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Drive Power Initiative – 2020 Long-Term Monitoring and Tracking Report

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Executive Summary

The Northwest Energy Efficiency Alliance's (NEEA) Drive Power Initiative (DPI) (via the Green Motor Initiative [GMI][1] and the Green Motors Practices Group [GMPG])[2] encouraged adoption of green motor rewind practices by Northwest motor service centers between 1999 and 2004. Since the DPI's inception, the GMPG has actively promoted green motor rewind practices. Green rewind practices are rigorous and include motor testing. When motor service centers use these practices in commercial and industrial motor rewinds, the energy efficiency of these motors is maintained or improved; often this is not the case with standard motor rewinds.

NEEA began tracking the market activities and trends of the drive power and motor rewinds markets in 2007, via its long-term monitoring and tracking (LTMT) efforts. In preparing this report of 2020 findings, The Cadmus Group (Cadmus) collected data to meet three major objectives: update the size of the Northwest motor rewind market; establish the market share[3] of green motor rewinds; and, calculate regional savings for green motor rewinds.

Key Findings

This section presents Cadmus' key findings for 2020, organized by market size, market share of green motor rewinds, and regional savings.

Market Size

Cadmus determined that 64 motor service centers in the Northwest market (28 GMPG members and 36 nonmembers) conducted motor rewinds in 2020, a decrease from 65 service centers (29 GMPG members and 36 nonmembers) in 2019.

The following describes performance by member and nonmember centers:

- **Total Number of Rewinds**. In 2020, motor service centers performed an estimated 1,836 motor rewinds (green and standard combined) in the Northwest. Of that total, GMPG members performed 1,268 (69%) and nonmembers performed 568 (31%).
- **Total Horsepower Rewound**. In 2020, motors rewound by motor service centers represented 287,670 horsepower (green and standard combined) in the Northwest.

[1] The GMI offers electric utility-financed incentives for rewinds meeting the GMI standards. See https://www.greenmotors.org/.

[2] The non-profit GMPG oversees GMI's services and practices. See http://greenmotors.org/about_gmpg.htm.

[3] Market share is defined as the percent of total motor rewinds (GMPG member and nonmember motor service center rewinds combined) that are green motor rewinds.

GMPG members rewound 242,233 horsepower (84%), and nonmembers rewound 45,437 horsepower (16%).

Market Share of Green Motor Rewinds

Cadmus found that of the 1,836 motor rewinds performed by GMPG member and nonmember service centers in 2020, 316 were green motor rewinds, representing 17% of total rewinds and 27% of total horsepower rewound. Of the 1,286 motors rewound by GMPG member service centers, green motor rewinds represented 25% of rewinds and 32% of horsepower. Among nonmembers, one performed four green motor rewinds in 2020, representing <1% of nonmember rewinds and 4% of nonmember horsepower.[4]

Regional Savings

In 2020, green motor rewinds performed by GMPG members resulted in an estimated annual total of 1,216,795 kilowatt hours (kWh) in energy savings. Table 1 shows these savings by state for GMPG members and nonmembers.

Table 1. 2020 Annual kWh Savings from Green Motor Rewinds

State	Green Motor Rewind Savings (Annual kWh)		
	Member	Nonmember	Total
Washington	469,346	0	469,346
Oregon	292,105	0	292,105
Idaho	405,229	0	405,229
Montana	16,668	33,446	50,115
Total [1]	1,183,349	33,446	1,216,795

[1] Total does not equal sum of column due to rounding.

Conclusions

The Northwest market for green motor rewinds continues to contract due to a decline in the number of rewinds (both standard and green rewinds).

- As in prior years, the estimated number of motor rewinds (standard and green combined) in the Northwest continued to decrease, falling 12% from 2019 to 2020. The prior year's decrease (2018 to 2019) had been 19%. The number of rewinds has declined 60% from 2013 (4,631 rewinds) to 2020 (1,836 rewinds).
- The 2020 share of GMPG member green motor rewinds (25% of total rewinds and 32% of all horsepower rewound) is similar to the average share of GMPG green motor rewinds from 2013 to 2019 (27% of total rewinds and 36% of all horsepower rewound).

[4] Given that only one nonmember performed any green motor rewinds and likely does not represent the nonmember population, Cadmus did not extrapolate the sample green rewinds to the population of nonmember service centers.

However, as the overall market for rewinds has contracted over time, so has the market for green motor rewinds.

The decrease in savings generated from green motor rewinds is due to the general decline in number of rewinds over time. While it is possible that the COVID-19 pandemic is suppressing demand for motor rewinds, other long-term market forces such as low prices for new motors are likely still at play.

