

## CHAPTER 9. SHIPMENTS ANALYSIS

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## CHAPTER 9. SHIPMENTS ANALYSIS

### 9.1 INTRODUCTION

Product shipments estimates are a necessary input to the national energy savings (NES) and net present value calculations. Shipments are also a necessary input to the manufacturer impact analysis. A key output of the shipments model is an estimate of the rate at which an in-service stock of old, less-efficient motors may be replaced by more-efficient motors meeting the candidate standard. The core of the shipments analysis is an accounting model that the U.S. Department of Energy (DOE) developed to simulate how existing and future purchases are incorporated into an in-service stock of aging motors that are gradually replaced.

### 9.2 APPROACH

DOE developed a shipments forecast for each small motor equipment class. Within each class, small motor shipments are comprised of products in a number of horsepower ratings and three rotation speeds (corresponding to 2-pole, 4-pole, and 6-pole motors). DOE conducted its life-cycle cost analysis (see preliminary Technical Support Document (TSD) chapter 8) using representative 4-pole motors in each equipment class. To formulate its shipments estimates, DOE began with shipments data provided by National Electrical Manufacturers Association (NEMA) during for the determination analysis.<sup>1</sup> According to these data, polyphase motors account for an estimated 8 percent of total unit shipments while capacitor-start, induction-run (CSIR) motors are 87 percent and capacitor-start, capacitor-run (CSCR) motors are 5 percent. To calculate national impacts, DOE applied the average costs and energy use for a typical motor in each equipment class and applied these cost and energy use estimates to the total shipments in that product class for all speeds and horsepower ratings. This amounts to an assumption that the 4-pole motors are representative of the entire market.

In the main shipments analysis, DOE's forecast assumes that motors sales are driven by macroeconomic activity of the sectors in which they are used. In contrast, during the determination analysis, DOE examined medium growth and high growth cases that had shipments growing at an annual rate of one percent and 1.5 percent per year respectively. Small electric motors are mainly used in the industrial, agricultural, and commercial sectors. DOE estimates that less than one percent of the motors covered in this rule are used in the residential sector. Annual shipments growth rates for each sector are set as equal to annual growth rates in the following drivers, which are provided by the 2008 Annual Energy Outlook (*AEO 2008*) through 2030:<sup>2</sup>

- Industrial and Agricultural: Manufacturing activity (total shipments—manufacturing only, in dollars);
- Commercial: Commercial floor space;
- Residential: Number of households.

For each equipment class, DOE calculated average annual growth rates by weighting the growth rates in the sectoral drivers by the ownership shares of each sector in that class. The sector ownership shares are shown in Table 9.2.1 for each application and the application types for each equipment class are shown in Table 9.2.2.

**Table 9.2.1 Shares of Motor Owner Type by Application**

No.	Application	Motor Owner Type			
		Industrial	Commercial	Agricultural	Residential
1	Air and gas compressors	40%	49%	10%	1%
2	Commercial and industrial heating, ventilating, air-conditioning, and refrigeration equipment	40%	50%	10%	0%
3	Commercial laundry machinery	0%	100%	0%	0%
4	Conveyors	40%	40%	20%	0%
5	Farm machinery	0%	0%	100%	0%
6	Food machinery	20%	60%	20%	0%
7	General industrial machinery	40%	40%	20%	0%
8	Industrial and commercial fans and blowers	50%	50%	0%	0%
9	Machine tools	65%	20%	10%	5%
10	Packaging machinery	75%	10%	10%	5%
11	Pumps and pumping equipment	40%	40%	20%	0%
12	Service industry machinery	40%	40%	20%	0%
13	Textile machinery	100%	0%	0%	0%
14	Woodworking machinery	75%	10%	5%	10%

**Table 9.2.2 Application Shares by Equipment Class**

No.	Application	Equipment Class		
		Polyphase	CSIR	CSCR
1	Air and gas compressors	9.2%	8.1%	8.1%
2	Commercial and industrial heating, ventilating, air-conditioning, and refrigeration equipment	4.3%	8.4%	8.4%
3	Commercial laundry machinery	0.4%	1.2%	1.2%
4	Conveyors	18.8%	11.8%	11.8%
5	Farm machinery	3.0%	10.9%	10.9%
6	Food machinery	8.2%	2.1%	2.1%
7	General industrial machinery	3.4%	2.4%	2.4%
8	Industrial and commercial fans and blowers	5.6%	5.9%	5.9%
9	Machine tools	7.3%	1.9%	1.9%
10	Packaging machinery	1.0%	0.3%	0.3%
11	Pumps and pumping equipment	33.0%	41.1%	41.1%
12	Service industry machinery	1.5%	3.0%	3.0%
13	Textile machinery	1.2%	0.4%	0.4%
14	Woodworking machinery	3.1%	2.4%	2.4%
	TOTAL	100%	100%	100%

