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Energy Savings from NEMA Premium™ Electric Motors in the Northwest in 2012

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Executive Summary

In late 2010, energy efficiency standards that require electric motors to meet National Electrical Manufacturers Association (NEMA) Premium™ efficiency levels became effective in the United States. This federal regulation represented a significant increase in the energy efficiency requirements that the Energy Policy Act (EPAct) mandated for electric motors. This report estimates the annual energy savings in the Pacific Northwest due to 2012 shipments of these more efficient motors. For many motors, NEMA Premium™ is now the federally required efficiency level; however, at the Northwest Energy Efficiency Alliance's (NEEA's) request, Navigant assumes a baseline efficiency level corresponding to EPAct standards in the estimation of ongoing NEMA Premium™ motor savings.

NEMA Premium Motors Shipments in the Northwest in 2012

Motor *sales data* is not widely available, but *shipment data* is reasonably available and serves as a proxy for estimating sales. To generate an estimate for Northwest motor shipments in 2012, Navigant extrapolated 2009 *regional and national* shipment data (from the Consortium for Energy Efficiency, or CEE reports) after examining *national trends* (from DOE's preliminary analysis) and *market breakdown data* (from industry experts). Specifically, Navigant employed the following approach:

1. Procure reported shipment data distributed by NEMA through CEE
2. Adjust the latest year's data (i.e., 2009) to account for sales to Original Equipment Manufacturers (OEMs)
3. Extrapolate the adjusted 2009 shipments estimate to 2012 using DOE motor shipment projections
4. Estimate the portion of motors that are subtype I and therefore required to meet NEMA Premium™ efficiency levels

Under the new regulations, only general-purpose subtype I motors must to meet NEMA Premium™ efficiency levels, while special-purpose and definite-purpose motors do not. Navigant estimates that 59,947 general-purpose subtype I motors were shipped in the Pacific Northwest in 2012, with 59,700 meeting NEMA Premium™ efficiency standards (after adjusting for exempt motors over 200 horsepower). Table ES-1 summarizes the steps and calculations that Navigant used to estimate these values.

Table ES-1. Step-by-Step Estimation of 2012 NEMA Premium™ Shipments in the Northwest

Step	Description of Calculation	Input Estimate	Adjustment Factor*	Estimate After Adjustment
1	Obtain reported NEMA data for 2009	37,975	n/a	37,975
2	Adjust reported data to account for OEM sales	37,975	1.66	62,993
3	Forecast 2009 estimate to account for growth to 2012	62,993	1.29	81,339
4	Estimate portion of motor shipments that are subtype I	81,339	0.737	59,947**

Source: Navigant analysis

* See Section 3 for discussion of adjustments and related sources.

** Subtype I motors greater than 200 horsepower are not required to meet NEMA Premium™ efficiency standards. After adjusting for the penetration of large premium efficiency motors, Navigant estimates total NEMA Premium™ shipments of 59,700 in the Northwest in 2012. See Section 4 below for additional discussion.

Annual Energy Savings from 2012 Shipments of NEMA Premium™ Motors in the Northwest

Energy savings from NEMA Premium™ motors is a function of motor shipments and the per-unit savings from each motor. Estimation of per-unit savings values uses the approach from the 2011 Long-Term Monitoring and Tracking (LTMT) report (including an assumed baseline efficiency equivalent to the EPAct standards), but with updated shipments estimates by size category. Using this methodology, Navigant estimates per-unit savings of 483 kilowatt-hours (kWh) per year.

The implied energy savings from the estimated 59,700 NEMA Premium™ motors shipped to the Northwest in 2012 are 28,853 megawatt-hours (MWh) per year. This translates to annual savings of approximately 3.3 average megawatts (aMW) (Table ES-2).

Table ES-2. Implied Annual Energy Savings from NEMA Premium™ Electric Motor Shipments in the Northwest in 2012

	Annual Energy Savings (MWh)	(aMW)
Annual Energy Savings	28,853	3.3

Source: Navigant analysis

Navigant believes that the methodology used in this report is repeatable for updates to past LTMT reports and, with fresh data, is appropriate for future estimates of energy savings. However, NEEA may consider searching for updated data sources to ensure the validity of future projections.