- Total estimated savings from green motor rewinds decreased 29% from 2019 to 2020 due to the decline in the number of green motor rewinds (34% fewer green rewinds in 2020 compared to 2019). The decline in savings from 2019 to 2020 continues a long-term trend in the decline of both savings and the number of rewinds. Estimated energy savings from green motor rewinds decreased 54% from 2013 (2,632,305 kWh) to 2020 (1,216,795).
- Fewer motor service centers performed motor rewinds in 2020 than in 2019, which continues an overall trend since 2013. Cadmus determined that 64 motor service centers (28 GMPG members and 36 nonmembers) in the Northwest market performed motor rewinds in 2020, a decrease from 65 motor service centers in 2019 and 70 motor service centers in 2018. The number of service centers performing motor rewinds has declined 32% since 2013 when there were 94 service centers.
- Cadmus' and NEEA's prior market research suggest the Northwest motor rewind market has contracted due to less expensive new motors encouraging motor replacements rather than rewinds, and a declining number of industrial manufacturing facilities based in the United States.
- Economic uncertainties during the COVID-19 pandemic may have also reduced demand for both standard and green motor rewinds in 2020. Some market actors may have postponed motor rewinds for financial reasons.

Introduction

Drive Power Initiative and LTMT Background

NEEA funded the Drive Power Initiative (DPI) between 1999 and 2004 to increase efficiency of existing and new motors and to transform the electric motor market. The Electric League of the Pacific Northwest provided initial funding.

Through the DPI, NEEA sought to achieve the following objectives that included, but were not limited to, increasing green motor rewinds:

- Increase the region's overall motor fleet efficiency.
- Influence end-users' decision-making processes to rewind or replace motors and encourage consideration of lifecycle costing in investment decisions.
- Help motor service centers improve their maintenance practices and expand their motor management services.

In 2007, NEEA began tracking activities and trends of the drive power and motor rewind market through its LTMT efforts.

Also in 2007, the Green Motors Practices Group (GMPG) submitted a request to the Regional Technical Forum (RTF) for approval of deemed savings for motors rewound to a particular specification by participating GMPG member service centers. GMPG further requested that the RTF recognize and include green motor rewinds on its list of eligible energy efficiency measures. Later that year, the RTF approved green motor rewinds as an eligible energy efficiency measure.

Shortly thereafter, a group of Northwest utilities convened to discuss an approach for supporting certified green motor rewinds at GMPG member service centers. The utilities decided to pursue a regional approach, focusing on helping the GMPG, utilities, and motor service centers achieve increased numbers of certified green motor rewinds. Though the group of utilities recognized that success depended on agreeing to a simple program approach (for example, providing uniform incentives across the region for green motor rewinds), the group understood that complete uniformity in executing the approach might not be possible due to utility-specific preferences.

With assistance from NEEA and the region's utilities, the Bonneville Power Administration (BPA) formed the Green Motors Initiative (GMI) in 2008, which sought to educate, train, and certify service centers that followed effective shop procedures, and also offered incentives to service centers and end users for efficient motor rewinds.

Specific GMI objectives included the following:

- By 2010, grow the GMPG to sustain itself without NEEA funding, through membership and utility programs.
- By 2010, ensure Northwest motor service centers train personnel and adopt GMPG rewind practices.
- Continue to promote customer motor management practices that result in all industrial customers demanding GMPG-certified rewinds.

In partnership with the GMI and the GMPG, the DPI encouraged the Northwest's motor service center market to adopt green motor rewind practices intended to reduce energy use for motors utilized in the agricultural and industrial sectors. Though green motor rewinds require rigorous testing, they result in greater energy savings than standard motor rewinds.

Service centers offering green motor rewinds must, at a minimum, meet the following GMPG specifications:

- There must be no visible damage to the motor's core.
- The burn-off temperature must not exceed 385 degrees Celsius (720 degrees Fahrenheit) using verified water-mist controls.
- The motor must undergo two (or more) core loss tests before and after stripping; the final core's test watts loss per pound must be no more than 20% greater than the results from the first test.
- No hot spots greater than 10 degrees Celsius may occur.
- Final core tests must be less than or equal to a 4-watt loss per pound.
- New winding must achieve an equivalent to the manufacturer's original length, and may exceed circular mils (that is, voltage changes must be calculated to circular mil equivalents).

Energy Trust of Oregon and regional utilities provide GMPG member service centers with incentives of $2 per horsepower for green motor rewinds. As part of the GMPG's member agreement, these centers each retain $1 per horsepower rewound, and pass the other $1 per horsepower rewound directly to the customer in the form of an instant rebate. Nonmember service centers remain ineligible to receive utility incentives.

GMPG serves as the program administrator for each of the region's utilities, providing the documentation necessary for each utility to claim savings and pay incentives. GMPG collects this documentation from each member service center monthly.

Although NEEA no longer provides funding for the project, GMI's formation would not have been possible without NEEA's initial funding of the DPI and its subsequent funding to support development of the GMPG and GMI. Due to NEEA's crucial role as a regional collaborator, it continues through LTMT to study the Northwest motor rewind marketplace and collect data to calculate regional energy savings from green motor rewinds.

