CHAPTER 13. MANUFACTURER IMPACT ANALYSIS

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 13. MANUFACTURER IMPACT ANALYSIS

13.1 INTRODUCTION

In determining whether a standard is economically justified, the Secretary of Energy is required to consider "the economic impact of the standard on the manufacturers and on the consumers of the equipment subject to such a standard."[a] The legislation also calls for an assessment of the impact of any lessening of competition as determined in writing by the Attorney General. The U.S. Department of Energy (DOE) conducted a manufacturer impact analysis (MIA) to estimate the financial impact of higher efficiency standards on manufacturers of commercial refrigeration equipment (CRE) and to assess the impact of such standards on employment and manufacturing capacity. The MIA has both quantitative and qualitative aspects.

The quantitative portion of the MIA primarily relies on the Government Regulatory Impact Model (GRIM), an industry cash-flow model adapted for this rulemaking. GRIM inputs are industry cost structure, shipments, and pricing strategies. The GRIM's key output is industry net present value (INPV). The model estimates the financial impact of higher efficiency standards by comparing changes in INPV between a base case and various trial standard levels (TSLs).

The qualitative portion of the MIA addresses factors such as equipment characteristics, characteristics of particular firms, and market and equipment trends, and includes an assessment of the impacts of standards on sub-groups of manufacturers.

13.2 METHODOLOGY

DOE conducted the MIA in three phases. Phase I, Industry Profile, consisted of the preparation of an industry characterization including data on market share, sales volumes and trends, pricing, employment, and financial structure. Phase II, Industry Cash-Flow Analysis and Interview Guide, focused on the industry as a whole. In this phase, DOE used the GRIM to prepare an industry cash-flow analysis. For the quantitative portion of the MIA analysis, DOE analyzed the same 15 product classes used in the national impact analysis (NIA) and the life-cycle cost (LCC) analysis. Because these 15 product classes represent 98 percent of covered equipment, the reported results are representative of the entire CRE industry. In this phase DOE also used publicly available information developed in Phase I to adapt the GRIM's structure to facilitate analysis of new CRE standards. In Phase III, Sub-Group Impact Analysis, DOE conducted interviews with several manufacturers comprising over 90 percent of the CRE industry. During these interviews, DOE discussed financial topics specific to each company 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 a new standard on manufacturer cash flows, manufacturing capacities, and employment levels. The following subsections describe more specifically the steps DOE took in developing information for the MIA.

---

[a] DOE's standards program for commercial equipment is conducted under Title III, Part C of the Energy Policy and Conservation Act (EPCA), 42 U.S.C. 6311-6317.

13.2.1 Phase I: Industry Profile

In Phase I of the MIA, DOE prepared a profile of the CRE industry that built on the market and technology assessments prepared for this rulemaking (Chapter 3 of this TSD). Before initiating the detailed impact studies, DOE collected information on the past and present structure and market characteristics of the CRE industry. This included estimated market shares of CRE manufacturers, corporate operating ratios, wages, employment, and production cost ratios. The industry profile included a top-down cost analysis of the CRE manufacturing industry that DOE used to derive cost and financial inputs for the GRIM (*e.g.*, revenues; material; labor; overhead; depreciation; sales, general, and administration expenses (SG&A); and research and development (R&D) expenses). DOE used additional sources of information to further calibrate its characterization of the industry, including company Securities and Exchange Commission (SEC) 10–K reports, Standard & Poor's (S&P) stock reports, and corporate annual reports. DOE also relied on information from its engineering analysis, LCC analysis, NIA, and analysis of markups to characterize the CRE manufacturing industry.

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

In Phase II, DOE performed a preliminary industry cash-flow analysis and prepared written guidelines for interviewing manufacturers.

13.2.2.1 Industry Cash-Flow Analysis

The industry cash-flow analysis focused on the financial impacts of new standards on the CRE industry as a whole. New energy conservation standards can affect CRE manufacturers in three distinct ways: (1) require additional investment, (2) raise production costs, and (3) affect revenues through variations in prices and shipments. The analytical tool DOE uses for calculating the financial impacts of new energy conservation standards on manufacturers is the GRIM. DOE performed a cash-flow analysis using the GRIM on the CRE industry to quantify these impacts.

13.2.2.2 Interview Guide

During Phase III of the MIA, DOE conducted interviews with manufacturers to gather information on the effects of new energy conservation standards on revenues and finances, direct employment, capital assets, and industry competitiveness. Before the interviews, DOE distributed an interview guide to help identify the impacts of new energy conservation standards on individual manufacturers or sub-groups of manufacturers. Manufacturers received the guide before the interviews to allow them to prepare their responses in advance. The interview guide led interviewers through a series of questions on current organizational characteristics, industry infrastructure, manufacturer cash flow, competitive impacts, employment impacts, and manufacturing capacity impacts. The interview guide used to conduct the manufacturer interviews is found in Appendix J of this TSD.

13.2.3 Phase III: Sub-Group Impact Analysis

Many of the same companies that participated in the MIA interviews also participated in interviews for the engineering analysis. However, the MIA interviews broadened the discussion from primarily technology-related issues to business-related topics. The objectives were to obtain feedback from industry on the GRIM's assumptions and to isolate key issues and concerns. DOE defined two distinctive sub-groups that could be affected by the new energy conservation standards: major manufacturers and small businesses. The following sections summarize the methodology and findings of this assessment.

13.2.3.1 Manufacturer Interviews

DOE supplemented the information gathered in Phase I and the cash-flow analysis performed in Phase II with information gathered during interviews with manufacturers during Phase III. The interview process has a key role in the manufacturer impact analyses 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 contacted companies from its database of manufacturers, which provided names of manufacturers across the CRE industry. DOE interviewed small and large companies, subsidiaries and independent firms, public and private corporations, and Air-Conditioning and Refrigeration Institute (ARI) and non-ARI members. DOE scheduled interviews 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 prefers interactive interviews because they help clarify responses and provide the opportunity to identify additional issues.

DOE conducted detailed interviews with all manufacturers, who agreed to participate to gain insight into the range of potential impacts and how these impacts vary with each TSL. During the interviews, DOE solicited information on the possible impacts of energy conservation standards on sales, direct employment, capital assets, and industry competitiveness. Both qualitative and quantitative information are valuable to the interview process. DOE then used the information gathered during manufacturer interviews to tailor the GRIM to incorporate unique financial characteristics from each equipment class.

13.2.3.2 Revised Industry Cash-Flow Analysis

In Phase II of the MIA, DOE provided manufacturers with preliminary financial input figures from the GRIM for review and evaluation. During the interviews, DOE requested comments on the values DOE selected for the parameters. Upon completion of the interviews, DOE revised its industry cash-flow model where applicable.

13.2.3.3 Manufacturer Sub-Group Analysis

Using average cost assumptions to develop an industry cash-flow estimate is not adequate for assessing differential impacts among sub-groups of manufacturers. Smaller manufacturers, niche players, or 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 interviews, DOE discussed the potential sub-groups and sub-group members identified for the analysis. DOE looked to the manufacturers and other stakeholders to suggest what sub-groups or characteristics are most appropriate for the analysis.

13.2.3.4 Small-Business Manufacturer Sub-Group

DOE used the small business size standards published on January 31, 1996, as amended, by the Small Business Administration (SBA) to determine whether any small entities would be required to comply with the rule. 61 FR 3286 and codified at 13 CFR Part 121. The North American Industry Classification System (NAICS) code lists the size standards for various industries. CRE manufacturing is classified under NAICS 333415 (air conditioning, forced air heating, and refrigeration equipment manufacturing). To be categorized as a small business, a CRE manufacturer and its affiliates may employ a maximum of 750 employees.

DOE reviewed ARI's listing of CRE members and surveyed the industry to develop a list of every manufacturer. DOE also asked stakeholders and ARI representatives within the CRE industry if they were aware of other small business manufacturers. DOE then examined publicly available data and contacted manufacturers, when needed, to determine if they meet the SBA's definition of a small business manufacturer and if their manufacturing facilities are located in the United States. Based on this analysis, DOE estimates that there are nine small CRE manufacturers. DOE contacted all nine small business manufacturers to request interviews. Out of the nine possible small business manufacturers identified, two agreed to be interviewed. DOE conducted on-site interviews with the two manufacturers to determine if the standards could result in differential impacts on these companies.

DOE found that small business manufacturers generally have the same concerns as large manufacturers regarding energy conservation standards. DOE also found no significant differences in the R&D emphasis or marketing strategies between small and large manufacturers. Therefore, DOE believes the GRIM analysis, which models each equipment class separately and aggregates the results to produce an industry-wide impact, is representative of the small business manufacturers that would be affected by standards.

13.2.3.5 Manufacturing Capacity Impact

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

13.2.3.6 Employment Impact

The impact of new energy conservation standards on employment is an important consideration in the rulemaking process. To assess how domestic employment patterns might be affected, DOE used the GRIM to calculate employment impacts at each TSL. During interviews, DOE explored current employment trends in the CRE industry. In addition, DOE solicited manufacture 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 new energy conservation standards, and differences in workforce skills and issues related to employee retraining.

13.2.3.7 Cumulative Regulatory Burden

DOE seeks to mitigate the overlapping effects on manufacturers of new energy conservation standards and other regulatory actions affecting the same equipment. DOE analyzed and considered the impact on manufacturers of multiple equipment-specific regulatory actions.

Based on its own research and discussions with manufacturers, DOE identified several regulations relevant to CRE, including the hydrochlorofluorocarbon (HCFC) phaseout, foam insulation blowing agent phaseout and standards for other equipment made by CRE manufacturers.

13.3 MANUFACTURING IMPACT ANALYSIS KEY ISSUES

The first question each of the MIA interview guides asks is the following: "What are the key issues for your company regarding energy conservation standards for commercial refrigeration equipment and this rulemaking?" This open question initiated dialogue with manufacturers, prompting them to identify key points that DOE could explore during the interview. This section describes the issues that the manufacturers raised most often[b].

- *Meeting Standards*—Manufacturers expressed concern that they would have difficulty meeting certain efficiency levels for some equipment classes. First, some manufacturers stated that they could not meet or would have extreme difficulty meeting the efficiency levels for self-contained equipment (*e.g.*, horizontal open units). One manufacturer stated the small number of parts in self-contained equipment limits the potential opportunities for efficiency improvements. The same manufacturer stated that it already uses the most efficient options available on the market that fall within the company's price range. For some manufacturers, self-contained equipment represents only a small portion of their business. They manufacture more remote condensing equipment and simply convert the design of remote condensing units into self-contained units. Second, some manufacturers stated that they could not meet efficiency levels 3 and 4 for medium-temperature equipment (*e.g.*, SOC.RC.M, VCT.RC.M, VOP.RC.M), and that they would need technological innovation to achieve these levels by 2012. One manufacturer stated that none of the equipment it manufactures in the VOP.RC.M equipment class meets DOE's baseline level.

- *Customer Needs*—Manufacturers are concerned that equipment efficiency improvements will come at the expense of equipment functionality, utility, and customizability. The CRE industry focuses meeting its customers' need to merchandise products, and

[b] Manufacturers indicated that the risks associated with these issues generally increase with increasing TSL.

customers place a higher priority on marketing and displaying their goods than on energy efficiency. Customers demand high levels of customization to differentiate themselves from other retail stores. They do not want to lose any functionality or utility in their equipment, such as display area, that would affect their ability to merchandise products. Often, the customer's desire for easy consumer access requires equipment that is less energy efficient. They also do not want to lose any flexibility in design choices, such as lighting options. For example, some customers specify certain lighting configurations (*e.g.,* color rendering, color temperature, light distribution) to maximize the sale of products like fresh meat, produce, or dairy items. Manufacturers believe that setting standards at the maximum level will affect their customers' ability to merchandise products by limiting the flexibility in choosing design options, which they expect would commoditize the industry and reduce profit margins. Having some allowance in the efficiency thresholds would allow tradeoffs in design options, which would ease the reconciliation of energy savings with the ability to merchandise products.

