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Assessment of NEEA Influence on 2010 Small Electric Motors Standard

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Executive Summary

Federal energy efficiency appliance and equipment standards play an important role in achieving large energy savings. Through its standards efforts, the Northwest Energy Efficiency Alliance (NEEA) supports the establishment of minimum energy performance requirements for appliances and commercial equipment. Supporting standards development and adoption is one of NEEA's key strategies in its efforts to increase market adoption of energy-efficient products. NEEA collaborates with stakeholders to develop strategies for advancing higher standards for appliances and equipment at the federal level. These strategies often include NEEA attending U.S. Department of Energy (DOE) meetings, engaging in negotiations with other stakeholders, collecting and submitting technical data, and making recommendations to the DOE throughout the stages of a standard's adoption process.

The Non-Residential Small Electric Motors Standard Rulemaking, which is the focus of this study, began with the release of the DOE framework document in 2007, then continued through the final rule release on March 9, 2010, and the compliance stage beginning in 2015. DOE estimates the potential savings of the small electric motors standard as 2.2 quads (quadrillion) British thermal units (BTU) savings from 2015 to 2045. Small electric motors used in commercial and industrial sectors operate a variety of equipment types, including fans, pumps, belts, machinery. Motor functions and applications account for 70% of the total electric use in the commercial sector and 37% in the industrial sector.[1]

NEEA engaged Cadmus in November 2015 to conduct an assessment of NEEA's influence and role in the rulemaking. The objectives of this research were to: 1) determine whether NEEA influenced adoption of the standard; 2) enhance NEEA's understanding of the appropriateness of its response and effectiveness of its efforts to influence the standard; and 3) develop an influence score for the Non-Residential Small Electric Motors Standard. Cadmus' assessment relied on a review of documents related to standard adoption, interviews with knowledgeable stakeholders, and review of the evidence on NEEA's influence by an expert panel.

Key Findings

NEEA's Influence on the Rulemaking Process

Both the manufacturers and efficiency stakeholders said this rulemaking posed significant challenges and identified several concerns about the technical and economic feasibility of DOE's proposed standard. NEEA's objective in the rulemaking was to influence the development of the most stringent energy efficiency standard possible that was still technically feasible within the market. To support this position, NEEA's senior codes and standards engineer relied on his technical expertise, reputation, and relationships with manufacturers to ask about their concerns and explore technically and economically viable options from their perspectives. He acted as an intermediary, discussing issues and concerns with a variety of key stakeholders in the rulemaking process. He also reviewed DOE's technical materials and other

[1] Nadel, S.R., Elliott, N. Shepard, M., Greenberg, S., Katz, G., and Almeida, A.T. (1992). *Energy-Efficient Motor Systems: A Handbook on Technology, Program, and Policy Opportunities.* Washington D.C.: American Council for an Energy-Efficient Economy, Revised First Edition.

industry literature and studies and submitted comments to DOE to support the adoption of the highest motor efficiency level that NEEA believed would be acceptable to manufacturers.

Several stakeholder interviewees, both manufacturers and an efficiency stakeholder, expressed dissatisfaction with the outcome of the process and their ability to influence DOE's proposed rule. However, the majority of the responding manufacturer interviewees (five of six) said NEEA was "somewhat effective" or "very effective" in supporting the small motors standard adoption. They believed NEEA's representative in the DOE meetings was very knowledgeable about motors, and that the technical expertise NEEA provided was an important contribution for the efficiency stakeholder groups. Stakeholders also believed NEEA's role at the DOE meetings was not limited to technical expertise and agreed that NEEA served an important role as a facilitator and as a peacekeeper.

Influence Score and Energy Savings

Based on NEEA's contribution to the small electric motors rulemaking, Cadmus' assessment panel determined an influence score of 33%, which was used to calculate NEEA's reportable savings of 3.21 aMW from its work in the development and adoption of the Non-Residential Small Electric Motors Standard from 2010 (compliance began in 2015) through 2034 (Table 1).

Table 1. Regional Savings (aMW) Influenced by NEEA

Motor Class	NW 2010-2034 Potential (aMW)[2]	Incremental Improvement in Savings	Influence Score	Share of Savings	Claimable Savings 2010-2034 (aMW)
Polyphase	8.6	21%	33%	7%	0.61
CSIR	49.4	15%	33%	5%	2.54
CSCR	1.7	12%	33%	4%	0.07
Small Electric Motors Total					**3.21**

Conclusions and Recommendations

Conclusions about NEEA's Role in the Small Electric Motors Standard Rulemaking

Although some stakeholders described the rulemaking as adversarial, and expressed doubts about their impact on the outcome, NEEA was considered effective for its ability to balance higher efficiency levels and manufacturers' concerns.