Organization of This Report

Cadmus organized this report into the following sections:

- Research Objectives and Methodology
- Findings
- Conclusions and Recommendations
- Appendix

The appendix includes a copy of the data collection form.

LTMT Research Objectives and Methodology

Cadmus designed this study to meet three key research objectives necessary to update the assumptions for NEEA's cost-effectiveness model: update the size of the Northwest motor rewind market; establish the market share of green motor rewind practices; and calculate regional savings for green motor rewinds. Cadmus conducted secondary and primary research to meet the study's major objectives. Table 2 lists these objectives, their associated research activities, and respondents to the primary research data collection forms.

Table 2. Key Study Objectives and Activities

Research Objectives	Study Activities	Respondents (To Primary Research)
Market Size	Review GMPG membership list; data collection form	GMPG members and nonmembers
Market Share	Data collection form	GMPG members and nonmembers
Regional Savings	Data collection form	GMPG members and nonmembers

This report presents extrapolation results for motor rewinds, horsepower rewound, and savings at a 90% confidence level. Extrapolating from a sample to a population introduces uncertainty into the population estimate. Therefore, a confidence interval should be built around an estimate to describe its uncertainty level. The confidence interval contains two parts: the confidence level and the precision level. Precision is the radius of the confidence interval, as a percent of the estimate itself, and can be called the "relative precision" or "relative error."[5]

Market Size

To determine the motor rewind market size, Cadmus conducted secondary and primary research.

Secondary Research

Cadmus determined the number of Northwest motor service centers, and, among these, identified the number of GMPG members and nonmembers. For 2020, Cadmus identified 64 Northwest motor service centers (28 GMPG members and 36 nonmembers), compared to 65 motor service centers for 2019. To determine the number and membership status of Northwest

[5] As precision values differ for each estimate of member and nonmember rewinds, horsepower rewound, abd savings rewinds, there is not an overall precision level for the study.

motor service centers in 2020, Cadmus asked the GMPG administrator to review the 2019 list of motor service centers (29 GMPG members, 36 nonmembers).

As a result of data collection phone calls and emails (detailed in the next section), Cadmus adjusted the service center population as follows:

- Removed two motor service centers (one nonmember and one member) that had gone out of business.
- Removed one motor service center (a member) that did not perform motor rewinds in the Northwest in 2020.
- Removed one motor service center (a nonmember) that reported they no longer offer rewinds as a service.
- Added one member and two nonmember motor service centers that did not perform motor rewinds in 2019 but did so in 2020.

These changes reduced the population from 65 to 64 service centers (28 member service centers and 36 nonmember service centers).

Primary Research

Cadmus sent the data collection form shown in Appendix A to both GMPG member and nonmember motor service centers for completion. To ensure uniform data collection across the study years, Cadmus has employed the same data collection form since 2013. This form asked service centers to provide the following data from their businesses:

- The number of motor rewinds conducted in the Northwest during 2020, by horsepower and by state. Cadmus uses this data to determine the total number of rewinds performed annually in the Northwest.
- The number of green motor rewinds conducted in the Northwest during 2020, by horsepower and by state. This data enables Cadmus to determine the market share of green motor rewinds.

In addition, the GMPG provides Cadmus with the number of green motor rewinds documented by motor service centers as required for receiving utility incentives.

Prior to the start of data collection, the GMPG administrator and Cadmus twice contacted motor service centers (once in August 2020 and once in December 2020) to notify them of the 2020 study and to encourage their participation. NEEA offered nonmember service centers a $150 incentive to complete the data collection form. To accommodate motor service centers' preferences and needs and to encourage high response rates, Cadmus provides service centers

with three options for completing the data collection form: email, fax, or verbally over the telephone.

From mid-December to mid-January, Cadmus followed up with all motor service centers via telephone, requested their participation in the study, and collected data collection forms. Cadmus contacted the motor service centers up to five times by phone. As a result, 32 motor service centers (17 members and 15 nonmembers) completed the data collection forms. Table 3 shows the number of data collection forms completed by members and nonmembers, by state and study year.

Table 3. Completed Member and Nonmember Data Collection Forms by State

State	Member		Nonmember	
	2020 Population (N)	2020 Sample (n)	2020 Population (N)	2020 Sample (n)
Washington	8	5	7	2
Oregon	9	5	14	5
Idaho	9	6	10	5
Montana	2	1	5	3
NEEA Region Total	**28**	**17**	**36**	**15**

Market Share

Using the data that the motor service centers provided from the above-described data collection forms, Cadmus calculated the market share for green motor rewind practices among Northwest motor service centers. Specifically, Cadmus determined the following:

- The number of rewinds in compliance with green motor rewind specifications.
- The market share of green motor rewinds among all rewinds (standard and green rewinds combined) conducted by GMPG member and nonmember centers.