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1 Introduction

In late 2010, energy efficiency standards that require electric motors to meet National Electrical Manufacturers Association (NEMA) Premium™ efficiency levels became effective in the United States. This federal regulation represented a significant increase in the energy efficiency requirements that the Energy Policy Act (EPAct) mandated for electric motors.

This report estimates the annual energy savings in the Pacific Northwest due to 2012 shipments of these more efficient motors. In order to make these estimates, Navigant Consulting, Inc. (Navigant), leveraged information from multiple sources including reports from the Consortium for Energy Efficiency (CEE) and the United States Department of Energy (DOE).

The energy savings estimates in this report represent an estimation of premium motor savings in the absence of the new energy efficiency standards for electric motors. For many motors, NEMA Premium™ is now the federally required efficiency level; however, at the Northwest Energy Efficiency Alliance's (NEEA's) request, Navigant assumes a baseline efficiency level corresponding to EPAct standards in the estimation of ongoing NEMA Premium™ motor savings.

2 Background on Efficiency Standards in the Electric Motors Market

The Energy Independence and Security Act of 2007 (EISA) affected multiple aspects of the electric motors market. First, EISA established new terminology applicable to electric motors. Second, EISA increased the stringency of the energy conservation standards that had been in effect for a certain set of electric motors by raising minimum efficiency requirements. Finally, EISA expanded the scope of energy conservation standards for electric motors to include new types of motors, which Navigant discusses in the following paragraph.

EISA amended the United States Code and established two new terms related to electric motors: "general-purpose electric motor (subtype I)" (subtype I) and "general-purpose electric motor (subtype II)" (subtype II). Prior to EISA, electric motors that were subject to energy conservation standards were simply termed "electric motors," although that term only encompassed general-purpose electric motors with a specific set of physical characteristics. The EISA amendments re-designated these motors as "general-purpose electric motors (subtype I)." The term for subtype II motors established a new category of motors that were not previously subject to energy conservation standards. In conjunction with the introduction of these two terms, EISA established energy conservation standards for subtype II motors (at the standard EPAct efficiency level) and increased the efficiency levels required for subtype I motors (to NEMA Premium™). On December 19, 2010, these new energy conservation standards became effective.[1]

[1] Additional details on these terms and their respective energy conservation standards are available in DOE's final rule on Test Procedures for Electric Motors and Small Electric Motors published in the *Federal Register* on May 4, 2012. (77 FR 26608).

Finally, the electric motors market also consists of "special purpose" and "definite purpose" motors in addition to the two general-purpose subtypes. These motors have unique characteristics because they are designed for specific environments and operating conditions. These motors are not currently subject to any energy conservation standards.

3 Northwest Premium Efficiency Motor Shipments in 2012

To generate an estimate of energy savings due to NEMA Premium™ sales in the Northwest in 2012, Navigant first needed to estimate the shipments of electric motors in the region, then adjust for premium efficiency shipments. Navigant then combined that information with assumptions regarding horsepower (hp), hours of operation, and efficiency levels to calculate energy savings. This section describes Navigant's efforts to estimate premium efficiency motor shipments, according to the following topics:

1. Data sources
2. Shipment estimation methodology
3. Estimated NEMA Premium™ shipments in the Northwest in 2012

3.1 Data Sources

To estimate the shipments of electric motors into the Northwest, this report built upon the activities conducted for the previous Long-Term Monitoring and Tracking (LTMT) assessments of the Drive Power Initiative (DPI). Navigant performed the following research activities:

- **Obtained motor shipment data from the CEE.** Motor sales data are not widely available and are difficult to obtain; however, shipment data is reasonably available and serves as a proxy for estimating sales. NEMA generates this data and the CEE distributes the NEMA data to its members. Navigant obtained 2009 shipment data for both standard and NEMA Premium™ motors as a part of the last iteration of the LTMT.

