CHAPTER 12 PRELIMINARY MANUFACTURER IMPACT ANALYSIS

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12.1 INTRODUCTION

The purpose of the manufacturer impact analysis (MIA) is to identify and quantify the likely impacts of amended energy conservation standards on manufacturers. In the notice of the proposed rulemaking (NOPR), the United States Department of Energy (DOE) considers a wide range of quantitative and qualitative industry impacts that might occur due to an amended energy conservation standard. For example, a particular standard level could require changes in manufacturing practices, equipment, raw materials, etc. DOE fully analyzes these impacts during the NOPR stage of analysis.

DOE announced changes to the preliminary analysis MIA format through a report issued to Congress on January 31, 2006 (as required by section 141 of the Energy Policy Act of 2005 (EPACT 2005), entitled "Energy Conservation Standards Activities."[1] As a result, DOE collects, evaluates, and reports preliminary MIA information in the preliminary analysis prior to the NOPR stage. Such preliminary information includes market data, market shares, industry consolidation, equipment mix, key issues, conversion costs, foreign competition, and cumulative regulatory burden information, if available. DOE solicits this information during the preliminary manufacturer interviews and reports the results in this chapter. Appendix 12A includes a copy of the interview guide that DOE distributed to manufacturers.

To the extent appropriate for this rulemaking, DOE plans to apply the methodology described below to evaluate amended energy conservation standards for electric motors rated from 1 to 500 horsepower.

12.2 METHODOLOGY

DOE conducts the MIA in three phases. In Phase I, DOE creates an industry profile to characterize the industries and conducts a preliminary MIA to identify important issues that require consideration. Section 12.3 of this chapter presents initial findings of the Phase I analysis. In Phase II, DOE prepares an industry cash-flow model and a detailed interview questionnaire to guide subsequent interviews with manufacturers. In Phase III, DOE interviews manufacturers and assesses the impacts of amended energy conservation standards both quantitatively and qualitatively. DOE assesses industry and subgroup cash-flow impacts and industry net present value using the Government Regulatory Impact Model (GRIM). DOE also assesses impacts on competition, manufacturing capacity, employment, and regulatory burden based on manufacturer interviews and discussions. The *Federal Register* NOPR and technical support document present results of the Phase II and III analyses.

[1] This report is available on the DOE website at: http://www1.eere.energy.gov/buildings/appliance_standards/pdfs/congressional_report_013106.pdf.

12.2.1 Phase I: Industry Profile

In Phase I of the MIA, DOE collects pertinent qualitative and quantitative financial and market information. This includes data on wages, employment, industry costs, and capacity utilization rates for manufacturers of electric motors. Sources of information include reports published by industry groups, trade journals, the U.S. Census Bureau, and Securities Exchange Commission (SEC) 10-K filings. In addition, DOE relies on information from its own market and technology assessment, engineering analysis, life-cycle cost analysis, shipments analysis, and equipment price determination to characterize the electric motor manufacturing industry.

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

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

12.2.2.1 Industry Cash-Flow Analysis

DOE uses the GRIM to analyze the financial impacts of amended energy conservation standards. Amended energy conservation standards may require additional investment, higher production costs, and could affect revenue through higher prices and, potentially, lower shipments. The GRIM uses several financial parameters to determine a series of annual cash flows for the year that amended energy conservation standards become effective and for several additional years. These factors include annual expected revenues, costs of goods sold, selling and general administration expenses, research and development expenses, taxes, and capital expenditures. Inputs to the GRIM include those financial parameters, manufacturing costs, shipment forecasts, and markup assumptions. The financial information is developed from publicly available data and confidentially submitted manufacturer information. DOE compares the GRIM results for the standards case at each trial standard level against the results for the base case in which no amended energy conservation standards are in place. The financial impact of amended energy conservation standards is the difference between the two sets of discounted annual cash flows.

12.2.2.2 Interview Guide

DOE conducts interviews with manufacturers to gather information on the effects of amended energy conservation standards on revenues, costs, direct employment, capital assets, and industry competitiveness. Before the interviews, which occur in Phase III, DOE distributes an interview guide to help identify the impacts of amended energy conservation standards on individual manufacturers or subgroups of manufacturers. Interview guide topics include: production costs; shipment projections; market share; equipment mix; conversion costs; markups and profitability; competition; manufacturing capacity; cumulative regulatory burden; and other relevant topics.