Regional Savings Analysis

To determine regional savings resulting from green motor rewinds, Cadmus calculated savings attributable to both agricultural and industrial applications for members and nonmembers. The prior evaluation studies used the same methods.

Using feedback from the above-described data collection forms, Cadmus measured the number of rewinds in compliance with green motor rewind specifications.

Cadmus used several sources to estimate regional savings from green motor rewinds:

- The data collection form
- The RTF industrial and agricultural workbooks (version 2.3), which recorded details and assumptions pertaining to green motor rewinds.[6,7]

The RTF maintains separate workbooks for industrial and agricultural green motor rewinds. Motors in industrial applications typically operate for more hours in a year than do motors in agricultural settings, so the RTF adopts different assumptions per application in terms of operating hours, savings values, and measure lifetimes.

The RTF workbooks also contain annual energy savings estimates for agricultural and industrial motors for a range of discrete horsepower values, from 15 horsepower to 5,000 horsepower. Cadmus multiplied these savings estimates by the number of green rewinds for each horsepower level within each market sector; this determined total annual energy savings for green motor rewinds.

To calculate savings, Cadmus used the following equation:

$$Energy\ Savings = \sum_{ij} Savings\ Rate_{ij} \times Reported\ Units_{ij}$$

Where:

i	=	sector (agricultural or industrial)
j	=	motor rewind horsepower
Savings rate$_i$	=	incremental per-unit savings (kWh per year) over baseline unit energy consumption
Reported units$_i$	=	green motor compliant rewinds

On the data collection forms, the motor service centers recorded the number of rewinds (green or standard) by horsepower and within the agricultural or industrial sectors. Cadmus built a table using these quantities and descriptions.

The RTF unit energy-savings Excel workbooks provided savings rates for each horsepower value indicated on the data collection forms. Cadmus calculated regional savings for green motor

[6] Regional Technical Forum. *UES Measure: Green Motor Rewind.* Available online: https://rtf.nwcouncil.org/measure/green-motor-rewind?id=115.

[7] Though the RTF released the green motor rewind workbooks, version 3.1, in December 2017, Cadmus used version 2.3 (published in December 2016) as these values reflect the market baseline.

rewinds by building a simple lookup function, which multiplied the number of rewinds by the respective annual kWh savings for a given horsepower, applicable to agricultural and industrial sector motors.

Savings Extrapolations

To estimate total energy savings attributable to green motor-compliant rewinds, Cadmus extrapolated savings from the reported sample of members to the population. This section provides methodology used for the savings extrapolations.

Cadmus calculated the total savings estimate for the population and its precision level using a standard, stratified mean estimation:

$$Total\ Savings_{\mathrm{i,h}} = Savings_{i,h} \times N_h / n_h$$

Where:

i	=	motor service center
h	=	stratum
N	=	population
n	=	sample

Cadmus used the same total energy savings calculation method for both industrial and agricultural applications. This included using a standard, stratified ratio estimation to calculate the total number of industrial and agricultural rewinds and the total horsepower rewound.

Findings

This section describes findings for market size, market share, and savings rate calculations.

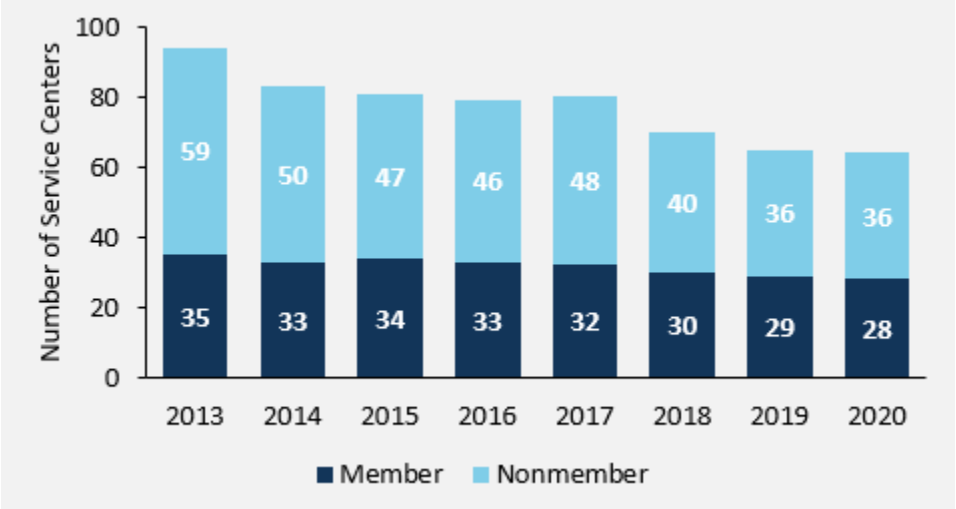
Market Size

Cadmus assessed the size of the motor rewinds market using secondary research and data collection forms.