- *Customer Awareness*—Manufacturers expressed concern that their customers are not sufficiently aware of pending energy conservation standards and the impacts these standards could have on their purchasing decisions. The supermarket industry is a low-margin industry, where much emphasis is placed on low first cost. Manufacturers believe that many customers may not be able to afford more expensive, more efficient equipment since they operate within a fixed budget. Manufacturers stated that customers with a fixed capital budget would tend to extend refurbishment periods and cut back on equipment growth in response to higher equipment prices, both of which will reduce annual CRE sales. Manufacturers expect that smaller stores and even small regional chains will feel significant financial pressure when faced with higher prices for higher efficiency equipment. In fact, single family-owned stores and local stores in large cities may have no capital budget to replace existing cases with cases that are 30-50 percent higher in price. Manufacturers stated that lower sales would reduce employment because labor is proportional to the number of units sold, not the equipment price. Manufacturers also stated that customers have usually been unwilling to adopt energy efficiency improvements unless there is a 12-month payback period or less.

- *Equipment Classes*—Manufacturers expressed concern about how their equipment would be classified according to the equipment classes DOE established. Manufacturers stated that certain low-volume equipment does not easily fit into DOE's equipment classes, and other equipment is excluded from coverage. For example, custom pieces of equipment, especially hybrid or combination units, do not easily fall within the DOE equipment classes since they could be classified in more than one category. A self-contained case with a service-over-counter upper portion and an open lower portion could be classified as a self-contained service-over-counter unit as well as a self-contained open unit. Wedges and transition pieces at the corners of a case lineup have a disproportionate relationship between TDA and energy consumption, and therefore do not have meaningful energy consumption levels when normalized to TDA. Some manufacturers stated that low-volume equipment that cannot meet energy conservation standards may be discontinued, because the cost to increase efficiency will not be worth the benefit gained. Manufacturers also expressed concern about secondary coolant systems, which could provide a loop hole. Manufacturers estimate that secondary coolant systems represent about 10 percent of the market currently and consume about 5 percent more energy than their direct expansion equivalent. Some manufacturers stated that customers might purchase these less-efficient secondary coolant systems instead of the direct expansion equipment that is subject to standards. This concerns manufacturers by defeating the purpose of regulatory action.

- *Component Manufacturers*—Manufacturers expressed concern that they have little control over the options available to them and the price of components used to manufacture commercial refrigeration equipment. CRE manufacturers purchase many of the components needed to build the equipment and rely heavily on component manufacturers to deliver parts such as compressors, coils, doors, motors, fans, and lights. However, CRE manufacturers stated that more-efficient components may not be readily available to meet standards. For self-contained equipment, for example, high-efficiency compressors may not be readily available. Manufacturers stated that the compressors they purchase for commercial refrigeration are left over from the higher volume white goods industry. According to manufacturers, the compressor industry has little or no incentive to invest in improving efficiency due to the lower volume of shipments to the CRE industry. Manufacturers also stated that they have no control over the prices set by their component suppliers. Manufacturers are concerned about the future prices for more-efficient components.

- *Possible Margin Impacts*—Manufacturers expressed concern that standards could impact profitability. Higher efficiency equipment adds pricing pressures because of commoditization of premium equipment and the potential that production cost increases could not be fully passed on to customers. Though different manufacturers stated that they have had different experiences passing through increased material costs, most expressed concern about the potential for lower margins due to higher production costs of higher efficiency equipment.

13.4 GRIM INPUTS AND ASSUMPTIONS

The GRIM serves as the main tool for assessing the impact on the CRE industry due to the imposition of new efficiency standards. DOE relied on several sources to obtain inputs for the GRIM. Data and assumptions from these sources are then fed into an accounting model that details the cash flow on a base case basis, as well as calculates the impacts on manufacturers due to new energy conservation standards.

13.4.1 Overview of the GRIM

The basic structure of the GRIM, illustrated in Figure 13.4.1, is a standard annual cash-flow analysis that uses manufacturer prices, manufacturing costs, shipments, and industry financial information as inputs. The GRIM estimates the effects of regulatory conditions caused by changes in costs, investments, and associated margins. The GRIM spreadsheet uses several inputs to arrive at a series of annual cash flows, beginning with the base year of the analysis, 2007, and continuing to 2042. The model calculates the INPV by summing the stream of annual discounted cash flows during this period.

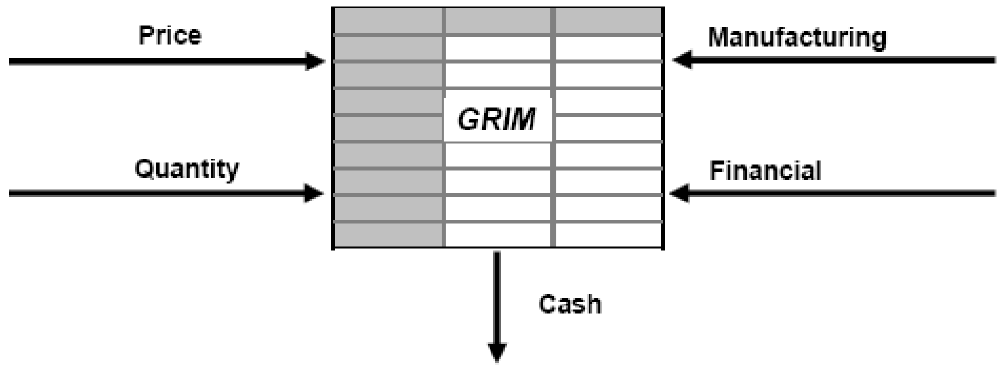

Figure 13.4.1 Using the GRIM to Calculate Cash Flow

The GRIM projected cash flows using standard accounting principles. The model compared changes in INPV between the baseline equipment information (the base-case scenario) and different TSLs (the standards-case scenario). The difference in INPV between the base case and the standards case(s) represents the estimated financial impact of the new energy conservation standard on manufacturers. Appendix J provides more technical details and user information for the GRIM.

13.4.2 Sources of GRIM Inputs

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

13.4.2.1 Corporate Annual Reports

Corporate annual reports to the SEC (SEC 10-Ks) provided many of the financial inputs to the GRIM.[1] These reports exist for publicly held companies and are freely available to the public. The SEC 10-Ks provide consistent financial data for the consolidated corporation but do not provide detailed financial information for the company's CRE lines. Some SEC 10-Ks are therefore more relevant than others to the CRE industry analysis, depending on the prominence that business has in the company's overall operations. In determining financial parameters for the industry, DOE weighted corporate financial information contained in the SEC 10-Ks by each company's market share in the CRE industry to arrive at industry-weighted averages. DOE used corporate annual reports to derive the following GRIM inputs:

- tax rate
- working capital
- SG&A expenses
- research and development (R&D) expenses
- depreciation
- capital expenditures
- 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.

13.4.2.2 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 for the cost of capital calculation.

13.4.2.3 Shipments 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 commercial refrigeration equipment from a study by Freedonia Inc. for the Advanced Notice of Proposed Rulemaking (ANOPR) analysis[2]. However, DOE updated the shipments analysis using ARI aggregated shipments data for the final analysis. Chapter 10 of the TSD is exclusively dedicated to describing the methodology and analytical model DOE used to forecast shipments.

13.4.2.4 Engineering Analysis

During the engineering analysis, DOE used a reverse-engineering methodology supplemented by a design-option approach to develop manufacturing cost estimates for commercial refrigeration equipment. DOE calibrated the reverse-engineering cost model with individual manufacturers' cost data, and aggregated the costs for individual manufacturers to create cost-efficiency curves for the industry. The GRIM manufacturing costs are derived from the engineering analysis curves.

13.4.2.5 Manufacturer Interviews

Key topics discussed during the interviews and reflected in the GRIM include

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

13.4.3 Financial Parameters

For the ANOPR, DOE developed financial estimates of the CRE industry by examining several major CRE manufacturers' financial information from annual reports and SEC 10-K reports. Each company DOE analyzed is a subsidiary of a more diversified parent company that manufactures equipment other than commercial refrigeration equipment. Because the SEC 10-K reports did not provide financial information at the subsidiary level, the financial parameters DOE calculated represented averages of the parent companies applied over the entire range of their equipment offerings; these parameters did not necessarily represent the CRE industry alone.

DOE presented these values to manufacturers during the interviews for comment. While most manufacturers were unable to provide estimates for the CRE industry, they were able to provide their own financial parameters. Using these values, DOE calibrated its original estimates to develop financial parameters that it considers representative of the CRE industry. An aggregation of the MIA interview responses yielded the market-share-weighted financial parameters shown in Table 13.4.1. These aggregated values were the financial parameter inputs DOE used in the GRIM analysis for the final rule.

Table 13.4.1 GRIM Financial Parameters

Parameter	Industry Weighted Average
Tax Rate ***(% of Taxable Income)***	22.1
Working Capital ***(% of Revenues)***	8.6
SG&A ***(% of Revenues)***	13.5
R&D ***(% of Revenues)***	1.9
Depreciation ***(% of Revenues)***	1.1
Capital Expenditures ***(% of Revenues)***	1.2
Net Property, Plant, and Equipment ***(% of Revenues)***	12.1

13.4.4 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 CRE 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.

Risk premium is the difference between the expected return on stocks and the risk-free 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.

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 the manufacturers with public financial information. S&P had bond ratings for most manufacturers, so DOE used these ratings to estimate the manufacturers' cost of debt by adding the relevant spread to the risk-free rate. An S&P bond rating was not available for one manufacturer. In this case, DOE used the company's size and interest coverage ratio to arrive at the spread of corporate debt over risk-free securities. The interest coverage ratio measures a company's ability to service its debt-financing obligation through its earnings.

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 in the GRIM. The risk-free rate is estimated as approximately six 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 manufacturers from 2002 to 2006. 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.

13.4.5 Trial Standard Levels

DOE developed five TSLs that include combinations of energy efficiency levels representing comparable stringency for CRE equipment classes. Table 13.4.2 presents the efficiency levels DOE used in the GRIM. The metric used for remote condensing equipment is calculated daily energy consumption (CDEC) in kWh per day. The metric used for self-contained equipment is total daily energy consumption (TDEC) in kWh per day.

Table 13.4.2 Baseline Efficiency Levels and Trial Standard Levels

Equipment Class	Test Metric	Trial Standard Levels for Primary Equipment Classes Analyzed					
		Baseline	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
VOP.RC.M	*CDEC kWh/day*	1.01 x TDA + 4.07	0.9 x TDA + 4.07	0.87 x TDA + 4.07	0.82 x TDA + 4.07	0.82 x TDA + 4.07	0.74 x TDA + 4.07
VOP.RC.L	*CDEC kWh/day*	2.84 x TDA + 6.85	2.5 x TDA + 6.85	2.38 x TDA + 6.85	2.35 x TDA + 6.85	2.27 x TDA + 6.85	2.27 x TDA + 6.85
VOP.SC.M	*TDEC kWh/day*	2.34 x TDA + 4.71	2.09 x TDA + 4.71	1.92 x TDA + 4.71	1.74 x TDA + 4.71	1.74 x TDA + 4.71	1.65 x TDA + 4.71
VCT.RC.M	*CDEC kWh/day*	0.48 x TDA + 1.95	0.46 x TDA + 1.95	0.43 x TDA + 1.95	0.22 x TDA + 1.95	0.22 x TDA + 1.95	0.22 x TDA + 1.95
VCT.RC.L	*CDEC kWh/day*	1.03 x TDA + 2.61	0.97 x TDA + 2.61	0.68 x TDA + 2.61	0.57 x TDA + 2.61	0.56 x TDA + 2.61	0.56 x TDA + 2.61
VCT.SC.I	*TDEC kWh/day*	1.63 x TDA + 3.29	1.16 x TDA + 3.29	0.77 x TDA + 3.29	0.69 x TDA + 3.29	0.67 x TDA + 3.29	0.67 x TDA + 3.29
VCS.SC.I	*TDEC kWh/day*	0.55 x V + 0.88	0.49 x V + 0.88	0.43 x V + 0.88	0.38 x V + 0.88	0.38 x V + 0.88	0.38 x V + 0.88
SVO.RC.M	*CDEC kWh/day*	1.01 x TDA + 3.18	0.91 x TDA + 3.18	0.89 x TDA + 3.18	0.83 x TDA + 3.18	0.83 x TDA + 3.18	0.76 x TDA + 3.18
SVO.SC.M	*TDEC kWh/day*	2.23 x TDA + 4.59	2.04 x TDA + 4.59	1.9 x TDA + 4.59	1.73 x TDA + 4.59	1.73 x TDA + 4.59	1.65 x TDA + 4.59
SOC.RC.M	*CDEC kWh/day*	0.62 x TDA + 0.11	0.59 x TDA + 0.11	0.55 x TDA + 0.11	0.51 x TDA + 0.11	0.51 x TDA + 0.11	0.4 x TDA + 0.11
HZO.RC.M	*CDEC kWh/day*	0.51 x TDA + 2.88	0.45 x TDA + 2.88	0.39 x TDA + 2.88	0.36 x TDA + 2.88	0.35 x TDA + 2.88	0.35 x TDA + 2.88
HZO.RC.L	*CDEC kWh/day*	0.68 x TDA + 6.88	0.62 x TDA + 6.88	0.58 x TDA + 6.88	0.57 x TDA + 6.88	0.57 x TDA + 6.88	0.57 x TDA + 6.88
HZO.SC.M	*TDEC kWh/day*	1.14 x TDA + 5.55	1.03 x TDA + 5.55	0.91 x TDA + 5.55	0.78 x TDA + 5.55	0.77 x TDA + 5.55	0.77 x TDA + 5.55
HZO.SC.L	*TDEC kWh/day*	2.63 x TDA + 7.08	2.41 x TDA + 7.08	2.2 x TDA + 7.08	1.94 x TDA + 7.08	1.92 x TDA + 7.08	1.92 x TDA + 7.08
HCT.SC.I	*TDEC kWh/day*	1.33 x TDA + 0.43	1.16 x TDA + 0.43	0.64 x TDA + 0.43	0.6 x TDA + 0.43	0.56 x TDA + 0.43	0.56 x TDA + 0.43