The estimated growth rates for each class vary by year. The average annual growth rates for shipments in 2015-2030 are 1.4 percent for polyphase motors and 1.1 percent for CSIR and CSCR motors. After 2030, DOE forecasted shipments using the average growth rates for the years 2020-2030.

### 9.2.2 Sensitivity of Shipments to Installed Cost

Sales of small electric motors may be sensitive to increases in the installed cost that may result from efficiency standards. Totally enclosed motors are potential substitutes for the open-construction motors covered in this rulemaking. These types of motors come in the same frame sizes, hp ratings and have similar performance characteristics. Today, the incremental cost of using a totally enclosed motor instead of an open-construction motor is approximately 18 percent. If the installed cost of open-construction motors were to increase much beyond 18 percent due to energy efficiency standards, there might be some migration to (non-covered) totally enclosed motors.

DOE believes that increases in the installed cost of small electric motors could reduce their purchase due to migration to totally enclosed motors or other factors. However, DOE has not found any data that would allow it to estimate the elasticity of small electric motor shipments to change in their purchase price. DOE would like to incorporate an appropriate purchase price elasticity in the notice of proposed rulemaking (NOPR) phase of its analysis. Therefore, it has

requested information and data on what would be an appropriate value to use for purchase price elasticity, and whether this elasticity should only be applied to energy efficiency levels that have an installed cost that is significantly higher than the base case.

### 9.2.3 Shipments by Product Class

To estimate current shipments market shares, DOE submitted to NEMA, on December 7, 2007, a request for shipment data for this purpose. However, NEMA did not receive adequate data from its membership and thus DOE pursued an alternate approach to estimating shipments by equipment class, speed and rated capacity.

For the Small Motors Determination Analysis published on July 10, 2006 (71 FR 38799), NEMA provided shipment data on small electric motors to DOE. DOE used these data to create an estimate of national shipments for 2007. The result of this projection is shown in Tables 9.2.3, 9.2.4, and 9.2.5. DOE invited NEMA and/or its members to review and submit comments on the shipments estimates. No comments were received by March 31, 2008. Consequently, DOE locked down the shipments estimate for the preliminary NOPR analysis. Interested parties will have an opportunity to comment on the shipments estimate again once it is made available by DOE in early 2009.

**Table 9.2.3 Estimated Polyphase Small Electric Motor National Shipments, 2007**

<b>Motor Horsepower/Standard Kilowatt Equivalent</b>	<b>Six Poles</b>	<b>Four Poles</b>	<b>Two Poles</b>	<b>Total</b>
<b>1/4 hp/0.18 kW</b>	1,967	7,637	1,967	11,571
<b>1/3 hp/0.25 kW</b>	4,784	16,289	3,264	24,338
<b>1/2 hp/0.37 kW</b>	8,181	49,884	3,607	61,671
<b>3/4 hp/0.55 kW</b>	12,286	59,460	82,596	154,342
<b>1 hp/0.75 kW</b>	17,608	71,708	17,608	106,925
<b>1½ hp/1.1 kW</b>	5,885	146,033	5,885	157,804
<b>2-3 hp/1.5-2.2 kW</b>	-	28,268	12,817	41,084
<b>Total</b>	50,711	379,279	127,744	557,735