Number of Motor Service Rewind Centers

Cadmus determined that 64 motor service centers in the Northwest market (28 GMPG members and 36 nonmembers) conducted motor rewinds in 2020, a decrease from 65 service centers (29 GMPG members and 36 nonmembers) in 2019. The decrease resulted from a number of factors: motor service centers going out of business, reporting that they did not perform any rewinds in 2020, or reporting that rewinds are no longer a service they offer. Figure 1 shows that the decline in the number of motor service centers is part of a trend that has continued throughout the life of this study.

Figure 1. Number of Motor Service Centers Performing Rewinds in the Northwest by Study Year



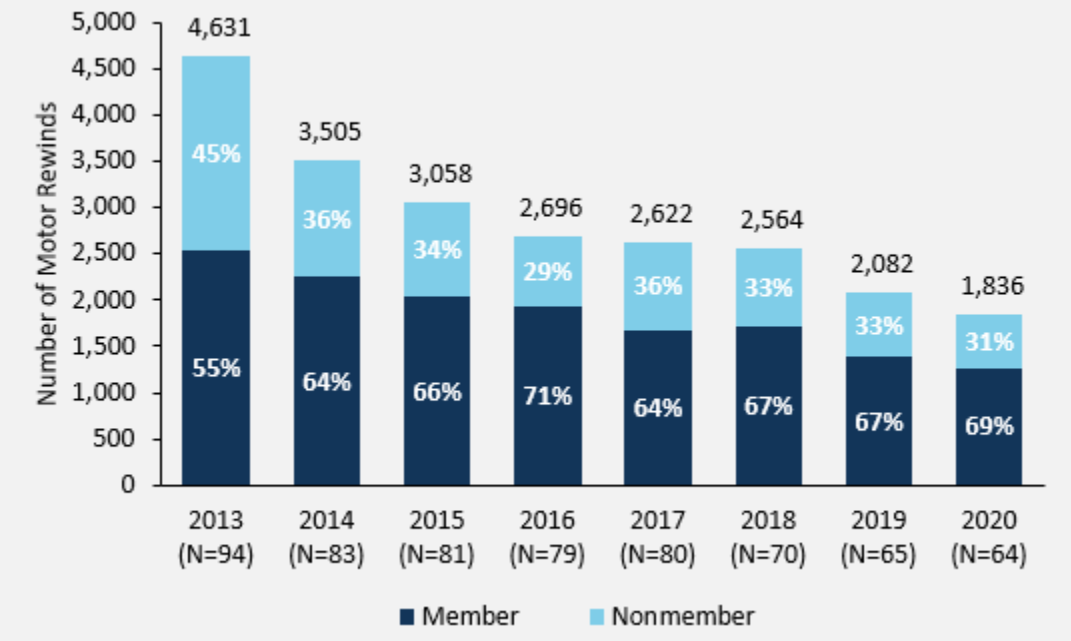
Number of Motor Rewinds Performed in 2020

In 2020, motor service centers performed an estimated 1,836 motor rewinds (green and standard combined) in the Northwest. Of that total, GMPG members performed 1,268 rewinds (69%) and nonmembers performed 568 rewinds (31%).

As shown in Figure 2 below, the Northwest's estimated number of motor rewinds has decreased substantially over time – most notably between 2013 and 2016, during which period the number decreased from 4,631 to 2,696—a decrease of 1,935.Between 2016 and 2018, the

number of motor rewinds decreased only slightly. From 2018 to 2020, the motor rewinds rate dropped again, with the number of motor rewinds in the Northwest falling by 728 rewinds from the 2018 level, resulting in an annual total of 1,836 – less than 40% of the 2013 level.

Figure 2. Historical Number of Motor Rewinds



The overall decrease in estimated motor rewinds since 2013 likely resulted from a decline in the number of motor service centers and a general decline in the motor rewind industry. Prior Cadmus research indicates that motor replacements are more common than motor rewinds due to falling new motor prices and a decline in the number of U.S.-based industrial manufacturing facilities.[8] For the 2020 study, two key market actors who promote green motor rewinds were asked about how the COVID-19 pandemic might have impacted demand for motor rewinds. Both respondents surmised that economic uncertainty during the pandemic may have caused some companies to postpone motor repairs to reduce operating costs and financial risks. One of the market actors also noted that some companies may have chosen to purchase new motors instead of rewinding them due to the extra logistics involved with rewinding motors. While purchasing a new motor involves two steps (ordering and installing a new motor), rewinding an existing motor requires more: shipping out unit, tracking shipping, coordinating shipment of the rewound motor back to the facility, and reinstalling the rewound motor.