13.4.6 Shipments

The GRIM estimated yearly revenues using the shipment forecasts and average efficiency values produced by the NES model (Chapter 10 of this TSD). The shipment analysis is a key driver of manufacturer finances because changes in the efficiency mix at the various trial standard levels are tied to shipments. Further explanation of assumptions and calculations of total shipments can be found in Chapter 10 of this TSD. Total shipments forecasted in the shipment analysis for all efficiency levels in 2012 are shown in Table 13.4.3 and discussed below.

Table 13.4.3 Industry-Wide Shipments Forecast in 2012

Equipment Class	Total Industry Shipments *(Number of Units)*
VOP.RC.M	37,774
VOP.RC.L	1,889
VOP.SC.M	7,619
VCT.RC.M	2,544
VCT.RC.L	35,342
VCT.SC.I	2,582
VCS.SC.I	639
SVO.RC.M	28,813
SVO.SC.M	11,407
SOC.RC.M	7,263
HZO.RC.M	4,427
HZO.RC.L	13,921
HZO.SC.M	980
HZO.SC.L	2,033
HCT.SC.I	10,534

DOE assumed a roll-up of efficiency distribution in the standards year followed by a gradual improvement in efficiency, which mimics the growth in efficiency observed in historical data (parallel growth trend). Under the parallel growth trend, the equipment mix moves to higher efficiency levels until the maximum efficiency level is reached. Table 13.4.4 through Table 13.4.18 show the distributions of shipments by TSL estimated in the NES for various equipment classes in 2012.

Table 13.4.4 Distribution of VOP.RC.M by Efficiency Level in 2012 for Different Trial Standard Levels

Shipments Efficiency by TSL (CDEC/TDA - kWh/day/ft^2)	TSL (CDEC/TDA - kWh/day/ft^2)				
	Baseline (1.09)	**TSL 1 (0.98)**	**TSL 2 (0.95)**	**TSL 3, 4 (0.89)**	**TSL 5 (0.82)**
Baseline (1.09)	17.4%	36.5%	16.9%	14.6%	14.6%
TSL 1 (0.98)		53.9%	16.9%	14.6%	14.6%
TSL 2 (0.95)			70.9%	14.6%	14.6%
TSL 3, 4 (0.89)				85.4%	14.6%
TSL 5 (0.82)					100.0%

Table 13.4.5 Distribution of VOP.RC.L by Efficiency Level in 2012 for Different Trial Standard Levels

Shipments Efficiency by TSL (CDEC/TDA - kWh/day/ft^2)	TSL (CDEC/TDA - kWh/day/ft^2)				
	Baseline (2.99)	TSL 1 (2.65)	TSL 2 (2.54)	TSL 3 (2.51)	TSL 4, 5 (2.43)
Baseline (2.99)	15.2%	32.5%	15.0%	29.1%	8.2%
TSL 1 (2.65)		47.8%	15.0%	29.1%	8.2%
TSL 2 (2.54)			62.8%	29.1%	8.2%
TSL 3 (2.51)				91.8%	8.2%
TSL 4, 5 (2.43)					100.0%

Table 13.4.6 Distribution of VOP.SC.M by Efficiency Level in 2012 for Different Trial Standard Levels

Shipments Efficiency by TSL (TDEC/TDA - kWh/day/ft^2)	TSL (TDEC/TDA - kWh/day/ft^2)				
	Baseline (2.65)	TSL 1 (2.41)	TSL 2 (2.24)	TSL 3, 4 (2.06)	TSL 5 (1.96)
Baseline (2.65)	16.1%	33.9%	29.3%	10.0%	10.6%
TSL 1 (2.41)		50.0%	29.3%	10.0%	10.6%
TSL 2 (2.24)			79.3%	10.0%	10.6%
TSL 3, 4 (2.06)				89.4%	10.6%
TSL 5 (1.96)					100.0%

Table 13.4.7 Distribution of VCT.RC.M by Efficiency Level in 2012 for Different Trial Standard Levels

Shipments Efficiency by TSL (CDEC/TDA - kWh/day/ft^2)	TSL (CDEC/TDA - kWh/day/ft^2)				
	Baseline (0.51)	TSL 1 (0.49)	TSL 2 (0.46)	TSL 3 (0.37)	TSL 4, 5 (0.25)
Baseline (0.51)	19.9%	20.0%	19.7%	14.8%	25.6%
TSL 1 (0.49)		39.9%	19.7%	14.8%	25.6%
TSL 2 (0.46)			59.6%	14.8%	25.6%
TSL 3 (0.37)				74.4%	25.6%
TSL 4, 5 (0.25)					100.0%

Table 13.4.8 Distribution of VCT.RC.L by Efficiency Level in 2012 for Different Trial Standard Levels

Shipments Efficiency by TSL (CDEC/TDA - kWh/day/ft^2)	TSL (CDEC/TDA - kWh/day/ft^2)				
	Baseline (1.07)	TSL 1 (1.01)	TSL 2 (0.72)	TSL 3 (0.62)	TSL 4, 5 (0.60)
Baseline (1.07)	19.2%	38.3%	12.0%	10.5%	20.1%
TSL 1 (1.01)		57.4%	12.0%	10.5%	20.1%
TSL 2 (0.72)			69.4%	10.5%	20.1%
TSL 3 (0.62)				79.9%	20.1%
TSL 4 and TSL 5 (0.60)					100.0%

Table 13.4.9 Distribution of VCT.SC.I by Efficiency Level in 2012 for Different Trial Standard Levels

Shipments Efficiency by TSL (TDEC/TDA - kWh/day/ft^2)	TSL (TDEC/TDA - kWh/day/ft^2)				
	Baseline (1.75)	TSL 1 (1.28)	TSL 2 (0.90)	TSL 3 (0.81)	TSL 4, 5 (0.80)
Baseline (1.75)	14.3%	44.3%	11.3%	20.6%	9.5%
TSL 1 (1.28)		58.7%	11.3%	20.6%	9.5%
TSL 2 (0.90)			69.9%	20.6%	9.5%
TSL 3 (0.81)				90.5%	9.5%
TSL 4 and TSL 5 (0.80)*					100.0%

Table 13.4.10 Distribution of VCS.SC.I by Efficiency Level in 2012 for Different Trial Standard Levels

Shipments Efficiency by TSL (TDEC/V - kWh/day/ft^3)	TSL (TDEC/V - kWh/day/ft^3)			
	Baseline (0.57)	TSL 1 (0.51)	TSL 2 (0.45)	TSL 3, 4, 5 (0.40)
Baseline (0.57)	11.7%	25.2%	27.2%	36.0%
TSL 1 (0.51)		36.9%	27.2%	36.0%
TSL 2 (0.45)			64.0%	36.0%
TSL 3, 4, 5(0.40)				100.0%

Table 13.4.11 Distribution of SVO.RC.M by Efficiency Level in 2012 for Different Trial Standard Levels

Shipments Efficiency by TSL (CDEC/TDA - kWh/day/ft^2)	TSL (CDEC/TDA - kWh/day/ft^2)				
	Baseline (1.09)	TSL 1 (0.99)	TSL 2 (0.96)	TSL 3, 4 (0.91)	TSL 5 (0.84)
Baseline (1.09)	17.1%	35.7%	16.9%	15.1%	15.2%
TSL 1 (0.99)		52.8%	16.9%	15.1%	15.2%
TSL 2 (0.96)			69.7%	15.1%	15.2%
TSL 3, 4 (0.91)				84.8%	15.2%
TSL 5 (0.84)					100.0%

Table 13.4.12 Distribution of SVO.SC.M by Efficiency Level in 2012 for Different Trial Standard Levels

Shipments Efficiency by TSL (TDEC/TDA - kWh/day/ft^2)	TSL (TDEC/TDA - kWh/day/ft^2)				
	Baseline (2.59)	TSL 1 (2.40)	TSL 2 (2.26)	TSL 3, 4 (2.09)	TSL 5 (2.01)
Baseline (2.59)	15.5%	33.0%	29.6%	10.6%	11.3%
TSL 1 (2.40)		48.5%	29.6%	10.6%	11.3%
TSL 2 (2.26)			78.1%	10.6%	11.3%
TSL 3, 4 (2.09)				88.7%	11.3%
TSL 5 (2.01)					100.0%

Table 13.4.13 Distribution of SOC.RC.M by Efficiency Level in 2012 for Different Trial Standard Levels

Shipments Efficiency by TSL (CDEC/TDA - kWh/day/ft^2)	TSL (CDEC/TDA - kWh/day/ft^2)				
	Baseline (0.62)	TSL 1 (0.59)	TSL 2 (0.55)	TSL 3, 4 (0.51)	TSL 5 (0.40)
Baseline (0.62)	17.6%	18.0%	18.2%	34.5%	11.7%
TSL 1 (0.59)		35.6%	18.2%	34.5%	11.7%
TSL 2 (0.55)			53.8%	34.5%	11.7%
TSL 3,4 (0.51)				88.3%	11.7%
TSL 5 (0.40)					100.0%

Table 13.4.14 Distribution of HZO.RC.M by Efficiency Level in 2012 for Different Trial Standard Levels

Shipments Efficiency by TSL (CDEC/TDA - kWh/day/ft^2)	TSL (CDEC/TDA - kWh/day/ft^2)				
	Baseline (0.59)	TSL 1 (0.54)	TSL 2 (0.48)	TSL 3 (0.45)	TSL 4, 5 (0.44)
Baseline (0.59)	19.6%	20.5%	21.0%	20.0%	18.9%
TSL 1 (0.54)		40.1%	21.0%	20.0%	18.9%
TSL 2 (0.48)			61.1%	20.0%	18.9%
TSL 3 (0.45)				81.1%	18.9%
TSL 4 and TSL 5 (0.44)*					100.0%

Table 13.4.15 Distribution of HZO.RC.L by Efficiency Level in 2012 for Different Trial Standard Levels

Shipments Efficiency by TSL (CDEC/TDA - kWh/day/ft^2)	TSL (CDEC/TDA - kWh/day/ft^2)			
	Baseline (0.83)	TSL 1 (0.77)	TSL 2 (0.73)	TSL 3, 4, 5 (0.72)
Baseline (0.83)	20.1%	41.0%	19.9%	19.1%
TSL 1 (0.77)		61.1%	19.9%	19.1%
TSL 2 (0.73)			80.9%	19.1%
TSL 3, 4, 5 (0.72)				100.0%

Table 13.4.16 Distribution of HZO.SC.M by Efficiency Level in 2012 for Different Trial Standard Levels

Shipments Efficiency by TSL (TDEC/TDA - kWh/day/ft^2)	TSL (TDEC/TDA - kWh/day/ft^2)				
	Baseline (1.60)	TSL 1 (1.49)	TSL 2 (1.38)	TSL 3 (1.24)	TSL 4, 5 (1.23)
Baseline (1.60)	13.0%	27.8%	27.2%	22.3%	9.7%
TSL 1 (1.49)		40.8%	27.2%	22.3%	9.7%
TSL 2 (1.38)			68.0%	22.3%	9.7%
TSL 3 (1.24)				90.3%	9.7%
TSL 4, 5 (1.23)					100.0%