- **Reviewed publicly available information from DOE.** On July 23, 2012, DOE published a notice of a preliminary technical support document (TSD) regarding energy conservation standards for electric motors.[2] Part of the data published was a shipments analysis that projected the shipments of electric motors forward through the year 2044. This report refers to this publicly available data as "DOE Data."

- **Interviewed and obtained data from manufacturers and other industry experts.** In these interviews, the evaluation team discussed various topics, such as the approximate market breakdown of different electric motors types and distribution channels with

[2] The notice and preliminary TSD can be found at:
http://www1.eere.energy.gov/buildings/appliance_standards/rulemaking.aspx/ruleid/42

manufacturers. The team also obtained 2012 shipments information from the "Motor Coalition."[3]

By combining information from these data sources, Navigant was able to extrapolate data submitted by NEMA members in the 2009 CEE report to generate an estimate of Northwest shipments in 2012 (see section 3.2 below).

3.2 Shipment Estimation Methodology

Motor *sales data* is not widely available, but *shipment data* is reasonably available and serves as a proxy for estimating sales. National **s**hipment data for NEMA Premium™ motors dates back to 2001, with 2009 the most recent year covered in the shipment data distributed by the CEE through NEMA. Regional data has been available since 2004. As discussed in LTMT reports, motor shipment reporting sources were not consistent at several points in time since 2004.[4] For this reason, Navigant has estimated the true number of motor shipments since that time.

To generate an estimate for Northwest motor shipments in 2012, Navigant extrapolated 2009 *regional and national* shipment data (from the CEE reports) after examining *national trends* (from DOE's preliminary analysis) and *market breakdown data* (from industry experts). The following explanation of Navigant's findings begins with a discussion of motor shipment data and addresses the national trends and market breakdown data used to extrapolate those reported shipments.

To estimate the shipments of NEMA Premium™ motors in the Pacific Northwest in 2012, Navigant employed the following approach:

1. Procure reported shipment data distributed by NEMA through CEE
2. Adjust the latest year's data (i.e., 2009) to account for sales to Original Equipment Manufacturers (OEMs)
3. Extrapolate the adjusted 2009 shipments estimate to 2012 using DOE motor shipment projections
4. Estimate the portion of motors that are subtype I and therefore required to meet NEMA Premium™ efficiency levels

[3] The Motor Coalition is a group of interested parties that includes NEMA, American Council for an Energy-Efficient Economy, Appliance Standards Awareness Project, Alliance to Save Energy, Earthjustice, Natural Resources Defense Council, Northeast Energy Efficiency Partnerships, Northwest Power and Conservation Council, and NEEA. This group has come together to advocate specific energy conservation standards for an expanded scope of electric motors.

[4] Motor shipment data does not include OEMs in 2004, and one of the major motor manufacturers dropped out of the survey in 2005 (rejoining in 2008).

STEP 1: REPORTED MOTOR SHIPMENTS DATA

As noted in the 2010 LTMT report, the raw shipment data as reported by NEMA indicate that national shipments of NEMA Premium™ motors increased steadily between 2001 (the first year the branded motors were available) and 2006, dropping in 2007. Reported shipments in 2008 increased when compared to 2007, but the 2008 figures included one additional motor manufacturer relative to the prior three years.[5] In 2009, the same set of manufacturers reported shipment data as in 2008. Table 1 shows reported shipments of NEMA Premium™ and standard efficiency motors in 2009.

According to the most recent NEMA data available (Table 1), 830,051 non-OEM standard efficiency and NEMA Premium™ motors shipped nationally in 2009. NEMA data also indicate that 37,975 of those 830,051 motors shipped to the Northwest. These two shipments numbers are important for this analysis because they serve as the basis for the extrapolation used to generate 2012 shipments in the Northwest[6].

Table 1. Reported Shipments of NEMA Premium™ and Standard Efficiency Motors, 2009

Region	Premium	Non-Premium	Total
Idaho/Montana	11,830	4,455	16,285
Washington	2,379	5,314	7,693
Oregon	9,981	4,016	13,997
Northwest	24,190	13,785	37,975
Nation	201,933	628,118	830,051

Source: NEMA motor shipment data as reported by the CEE.