[8] *Cadmus. Evaluation of Key ACE Model Assumptions for Motor Rewinds.* Prepared for NEEA. February 14, 2014

Distribution of Motor Rewinds by Horsepower

In 2020, motors rewound by motor service centers represented 287,670 horsepower (green and standard combined) in the Northwest. GMPG members rewound 242,233 horsepower (84%), and nonmembers rewound 45,437 horsepower (16%). In 2020, industrial motors accounted for 51% of the total horsepower rewound at GMPG member motor service centers and 39% rewound at nonmember motor service centers. Agricultural motors accounted for the remaining 49% and 61% of total horsepower rewound for GMPG members and nonmember motor service centers, respectively.

Motor Rewind Applications and Undocumented Rewinds

The share of green motor rewinds receiving incentives increased from 53% in 2019 to 79% in 2020. The share of agricultural motors receiving incentives increased from 34% in 2019 to 53% in 2020, and the share of industrial rewinds increased from 73% to 100%.

Cadmus compared the total number of green motor rewinds reported by GMPG member motor service centers in the study survey with the number of green motor rewinds the motor service centers documented and reported to GMPG for purposes of obtaining utility incentives. This comparison revealed that in 2020, motor service centers did not document (and therefore did not receive incentives for) an estimated 21% of the green motor rewinds they reported in the study survey. These non-documented/non-incented green motor rewinds constituted 23% of the total horsepower rewound in 2020 using green rewind practices.

Table 4 lists the number of 2020 green motor rewinds by application that motor service centers reported to GMPG for incentive payments (as reported to Cadmus), along with the percent of undocumented green motor rewinds.

Table 4. Green Motor Rewinds Documented and Not documented by Member Motor Service Centers (MSCs) in 2020

Sector	Number of Green Motor Rewinds			
	Documented by MSCs for GMPG (n = 13)	Reported by MSCs in Study Survey (n = 17)	Percent Documented by MSCs for GMPG	Percent not Documented by MSCs for GMPG
Agricultural	47	88	53%	47%
Industrial	106	106	100%	0%
Total	153	194	79%	21%

Market Share

Cadmus assessed the market share of green motor rewinds using secondary research and primary data from the collection forms.

Number of Green Motor Rewinds

As shown in Table 5, Cadmus found that, of 1,268 motor rewinds performed by GMPG member service centers in 2020, approximately 316 were green motor rewinds, representing 25% of GMPG member rewinds. Among nonmembers, one performed four green motor rewinds in 2020, representing <1% of nonmember rewinds.[9] For the market as a whole (total rewinds performed by both GMPG members and nonmembers) the market share of green motor rewinds was 17%.

Table 5. Green Motor Rewind Market Share by Number of Rewinds

	Number of Rewinds		
	Total Rewinds	**Green Motor Rewinds**	**Percent Green Motor Rewinds**
Member (N=28)	1,268	316	25%
Nonmember (N=36)	568	4	1%
Total (N=64)	**1,836**	**320**	**17%**

Horsepower of Green Motor Rewinds

Table 6 shows the green motor rewind market share in 2020 for GMPG members and nonmembers by horsepower rewound. The horsepower of green motor rewinds completed by GMPG members in 2020 represents 32% of their total horsepower rewound, and the horsepower of nonmember green motor rewinds represents 4% of their total horsepower rewound.

Table 6. Green Motor Rewind Market Share by Horsepower Rewound

	Horsepower of Rewinds		
	Total Horsepower	**Green Motor Rewind Horsepower**	**Percent Green Motor Rewind Horsepower**
Member (N=28)	242,233	76,604	32%
Nonmember (N=36)	45,437	1,700	4%
Total (N=64)	**287,670**	**78,304**	**27%**

[9] Given that only one nonmember performed any green motor rewinds and likely does not represent the nonmember population, Cadmus did not extrapolate the sample green rewind to the population of nonmember service centers.

Penetration of Green Motor Rewinds

Table 7 shows the share of all GMPG member rewinds that were green motor rewinds each year since tracking started in 2013, and Table 8 shows the share of all horsepower rewound attributable to those green motor rewinds. Between 2013 and 2020, the share of rewinds fluctuated between 21% and 36%. Though the 2020 share of 25% is lower than the 2019 share of 36%, the 2020 share is more in line with the 2017 and 2018 shares (22% and 21% respectively). Additionally, though the share of all horsepower rewound by GMPG members to green motor rewind specifications declined from 43% of horsepower in 2019 to 32% in 2020, the 2020 share is similar to the 2018 share (34%).

Table 7. 2013-2020 Green Motor Rewind Market Share by Number of Rewinds

	Share of Green Motor Rewinds							
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
GMPG Members	29%	22%	23%	33%	22%	21%	36%[a]	25%
GMPG Nonmembers	36%	5%	12%	0%	0%	0%	1%	1%

[a]The increase in the share of green motor rewinds from 2018 and 2019 is statistically significant at the 90 percent level ($p<0.1$), as is the decline in the share of motor rewinds from 2019 to 2020.