Table 13.4.17 Distribution of HZO.SC.L by Efficiency Level in 2012 for Different Trial Standard Levels

Shipments Efficiency by TSL (TDEC/TDA - kWh/day/ft^2)	TSL (TDEC/TDA - kWh/day/ft^2)				
	Baseline (3.22)	TSL 1 (3.00)	TSL 2 (2.79)	TSL 3 (2.53)	TSL 4, 5 (2.51)
Baseline (3.22)	12.8%	27.9%	27.2%	22.1%	10.0%
TSL 1 (3.00)		40.7%	27.2%	22.1%	10.0%
TSL 2 (2.79)			67.9%	22.1%	10.0%
TSL 3 (2.53)				90.0%	10.0%
TSL 4, 5 (2.51)					100.0%

Table 13.4.18 Distribution of HCT.SC.I by Efficiency Level in 2012 for Different Trial Standard Levels

Shipments Efficiency by TSL (TDEC/TDA - kWh/day/ft^2)	TSL (TDEC/TDA - kWh/day/ft^2)				
	Baseline (1.42)	TSL 1 (1.24)	TSL 2 (0.72)	TSL 3 (0.69)	TSL 4, 5 (0.65)
Baseline (1.42)	17.3%	35.8%	16.8%	16.3%	13.8%
TSL 1 (1.24)		53.1%	16.8%	16.3%	13.8%
TSL 2 (0.72)			69.9%	16.3%	13.8%
TSL 3 (0.69)				86.2%	13.8%
TSL 4, 5 (0.65)					100.0%

13.4.7 Production Costs

Changes in equipment costs affect revenues and gross profits. As the engineering analysis (Chapter 5) shows, equipment that is more efficient costs more to produce than baseline equipment. For the MIA, DOE used the production costs derived in the engineering analysis and the production volume assumptions from the shipment projections in the NES. Since more-efficient equipment is manufactured at lower production volumes than standard efficiency equipment, enacting energy conservation standards will increase production volumes for more-efficient units.

The GRIM included the proportion of costs devoted to labor, materials, depreciation, and overhead that make up the manufacturer production cost of the equipment. DOE estimated the proportion of costs associated with each cost category by using the U.S. Census Bureau's 2006 Annual Survey of Manufactures (2006 ASM) and information provided by manufacturers of CRE. Table 13.4.19 through Table 13.4.33 provide the production cost assumptions at the various TSLs used in the GRIM for the equipment classes analyzed in the engineering analysis.

Table 13.4.19 Production Cost Breakdown for VOP.RC.M Equipment Class (2007$)

TSL	Labor Cost	Material Cost	Overhead Cost	Depreciation Cost	Total Cost
Baseline	$378.89	$2,271.76	$541.16	$44.86	$3,236.66
TSL 1	$389.34	$2,334.44	$556.09	$46.10	$3,325.97
TSL 2	$397.01	$2,380.44	$567.05	$47.01	$3,391.50
TSL 3	$419.44	$2,514.94	$599.09	$49.66	$3,583.13
TSL 4	$419.44	$2,514.94	$599.09	$49.66	$3,583.13
TSL 5	$760.04	$4,557.12	$1,085.56	$89.99	$6,492.71

Table 13.4.20 Production Cost Breakdown for VOP.RC.L Equipment Class (2007$)

TSL	Labor Cost	Material Cost	Overhead Cost	Depreciation Cost	Total Cost
Baseline	$575.98	$3,453.49	$822.66	$68.20	$4,920.32
TSL 1	$600.37	$3,599.74	$857.50	$71.08	$5,128.70
TSL 2	$626.78	$3,758.10	$895.22	$74.21	$5,354.31
TSL 3	$634.84	$3,806.46	$906.74	$75.17	$5,423.21
TSL 4	$723.15	$4,335.92	$1,032.87	$85.62	$6,177.56
TSL 5	$723.15	$4,335.92	$1,032.87	$85.62	$6,177.56

Table 13.4.21 Production Cost Breakdown for VOP.SC.M Equipment Class (2007$)

TSL	Labor Cost	Material Cost	Overhead Cost	Depreciation Cost	Total Cost
Baseline	$195.40	$1,171.59	$279.09	$23.14	$1,669.22
TSL 1	$201.53	$1,208.34	$287.84	$23.86	$1,721.57
TSL 2	$215.59	$1,292.63	$307.92	$25.53	$1,841.66
TSL 3	$240.27	$1,440.64	$343.18	$28.45	$2,052.53
TSL 4	$240.27	$1,440.64	$343.18	$28.45	$2,052.53
TSL 5	$355.87	$2,133.74	$508.28	$42.13	$3,040.02

Table 13.4.22 Production Cost Breakdown for VCT.RC.M Equipment Class (2007$)

TSL	Labor Cost	Material Cost	Overhead Cost	Depreciation Cost	Total Cost
Baseline	$602.90	$3,614.90	$861.11	$71.38	$5,150.29
TSL 1	$605.45	$3,630.21	$864.76	$71.69	$5,172.10
TSL 2	$611.61	$3,667.13	$873.55	$72.41	$5,224.71
TSL 3	$662.68	$3,973.34	$946.50	$78.46	$5,660.98
TSL 4	$764.26	$4,582.40	$1,091.58	$90.49	$6,528.73
TSL 5	$764.26	$4,582.40	$1,091.58	$90.49	$6,528.73

Table 13.4.23 Production Cost Breakdown for VCT.RC.L Equipment Class (2007$)

TSL	Labor Cost	Material Cost	Overhead Cost	Depreciation Cost	Total Cost
Baseline	$660.96	$3,963.04	$944.04	$78.26	$5,646.30
TSL 1	$669.67	$4,015.28	$956.49	$79.29	$5,720.73
TSL 2	$785.03	$4,706.94	$1,121.25	$92.95	$6,706.16
TSL 3	$836.10	$5,013.15	$1,194.19	$98.99	$7,142.43
TSL 4	$850.92	$5,102.03	$1,215.36	$100.75	$7,269.07
TSL 5	$850.92	$5,102.03	$1,215.36	$100.75	$7,269.07

Table 13.4.24 Production Cost Breakdown for VCT.SC.I Equipment Class (2007$)

TSL	Labor Cost	Material Cost	Overhead Cost	Depreciation Cost	Total Cost
Baseline	$314.81	$1,887.58	$449.64	$37.27	$2,689.30
TSL 1	$343.23	$2,057.94	$490.23	$40.64	$2,932.03
TSL 2	$389.37	$2,334.60	$556.13	$46.10	$3,326.20
TSL 3	$408.18	$2,447.41	$583.00	$48.33	$3,486.93
TSL 4	$412.96	$2,476.06	$589.83	$48.89	$3,527.74
TSL 5	$412.96	$2,476.06	$589.83	$48.89	$3,527.74

Table 13.4.25 Production Cost Breakdown for VCS.SC.I Equipment Class (2007$)

TSL	Labor Cost	Material Cost	Overhead Cost	Depreciation Cost	Total Cost
Baseline	$187.08	$1,121.68	$267.20	$22.15	$1,598.10
TSL 1	$189.37	$1,135.44	$270.48	$22.42	$1,617.71
TSL 2	$194.20	$1,164.41	$277.38	$22.99	$1,658.98
TSL 3	$210.19	$1,260.27	$300.21	$24.89	$1,795.56
TSL 4	$210.19	$1,260.27	$300.21	$24.89	$1,795.56
TSL 5	$210.19	$1,260.27	$300.21	$24.89	$1,795.56

Table 13.4.26 Production Cost Breakdown for SVO.RC.M Equipment Class (2007$)

TSL	Labor Cost	Material Cost	Overhead Cost	Depreciation Cost	Total Cost
Baseline	$341.78	$2,049.27	$488.16	$40.47	$2,919.67
TSL 1	$348.75	$2,091.05	$498.11	$41.29	$2,979.21
TSL 2	$354.23	$2,123.91	$505.94	$41.94	$3,026.02
TSL 3	$369.87	$2,217.68	$528.28	$43.79	$3,159.61
TSL 4	$369.87	$2,217.68	$528.28	$43.79	$3,159.61
TSL 5	$619.15	$3,712.35	$884.33	$73.31	$5,289.14

Table 13.4.27 Production Cost Breakdown for SVO.SC.M Equipment Class (2007$)

TSL	Labor Cost	Material Cost	Overhead Cost	Depreciation Cost	Total Cost
Baseline	$159.76	$957.92	$228.19	$18.92	$1,364.79
TSL 1	$163.06	$977.70	$232.90	$19.31	$1,392.97
TSL 2	$172.02	$1,031.42	$245.70	$20.37	$1,469.51
TSL 3	$190.89	$1,144.54	$272.64	$22.60	$1,630.67
TSL 4	$190.89	$1,144.54	$272.64	$22.60	$1,630.67
TSL 5	$276.61	$1,658.50	$395.07	$32.75	$2,362.93

Table 13.4.28 Production Cost Breakdown for SOC.RC.M Equipment Class (2007$)

TSL	Labor Cost	Material Cost	Overhead Cost	Depreciation Cost	Total Cost
Baseline	$670.69	$4,021.36	$957.94	$79.41	$5,729.39
TSL 1	$672.73	$4,033.61	$960.85	$79.65	$5,746.84
TSL 2	$677.66	$4,063.15	$967.89	$80.23	$5,788.93
TSL 3	$688.85	$4,130.26	$983.88	$81.56	$5,884.55
TSL 4	$688.85	$4,130.26	$983.88	$81.56	$5,884.55
TSL 5	$900.64	$5,400.15	$1,286.38	$106.64	$7,693.80

Table 13.4.29 Production Cost Breakdown for HZO.RC.M Equipment Class (2007$)

TSL	Labor Cost	Material Cost	Overhead Cost	Depreciation Cost	Total Cost
Baseline	$383.17	$2,297.42	$547.27	$45.37	$3,273.23
TSL 1	$385.21	$2,309.67	$550.19	$45.61	$3,290.68
TSL 2	$390.14	$2,339.21	$557.23	$46.19	$3,332.76
TSL 3	$397.15	$2,381.28	$567.25	$47.02	$3,392.71
TSL 4	$401.93	$2,409.93	$574.07	$47.59	$3,433.52
TSL 5	$401.93	$2,409.93	$574.07	$47.59	$3,433.52

Table 13.4.30 Production Cost Breakdown for HZO.RC.L Equipment Class (2007$)

TSL	Labor Cost	Material Cost	Overhead Cost	Depreciation Cost	Total Cost
Baseline	$386.96	$2,320.19	$552.70	$45.82	$3,305.67
TSL 1	$393.93	$2,361.98	$562.65	$46.64	$3,365.21
TSL 2	$402.57	$2,413.78	$574.99	$47.66	$3,439.01
TSL 3	$407.35	$2,442.43	$581.82	$48.23	$3,479.82
TSL 4	$407.35	$2,442.43	$581.82	$48.23	$3,479.82
TSL 5	$407.35	$2,442.43	$581.82	$48.23	$3,479.82

Table 13.4.31 Production Cost Breakdown for HZO.SC.M Equipment Class (2007$)

TSL	Labor Cost	Material Cost	Overhead Cost	Depreciation Cost	Total Cost
Baseline	$142.52	$854.55	$203.56	$16.87	$1,217.51
TSL 1	$143.77	$862.01	$205.34	$17.02	$1,228.14
TSL 2	$148.60	$891.00	$212.25	$17.59	$1,269.44
TSL 3	$159.93	$958.90	$228.42	$18.94	$1,366.18
TSL 4	$164.70	$987.55	$235.25	$19.50	$1,407.00
TSL 5	$164.70	$987.55	$235.25	$19.50	$1,407.00

Table 13.4.32 Production Cost Breakdown for HZO.SC.L Equipment Class (2007$)

TSL	Labor Cost	Material Cost	Overhead Cost	Depreciation Cost	Total Cost
Baseline	$166.09	$995.85	$237.22	$19.66	$1,418.83
TSL 1	$168.04	$1,007.52	$240.00	$19.90	$1,435.46
TSL 2	$175.15	$1,050.16	$250.16	$20.74	$1,496.20
TSL 3	$193.89	$1,162.55	$276.93	$22.96	$1,656.34
TSL 4	$198.67	$1,191.20	$283.76	$23.52	$1,697.15
TSL 5	$198.67	$1,191.20	$283.76	$23.52	$1,697.15

Table 13.4.33 Production Cost Breakdown for HCT.SC.I Equipment Class (2007$)

TSL	Labor Cost	Material Cost	Overhead Cost	Depreciation Cost	Total Cost
Baseline	$93.06	$557.98	$132.92	$11.02	$794.98
TSL 1	$94.32	$565.55	$134.72	$11.17	$805.76
TSL 2	$103.94	$623.19	$148.45	$12.31	$887.88
TSL 3	$105.17	$630.57	$150.21	$12.45	$898.40
TSL 4	$109.95	$659.22	$157.03	$13.02	$939.21
TSL 5	$109.95	$659.22	$157.03	$13.02	$939.21

As the engineering analysis explains, DOE calculated the manufacturer markup as the market-share-weighted average value for the industry. DOE developed this manufacturer markup for the ANOPR by examining several major CRE manufacturers' gross margin information from annual reports and SEC 10-K reports. Because the 10-K reports do not provide gross margin information at the subsidiary level, the estimated markups represent the average markups that the parent company applies over its entire range of equipment offerings and does not necessarily represent the manufacturer markup of the subsidiary. The result of the ANOPR analysis showed that the average manufacturer markup was 1.39. Following the interviews with manufacturers, DOE adjusted the markups to be more representative of the industry. An aggregation of the MIA interview responses gave a market-share-weighted average manufacturer markup value of 1.32. DOE used this updated manufacturer markup with the manufacturing production costs (MPCs) from the engineering analysis to arrive at the manufacturer selling prices (MSPs) used in the GRIM. DOE kept the 1.32 markup for the final rule.