NEEA served two key roles in the small electric motors standard rulemaking process:

- NEEA participated as a technically knowledgeable representative.
- NEEA served as an intermediary, discussing issues and concerns with a variety of opposing stakeholders and exploring technically and economically viable options from their perspectives.

Recommendation

[2] Source: Cadeo Group, Bonneville Power Administration, Appliance Standards, 2015.

NEEA should continue to participate in the standards setting process using representatives who have technical knowledge and existing relationships with manufacturers, DOE, and energy-efficiency stakeholders. Continue prioritizing efforts for standards where NEEA can:

- Serve as technical expert on the specific market, technology, or test procedures, and/or
- Provide technology or market data (e.g., field data, original analyses, or reports)

While the small electric motors rulemaking did not include a formal coalition of manufacturer and energy stakeholders, subsequent motors rulemakings have involved a motors coalition which stakeholders believed has given them more of an impact in standard development and adoption. Even when NEEA staff are not technical experts, NEEA may serve an important role as an intermediary between stakeholders. In addition, NEEA could consider using an outside consultant to support NEEA for standards with significant potential energy savings where NEEA does not have technical expertise.

Conclusions about Future Study Improvements and Limitation

Cadmus conducted the small electric motors influence assessment nine years after DOE released its intent to rule on the small electric motors standard and five years after DOE's final ruling. While stakeholders spoke frequently about subsequent motors rulemakings, they had difficulty recalling specific details of the small electric motors rulemaking. This included activities they and other stakeholders engaged in, important discussions, and technical information. In addition, documentation, such as email exchanges and personal meeting notes, was frequently unavailable. This narrowed the availability of evidence for the determination of influence.

Recommendation

Consider dedicating additional resources for documenting efforts and preparing for evaluations. As a first step, NEEA could identify a methodology and/or key metrics for the evaluation. Then, NEEA could explore methods for formally documenting NEEA's activities that contributed to these key metrics. NEEA's existing logic model may provide a useful template for documenting these activities. NEEA should also consider encouraging its representatives to save all written communication among stakeholders, such as e-mails and meeting notes, for future review. With the increasing prevalence of coalitions, it may be increasingly difficult to single out the efforts of individual actors. To provide additional justification for NEEA's individual influence score, NEEA could also provide a summary of their involvement that makes the case for the significance of their contribution.

1 Introduction

Since the 1990s, utility energy efficiency planners have envisioned a role for energy efficiency building codes and appliance standards in achieving large savings through market transformation. Support for codes and standards raises planning questions, such as how to best quantify savings from support efforts. In its role encouraging market transformation, the Northwest Energy Efficiency Alliance (NEEA) applies its research, support, and coalition building efforts to increase the number and stringency of federal appliance and equipment standards through the public rulemaking processes implemented by the U.S. Department of Energy (DOE).

This report focuses on Cadmus' assessment of NEEA's influence in the development and adoption of the federal Non-Residential Small Electric Motors Standard.

1.1 NEEA's Standards Efforts

NEEA supports the establishment of minimum energy performance requirements for appliances and commercial equipment, one of its key strategies to increase market adoption of energy-efficient products. NEEA collaborates with stakeholders to develop plans for advancing higher standards. These plans can include NEEA's attendance at DOE meetings, negotiations with other stakeholders, collection and submittal of technical data, and recommendations to the DOE throughout the various stages of a standard's adoption process. The Non-Residential Small Electric Motors Standard Rulemaking, the focus of this assessment, began with the release of the DOE framework document in 2007. The final rule was released on March 9, 2010, and compliance began in 2015.

1.2 Department of Energy Rulemaking

Federal energy efficiency standards set minimum efficiencies, known as trial standard levels (TSLs), that new appliances and equipment must meet or exceed. Because efficiency standards eliminate less efficient products from the market over time, they are an important strategy for reducing energy consumption. Federal standards affect the entire U.S. market and are established in two ways:

- **Administrative rulemaking: DOE initiates rulemaking and sets standards.** The Energy Policy and Conservation Act of 1975 (EPCA) gives DOE the general authority to regulate specific product classes (e.g., appliances and equipment) and set efficiency standard levels. DOE considers transparency to be essential and encourages stakeholders to participate in the rulemaking process. Typical stakeholders include manufacturers, trade associations, utilities, energy efficiency stakeholders, and the general public. Key points of technical support that stakeholders provide include the market and technology assessment, engineering analysis, life-cycle cost and payback period analysis, national impact analysis, and manufacturer impact analysis.
- **Legislative rulemaking: Congress sets specific efficiency requirements and leaves implementation to DOE**. The most common types of legislative rulemaking that govern efficiency standards are the result of the 2007 Energy Independence and Security Act (EISA), which includes provisions that set federal standards for ten types of appliances and equipment, such as heating and cooling equipment, lighting, and kitchen appliances (Title III).