Table 8. 2013-2020 Green Motor Rewind Market Share by Horsepower Rewound

	Share of Green Motor Rewinds							
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
GMPG Members	34%	34%	32%	37%	38%	34%	43%	32%
GMPG Nonmembers	33%	13%	22%	0%	0%	2%	2%	5%

Regional Savings

Savings Results

Using results from the data collection efforts and RTF per-unit energy savings, Cadmus estimated regional savings for GMPG member and nonmember motor service centers resulting from green motor rewinds conducted in 2020.

In 2020, green motor rewinds performed by GMPG members resulted in an estimated annual total of 1,216,795 kilowatt hours (kWh) in energy savings. Table 9 provides annual kWh energy savings from green motor rewinds (by state) for GMPG members and nonmembers.

Table 9. 2020 Annual kWh Savings from Green Motor Rewinds

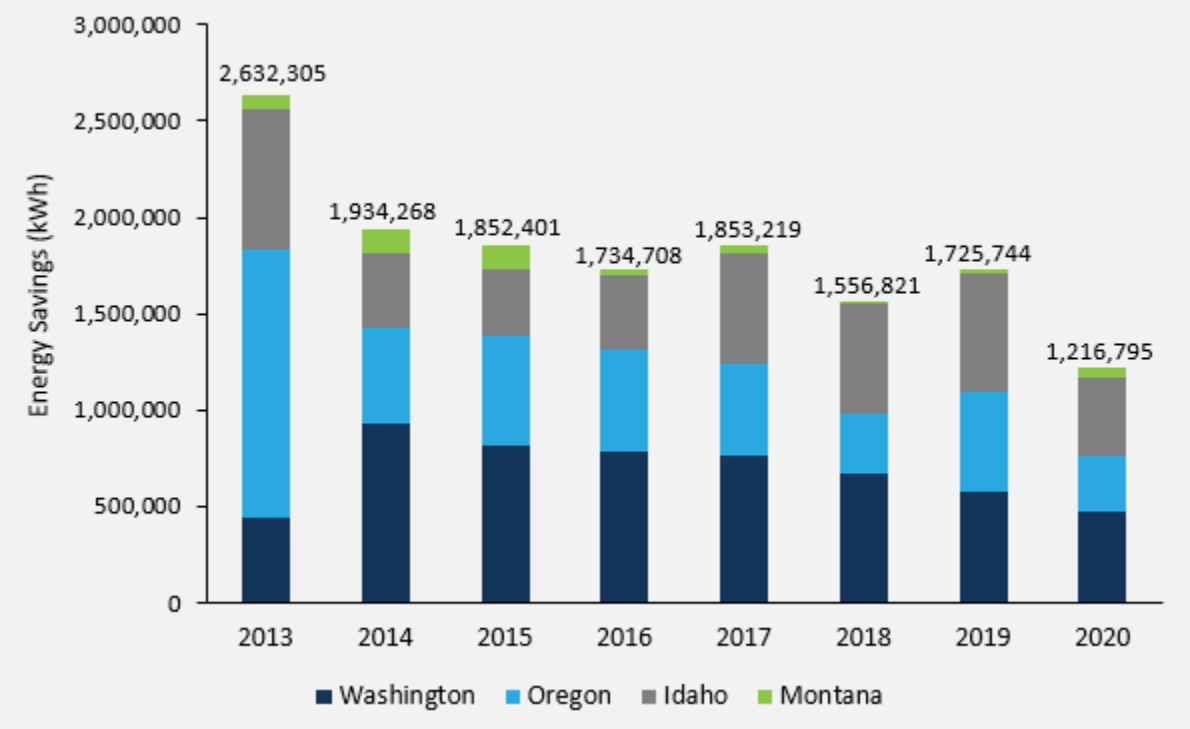
State	Green Motor Rewind Savings (Annual kWh)		
	Member	Nonmember	Total
Washington	469,346	0	469,346
Oregon	292,105	0	292,105
Idaho	405,229	0	405,229
Montana	16,668	33,446	50,115
Total [1]	1,183,349	33,446	1,216,795

[1] Total does not equal sum of column due to rounding.

Savings Trends

Table 3 shows regional savings over time. Since 2013, total savings have decreased year-over-year except from 2016 to 2017 and 2018 to 2019. Green motor rewinds performed in 2020 resulted in an estimated annual total savings of 1,216,795 kWh, down 29% from 2019 savings (1,725,744 kWh) and 60% from 2013 (2,632,305).

Figure 3. Historical Green Motor Rewind Regional Savings



The savings decrease from 2019 to 2020 resulted primarily from the drop in estimated green motor rewinds performed—320 in 2020 compared to 486 in 2019 (a decrease of 34%). The decrease in the number of rewinds from 2019 to 2020 was partially offset by an increase in motor size: the weighted average size of green rewinds increased from 211 horsepower in 2019

to 248 horsepower in 2020. Savings per rewind relates directly to the horsepower rewound. The increase in horsepower per rewind in 2020 stemmed from an increase in agriculture motor sizes (214 horsepower per rewind in 2019 and 297 horsepower per rewind in 2020). Even as the number of green motor rewinds has decreased from 2013 to 2020, the average horsepower per green rewind has increased from 154 to 248.