13.4.8 Conversion Costs

New efficiency standards typically cause manufacturers to incur one-time conversion costs to bring their production facilities and product designs in compliance with the new regulation. For the MIA, DOE classified these one-time conversion costs into three major groups. Equipment conversion expenditures are one-time investments in research, development, testing, and marketing focused on making equipment designs comply with the new efficiency standard. Capital conversion expenditures are one-time investments in property, plant, and equipment to adapt or change existing production facilities so that new equipment designs can be fabricated and assembled under the new regulation. Stranded assets are equipment or tooling that become obsolete as a result of new regulation.

During the MIA interviews, DOE asked manufacturers to estimate the conversion costs they would incur due to new energy conservation standards. DOE then used the costs manufacturers provided and their respective market shares to develop estimates for the conversion costs of the entire CRE industry at each TSLs. Capital conversion expenditures include replacing foam fixtures for various models, retooling machinery for redesigned components, and possible changes to factory layout. Equipment conversion expenditures include R&D, certification and testing, marketing, and other costs required to bring more efficient equipment into the market. Since some manufacturers do not manufacture high efficiency equipment, as required efficiencies increase with higher TSLs the industry must convert more equipment and thus incur higher conversion costs. Table 13.4.34 through Table 13.4.36 summarize these estimates.

Table 13.4.34 Capital Conversion Expenditures by Trial Standard Level (2007$ millions)

Equipment Class	Trial Standard Level				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
VOP.RC.M	0.06	0.39	2.85	2.85	7.13
VOP.RC.L	0.06	0.39	2.85	7.13	7.13
VOP.SC.M	0.07	0.42	3.11	3.11	7.78
VCT.RC.M	0.06	0.39	2.85	7.13	7.13
VCT.RC.L	0.06	0.39	2.85	7.13	7.13
VCT.SC.I	0.03	0.16	1.18	2.96	2.96
VCS.SC.I	0.03	0.16	1.18	2.96	2.96
SVO.RC.M	0.06	0.34	2.47	2.47	6.17
SVO.SC.M	0.06	0.37	2.73	2.73	6.81
SOC.RC.M	0.04	0.26	1.93	1.93	4.83
HZO.RC.M	0.06	0.39	2.85	7.13	7.13
HZO.RC.L	0.06	0.39	2.85	7.13	7.13
HZO.SC.M	0.06	0.39	2.85	7.13	7.13
HZO.SC.L	0.06	0.39	2.85	7.13	7.13
HCT.SC.I	0.02	0.13	0.92	2.31	2.31
TOTAL	0.83	4.95	36.33	71.19	90.82

Table 13.4.35 Equipment Conversion Expenditures by Trial Standard Level (2007$ millions)

Equipment Class	Trial Standard Level				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
VOP.RC.M	0.04	0.22	1.62	1.62	4.05
VOP.RC.L	0.04	0.22	1.62	4.05	4.05
VOP.SC.M	0.04	0.24	1.77	1.77	4.42
VCT.RC.M	0.04	0.22	1.62	4.05	4.05
VCT.RC.L	0.04	0.22	1.62	4.05	4.05
VCT.SC.I	0.02	0.09	0.67	1.68	1.68
VCS.SC.I	0.02	0.09	0.67	1.68	1.68
SVO.RC.M	0.03	0.19	1.40	1.40	3.50
SVO.SC.M	0.04	0.21	1.55	1.55	3.87
SOC.RC.M	0.02	0.15	1.10	1.10	2.74
HZO.RC.M	0.04	0.22	1.62	4.05	4.05
HZO.RC.L	0.04	0.22	1.62	4.05	4.05
HZO.SC.M	0.04	0.22	1.62	4.05	4.05
HZO.SC.L	0.04	0.22	1.62	4.05	4.05
HCT.SC.I	0.01	0.07	0.52	1.31	1.31
TOTAL	0.47	2.81	20.64	40.44	51.59

Table 13.4.36 Stranded Assets by Trial Standard Level (2007$ millions)

Equipment Class	Trial Standard Level				
	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
VOP.RC.M	0.04	0.24	1.73	1.73	4.32
VOP.RC.L	0.04	0.24	1.73	4.32	4.32
VOP.SC.M	0.04	0.26	1.88	1.88	4.71
VCT.RC.M	0.04	0.24	1.73	4.32	4.32
VCT.RC.L	0.04	0.24	1.73	4.32	4.32
VCT.SC.I	0.02	0.10	0.72	1.79	1.79
VCS.SC.I	0.02	0.10	0.72	1.79	1.79
SVO.RC.M	0.03	0.20	1.49	1.49	3.73
SVO.SC.M	0.04	0.23	1.65	1.65	4.13
SOC.RC.M	0.03	0.16	1.17	1.17	2.92
HZO.RC.M	0.04	0.24	1.73	4.32	4.32
HZO.RC.L	0.04	0.24	1.73	4.32	4.32
HZO.SC.M	0.04	0.24	1.73	4.32	4.32
HZO.SC.L	0.04	0.24	1.73	4.32	4.32
HCT.SC.I	0.01	0.08	0.56	1.40	1.40
TOTAL	0.50	2.99	21.96	43.00	54.89

13.4.9 Markup Scenarios

To understand how baseline and more-efficient equipment are differentiated, DOE reviewed manufacturer catalogs and utilized information gathered from manufacturers. To estimate the manufacturer price of the equipment sold, DOE applied markups to the production costs. For the analysis, DOE considered different markup scenarios based on manufacturer input for commercial refrigeration equipment. Scenarios were used to bound the range of expected equipment prices following new energy conservation standards. For each equipment class, DOE used the markup scenarios that best characterized the prevailing markup conditions and described the range of market responses manufacturers expect as a result of new energy conservation standards.

After discussions with manufacturers and market research, DOE modeled two markup scenarios: The preservation-of-gross-margin-percentage scenario and the preservation-of-gross-margin (absolute dollars) scenario.

13.4.9.1 Preservation-of-Gross-Margin-Percentage Scenario

Under the preservation-of-gross-margin-percentage scenario, DOE applied a single uniform “gross margin percentage” markup across all efficiency levels. In this scenario, DOE assumed that as production costs increase in response to energy conservation standards, manufacturers would be able to maintain the same gross margin percentage markup. As production costs increase with efficiency, this scenario implies that the absolute dollar markup would increase. DOE assumed the non-production cost markup—which includes SG&A expenses; research and development expenses; interest; and profit—to be 1.32. This markup is consistent with the one DOE assumed in the base case for the GRIM.

During interviews, manufacturers expressed a range of opinions on how selling prices would be impacted by new energy conservation standards. While some manufacturers stated it has been difficult passing along any increase in material or component costs on to customers, others stated that that these cost increases have had a minimal affect on their margins. Due to the uncertainty in how market prices will response to standards, DOE assumes that this scenario represents a high bound to industry profitability after a new energy conservation standard.

13.4.9.2 Preservation-of-Gross-Margin (Absolute Dollars) Scenario

The implicit assumption behind this markup scenario is that the industry could only maintain its gross margin in absolute dollars after the standard. The industry would do so by passing through part of its increased production costs to customers without increasing its gross margin in absolute dollars. DOE implemented this scenario in the GRIM by setting the non-production cost markups for each TSL to yield approximately the same gross margin in the standards cases in the year after standard implementation (2012) as is yielded in the base case. In this scenario manufacturers do not recoup all of the increase costs of production in response to new energy conservation standards, lowering the prices they earn from their customers and decreasing operating cash flow. Because the gross margin percentage decreases at each TSL, DOES assumes that this scenario represents a low bound to industry profitability after a new energy conservation standard. The non-production cost markups under this scenario are summarized in Table 13.4.37 through Table 13.4.51.

Table 13.4.37 Preservation-of-Gross-Margin (Absolute Dollars) Markup for VOP.RC.M

TSL ***(CDEC/TDA - kWh/day/ft²)***	**Baseline**	**TSL 1**	**TSL 2**	**TSL 3**	**TSL 4**	**TSL 5**
Baseline (1.09)	1.32	-	-	-	-	-
TSL 1 (0.98)	1.32	1.31	-	-	-	-
TSL 2 (0.95)	1.32	1.32	1.31	-	-	-
TSL 3, 4 (0.89)	1.32	1.32	1.32	1.29	1.29	-
TSL 5 (0.76)	1.32	1.32	1.32	1.32	1.32	1.16

Table 13.4.38 Preservation-of-Gross-Margin (Absolute Dollars) Markup for VOP.RC.L

TSL ***(CDEC/TDA - kWh/day/ft²)***	**Baseline**	**TSL 1**	**TSL 2**	**TSL 3**	**TSL 4**	**TSL 5**
Baseline (2.99)	1.32	-	-	-	-	-
TSL 1 (2.65)	1.32	1.31	-	-	-	-
TSL 2 (2.54)	1.32	1.32	1.29	-	-	-
TSL 3 (2.51)	1.32	1.32	1.32	1.29	-	-
TSL 4, 5 (2.43)	1.32	1.32	1.32	1.32	1.25	1.25

Table 13.4.39 Preservation-of-Gross-Margin (Absolute Dollars)Markup for VOP.SC.M

TSL *(CDEC/TDA - kWh/day/ft²)*	Baseline	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Baseline (2.65)	1.32	-	-	-	-	-
TSL 1 (2.41)	1.32	1.31	-	-	-	-
TSL 2 (2.24)	1.32	1.32	1.29	-	-	-
TSL 3, 4 (2.06)	1.32	1.32	1.32	1.26	1.26	-
TSL 5 (1.96)	1.32	1.32	1.32	1.32	1.32	1.18

Table 13.4.40 Preservation-of-Gross-Margin (Absolute Dollars) Markup for VCT.RC.M

TSL *(CDEC/TDA - kWh/day/ft²)*	Baseline	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Baseline (0.51)	1.32	-	-	-	-	-
TSL 1 (0.49)	1.32	1.32	-	-	-	-
TSL 2 (0.46)	1.32	1.32	1.32	-	-	-
TSL 3 (0.37)	1.32	1.32	1.32	1.29	1.29	-
TSL 4, 5 (0.25)	1.32	1.32	1.32	1.32	1.32	1.25

Table 13.4.41 Preservation-of-Gross-Margin (Absolute Dollars) Markup for VCT.RC.L

TSL *(CDEC/TDA - kWh/day/ft²)*	Baseline	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Baseline (1.07)	1.32	-	-	-	-	-
TSL 1 (1.01)	1.32	1.32	-	-	-	-
TSL 2 (0.72)	1.32	1.32	1.27	-	-	-
TSL 3 (0.62)	1.32	1.32	1.32	1.25	-	-
TSL 4, 5 (0.60)	1.32	1.32	1.32	1.32	1.25	1.25

