance date of January 1, 2010 were published in October 2007. 72 FR 58190. DOE expects to publish amended standards with a compliance date of 2015.
[h] Estimated industry conversion expenses were published in the TSD for the October 2007 commercial distribution transformer final rule. 72 FR 58190. The TSD can be found at www1.eere.energy.gov/buildings/appliance_standards/commercial/distribution_transformers_fr_tsd.html
[i] 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 can be found at www1.eere.energy.gov/buildings/appliance_standards/commercial/ptacs_pthps_final_tsd.html.
[j] Estimated industry conversion expenses were published in the TSD for the April 2009 residential cooking products final rule. 74 FR 16040. The TSD can be found at www1.eere.energy.gov/buildings/appliance_standards/residential/cooking_products_final_rule_tsd.html.
[k] 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 can be found at www1.eere.energy.gov/buildings/appliance_standards/residential/incandescent_lamps_standards_final_rule_tsd.html.
[l] Estimated industry conversion expenses were published in the TSD for the January 2010 commercial clothes washers final rule. 75 FR 1122. The TSD can be found at www1.eere.energy.gov/buildings/appliance_standards/commercial/clothes_washers_ecs_final_rule_tsd.html
[m] Estimated industry conversion expenses were published in the TSD for the September 2011 refrigerators and freezers final rule. 76 FR 57516. The TSD can be found at www1.eere.energy.gov/buildings/appliance_standards/pdfs/refrig_finalrule_tsd.pdf

Table 12.7.2 (continued) - Other DOE and Federal Actions Affecting the Residential Dishwasher Industry

Regulation	Approximate Compliance Date*	Number of Impacted Companies from the Market and Technology Assessment	Estimated Total Industry Conversion Costs
Room Air Conditioners	2014	3	171 million *(2009$)*[n]
Residential Clothes Dryers	2014	9	95 million *(2009$)*[o]
Fluorescent Lamp Ballasts	2014*	1	N/A††
Microwave Ovens	2014*	2	N/A††
Residential Water Heaters	2015	2	$95.9 million *(2009$)*[p]
Metal Halide Lamp Fixtures	2015*	1	N/A††
Residential Clothes Washers	2015*	10	N/A††
Commercial Electric Motors	2015*	1	N/A††
Commercial Distribution Transformers	2015*	1	N/A††
Commercial Refrigeration Equipment	2016*	1	N/A††

*The dates listed are an approximation. The exact dates are pending final DOE action.
† 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.
†† For energy conservation standards for rulemakings awaiting DOE final action, DOE does not have a finalized estimated total industry conversion cost.

Some Federal DOE regulations have a more significant impact on manufacturers of residential dishwashers than others because manufacturers hold a significant market share in those covered products. Where market share and company financial data is available, DOE attempts to quantify the cumulative regulatory burden as measured by the fraction of corporate revenues that are derived from the manufacture of products covered by other standards rulemakings.

Table 12.7.3 below shows the DOE energy conservation standards with compliance dates within 3 years of residential dishwashers where manufacturers are expected to be most impacted due to their market positions. For these rulemakings, residential dishwasher manufacturers would likely be burdened by a significant portion of the estimated industry conversion costs.

[n] Estimated industry conversion expenses were published in the TSD for the April 2011 room air conditioners final rule. 76 FR 22454. The TSD can be found at www1.eere.energy.gov/buildings/appliance_standards/residential/residential_clothes_dryers_room_ac_direct_final_rule_tsd.html.
[o] Estimated industry conversion expenses were published in the TSD for the April 2011 residential clothes dryers final rule. 76 FR 22454. The TSD can be found at www1.eere.energy.gov/buildings/appliance_standards/residential/residential_clothes_dryers_room_ac_direct_final_rule_tsd.html.
[p] 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 www1.eere.energy.gov/buildings/appliance_standards/residential/heating_products_fr_tsd.html.

Table 12.7.3 DOE Regulations on Products For Which Residential Dishwasher Manufacturers Hold Significant Market Share

		GE		Whirlpool		Electrolux		BSH	
	Revenue *($MM)*	$150,211		$18,366		$16,492		$12,031	
	Industry Sales *($MM)*	**Market share**	**% of Revenue**	**Market share**	**% of Revenue**	**Market share**	**% of Revenue**	**Market share**	**% of Revenue**
Refrigerators and Freezers	$10,310	22%	1.5%	24%	13.5%	23%	14.4%		
Residential Clothes Dryers	$2,486	14%	0.2%	71%	9.6%	7%	1.1%		
Room Air Conditioners	$1,050			13%	0.7%	13%	0.8%		
Residential Clothes Washers	$3,373	16%	0.4%	64%	11.8%	6%	1.2%		
Dishwashers	$2,106	27%	0.4%	49%	5.6%	18%	2.3%	5%	0.9%
Cooking Products	$4,491	44%	1.3%			15%	4.1%		
Dehumidifiers	$199			35%	0.4%	6%	0.1%		
Microwave Ovens	$1,377			4%	0.3%				
Totals			3.8%		41.9%		23.9%		0.9%

Where specific market share data was not available, DOE identified manufacturers of other products covered by additional efficiency standards as shown in Table 12.7.4.