STEP 2: ACCOUNTING FOR OEM SHIPMENTS

The first step in extrapolating the reported shipment data to 2012 was estimating the shipments of motors to OEMs because NEMA did not report OEM motor shipment data in 2009. In the 2011 LTMT, Navigant used an extrapolation factor of 1.32 to account for OEM sales. Navigant based its estimate of that extrapolation factor on interviews with the Green Motors Practices Group and historical NEMA data. Based on publicly available DOE data, Navigant now believes this estimate to be conservative. According to DOE's preliminary TSD, shipments to OEMs could be as high as 50 percent of all motor shipments, implying an extrapolation factor of 2.0.[7] In this analysis, Navigant assumed an average of the two estimates, which gives a new

[5] The raw data for 2004 to 2007 are incomplete because the records exclude motors from OEMs, and at least one of the non-OEM manufacturers pulled out of the motor surveys beginning with the 2005 reporting year (Sources: 2007 interviews with GMPG and Baldor Electric Co.). The data for 2008 includes all major motor manufacturers and no OEM motors.

[6] Navigant based its 2012 extrapolation of shipment data on only the reported 2009 data (not including 2008 data) because 2009 was the most recent year for which data were available. Navigant's projections did not rely on recent trends in the NEMA-reported data but rather used a DOE yearly shipment index and thus required only one year's worth of reported data. See "Step 3: Forecasting Shipments to 2012" for further explanation of Navigant's approach.

[7] DOE's electric motors preliminary TSD Chapter 6, which contains more detailed information on distribution channels, is available at: http://www1.eere.energy.gov/buildings/appliance_standards/rulemaking.aspx/ruleid/42.

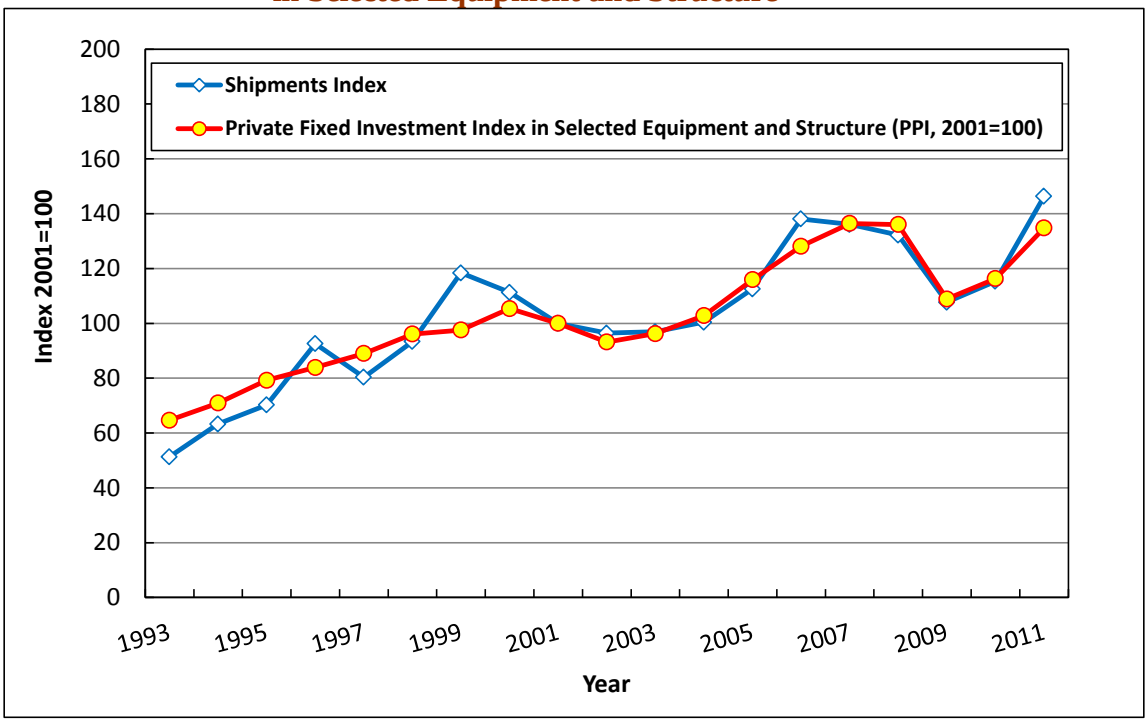
extrapolation factor of 1.66. Using this factor, Navigant estimated total shipments to the Northwest in 2009 of 62,993 motors.