**Table 9.2.4 Estimated Capacitor-Start, Induction-Run Small Electric Motor National Shipments, 2007**

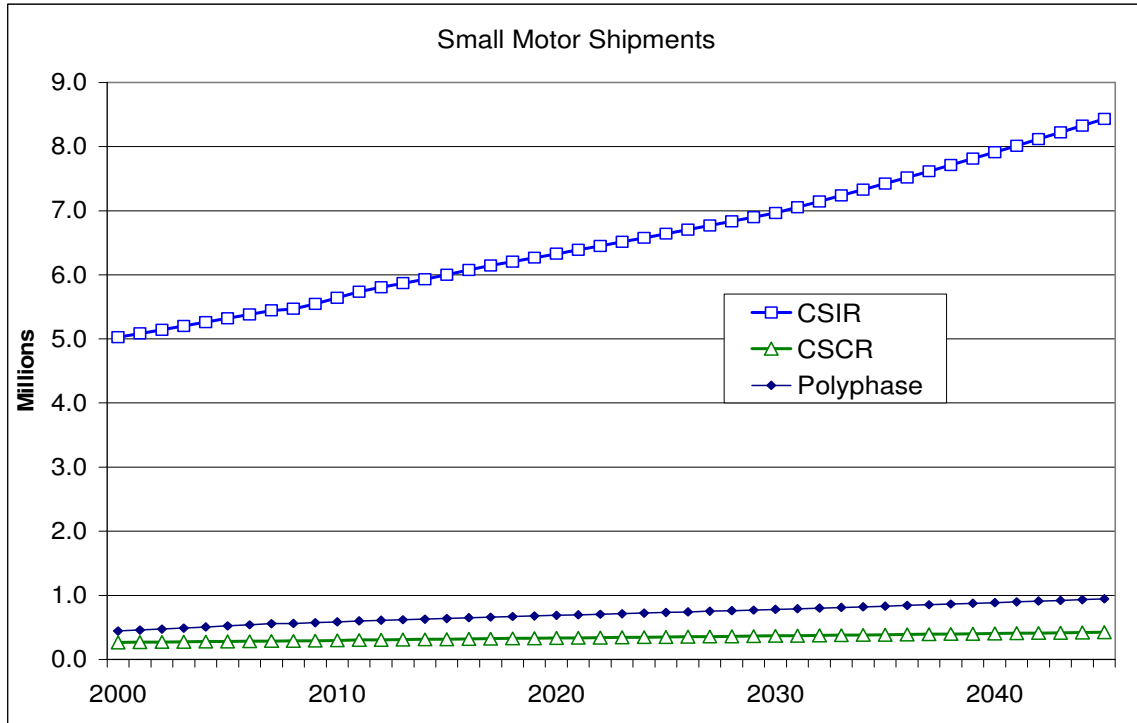
Motor Horsepower/Standard Kilowatt Equivalent	Six Poles	Four Poles	Two Poles	Total
1/4 hp/0.18 kW	348,160	384,581	223,615	956,357
1/3 hp/0.25 kW	597,471	659,971	383,742	1,641,183
1/2 hp/0.37 kW	326,266	534,194	504,566	1,365,025
3/4 hp/0.55 kW	290,405	475,480	449,108	1,214,994
1 hp/0.75 kW	-	57,456	155,520	212,976
>1 hp/0.75 kW	-	25,605	26,964	52,569
<b>Total</b>				5,443,104

**Table 9.2.5 Estimated Capacitor-Start, Capacitor-Run Small Electric Motor National Shipments, 2007**

Motor Horsepower/Standard Kilowatt Equivalent	Six Poles	Four Poles	Two Poles	Total
1/4 hp/0.18 kW	18,324	20,241	11,769	50,335
1/3 hp/0.25 kW	31,446	34,735	20,197	86,378
1/2 hp/0.37 kW	17,172	28,115	26,556	71,843
3/4 hp/0.55 kW	15,284	25,025	23,637	63,947
1 hp/0.75 kW	-	3,024	8,185	11,209
> 1 hp/0.75 kW	-	1,348	1,419	2,767
<b>Total</b>				286,479

### 9.3 SHIPMENTS FORECAST

DOE's forecast of annual small electric motor shipments is shown in Figure 9.3.1 and summarized in Table 9.3.1. The figure shows a steady increase in motor sales that corresponds to the steady increase in economic activity forecast by *AEO 2008*.