Table 13.4.42 Preservation-of-Gross-Margin (Absolute Dollars) Markup for VCT.SC.I

TSL *(CDEC/TDA - kWh/day/ft²)*	Baseline	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Baseline (1.75)	1.32	-	-	-	-	-
TSL 1 (1.28)	1.32	1.29	-	-	-	-
TSL 2 (0.90)	1.32	1.32	1.26	-	-	-
TSL 3 (0.81)	1.32	1.32	1.32	1.25	-	-
TSL 4, 5 (0.80)	1.32	1.32	1.32	1.32	1.24	1.24

Table 13.4.43 Preservation-of-Gross-Margin (Absolute Dollars) Markup for VCS.SC.I

TSL *(CDEC/TDA - kWh/day/ft²)*	Baseline	TSL 1	TSL 2	TSL 3, 4, 5
Baseline (0.57)	1.32	-	-	-
TSL 1 (0.51)	1.32	1.32	-	-
TSL 2 (0.45)	1.32	1.32	1.31	-
TSL 3, 4, 5 (0.40)	1.32	1.32	1.32	1.28

Table 13.4.44 Preservation-of-Gross-Margin (Absolute Dollars) Markup for SVO.RC.M

TSL *(CDEC/TDA - kWh/day/ft^2)*	Baseline	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Baseline (1.09)	1.32	-	-	-	-	-
TSL 1 (0.99)	1.32	1.31	-	-	-	-
TSL 2 (0.96)	1.32	1.32	1.31	-	-	-
TSL 3, 4 (0.91)	1.32	1.32	1.32	1.30	1.30	-
TSL 5 (0.84)	1.32	1.32	1.32	1.32	1.32	1.18

Table 13.4.45 Preservation-of-Gross-Margin (Absolute Dollars) Markup for SVO.SC.M

TSL *(CDEC/TDA - kWh/day/ft^2)*	Baseline	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Baseline (2.59)	1.32	-	-	-	-	-
TSL 1 (2.40)	1.32	1.31	-	-	-	-
TSL 2 (2.26)	1.32	1.32	1.30	-	-	-
TSL 3, 4 (2.09)	1.32	1.32	1.32	1.27	1.27	-
TSL 5 (2.01)	1.32	1.32	1.32	1.32	1.32	1.18

Table 13.4.46 Preservation-of-Gross-Margin (Absolute Dollars) Markup for SOC.RC.M

TSL *(CDEC/TDA - kWh/day/ft^2)*	Baseline	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Baseline (0.62)	1.32	-	-	-	-	-
TSL 1 (0.59)	1.32	1.32	-	-	-	-
TSL 2 (0.55)	1.32	1.32	1.32	-	-	-
TSL 3, 4 (0.51)	1.32	1.32	1.32	1.31	1.31	-
TSL 5 (0.40)	1.32	1.32	1.32	1.32	1.32	1.24

Table 13.4.47 Preservation-of-Gross-Margin (Absolute Dollars) Markup for HZO.RC.M

TSL *(CDEC/TDA - kWh/day/ft^2)*	Baseline	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Baseline (0.59)	1.32	-	-	-	-	-
TSL 1 (0.54)	1.32	1.32	-	-	-	-
TSL 2 (0.48)	1.32	1.32	1.31	-	-	-
TSL 3 (0.45)	1.32	1.32	1.32	1.31	-	-
TSL 4, 5 (0.44)	1.32	1.32	1.32	1.32	1.31	1.31

Table 13.4.48 Preservation-of-Gross-Margin (Absolute Dollars) Markup for HZO.RC.L

TSL (CDEC/TDA - kWh/day/ft²)	Baseline	TSL 1	TSL 2	TSL 3, 4, 5
Baseline (0.83)	1.32	-	-	-
TSL 1 (0.77)	1.32	1.31	-	-
TSL 2 (0.73)	1.32	1.32	1.31	-
TSL 3, 4, 5 (0.72)	1.32	1.32	1.32	1.30

Table 13.4.49 Preservation-of-Gross-Margin (Absolute Dollars) Markup for HZO.SC.M

TSL (CDEC/TDA - kWh/day/ft²)	Baseline	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Baseline (1.60)	1.32	-	-	-	-	-
TSL 1 (1.49)	1.32	1.32	-	-	-	-
TSL 2 (1.38)	1.32	1.32	1.31	-	-	-
TSL 3 (1.24)	1.32	1.32	1.32	1.29	-	-
TSL 4, 5 (1.23)	1.32	1.32	1.32	1.32	1.28	1.28

Table 13.4.50 P Preservation-of-Gross-Margin (Absolute Dollars) Markup for HZO.SC.L

TSL (CDEC/TDA - kWh/day/ft²)	Baseline	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Baseline (3.22)	1.32	-	-	-	-	-
TSL 1 (3.00)	1.32	1.32	-	-	-	-
TSL 2 (2.79)	1.32	1.32	1.30	-	-	-
TSL 3 (2.53)	1.32	1.32	1.32	1.27	-	-
TSL 4, 5 (2.51)	1.32	1.32	1.32	1.32	1.27	1.27

Table 13.4.51 Preservation-of-Gross-Margin (Absolute Dollars) Markup for HCT.SC.I

TSL (CDEC/TDA - kWh/day/ft²)	Baseline	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Baseline (1.42)	1.32	-	-	-	-	-
TSL 1 (1.24)	1.32	1.32	-	-	-	-
TSL 2 (0.72)	1.32	1.32	1.29	-	-	-
TSL 3 (0.69)	1.32	1.32	1.32	1.28	-	-
TSL 4, 5 (0.65)	1.32	1.32	1.32	1.32	1.27	1.27

13.5 INDUSTRY FINANCIAL IMPACTS

Using the inputs and scenarios described in the previous sections, the GRIM estimated financial impacts on the CRE industry due to new energy conservation standards. The main results of the MIA are also reported in this section and consist of two key financial metrics: INPV and annual cash flows.

13.5.1 Impacts on Industry Net Present Value

In the MIA, DOE compared the INPV of the base case (no energy conservation standards) to that of each TSL. The difference in INPV is an estimate of the economic impacts that implementing that particular TSL would have on the entire industry. For the CRE industry, DOE examined two markup scenarios as described in the markup section above. Table 13.5.1 and Table 13.5.2 provide the INPV estimates for the CRE industry under the different scenarios.

Table 13.5.1 Changes in Industry Net Present Value (Preservation-of-Gross-Margin-Percentage Markup Scenario)

Preservation-of-Gross-Margin-Percentage Markup Scenario with a Rollup Shipment Scenario							
	Units	Base Case	Efficiency Level				
			1	2	3	4	5
INPV	*2007$ millions*	540	540	548	530	501	560
Change in INPV	*2007$ millions*	-	0	8	(11)	(39)	20
	%	-	0.02%	1.42%	-1.95%	-7.29%	3.73%
Energy Conservation Standards Equipment Conversion Expenses	*2007$ millions*	-	0.5	2.8	20.6	40.4	51.6
Energy Conservation Standards Capital Investments	*2007$ millions*	-	0.8	5.0	36.3	71.2	90.8
Total Investment Required	*2007$ millions*	-	1.3	7.8	57.0	111.6	142.4

Table 13.5.2 Changes in Industry Net Present Value (Preservation-of-Gross-Margin (Absolute Dollars) Markup Scenario)

Preservation-of-Operating-Profit Markup Scenario with a Rollup Shipment Scenario							
	Units	Base Case	Efficiency Level				
			1	2	3	4	5
INPV	*2007$ millions*	540	533	502	442	392	200
Change in INPV	*2007$ millions*	-	(7)	(39)	(99)	(148)	(340)
	%	-	-1.27%	-7.16%	-18.26%	-27.35%	-63.01%
Energy Conservation Standards Equipment Conversion Expenses	*2007$ millions*	-	0.5	2.8	20.6	40.4	51.6
Energy Conservation Standards Capital Investments	*2007$ millions*	-	0.8	5.0	36.3	71.2	90.8
Total Investment Required	*2007$ millions*	-	1.3	7.8	57.0	111.6	142.4

13.5.2 Impacts on Annual Cash Flow

While INPV is useful for evaluating the long-term effects of new 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 a period of 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 though recovery may be 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, DOE presents the annual net or free cash flows from 2007 through 2020 for the different TSL levels. Figure 13.5.1 and Figure 13.5.2 present the annual net cash flows for the base case and each of the five TSLs for the CRE industry assuming the different markups scenarios.

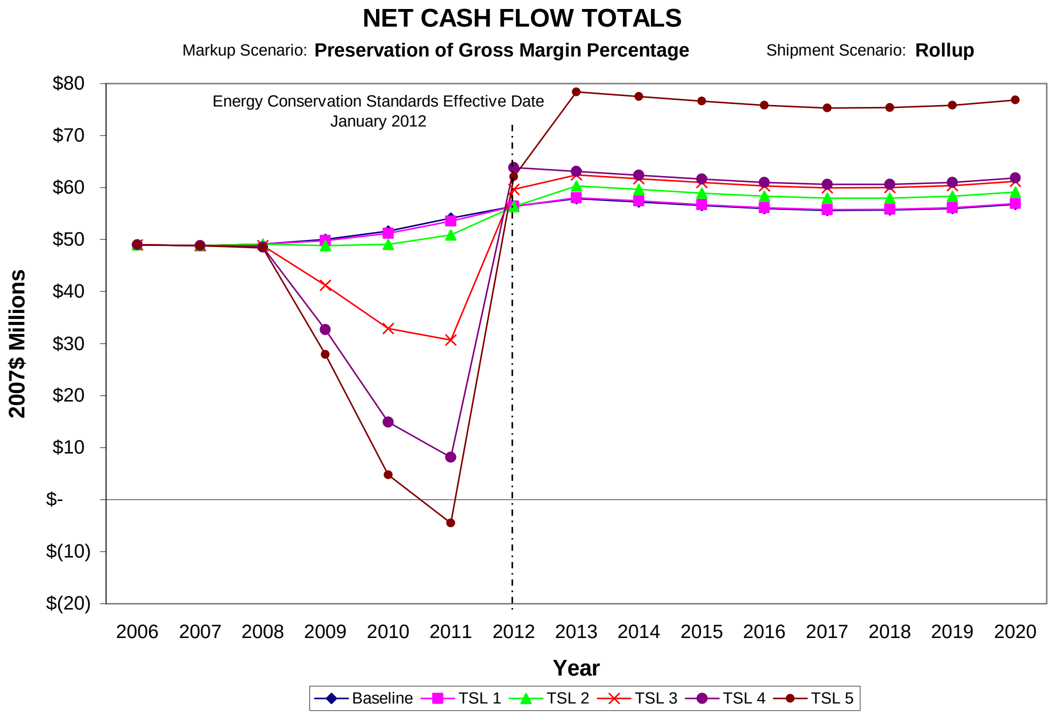

Figure 13.5.1 Annual Industry Net Cash Flows (Preservation-of-Gross-Margin-Percentage Markup Scenario)