STEP 3: EXTRAPOLATING HISTORIC SHIPMENT DATA TO 2012

In its preliminary TSD, DOE explains how it uses historical shipments data (from 1993 to 2011) to project electric motor shipments forward over 30 years (to 2044). DOE has also published a spreadsheet illustrating the corresponding calculations.[8] Navigant leveraged this publicly available information to project the 2009 NEMA data to 2012.

In its analysis, DOE assumes that the annual shipments growth rate correlates to the annual growth rate of private fixed investment in selected equipment and structures, including motors. DOE bases these assumptions on historical shipments data provided by the U.S. Census Bureau and NEMA for the years 1993 to 2011, as well as private fixed investment data from the Bureau of Economic Analysis.[9] Figure 1 displays the strong correlation between these two sets of data.

Figure 1. Shipments Index vs. Private Fixed Investment Index in Selected Equipment and Structure



Source: DOE

DOE used this data to derive a formula to project a shipments index forward to a given year based on the private fixed investment index. The private fixed investment index utilizes real

[8] DOE's electric motors preliminary TSD Chapter 9 and corresponding shipments spreadsheet is available at: http://www1.eere.energy.gov/buildings/appliance_standards/rulemaking.aspx/ruleid/42.

[9] The Bureau of Economic Analysis updates its data annually, truing up past projections and providing new forecasts.

"gross domestic product" growth from the Energy Information Administration's Annual Energy Outlook for 2011 (AEO 2011).[10]

Navigant used this data to extend its 2009 estimates of *national* motor shipments (total shipments to OEMs and non-OEMs) to project a 2012 value. Specifically, the estimation used the DOE's 29 percent growth projection between 2009 and 2012. Navigant corroborated this value with the proprietary data previously obtained from the Motor Coalition for *national* shipments. Once establishing the reliability of the growth projection, Navigant repeated the extrapolation calculations on the 2009 *Northwest* reported data to yield a 2012 estimate of 81,339 motors shipped.

STEP 4: ESTIMATING SUBTYPE I SHIPMENTS (REQUIRED TO BE NEMA PREMIUM™)

Upon review of the CEE reports, Navigant found that the shipment estimates provided by NEMA included special-purpose and definite-purpose motors in addition to general-purpose motors (both subtypes). As stated previously, only subtype I motors are required to meet NEMA Premium™ efficiency levels. Therefore, when Navigant projected the 2009 NEMA data forward to 2012, it was also necessary to estimate what share of these motors are required to meet NEMA Premium™ efficiency levels (i.e., what share of these motors are subtype I). To make these estimates, Navigant relied on information from interviews with manufacturers as well as information obtained from the Motor Coalition.

The information provided by the Motor Coalition contained a *national* estimate of total electric motor shipments for the year 2012. The Motor Coalition's data also parsed out *national* shipments estimates for just subtype I and II motors (relative to the market including special- and definite-purpose motors). For this analysis, Navigant applied the same ratio to its total 2012 *Northwest* shipments. Navigant also had to estimate the share of the combined subtype I and subtype II motors that were subtype I. To do this, Navigant relied on estimates obtained through interviews with manufacturers. During its interviews, Navigant found a range of estimates for the size of the subtype I market relative to the subtype II market. Navigant took an average of these estimates and when combined with the aforementioned ratio, calculated that 73.7 percent of total motor shipments (i.e., special-purpose, definite-purpose, and general-purpose [both subtypes]) correspond to general-purpose subtype I electric motors. Navigant used this factor to adjust the 2012 estimates of total motor shipments to produce an estimate of subtype I shipments only. For this analysis, Navigant assumes that 100 percent of these motors meet the NEMA Premium™ efficiency levels.[11]

[10] The data used by DOE is available in its shipments spreadsheet, available at: http://www1.eere.energy.gov/buildings/appliance_standards/rulemaking.aspx/ruleid/42.