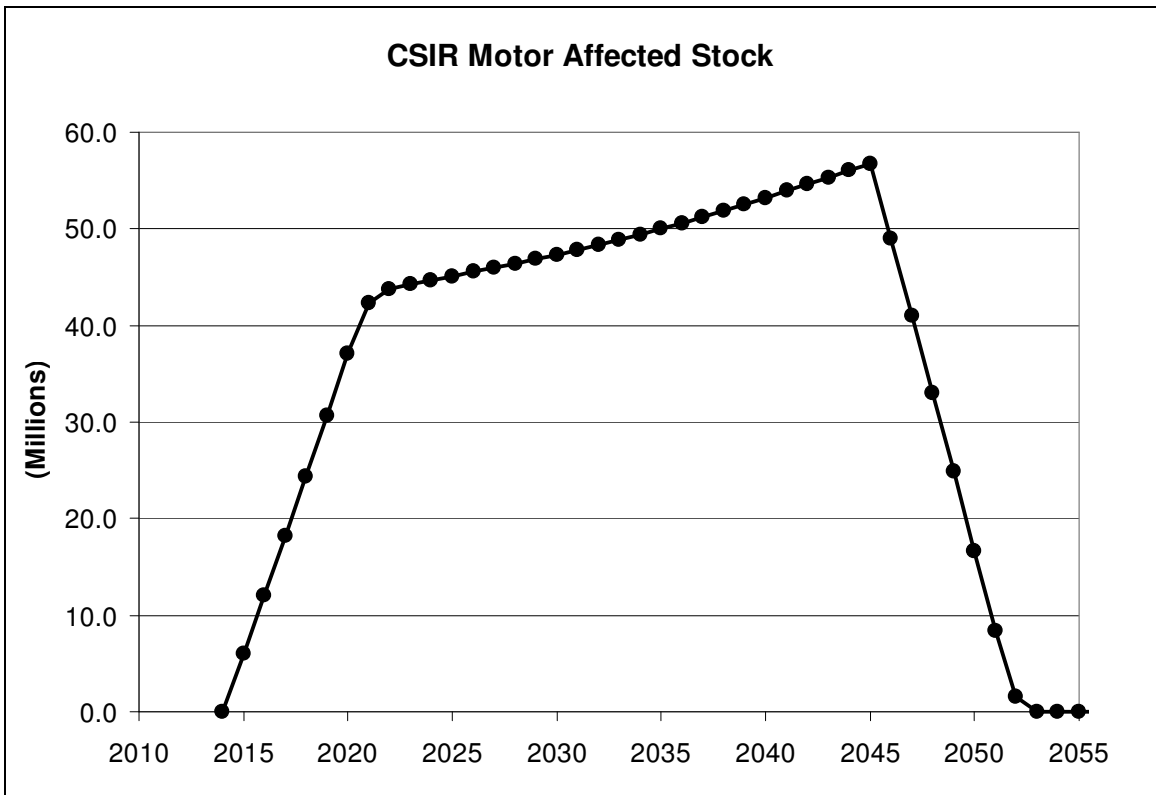
**Figure 9.3.1 Shipments Forecast for Small Motors by Equipment Class**

**Table 9.3.1 Annual and Cumulative Shipments Forecast for Small Electric Motors**

Equipment Class	Annual Shipments (millions)				Cumulative 2015–2045
	2015	2025	2035	2045	
Polyphase	0.638	0.732	0.831	0.944	24.3
CSIR	6.001	6.640	7.423	8.431	219.6
CSCR	0.316	0.349	0.385	0.423	11.4

Figure 9.3.2 shows the affected stock forecast from the shipments model for CSIR motors. The affected stock is the accumulation of motors in use that are subject to standards, and energy savings from a standard tends to increase with the accumulating affected stock of equipment. The affected stock increases rapidly initially as the older, inefficient stock of equipment is replaced by standard-compliant equipment. The stock then experiences a relatively long period of a gradual increase as the stock of equipment increases with gradually increasing national economic activity. Then at the end of the forecast period for annual shipments at 2045, the equipment is rapidly replaced by equipment purchased after the end of the forecast period.

Detailed data, estimates and forecasts on annual shipments and stocks are provided in the national impact analysis spreadsheet tool that accompanies this TSD.



**Figure 9.3.2** Affected Stock of Capacitor-Start, Induction-Run Small Electric Motors

## REFERENCES

1. National Electrical Manufacturers Association, *Joint NEMA/SMMA Bulletin of US Sales of Selected Small Motors in 2000*, September 5, 2001.
2. U.S. Department of Energy - Energy Information Administration, *Annual Energy Outlook 2008 with Projections to 2030*, 2008. Washington, DC. Report No. DOE/EIA-0383(2008).