Table 12.7.4 Other Covered Products

Manufacturer	Other Covered Products Manufactured
AM Appliance Group / Asko	Commercial clothes washers, residential clothes dryers, residential; clothes washers
Equator	Residential refrigerators and freezers, residential clothes dryers, residential clothes washers
Fagor	Cooking products, residential refrigerators and freezers, residential clothes dryers, residential clothes washers
Fisher & Paykel	Cooking products, residential clothes dryers, residential clothes washers
Haier	Cooking products, residential clothes dryers, room air conditioner, residential clothes washers
Indesit	Cooking products, residential refrigerators and freezers, residential clothes dryers, residential clothes washers
Miele	Cooking products, residential refrigerators and freezers, residential clothes dryers, residential clothes washers
Summit	Residential refrigerators and freezers, residential clothes dryers, commercial refrigeration equipment, residential clothes washers
Viking	Residential refrigerators and freezers, cooking products. microwave ovens, commercial refrigeration equipment, residential clothes washers

12.7.3.2 Other Regulations That Could Impact Residential Dishwasher Manufacturers

While the cumulative regulatory burden focuses on the impacts on manufacturers of other Federal requirements, in this section DOE has described a number of other regulations below that could also impact the residential dishwashers covered by this rulemaking.

State Energy Conservation Standards

Manufacturers indicated that California has several programs that are either already in place or are currently in development that affect manufacturers of residential dishwashers. Various building, electrical, mechanical, and plumbing codes in California affect dishwashers, and products are also subject to California's laws on the Restriction on the use of certain Hazardous Substances (RoHS). California's RoHS law took effect January 1, 2007 and was modeled after the European Union's (EU's) directive (described below), which bans certain hazardous substances from electrical and electronic equipment.

International Energy Conservation Standards

Residential dishwasher manufacturers that sell products outside of the United States are subject to several international energy conservation standards. In the EU, products are also subject to RoHS. This regulation bans the sale of new equipment in the EU that contains quantities in excess of agreed upon levels for lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyl (PBB) and PBDE flame retardants. Waste Electrical and Electronic Equipment (WEEE) and the Registration, Evaluation, Authorization, and restriction of Chemicals (REACH) are additional regulations that create compliance costs for manufacturers that compete in Europe. REACH deals with chemicals and their safe use and has provisions that will be phased-in over 11 years, beginning June 1, 2007. The EU also sets limits for the amount of energy consumed by equipment when it is in standby mode and off mode. Additionally, HFCs are banned in refrigerants in several countries, such as Austria, Denmark, and Switzerland. Canada and several other foreign countries have regulations or have initiated regulations affecting dishwasher manufacturers.

12.8 CONCLUSION

The following sections summarize the different impacts for the scenarios DOE believes are most likely to capture the range of impacts on residential dishwasher manufacturers at each TSL in the standards case. While these scenarios bound the range of the most plausible impacts on manufacturers, some circumstances could cause manufacturers to experience impacts outside this range.

12.8.1 Residential Dishwashers

At TSL 1, DOE estimates impacts on INPV to range from -$44.3 million to -$45.3 million, or a change in INPV of -7.0 percent to -7.1 percent. At this level, industry free cash flow is estimated to decrease by approximately 56.5 percent to $21.9 million, compared to the base-case value of $50.5 million in the year leading up to the amended energy conservation standards. As TSL 1 corresponds to current ENERGY STAR standards, and these products represent over 96 percent of shipments in the year leading up to amended standards, only a very small fraction of the market is affected at this efficiency level. In either markup scenario, the impact to INPV at TSL 1 stems from the conversion costs required to switch production lines from manufacturing baseline units to those meeting the standards set at EL 1 for both product classes.

As a large fraction of the energy used in dishwashing is associated with heating the wash water, the design options proposed to meet this efficiency level relate primarily to minimizing the amount of wash water through spray-arm optimization and enabling greater control over the wash water temperature. Both of these practices are in common use in higher efficiency platforms across the industry and contribute to an MPC of $209.25 for standard dishwashers. Because the industry already produces a substantial number of products at this efficiency level, product and capital conversion costs are limited to 73.2 million, which accounts for switching production lines from baseline products to existing higher efficiency platforms.