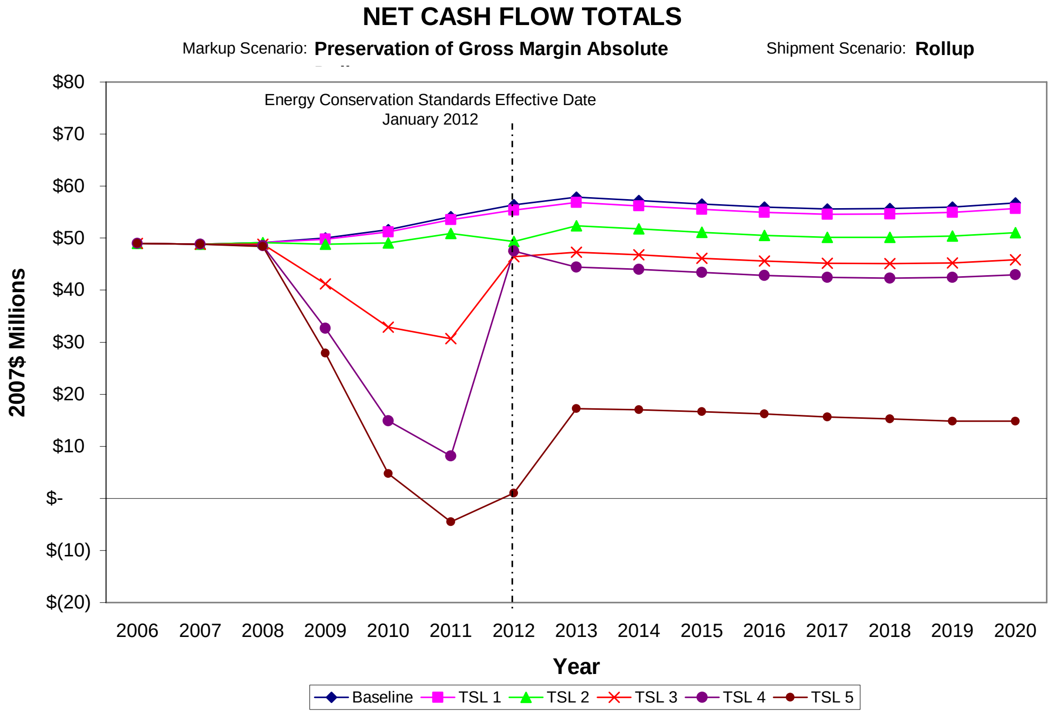

Figure 13.5.2 Annual Industry Net Cash Flows (Preservation-of-Gross-Margin (Absolute Dollars) Markup Scenario)

Prior to the effective date of the amended energy conservation standard, cash flows are driven by the level of capital investments and equipment conversion expenses and the proportion of these investments spent every year. After the standard announcement date, 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 running up to the effective date, as capital expenditures and equipment development costs depress cash flows from operations. Free cash flow begins to improve during the year the new energy conservation standard becomes effective. In this year, manufacturers write down the part of the value of existing tooling, equipment, and intellectual property whose value is impacted by the new efficiency standard. This one time write down acts as a tax shield that increases the cash flow from operations for this one year only. In the years following the standard, the impact on cash flow depends on the operating revenue. Higher TSLs have a positive impact on cash flows relative to the base case under the preservation of gross margin percentage markup scenario because manufacturers are able to fully pass along costs to customers. Under this scenario, free cash flow is restored to baseline level for all TSLs the year the standard becomes effective. Prior to 2012, higher TSLs have a greater improvement on the industry's cash position because the higher prices improve revenue brought in by standards compliant equipment and increase operating cash flows. All higher TSLs have a negative impact on free cash flow relative to the base case under the preservation of gross margin in absolute dollars markup scenario. In this scenario, higher TSLs squeeze the gross margin percentages as higher incremental price increases of standards compliant equipment lead to a greater proportion of those costs not being recouped, eroding operating cash flow.

13.6 OTHER IMPACTS

13.6.1 Employment

To quantitatively assess the impacts of energy conservation standards on CRE manufacturing employment, DOE used the GRIM to estimate the domestic labor expenditures and number of employees in the base case and at each TSL from 2007 through 2042. DOE used statistical data from the U.S. Census Bureau's 2006 Annual Survey of Manufactures (2006 ASM) 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 CRE, DOE used the industry cost structure constructed from 2006 ASM data classified under NAICS 333415 (AC, forced air heating, and refrigeration equipment manufacturing). The labor percentage and other components of the industry cost structure are show in Figure 13.6.1 below.

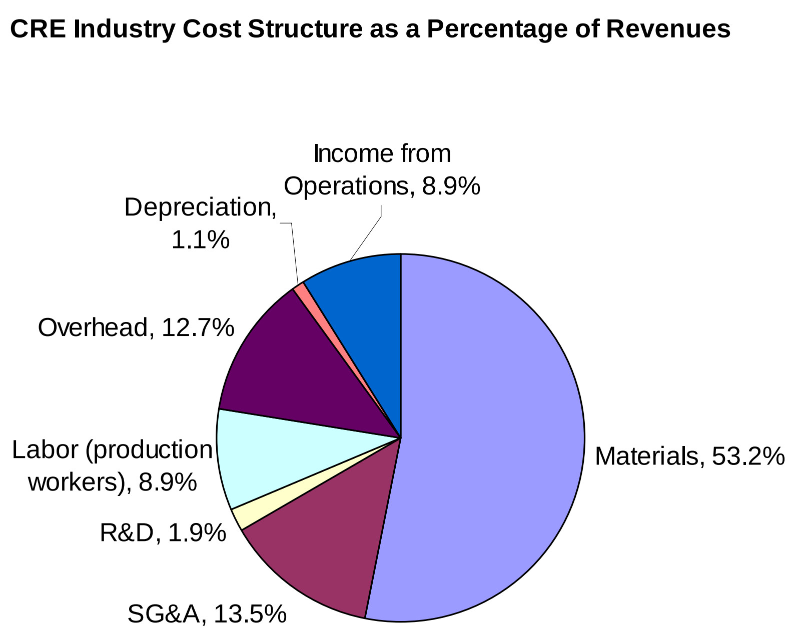

Figure 13.6.1 CRE Products Industry Cost Structure

To calculate the 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 by the production labor percentage. As a result, higher TSLs have greater direct labor costs because more efficient products have higher MPCs. Based on interviews with manufacturers, the vast majority of CRE sold in the U.S. are fully manufactured or assembled domestically. Though some manufacturers have production facilities abroad, these plants manufacturer components and partially finished CRE that are shipped to the U.S. for final assembly. Therefore, DOE assumed that the annual total labor expenditure represented U.S. labor expenditures.

The domestic annual labor expenditures in the GRIMs 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). 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.

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. The employment results presented in the GRIM represent U.S. production workers that are impacted by this rulemaking. U.S. workers involved in manufacturing or supporting products for exports would not be impacted and are not included as part of the labor impacts.

The GRIM calculates that the CRE industry's base case domestic labor expenditure for production labor in 2012 is approximately $76 million (total COGS in 2012 times the production labor percentage of COGS times the percentage of U.S production). Using the $17.16 wage rate and 2,009 production hours per year per employee found in the 2006 ASM, the GRIM estimates there are approximately 2,199 total commercial refrigeration equipment production employees involved in manufacturing products covered by this rulemaking. In addition, DOE estimates that 681 non-production employees in the U.S. support CRE production.[c] The employment spreadsheet of the convention CRE GRIM shows the annual domestic employment impacts in further detail.

Table 13.6.1 illustrates the impact of new energy conservation standards on domestic employment levels at each TSL for the CRE industry calculated by the GRIM.

---

[c] As defined in the 2006 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."

Table 13.6.1 Commercial Refrigeration Equipment Industry Estimated Employment Impacts in 2012

Trial Standard Level	Base Case	TSL 1	TSL 2	TSL 3	TSL 4	TSL 5
Total Number of Domestic CRE Production Employees in 2012	2,199	2,205	2,291	2,371	2,396	2,978
Change in Total Number of Domestic CRE Production Employees in 2012 Due to Standards	-	6	92	172	197	779
Total Number of Domestic CRE Non-Production Employees in 2012	681	683	709	734	742	922
Total Number of Domestic CRE Employees in 2012	2,880	2,888	3,000	3,105	3,137	3,900

Figure 13.6.2 shows total annual domestic employment levels for each TSL calculated by the GRIM.

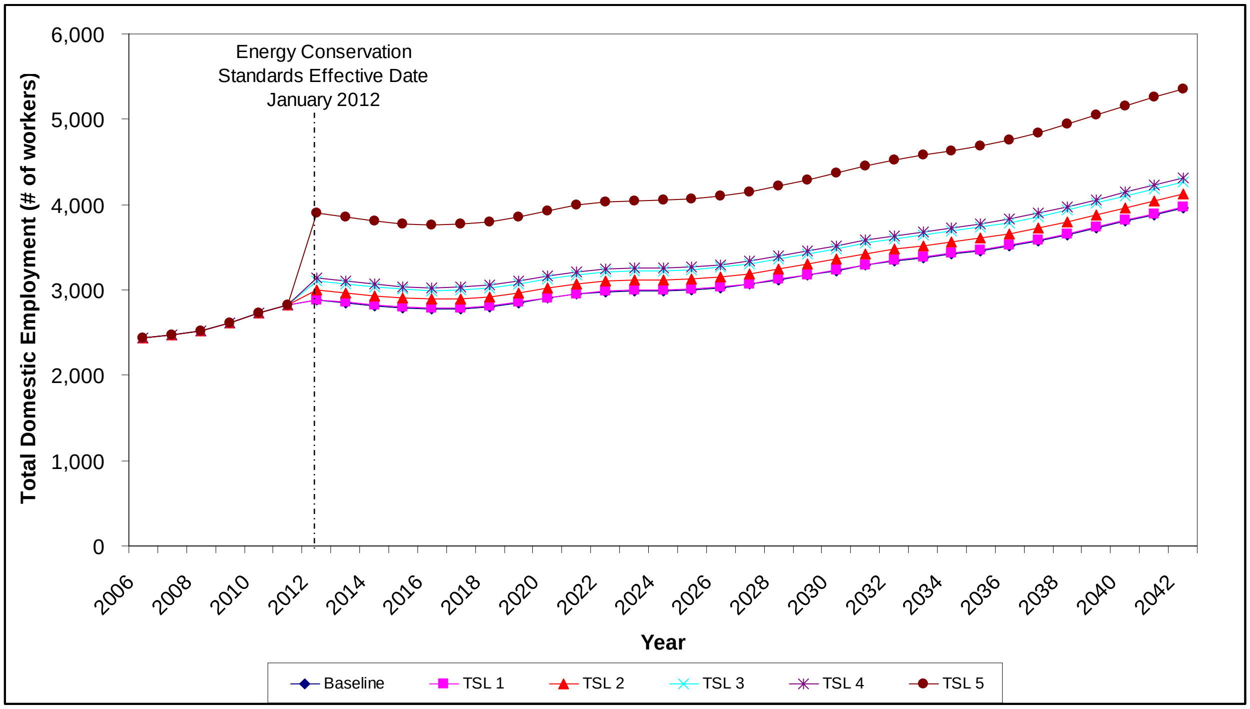

Figure 13.6.2 Total Commercial Refrigeration Equipment Industry Domestic Employment by Year

Because employment expenditures are assumed to be a fixed percentage of COGS and the MPCs increase with more efficient equipment, the GRIM predicts an increase in employment after standards. As discussed in manufacturing interviews, there are a variety of manufacturers with different capabilities. Larger, more vertically integrated companies typically manufacture more of the final product. Hence, an increase in the complexity of the products shipped would result in higher employment, as predicted in the GRIM. Smaller manufacturers are more typically assemblers. In response to standards, these manufacturers would most likely not alter employment levels because inserting a more efficient component does not necessarily require more labor (e.g., purchasing a more compressor only increases material costs). For assemblers, the greater labor expenditures for more efficient components are born by their suppliers. For smaller manufacturers that assemble final products, labor is more a function of units shipped, not production costs. Since the GRIM predicts an increase in shipments, it is unlikely that assemblers will lower employment in response to standards. Manufacturers agreed that the more efficient equipment would require more labor and that employment in existing facilities would remain constant or increase as long as shipments do not decrease.

Currently the vast majority of commercial refrigeration equipment is manufactured in the U.S. DOE expects that there would be positive direct employment impacts among domestic commercial refrigeration equipment manufacturers for TSL 1 through TSL 5. This conclusion ignores 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. Because the labor impacts in the GRIM do not take relocation into account, the labor impacts would be different if manufacturers chose to relocate to lower cost countries. Some manufactures stated that there would be increasing pressure to cut costs at higher TSLs, which could result in relocation. However, most manufacturers stated that they would likely modify existing facilities to manufacturer standards-compliant CRE. Manufacturers stated that their sourcing decisions would not be greatly influenced by this rulemaking so long as shipments do not drastically change.

13.6.2 Production Capacity

According to the majority of CRE manufacturers, new energy conservation standards will not significantly affect production capacity. Since DOE based the design options on more efficient components, manufacturing redesigned equipment will not necessarily change the fundamental assembly of the equipment. However, manufacturers anticipate some minor changes to tooling. Thus, DOE believes manufacturers will be able to maintain manufacturing capacity levels and continue to meet market demand under new energy conservation standards. During interviews manufacturers stated that they would be able to modify their existing production facilities to meet demand.