[11] Navigant assumes 100 percent of subtype I motors that are required to meet NEMA Premium™ energy efficiency levels meet those levels. Subtype I motors greater than 200 horsepower are not required to meet NEMA Premium™ efficiency standards. Navigant makes adjustments below to account for this issue.

3.3 Estimated NEMA Premium™ Shipments in the Northwest in 2012

Navigant estimates that 59,947 general-purpose subtype I motors were shipped in the Pacific Northwest in 2012, with 59,700 meeting NEMA Premium™ efficiency standards. Table 2 summarizes the steps and calculations that Navigant used to estimate these values.

Table 2. Step-by-Step Estimation of 2012 NEMA Premium™ Shipments in the Northwest

Step	Description of Calculation	Input Estimate	Adjustment Factor*	Estimate After Adjustment
1	Obtain reported NEMA data for 2009	37,975	n/a	37,975
2	Adjust reported data to account for OEM sales	37,975	1.66	62,993
3	Forecast 2009 estimate to account for growth to 2012	62,993	1.29	81,339
4	Estimate portion of motor shipments that are subtype I	81,339	0.737	59,947**

Source: Navigant analysis
* See above for discussion of adjustments and related sources.
** Subtype I motors greater than 200 horsepower are not required to meet NEMA Premium™ efficiency standards. After adjusting for the penetration of large premium efficiency motors, Navigant estimates total NEMA Premium™ shipments of 59,700 in the Northwest in 2012. See Section 4 below for additional discussion.

4 Energy Savings from NEMA Premium™ Motors in the Northwest in 2012

Energy savings from NEMA Premium™ motors is a function of motor shipments (as a proxy for sales and use of the motors) and the per-unit savings from each motor. This section presents estimates of the per-unit savings by size category and in aggregate, and applies the motor shipments estimates from the previous section to estimate regional energy savings.

4.1 Per-Unit Energy Savings

Estimation of per-unit savings values uses the approach from the 2011 LTMT report (including an assumed baseline efficiency equivalent to the EPAct standards), but with the updated shipments estimates by size category. Using this methodology, Navigant estimates per-unit savings of 483 kilowatt-hours (kWh) per year. To estimate the savings from replacing standard efficiency motors with NEMA Premium™ motors, Navigant compiled data for hours of operation and average efficiency[12] for EPAct and premium efficiency motors.[13]

[12] Hours of operation are available for six size ranges only, but motor efficiencies are available for each motor size that is commercially available. Energy savings calculations for motors in a given size range use an average efficiency for available motors in that size range. This average efficiency is the average of the respective nominal efficiencies of different motor sizes.

Annual energy consumption for a motor is the product of the following factors:

1) Motor horsepower multiplied by the kW conversion factor of 0.746 kW/hp[14]
2) Annual run-time hours[15]
3) Motor loading factor[16]
4) The number 1 divided by motor efficiency[17]

The savings due to the use of a more efficient NEMA Premium™ motor is then the difference in energy consumption between the old motor and the premium efficiency motor. Navigant weighted savings for various motor size categories according to average regional sales volumes taken from as many years of data as available (2005-2009). In other words, the distribution of motor shipments by horsepower category is the average of historical data. Navigant found that from 2005 to 2008, the distribution of motor shipments by horsepower remained relatively constant; however, in 2009, there was a spike in small motor (1 to 5 horsepower) shipments. Therefore, Navigant elected to use historical data rather than the most recent data available in case the 2009 data was an anomaly. The following table shows the resulting distribution of motor shipments by horsepower category after Navigant averaged the five years of historical data (Table 3).