DOE's typical process in creating standards in an administrative rulemaking involves four phases:

- **Framework Phase:** DOE publishes a framework document that presents the basic analytical and procedural principles and legal authority that will guide rulemaking. The framework document also typically solicits feedback from stakeholders on specific questions.
- **Preliminary Analysis Phase**: DOE gathers available data and information about the product's technical, economic, and market characteristics and makes preliminary determinations concerning methods for improving efficiencies and the impacts of doing so. DOE then publishes this analysis and solicits public input.
- **Notice of Proposed Rulemaking (NOPR) Phase**: DOE considers public input from the preliminary analysis phase, revises its analysis, and proposes an efficiency level that it has determined would result in the maximum improvement in energy efficiency that is both technologically feasible and economically justified. After revising its analysis and proposing an efficiency level, DOE again solicits public input on the standard.
- **Final Rule Phase**: DOE considers public input from the NOPR phase, further revises its analysis, and issues the final rule, which establishes a mandatory minimum energy conservation standard. Typically, the rule requires that manufacturers must comply with the new standard within three to five years to provide sufficient time to make any investments or manufacturing changes required for compliance.

1.3 Small Electric Motors Standard

Title III of the EPCA defines a small electric motor as "[A] NEMA general purpose alternating current single-speed induction motor, built in a two-digit frame number series in accordance NEMA Standards Publication MG1-1987."

The commercial and industrial sectors use small electric motors to operate a variety of equipment types, including fans, pumps, belts, and machinery. Motor functions and applications account for a significant share of total electricity use in the commercial and industrial sectors.

DOE splits small electric motors into three classes for this rulemaking. Table 2 shows these three motor classes and their final adopted TSLs.

Table 2. Final Standard Small Electric Motor Classes and TSL

Motor Class	Final TSL
Polyphase	4b
Capacitor-Start Induction-Run (CSIR)	7
Capacitor-Start Capacitor-Run (CSCR)	7

These motor classes separate single-phase motors and polyphase motors:

- **Single-phase motors** have a single winding that acts as an electromagnet when single-phase current is supplied. DOE determined that single-phase motors are either capacitor-start induction-run (CSIR) or capacitor-start capacitor-run (CSCR).

- **Polyphase motors** have three windings that act as electromagnets when three-phase current is supplied.

DOE released the framework document for the Small Electric Motors Rulemaking in August 2007. In December 2008, DOE published the NOPR for establishing test procedures for small electric motors energy use and released a notice of public meeting (NOPM). In July 2009, DOE established and adopted the test procedures for small electric motors. In November 2009, it released the NOPR for the final rule for small electric motors.

During 2009, DOE held public meetings on January 30, December 14, December 19, and December 21. It released the final rule in March 9, 2010, with an effective date of February 28, 2015.

Major events are listed in Table 3.

Table 3. Small Electric Motors Rulemaking Timeline

Date	Timeline
July 10, 2006	DOE publishes "Determination Concerning the Potential for Energy Conservation Standards for Small Electric Motors" in the *Federal Register*
August 10, 2007	DOE publishes Framework Document and creates Notice of Public Meeting for Small Electric Motors
December 22, 2008	DOE publishes Test Procedure Notice of Proposed Rulemaking
December 30, 2008	DOE publishes Preliminary Technical Support Document
January 29, 2009	DOE public meeting on NOPM for Small Electric Motors Test Procedures
July 7, 2009	New federal test procedures established by the DOE for small electric motors
November 24, 2009	DOE releases Notice of Proposed Rulemaking
December 17, 2009	DOE public meeting on NOPR for small electric motors
March 9, 2010	New federal standards established by the DOE for small electric motors
February 28, 2015	Federal standard for small electric motors effective

DOE estimates the potential savings of the small electric motors standard to be 2.2 quads (quadrillion) British thermal units (BTU) savings from 2015 to 2045.

1.4 Research Objectives

Cadmus' assessment of NEEA's role in the DOE's small motors standard rulemaking addressed the following research objectives:

- Understand NEEA's standards program objectives and its general role in the adoption of federal standards
- Document NEEA's contributions to the small motors standard rulemaking process
- Determine the activities that were most effective and influential in the small motors standard rulemaking process
- Determine an influence score for NEEA's involvement in the rulemaking process
- Calculate the share of savings that NEEA influenced through its efforts
- Identify ways NEEA could improve its future support efforts

1.5 Organization of this Report

Cadmus organized this report into four sections:

- Methodology
- Findings
- Conclusions and recommendations
- Appendices (including copies of all interview guides)

2 Methodology

2.1 Document Review

To gain a comprehensive understanding of the rulemaking process, Cadmus reviewed key documents—the NOPR, technical support documents, the final rule, transcripts from DOE meetings, stakeholder documents, and NEEA documents including comment letters to DOE and the NEEA logic model.