12.2.3 Phase III: Subgroup Analysis

Phase III activities take place after publication of the preliminary analysis. These activities include manufacturer interviews, revision of the industry cash-flow analysis, a

manufacturer subgroup analysis, and an assessment of the impacts on industry competition, manufacturing capacity, direct employment, and cumulative regulatory burden.

12.2.3.1 Manufacturer Interviews

DOE conducts detailed interviews with manufacturers to gain insight into the potential impacts of amended energy conservation standards on sales, direct employment, capital assets, and industry competitiveness. The interview process is critical to the MIA because it provides an opportunity for interested parties to privately express their views on important issues. Interviews are scheduled well in advance to provide every opportunity for stakeholders to be available for comment. Although a written response to the questionnaire is acceptable, DOE prefers interactive interviews, which help clarify responses and provide the opportunity to identify additional issues not specifically addressed in the interview questionnaire. A non-disclosure agreement allows DOE to consider confidential or sensitive information in its decision-making process. Confidential information will not be made available in the public record. At most, sensitive or confidential information may be aggregated and presented in industry-wide representations.

DOE uses information gathered during manufacturer interviews to supplement the information gathered in Phase I and the cash flow analysis performed in Phase II.

12.2.3.2 Revised Industry Cash-Flow Analysis

As discussed, DOE requests information about profitability impacts, changes in capital expenditures, and other manufacturing impacts during the interview process. DOE revises its industry cash flow model based on the feedback it receives in written comments and during interviews.

12.2.3.3 Manufacturer Subgroup Analysis

Using average cost assumptions to develop an industry cash flow estimate will not adequately assess differential impacts among manufacturer subgroups. Smaller manufacturers, niche players, and manufacturers exhibiting a cost structure that differs greatly from the industry average could be more negatively affected. Ideally, DOE would consider the impact on every firm individually; however, it typically uses the results of the industry characterization to group manufacturers with similar characteristics. During the interviews, DOE discusses the potential subgroups that have been identified for the analysis. DOE asks manufacturers and other interested parties to suggest what subgroups or characteristics are most appropriate for the analysis.

12.2.3.4 Competitive Impact Assessment

Section 342(a)(6)(B)(i)(V) of the Energy Policy and Conservation Act, as amended, (EPCA) directs DOE to consider any lessening of competition likely to result from the imposition of standards. EPCA further directs the U.S. Attorney General to determine the impacts, if any, of any decrease in competition. DOE makes a determined effort to gather and report firm-specific financial information and impacts. DOE bases the competitive impact assessment on manufacturer cost data and other information collected from interviews. When

assessing competitive impacts, DOE's interviews generally focus on assessing asymmetrical cost increases, the potential increase in business risks from an increased proportion of fixed costs, and potential barriers to market entry (e.g., proprietary technologies). The competitive analysis may also focus on assessing any differential impacts on smaller manufacturers.

12.2.3.5 Manufacturing Capacity Impact

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

12.2.3.6 Employment Impact

The impact of amended energy conservation standards on employment is an important consideration in the rulemaking process. To assess how domestic employment patterns might be affected, the interview process explores current employment trends in the electric motor industry and solicits manufacturer views on changes in employment patterns that may result from new or amended standards. The employment impacts section of the interview guide focuses on current employment levels at production facilities, expected future employment levels with and without an amended energy conservation standard, differences in workforce skills, and employee retraining.

12.2.3.7 Cumulative Regulatory Burden

DOE seeks to mitigate the overlapping effects on manufacturers of energy conservation standards and other regulatory actions. DOE analyzes and considers the impact on manufacturers of multiple, equipment-specific regulatory actions.

12.3 PRELIMINARY MANUFACTURER IMPACT ANALYSIS OVERVIEW

During the preliminary analysis phase, DOE conducted a preliminary evaluation of the impact of potential new and amended energy conservation standards on the electric motor industry.

The primary sources of information for this analysis are the U.S. Census Bureau, industry reports, and interviews with manufacturers of electric motors conducted in the first quarter of 2011. To maintain confidentiality, DOE only reports aggregated information here. DOE does not disclose company-specific information, nor does it identify the individual manufacturers that disclosed information.

12.3.1 Industry Overview

The following section summarizes publicly available industry data.