13.6.3 Exports

CRE exports comprise a small fraction of CRE sales. Manufacturers interviewed estimate that exports account for 10 to15 percent of total sales. Approximately one-third of exports are sold to Canada, approximately two-thirds to Mexico, and a very small percentage to some Caribbean and a few South American countries. Exports to Europe and Asia are rare because of the high cost of transporting commercial refrigeration equipment by ocean freight. Manufacturers also stated that their foreign exports are not generally affected by energy efficiency standards in other countries, except for Canada. The Canadian requirements are similar to California's requirements so standards in other countries are currently not a great concern for manufacturers.

Most manufacturers interviewed stated that they do not expect much change to their export strategies following standards. Once the U.S. standard takes effect, commercial refrigeration equipment manufacturers would still be able to produce and export units that do not meet DOE's efficiency standard, since the standard only applies to equipment for use in the United States.

Some manufacturers stated that in the absence of standards, production facilities are being relocated to other countries, particularly Mexico, due to lower labor rates. This activity is associated with internal operational and economic decisions and is not expected to accelerate due to energy conservation standards. Other manufacturers stated that they have no future plans to move production facilities outside the United States and that standards will not impact this decision.

Manufacturers also estimated that foreign competition has captured only a small portion of the CRE market. However, because of the high cost of transportation by ocean freight, foreign manufacturers have begun transitioning from importing equipment to establishing production facilities in or near the United States.

13.6.4 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 CRE manufactures or their parent company that will take effect three years before or three years after the effective date of the amended energy conservation standards for these products.[d]

Companies that produce a wider range of regulated equipment may be faced with more capital and equipment development expenditures than their competitors. Regulatory burdens can prompt companies to exit the market or reduce their equipment offerings, possibly reducing competition. Smaller companies may be especially affected since they have lower sales volumes over which to amortize the costs of meeting new regulations. A proposed standard is not economically justified if it contributes to an unacceptable level of cumulative regulatory burden.

In addition to the energy conservation regulations on commercial refrigeration equipment, 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.

13.6.4.1 Federal Regulations on Commercial Refrigeration Equipment and Other Equipment Produced by the Same Manufacturers

Besides the energy conservation regulations on CRE, several other Federal regulations and pending regulations apply to other equipment produced by the same manufacturers. DOE

[d] The effective date for commercial refrigeration equipment is three years from the date of publication of the final rule (approximately December 2012).

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 13.6.2 lists the Federal regulations that could also affect manufacturers of the CRE industry in the three years leading up to and the three years preceding the effective date of the amended energy conservation standards for this equipment. It must be noted that the amount of cumulative burden on any particular firm is extremely variable since the product scope of each company is different. Table 13.6.2 also provides the timetables for these regulations.

Table 13.6.2 Other DOE Actions Affecting the CRE Industry

Regulation	Approximate Effective Date*	Number of Impacted Companies from the MTA	Estimated Total Conversion Expenses**
Packaged Terminal Air Conditioners and Heat Pumps (PTAC and PTHP)	2012	2	$17.3 (2007$)[e]
Room Air Conditioners	2014*	1	N/A†
Residential Furnaces	2015	2	$97 (2006$)[f]
Walk-in Freezers and Coolers	2015*	6	N/A†

*The dates listed are an approximation. The exact dates are pending final DOE action
** Total conversion expenses include both capital and equipment conversion expenses.
† For energy conservation standards for ongoing rulemakings that are awaiting DOE final action, DOE does not have finalized estimated total industry conversion expense.

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 CRE. Differences in market shares and manufacturing processes of other regulated products for each manufacture could cause varying degrees of burdens on these manufactures. Therefore, DOE only estimated the cost of compliance to meet other energy conservation standards for regulated products if DOE had published a final rule.

In addition to other rulemakings setting minimum energy conservation standards, DOE recognizes that there are mandated federal restrictions that could impact CRE manufacturers. Production of foam insulation uses a blowing agent. The U.S. Environmental Protection Agency's (EPA's) strategy for meeting U.S. obligations under the Montreal Protocol requires the United States to phase out the production and use of HCFC blowing agents. HCFC-22 and HCFC-142b will be phased out on January 1, 2010, when manufacturers will have to switch to blowing agents with zero ozone depletion potential. The EPA has also mandated a phaseout of HCFC refrigerants. DOE based its analysis on hydrofluorocarbon-based refrigerants that comply

[e] Estimated industry conversion expenses were published in the TSD for the October 2008 PTAC and PTHP final rule. 73 FR 58772. The TSD for the 2008 PTAC and PTHP final rule can be found at: http://www1.eere.energy.gov/buildings/appliance_standards/commercial/ptacs_pthps_final_rule.html.
[f] Estimated industry conversion expenses were published in the TSD for the November 2007 residential furnace final rule. 72 FR 65136. The TSD for the 2007 residential furnace final rule can be found at: http://www1.eere.energy.gov/buildings/appliance_standards/residential/furnace_boiler_fr.html.

with the EPA phaseout of HCFCs. During interviews manufacturers indicated that they had already begun using other non-HCFC refrigerants and blowing agents.

13.6.4.2 Restriction of Hazardous Substances Directive

The Restriction of Hazardous Substance Directive[3] (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 market new electrical and electronic equipment containing more than agreed levels of lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyl, and polybrominated diphenyl ether flame retardants. Though manufacturers typically do not export CRE to the European Union, manufacturers stated this directive could potentially impact their business. 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 hazardous substances included in the RoHS directive that can be sold in California. CRE manufacturers said that RoHS could affect the way electronic components in commercial refrigeration equipment are incorporated into the design. However, manufacturers do not anticipate RoHS will significantly affect the CRE industry as a whole.

13.6.4.3 Other Regulations for Commercial Refrigeration Equipment

Following the August 2008 NOPR, public comments made DOE aware that commercial refrigeration equipment manufacturers must test equipment using the NSF 7 test procedure in addition to the DOE test procedure. NSF 7 measures product temperature for food safety requirements, while the DOE test procedure measures energy consumption for energy conservation standards. Although NSF 7 is not a Federal regulation, the commercial refrigeration equipment industry in general already tests their equipment using this procedure to meet food safety requirements.

In addition to Federal energy conservation standards, manufacturers also must comply with regulations imposed on equipment shipped to States and foreign countries. Certain types of commercial refrigeration equipment are regulated by Title 20 of the California Energy Commission (CEC) and the Energy Efficiency Regulations of Natural Resources Canada (NRCan). Also, a European Union Eco-Design study to establish an Energy Using Products (EuP) directive for a standard on commercial refrigerators and freezers is in its final stages.

13.7 CONCLUSIONS

The following section summarizes the different impacts for the two scenarios DOE believes are most likely to capture the range of impacts on CRE manufacturers as a result of new energy conservation standards. DOE also notes that while these two 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 on the CRE industry, DOE considered a scenario in which the industry gross margin percentage in the base case is preserved in the standards case (i.e., the markup is held constant for all products at all TSLs). Thus, a manufacturer is able to fully pass on any additional costs due to standards and maintain the percentage margin between COGS and MSP. Thus, if unit sales remain constant, the gross margin in absolute dollars will increase after a standard comes into effect.

To assess the higher end of the range of potential impacts on the CRE industry, DOE considered the scenario reflecting the preservation of industry gross margin in absolute dollars. Under this scenario, DOE assumed that the industry cannot pass on all additional costs due to efficiency-related changes (i.e., the markup decreases for all TSLs in the standards case.) Thus, the absolute gross margin in dollar terms is held constant. This means the percentage difference between MPC and MSP will decrease in the standards case compared to the base case and the gross margin percentage will be lower. As a result, the industry will make the same gross margin in absolute dollars post-standard in a scenario with constant shipments but the industry will also have a lower INPV since the gross margin percentage is eroding.

The impacts on INPV and cash flow are relatively minor at TSL 1 because minimal investments are required and the MSPs earned by manufacturers are nearly the same as the base case even under the preservation of gross margin (absolute dollars) markup scenario. DOE estimated the impacts in INPV at TSL 1 to range from approximately no impact to -$7 million, or a change in INPV of 0.02 percent to -1.27 percent. At this level, the industry cash flow is $53.6 million, or nearly the same as the base-case value of $54.1 million in the year leading up to the standards. Since DOE estimates that more than 80 percent of the equipment being sold is already at or above this level, those manufacturers that do not fall below TSL 1 will not have to make additional modifications to their equipment lines to conform to the energy conservation standards. The tight range of small impacts indicates that industry revenues and costs are not significantly negatively affected due to new energy conservation standards.

DOE estimated the impacts in INPV at TSL 2 to range from approximately $8 million to -$39 million, or a change in INPV of 1.42 percent to -7.16 percent. At this level, the industry cash flow decreases by approximately 6 percent, to $50.9 million, compared to the base-case value of $54.1 million in the year leading up to the standards. DOE estimates that roughly 45 percent of the equipment being sold is already at or above this level. The required higher level of efficiency will cause some manufactures to modify their equipment lines to conform to the energy conservation standards. At this TSL, revenues and costs are not substantially affected if manufacturers can fully recover the increase in manufacturer production cost from customers. Standards lead to a positive INPV if manufacturers raise MSP due to the higher costs of the equipment, so that manufacturers fully recover and even surpass the investments needed to achieve this level. The relatively small range of INPV impacts indicate that manufacturers are not significantly impacted even if they are not able to fully pass along costs to their customers.

At TSL 3, the impact on INPV and cash flow varies depending on the manufacturers and their ability to pass on MPC increases to the customer. DOE estimated the impacts in INPV at TSL 3 to range from approximately -$11 million to -$99 million, or a change in INPV of -1.95 percent to -18.26 percent. At this level, the industry cash flow decreases by approximately 43 percent, to $30.7 million, compared to the base-case value of $54.1 million in the year leading up to the standards. At TSL 3, the majority of manufacturers would require a complete redesign of their equipment. The relatively large conversion costs to redesign equipment and make plant changes drive INPV negative even if manufactures are fully able to pass along equipment cost increases to customers.

At TSL 4, the impact on INPV and cash flow varies depending on the manufacturers and their ability to pass on MPC increases to the customer. DOE estimated the impacts on INPV at TSL 4 to range from -$39 million to -$148 million, or a change in INPV of approximately -7.29 percent to -27.35 percent. At this level, the industry cash flow decreases by approximately 85 percent to $8.2 million, compared to the base-case value of $54.1 million in the year leading up to the standards. TSL 4 was created as a combination of TSL 3 (minimum LCC) and TSL 5 (max-tech). Manufacturers were not directly asked about this combination TSL during interviews. However, DOE estimated the impacts at this TSL by looking at responses at the efficiency levels on which this TSL is based. Because a large portion of the equipment is at max tech, the conversion costs manufacturers require to meet TSL 4 are substantially greater than TSL 3. Even if manufacturers are able to fully pass along costs to customers, the investments are large enough to drive INPV negative. In addition to large forced investments, there are substantial increases in production costs for standards-compliant equipment at TSL 4. The large increases in production costs drive INPV largely negative if manufacturers cannot fully pass along these increased costs to customers.

At TSL 5 (max-tech), DOE estimated the impacts in INPV to range from $20 million to -$340 million, or a change in INPV of approximately 3.73 percent to -63.01 percent. At this level, the industry cash flow decreases by approximately 108 percent to -$4.5 million, compared to the base-case value of $54.1 million in the year leading up to the standards. Currently, there is only one model being manufactured at these efficiency levels for most equipment classes, and some equipment classes have no equipment at these levels. Even though DOE created the max-tech TSL using components that are currently available for all equipment classes, manufacturers expressed great concern at the possibility of requiring an entire equipment line to be manufactured at the max- tech levels. In addition, at higher TSLs it is more likely that manufacturers would have greater difficulty fully passing on larger MPC increases to customers. At TSL 5, there is a risk of very large negative impacts if margins are reduced due to manufacturers’ inability to pass cost increases to customers.

REFERENCES

[1] Securities and Exchange Commission, *Annual 10-K Reports*, Various Years, Washington D.C., www.sec.gov.

[2] Freedonia. 2004. Commercial Refrigeration Equipment to 2008. Study 1849. Freedonia Group, Inc, Cleveland, Ohio, October 2004, 204 pp. available at http://www.freedoniagroup.com/Commercial-Refrigeration-Equipment.html

[3] Further information about RoHS can be found at http://eur-lex.europa.eu/LexUriServ/site/en/oj/2003/l_037/l_03720030213en00190023.pdf.