TSL 2 represents the efficiency level agreed upon in the Joint Petition, and establishes a compliance date of 2013 as compared to all other TSLs which require product compliance to amended standards by 2018. At TSL 2, DOE estimates impacts on INPV to range from -$73.9 million to -$84.6 million, or a change in INPV of -11.6 percent to -13.3 percent. At this level, industry free cash flow is estimated to decrease by approximately 192.2 percent to -$39.2 million, compared to the base-case value of $42.5 million in the year leading up to the amended energy conservation standards. As with TSL 1, the impact to INPV at TSL 2 stems from the conversion costs required to switch production lines from manufacturing baseline units to those meeting the standards set at EL 2 for both product classes. However, at TSL 2, these impacts grow as the number of products requiring changes grows nearly ten-fold from 3.8 percent of shipments in the year leading up to amended standards to 36.1 percent.

As a large fraction of the energy used in dishwashing is associated with heating wash water, the design options proposed to meet this efficiency level relate primarily to minimizing the amount of wash water through additional optimization of the water lines as well as upgrades to higher efficiency pumps and electronic controls. Incorporating these design options leads to an estimated MPC of $222.80 for standard products. While a significant fraction of dishwashers currently employ these energy and water saving measures, the product and capital conversion costs rise to $94.0 million (as compared to $73.2 million for TSL 1), to account for the additional switching of production lines to higher efficiency platforms.

At TSL 3, DOE estimates impacts on INPV to range from -$128.9 million to -$174.4 million, or a change in INPV of -20.2 percent to -27.4 percent. At this level, industry free cash flow is estimated to decrease by approximately 212.6 percent to -$56.8 million, compared to the base-case value of $50.5 million in the year leading up to the amended energy conservation standards. While TSL 3 returns the compliance date to 2018 (5 years after that at TSL 2) the impact to INPV is more severe as less than 20 percent of shipments in the year leading up to amended standards meet or exceed this efficiency level. As such, the capital and product conversion costs required to bring these products into compliance rise significantly to a total of $261.9 million, $167.9 million more than at TSL 2. These conversion costs stem from both the research programs needed to develop such optimized products, and the capital investment required to change over the majority of production lines to produce these high efficiency products.

The design options proposed to meet efficiency standards at TSL 3 include swapping a heated drying system in favor of a condensation drying system, further optimization of the hydraulic system extending to a redesign of both the sump and water lines, as well as the

incorporation of a flow meter, temperature control, and humidity sensor to finely tune water consumption, temperature, and the drying cycle. Beyond component swaps alone, the design options proposed at TSL 3 extend to include control strategies that would reduce the wash and rinse water temperatures. The component changes required to enable these improvements contribute to an MPC of $266.16 for standard dishwashers, $43.37 above that at TSL 2.

At TSL 4, DOE estimates impacts on INPV to range from -$145.6 million to -$202.7 million, or a change in INPV of -22.8 percent to -31.8 percent. At this level, industry free cash flow is estimated to decrease by approximately -246.0 percent to -$73.7 million, compared to the base-case value of $50.5 million in the year leading up to the amended energy conservation standards. TSL 4 represents the max-tech efficiency level for all dishwashers. The effects on INPV result from similar sources as TSL 3, however the fraction of products in the market that currently meet this standard shrinks to less than 9 percent in the year leading up to amended standards. As such, standards will affect nearly all platforms and will result in substantial capital conversion costs associated with improvements to nearly all production facilities. Because so few products exist at this level today, nearly all manufacturers will face clean sheet redesigns for products that meet this standard. Accordingly, the product conversion costs grow to reflect this substantial research effort. The total conversion cost required to meet standards at TSL 5 is approximately $303.0 million—a $41.1 million increase from TSL 4.

The design options proposed to meet the efficiency levels specified at TSL 4 start with those at TSL 3, but replace the in-line flow-through water heater with one that is integrated with the pump and eliminates the fan used to circulate air during drying. Where these design options have little impact on the product MPC, contributing to only a $7.77 increase over that at TSL 3, they significantly impact INPV because of the large conversion costs associated with developing and producing these highly optimized products.

REFERENCES

1 Association of Home Appliance Manufacturers. *Current Members*. Last accessed October 2, 2011. Available online at: www.aham.org/ht/d/Organizations/divisions/Y/pid/2344.

2 Consortium of Energy Efficiency. *Dishwasher Qualifying Products List*. Last accessed October 2011. Available online at: www.cee1.org/resid/seha/dishw/dishw-main.php3

3 California Energy Commission. *Appliance Efficiency Database*. Last accessed October 2011. Available online at: www.appliances.energy.ca.gov/QuickSearch.aspx

4 ENERGY STAR. *Qualified Dishwashers*. Last accessed October 2011. Available online at : www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=DW.

5 McKinsey & Company, Inc. *Valuation: Measuring and Managing the Value of Companies*, 3rd Edition, Copeland, Koller, Murrin. New York: John Wiley & Sons, 2000.