12.3.1.1 Industry Cost Structure

DOE is unaware of any publicly available industry-wide cost data specific to only manufacturers of electric motors. Electric motor manufacturing is classified as a subset under the North American Industry Classification System (NAICS) code 335312 (*Power Motor and Generator Manufacturing*). Therefore, DOE presents the data below as a broader industry proxy for the electric motor industry, which, in combination with information gained in interviews, inform DOE's analysis of the industry cost structures. For simplicity, DOE will refer to these broader categories by the equipment they represent, namely motors. DOE obtained the below data from U.S. Census Bureau, *Annual Survey of Manufacturers, Statistics for Industry Groups and Industries* from 2005-2009.

Table 12.1 presents the motor and generator manufacturing employment levels and payroll from 2005 to 2009. The statistics show a 26.8 percent decrease in the number of production workers from 2005 to 2009 with a corresponding 14.5 percent decrease in the overall industry payroll.

Table 12.1 Motor and Generator Manufacturing Industry Employment and Earnings

Year	Production Workers	All Employees	Payroll for All Employees *thousand current year dollars*
2005	34,193	47,799	1,836,194
2006	33,764	46,477	1,784,902
2007	31,201	44,451	1,732,333
2008	31,121	43,997	1,868,738
2009	25,018	37,640	1,570,853
U.S. Census Bureau. *2009 Annual Survey of Manufacturers: 2009 and 2008*. December 2010; *2008 Annual Survey of Manufacturers: 2008 and 2007*. March 2010; and *2006 Annual Survey of Manufacturers: 2006 and 2005*. November 2008.			

Table 12.2 presents the costs of materials and industry payroll as a percentage of shipment value from 2005 to 2009. The cost of materials as a percentage of shipment value fell by 1.9 percent from 2005 to 2009. During the same time period, the cost of total payroll and the cost of payroll for production workers decreased by 12.5 percent and 22.6 percent, respectively.

Table 12.2 Motor and Generator Manufacturing Industry Material and Payroll Costs

Year	Cost of Materials (% of shipment value)	Cost of Payroll for Production Workers (% of shipment value)	Cost of Total Payroll (% of shipment value)
2005	51.67	10.18	16.53
2006	58.10	9.41	15.24
2007	56.96	8.11	13.66
2008	56.44	7.66	13.33
2009	50.70	7.88	14.47
U.S. Census Bureau. *2009 Annual Survey of Manufacturers: 2009 and 2008*. December 2010; *2008*			

Annual Survey of Manufacturers: 2008 and 2007. March 2010; and *2006 Annual Survey of Manufacturers: 2006 and 2005*. November 2008.

12.3.1.2 Inventory Levels

Table 12.3 shows the year-end inventory for the motor and generator manufacturing industry obtained from the U.S. Census Bureau and *Annual Survey of Manufacturers: Value of Manufacturers' Inventories by Stage of Fabrication for Industry Groups and Industries* and *Annual Survey of Manufacturers*: *Statistics for Industry Groups and Industries*. The industry's end-of-year inventory from 2005 to 2009 increased 32.5 percent when expressed in dollars, and grew 5.1 percent when expressed as a percentage of shipment value.

Table 12.3 Motor and Generator Manufacturing Industry End-of-Year Inventory

Year	End-of-Year Inventory *thousand current year dollars*	End-of-Year Inventory *percent of shipment value*
2005	1,539,507	13.86%
2006	1,740,148	14.85%
2007	1,780,086	14.03%
2008	1,494,506	13.77%
2009	2,040,169	14.56%
U.S. Census Bureau. *2009 Annual Survey of Manufacturers: 2009 and 2008*. December 2010; *2008 Annual Survey of Manufacturers: 2008 and 2007*. March 2010; and *2006 Annual Survey of Manufacturers: 2006 and 2005*. November 2008.		

DOE obtained full production capacity utilization rates from the U.S. Census Bureau, "Current Industrial Reports," *Survey of Plant Capacity* from 2002 to 2006[2]. Table 12.4 presents production capacity utilization rates for NAICS code 335312. Full production capacity is defined as the maximum level of production an establishment can attain under normal operating conditions. In the *Survey of Plant Capacity* report, the full production capacity utilization rate is a ratio of the actual level of operations to the full production level.

Table 12.4 Motor and Generator Manufacturing Industry Full Production Capacity Utilization Rates

Year	Motor and Generator Manufacturing (%)
2006	70
2005	59
2004	75
2003	62
2002	60
U.S. Census Bureau. 2007 *Current Industrial Reports: Table 1a - Full Production Capacity Utilization Rates by Industry: Fourth Quarters 2002 through 2006.* November 2007	

[2] Report from the U.S. Census Bureau is available at http://www.census.gov/manufacturing/capacity/historical_data/index.html

12.3.2 Interview Topics and Preliminary Findings

The following section summarizes information gathered during interviews held during the first quarter of 2011 for the preliminary MIA.