[13] The source of the motor operation and efficiency data was a DOE report titled *"United States Industrial Electric Motor Systems Market Opportunities Assessment,"* December 2002. Also, see CEE, "CEE Premium Efficiency Motors Initiative – Efficiency Specifications," 2010.

[14] One kilowatt is equal to 0.746 horsepower. The factor converts motor power ratings (reported in hp) to kilowatts, the units commonly used by NEEA for measuring energy savings (and converted to average megawatts).

[15] Run-time hours vary for motors of different sizes. Navigant obtained these values from the Green Motors Practices Group's July 2007 submittal to the Northwest Power and Conservation Council's Regional Technical Forum (RTF).

[16] Motor loading factor is the percentage of total operation hours that a motor runs on full load. Navigant assumed that the motor loading factor was 0.68. Source: "Quality Motor Rewinding an Energy Efficiency Measure." See RTF submittal from previous footnote.

[17] For each motor size, Navigant averages the efficiency figures across the values for three revolutions per minute (RPM) levels as well as both open and drip-proof motors. Base efficiency assumptions were for efficiencies of federal standard (EPAct) efficiency motors. CEE publications are the source of NEMA Premium™ efficiencies.

Table 3 – Horsepower Distribution and Resulting Shipments Estimates

Size Category (HP)	Average Distribution of Motor Shipments (A)	2012 Northwest Shipments Estimates (A)*59,947
1 to 5	53.42 %	32,021
6 to 20	28.30 %	16,967
21 to 50	11.02 %	6,605
51 to 100	4.17 %	2,498
101 to 200	2.30 %	1,380
201 to 500	0.80 %	229[18]

Source: CEE and Navigant analysis

For purposes of calculating energy consumption, Navigant assigned a representative horsepower value to each size category. For this representative horsepower value, Navigant used the average horsepower rating among all NEMA Premium™ motor sizes sold in the Northwest in each size category.[19] This approach resulted in a single per-unit savings estimate of 483 kWh/year. Table 4 presents the average per-unit energy savings and annual savings for each horsepower size category. Table 4 also presents the total annual savings estimated for all NEMA Premium™ motors in the Northwest for 2012.

[18] Based on the average distribution of motor shipments by size category, Navigant estimates that approximately 476 motors of 200 horsepower or greater were shipped in the Northwest in 2012. However, motors greater than 200 horsepower are not currently required to meet NEMA Premium™ efficiency levels; therefore, Navigant assumed no growth in market penetration for premium efficiency within this size category between 2009 and 2012. Using the 2011 LTMT finding that 48 percent of motors shipped in this category meet NEMA Premium™ efficiency levels, Navigant estimates premium efficiency shipments of 229 motors of greater than 200 horsepower in 2012.

[19] For example, available motor sizes in the 1 to 5 hp category include 1hp, 1.5hp, 2hp, 3hp, and 5 hp, for an average of 2.5 hp. By contrast, the 2008 LTMT analysis assumed a simple average of the high and low values within the size category (i.e., the average of 1hp and 5 hp equals 3 hp). *Source: DOE.*

Table 4. Average Per-Unit Energy Savings and Regional Savings from NEMA Premium™ Motors in the Northwest, 2012

Size Category (HP)	Size of Average Motor (HP) (A)	Average Annual Hours of Operation (B)	Average EPAct Efficiency * (C)	Average NEMA Efficiency * (D)	Average Per-Unit Savings ** *kWh* (E)	Estimated Annual Shipments in the Northwest *** (F)	Annual Savings in the Northwest *MWh* (E*F/1000)
1 to 5	2.5	2,745	84.2%	86.2%	96	32,021	3,138
6 to 20	13.1	3,391	89.8%	91.2%	385	16,967	6,680
21 to 50	36.3	4,067	91.9%	93.0%	964	6,605	6,506
51 to 100	78.3	5,329	93.4%	94.4%	2,401	2,498	6,130
101 to 200	143.8	5,200	94.4%	95.2%	3,377	1,380	4,764
201 to 500	350.5	6,132	94.4%	95.2%	9,706	229	4,731
Total		**N/A**	**N/A**	**N/A**	**483******	**59,700[20]**	**28,853**

* Motor Efficiency data were available for different motor sizes (hp). Navigant calculated an average efficiency for a particular size range to estimate per-unit energy savings. Navigant assumed that all sizes had equal weight.