Conclusions

The Northwest market for green motor rewinds continues to contract due to a decline in the number of rewinds (both standard and green rewinds).

- As in prior years, the estimated number of motor rewinds (standard and green combined) in the Northwest continued to decrease, falling 12% from 2019 to 2020. The prior year's decrease (2018 to 2019) had been 19%. The number of rewinds has declined 60% from 2013 (4,631 rewinds) to 2020 (1,836 rewinds).
- The 2020 share of GMPG member green motor rewinds (25% of total rewinds and 32% of all horsepower rewound) is similar to the average share of GMPG green motor rewinds from 2013 to 2019 (27% of total rewinds and 36% of all horsepower rewound). As the overall market for rewinds has contracted over time, so has the market for green motor rewinds.

The decrease in savings generated from green motor rewinds is due to the general decline in number of rewinds over time. While it is possible that the COVID-19 pandemic is suppressing demand for motor rewinds, other long-term market forces such as low prices for new motors are likely still at play.

- Total estimated savings from green motor rewinds decreased 29% from 2019 to 2020 due to the decline in the number of green motor rewinds (34% fewer green rewinds in 2020 compared to 2019). The decline in savings from 2019 to 2020 reflects a long-term trend in the decline of both savings and the number of rewinds. Estimated energy savings from green motor rewinds decreased 54% from 2013 (2,632,305 kWh) to 2020 (1,216,795).
- Fewer motor service centers performed motor rewinds in 2020 than in 2019, which continues an overall trend since 2013. Cadmus determined that 64 motor service centers (28 GMPG members and 36 nonmembers) in the Northwest market performed motor rewinds in 2020, a decrease from 65 motor service centers in 2019 and 70 motor service centers in 2018. The number of service centers performing motor rewinds has declined 32% since 2013 when there were 94 service centers.
- Cadmus' and NEEA's prior market research suggest the Northwest motor rewind market has contracted due to less expensive new motors encouraging motor replacements rather than rewind and a declining number of industrial manufacturing facilities based in the United States.
- Economic uncertainties during the COVID-19 pandemic may have reduced demand for both standard and green motor rewinds in 2020. Some market actors may have postponed motor rewinds for financial reasons.

Appendix A. Data Collection Form

Motor Rewind Data Sheet Directions
On the next tab, labeled "Motor Rewind Data Sheet", you will find the motor rewind form. Please use the directions below to complete the form.
Section A
Record a count of all 15 to 5,000 HP motor rewinds (green motor rewinds **and** standard motor rewinds) in 2020.
In the data sheet, record the number of motor rewinds for each sector (agriculture or industrial), state, and HP.
Section B
Record a count of Green Motor rewinds for 15 to 5,000 HP motors in 2020.
(NOTE: If your company is a member of the Green Motors Practices Group, this includes both green motor rewinds you have reported and received an incentive for, as well as those you have not reported or received an incentive for.)

Important Definitions
Green Motor Rewinds, in contrast to standard motor rewinds, refer to motors that are rewound to their original nominal efficiency. The Green Motors Initiative rewind specifications require several criteria for a motor rewind to be considered a green rewind. The minimum criteria are as follows:
a. There must be no visible damage to the core
b. The burn-off temperature should not exceed 725 degrees F using verified water mist control
c. Service center must conduct two (or more) core-loss tests before and after stripping with the final core test watts loss per pound no more than 20% greater than the first test
d. There must be no hot spots greater than 10 degree C
e. The final core test must be less than or equal to 4 watts loss per pound
f. The new winding must be equivalent to the manufacturer's original length and (may exceed) circular mils (voltage changes must be calculated circular mil equivalent)

Contact Information and Form Submittal
For questions about this form or project, please contact Megan Ottesen at the Cadmus Group, at greenmotors@cadmusgroup.com or (303) 389-2534.
Please also email completed forms to Megan Ottesen at the email address above, or fax to: (503)-296-2771 by **December 11, 2020.**
Name:
Company:
Address:

Rewind Type	Section A: Count of all Motor Rewinds								Section B: Count of Green Motor Rewinds							
End Use	Agriculture				Industrial				Agriculture				Industrial			
State	ID	MT	OR	WA	ID	MT	OR	WA	ID	MT	OR	WA	ID	MT	OR	WA
15 HP																
20 HP																
25 HP																
30 HP																
40 HP																
50 HP																
60 HP																
75 HP																
100 HP																
125 HP																
150 HP																
200 HP																
250 HP																
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1000 HP																
1250 HP																
1500 HP																
2000 HP																
2250 HP																
2500 HP																
3000 HP																
3500 HP																
4000 HP																
4500 HP																
5000 HP																