12.3.2.1 Market Shares and Industry Consolidation

Amended energy conservation standards can alter the competitive dynamics of the marketplace, prompting companies to enter the market, exit the market, or merge with other companies. The preliminary MIA interview questions asked manufacturers to share their perspectives on industry consolidation both in the absence of amended energy conservation standards and assuming amended standards at various efficiency levels. The interview questions focused on gathering information that assessed:

- current and anticipated market share in the event of standards,
- potential disproportionate cost increases to some manufacturers,
- likelihood of industry consolidation,
- increased proportion of fixed costs potentially increasing business risks, and
- potential barriers to market entry (e.g., proprietary technologies).

The need to assess anti-competitive effects of proposed amended energy conservation standards derives from the need to protect consumer interests. During the interviews, DOE also solicited information to determine whether amended energy conservation standards could result in disproportionate economic or performance penalties for particular consumer or user subgroups. Manufacturers were also asked if amended energy conservation standards could result in equipment that would be more or less desirable to consumers due to changes in equipment functionality, utility, or other features.

Market Shares: DOE inquired about the current market shares of manufacturers in the electric motor industry and how those shares might change after amended energy conservation standards. Manufacturers indicated that increasing efficiency levels would cause domestic production market share to dramatically decline. Multiple manufacturers indicated that increasing efficiency levels above what is currently available will require the motors to be hand-wound, which is a labor intensive practice that is only profitable when the motor is made in a lower-labor rate country. This may shift the advantage to foreign motor manufacturers, decreasing domestic manufacturing market share. Manufacturers also cited tooling upgrade investments, availability of lower loss electrical steels, and lack of enforcement of standards on imported motors as reasons that may cause market share of domestic manufacturers to decline.

Industry Consolidation: DOE inquired about the current market shares of manufacturers in the electric motor industry and how those shares might change after amended energy conservation standards. The electric motor industry is composed of several large manufacturers and a few smaller, niche manufacturers. Many electric motor manufacturers have merged in the past few years, and some manufacturers stated that they believe this trend will continue even in the absence of amended standards. Due to this recent trend of mergers, very few independent electric motor manufacturers remain in the United States. These remaining smaller

manufacturers could be forced out of the market if higher efficiency standards are implemented or the scope of this rulemaking is expanded to include equipment manufactured by these smaller companies.

12.3.2.2 Equipment and Profitability

DOE requested manufacturers' feedback on what they perceived to be the possible impact of amended energy conservation standards on the equipment that a manufacturer produces and resultant profits. Higher energy conservation standards would likely result in higher per-unit costs that could cause consumers to shift to less expensive alternative equipment, if such equipment were available. New standards could result in a change in the utility of the equipment to consumers. Manufacturers could also foresee a scenario in which new standards caused margin compression, which could threaten the viability of some firms in the industry.

Equipment Differentiation: Manufacturers indicated that increasing conservation standards may cause some manufacturers to exit specialized portions of the market (i.e. U-frame motors). Manufacturers cited low profitability due to low equipment volume as a reason for exiting the market instead of converting tooling to create motors at higher efficiency levels.

Equipment Utility: DOE received feedback that increased conservation levels may require motors to be built in larger frame sizes for their horsepower rating than those designated in NEMA MG1-2009 Table 13.3. Manufacturers indicated that motors made in a larger frame sizes will no longer fit into existing space-constrained applications, and that this may lead to an increase in motor repair practices instead of replacement with higher efficiency motors. This could also lead to entire machinery being redesigned to fit the larger motors, cause foreign machinery to become more competitive. One manufacturer indicated that relaxing limits on locked-rotor currents may increase efficiency and reduce power consumption but may also decrease the power factor, which could reduce stability of the power grid and increase power consumption. The manufacturer suggested DOE conduct a study on the increased power demand resulting from higher locked-rotor currents.

Profit Margins: Several manufacturers commented on the adverse negative impact new energy conservation standards may have on profit margins. Manufacturers mentioned capital and equipment conversion outlays needed to upgrade or redesign equipment before they have reached the end of their useful life may create significant conversion costs, resulting in reduced cash flow and stranded investments. Higher energy conservation standards could also result in higher per-unit costs that could cause consumers to shift to less expensive equipment. These higher costs could cause manufacturers to see a decrease in profit margins of their equipment. Multiple manufacturers also mentioned users deciding to rewind or repair older motors rather than replace with more expensive, higher-efficiency motors. This would cause a decrease in production volume and therefore a decrease in profit margins.