** Navigant calculated per-unit energy savings according to the following formula (using lettered column labels above): kWh savings = A*(0.746)*B*(0.68)*(1/C – 1/D).
*** See Table 3 for Navigant's derivation of sales by size category.
****This shows the weighted average of per-unit savings per size category and annual NEMA Premium™ sales per size category, in the Northwest.
Source: Navigant analysis and DOE. December 2002. *United States Industrial Electric Motor Systems Market Opportunities Assessment.* Table 1-15.

4.2 Implied Energy Savings

NEMA Premium™ motors consume less electricity than less efficient motors, resulting in significant energy savings. Using a baseline efficiency equivalent to the EPAct standards, the implied energy savings from estimated 59,700 NEMA Premium™ motors shipped to the Northwest in 2012 are 28,853 megawatt-hours (MWh) per year, as shown above in Table 4. This translates to annual savings of approximately 3.3 average megawatts (aMW) (Table 5).

Table 5. Implied Annual Energy Savings from NEMA Premium™ Electric Motor Shipments in the Northwest in 2012

	Annual Energy Savings (MWh)	(aMW)
Annual Energy Savings	28,853	3.3

Source: Navigant analysis

[20] Total NEMA Premium™ shipments are less than the estimate of Type I shipments presented in Table 2 because of the adjustment for motors greater than 200 horsepower that may not meet premium efficiency standards. See Footnote 18.

4.3 Recommendations for Future Tracking

Navigant believes that the methodology used in this report is repeatable for updates to past LTMT reports and, with fresh data, is appropriate for future estimates of energy savings. **In updating 2011 savings,** NEEA could apply the following approach:

1. Begin with the same 2009 shipment data from CEE that Navigant used in the 2011 LTMT and in the 2012 analysis (Step 1 of Table 2, page 7).
2. Account for OEM shipments by applying the same 1.66 extrapolation factor used for the 2012 analysis (Step 2 of Table 2, page 7).
3. Extrapolate the 2009 data to 2011 using the approach from Step 3 of Table 2, page 7. However, instead of using the 29% growth between 2009 and 2012, NEEA would apply a 36% growth between 2009 and 2011 to reflect historical growth in motor shipments based on DOE estimates in the TSD.
4. Adjust for subtype I shipments only, using the 73.7 percent figure cited above in Step 4.

For future estimates of energy savings from NEMA Premium™ motors, NEEA could use future releases of DOE data on national shipments; DOE expects to publish an updated TSD as part of its ongoing rulemaking. In the absence of DOE estimates, NEEA could replicate the DOE analysis described in the TSD by utilizing data that the Bureau of Economic Analysis updates annually.[21] However, the quality of NEEA's estimates will diminish over time without additional data on the type, size, and location of future shipments. For example, the data that Navigant received from the Motor Coalition and used to gauge the accuracy of projecting sub-type I shipments in 2012 was unique and is not available for other years. Similarly, NEMA shipment data is no longer available from CEE, which suggests that NEEA may have to continue relying on breakdowns of shipments by horsepower and region from 2009.

In conclusion, Navigant believes that all of the necessary data is available for updates to previous estimates of energy savings, but NEEA may consider searching for updated data sources to ensure the validity of future projections.

[21] The Bureau publishes updated fixed investment data annually through its online interactive data application. The relevant tables the DOE used in its analysis are "Table 5.4.4U: Price Indexes for Private Fixed Investment in Structures by Type" and "Table 5.5.5U: Private Fixed Investment in Equipment and Software by Type," http://www.bea.gov/iTable/iTable.cfm?ReqID=12&step=1#reqid=12&step=1&isuri=1, accessed April 14, 2013.

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