12.3.2.3 Conversion Costs

DOE asked manufacturers to quantify and explain both the capital and the equipment conversion costs necessary to raise the energy efficiency of their equipment-lines. Depending on the stringency of any amended energy conservation standard levels, manufacturers may be able

to meet the levels with existing equipment or they may have to completely redesign their equipment-lines. In either case, more stringent energy conservation standards would cause manufacturers to incur one-time capital and equipment conversion costs. Capital conversion costs are one-time investments in property, plant and equipment. Equipment conversion costs include one-time investments in research, equipment development, testing and marketing.

All manufacturers stated that the conversion costs associated with amended standards would depend on the efficiency level established by those standards. At the highest efficiency level, one manufacturer cited conversion costs as possibly exceeding $100 million, and the time needed for compliance exceeding five years. Copper rotors would require a significant investment in additional die-casting machines, and copper rotors could also cause a decrease in production volume as the process time for each rotor is longer and consumes more energy than the current, aluminum die-casting process. At lower efficiency levels, manufacturers stated that minimal capital investment may be necessary if manufacturers can switch to a more labor-intensive process. Changing the labor content, however, is likely to result in production being moved off-shore.

Manufacturers were also concerned about the potential for assets to be stranded due to higher energy conservation standards for motors. For every new capital investment made by manufacturers, some portion of the manufacturers' existing equipment for core production would be stranded. Additionally, manufacturers indicated that there are often very long lead times for obtaining advanced machinery. Specifically, manufacturers estimated that it would take two years for installation of new machinery to be completed after the purchase request is made for some of these capital investments.

12.3.2.4 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 individual manufacturers, groups of manufacturers, or entire industries. Assessing the impact of a single regulation may overlook this cumulative regulatory burden.

Expenditures associated with meeting other regulations are an important aspect of DOE's consideration of the cumulative regulatory burden the industry faces. The manufacturer interviews helped DOE identify the level and timing of investments manufacturers are expecting to incur because of these regulations. Manufacturers were also asked under what circumstances they might be able to make expenditures related to regulations and energy conservation standards.

Manufacturers expressed concern about the 2015 compliance date for small electric motors being within three years of this rulemaking's effective date. Manufacturers stated that adopting these two regulations in a short timeframe would strain research and development for motor manufacturers. Manufacturers also noted several existing regulations with which they are required to comply: National Fire Protection Association (NFPA) 70, *National Electrical Code*; NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection*; and U.S. Occupational Safety and Health Administration regulations.

12.4 OVERALL KEY ISSUES

Perhaps the most important aspect of the preliminary MIA is the opportunity it creates for DOE to identify key manufacturer issues early in the development of amended energy conservation standards. During preliminary interviews, manufacturers identified three major areas of concern: core steel availability, equipment conversion costs, and intellectual property.

12.4.1 Core Steel Availability

Manufacturers commented that there is limited global supply for the types of core steel necessary to build higher efficiency electric motors, particularly high-grade lamination steel. This shortage of higher grade steel could be exacerbated if efficiency standards for other equipment require more widespread use of this steel, causing a sudden increase in demand.

12.4.2 Copper Die Cast Rotors

Manufacturers commented on the impracticability of die-casting copper rotors. Namely, they were concerned with the rising cost of copper, the health hazards of die-casting copper, and the difficulty of purchasing copper die-casting equipment. Several manufacturers noted that copper die-casting equipment cannot be purchased; instead, copper die-casting companies require manufacturers to contract out this procedure.

12.4.3 Increase in Equipment Repair

Manufacturers stated that higher efficiency standards would likely increase the price of electric motors, which would drive consumers to consider rewinding older, less efficient motors rather than purchase a new, more efficient motor. This could not only decrease the shipments of electric motors but also decrease the potential energy savings of higher efficiency standards, particularly because repairing or rewinding a motor may not return that motor to its previous efficiency.

12.4.4 Enforcement

Several manufacturers stated that NEMA manufacturers may be disproportionately affected by amended standards because DOE may not enforce penalties on foreign manufacturers who choose not to comply. Without proper enforcement of standards, domestic manufacturers may incur compliance costs that foreign manufacturers do not incur, decreasing the competitiveness of domestic manufacturers.