Cadmus used these documents to:

- Develop a list of stakeholders involved in the rulemaking process
- Understand the role of all stakeholders
- Identify important issues during the rulemaking process
- Determine the challenges NEEA and other stakeholders faced during the rulemaking process

2.2 Interviews

Cadmus conducted interviews with NEEA staff and stakeholders to identify NEEA's role and involvement in standard development and adoption and assess the overall effort that went into the small electric motors rulemaking, which Cadmus then incorporated into calculating NEEA's influence score.

2.2.1 Interviews with NEEA Staff Members

Cadmus conducted three in-person interviews with NEEA staff members with knowledge of the small electric motors standard. These interviews explored NEEA's role in standard adoption and its methodology for calculating and applying savings estimates from DOE's adoption of federal standards. The interviewees, who hold diverse roles and titles within the organization, were a:

- Senior codes and standards engineer
- Senior manager of codes and standards
- Planning analyst III

Cadmus reviewed NEEA's logic model for the standards rulemaking process with the two senior staff members. NEEA develops logic models to lay out the theory behind their initiative and support efforts. The logic model presents the barriers faced and illustrates market intervention activities NEEA can take to remove those barriers, as well as to identify the measurable outcomes that are expected to result from the activities. Cadmus used the logic model to guide the focus of the research effort.

2.2.2 Stakeholder Interviews

To obtain a more comprehensive account of NEEA's participation, Cadmus conducted seven phone interviews with nine stakeholders with in-depth knowledge of the rulemaking process for the small electric motors standard. These interviews explored the details of the process that led to adoption of the standard and provided insight into NEEA's effectiveness.

Table 4 lists interviewees' organizations, number of interviews, and titles.

Table 4. Stakeholder Interviews

Organization[1]	Number of Interviews	Interviewee Titles
ACEEE	1	Associate director for research
Advanced Energy	2	Program manager, technical lead
Baldor	1	Senior manager for industry affairs
NEMA	1	Industry director for industrial products and systems
Nidec	1	Government affairs and chair of energy management committee
WEG Electric	1	Project manager for motors
Regal-Beloit	2	Agency manager, regulatory engineer
Total	**9**	

[1] Organization names as of 2010 rulemaking.

2.3 Influence

NEEA can report energy savings[3] resulting from efficiency standards only to the extent that the organization can claim it influenced adoption of the standard. Cadmus developed and applied an analytical framework (referred to in this report as the influence scoring methodology) to estimate NEEA's influence in the process to adopt the small electric motors standard.

Cadmus' influence methodology relied on these assumptions:

- The input and support of outside stakeholders to address the rulemaking requirements are instrumental in DOE's ability to adopt a standard.
- Some factors in the final decision to adopt a standard are more impactful than others in terms of their influence on the adoption process outcome.
- Stakeholders can support DOE and contribute to a rulemaking in a number of ways including, but not limited to, providing data, performing market research, conducting engineering or economic analysis, or engaging in stakeholder outreach and negotiation.

Cadmus engaged in two activities to determine the influence score:

1. Collected data on stakeholder activities from a range of sources, including rulemaking dockets, the DOE final rule, and stakeholder interviews
2. Convened an influence panel to carefully and systematically review these data to assess NEEA's contribution to the rulemaking

2.3.1 Influence Panel

To ensure that the influence score was unbiased and reliable, Cadmus enlisted a panel of four codes and standards experts—one independent consultant and three Cadmus staff—who were unaffiliated with this project and the small electric motors standard rulemaking. Cadmus explained the influence methodology and the scoring protocol and instructed the four panelists about the evidence they should consider when determining scores. The Cadmus evaluation team then instructed the panelists to judge NEEA's contribution relative to the contributions of other stakeholders, such as industry members and other efficiency supporters.

[3] NEEA uses a savings reporting metric called Net Market Effects. This a metric is used to assess its Market Transformation work and is defined as total Northwest Region savings less baseline savings and savings claimed through the Bonneville Power Administration, the Energy Trust of Oregon, and local utility programs.

As part of their deliberations, this panel reviewed:

- A summary of the activities that took place in the rulemaking, including documentation of all stakeholder activity from the framework phase through the final rule phase.
- Documentation of important issues and difficulties stakeholders raised as presented in the public record and in Cadmus' interviews
- Other relevant information to help the panel understand the context for discussions and negotiations (e.g., the resulting lawsuit and appeal)

The panel members discussed their assessments of NEEA's and other stakeholders' contribution to the rulemaking process and asked Cadmus questions about the rulemaking activities, such as NEEA's involvement in coalitions and the official comments NEEA submitted. The panel then mutually agreed upon the influence score.

2.3.2 Influence Scoring

The panel determined an influence score for the small motors standard after reviewing the evidence about NEEA's and other stakeholder's contributions to the adoption process. This final influence score consisted of an average of the panel's score and quantified the percentage of NEEA's relative contribution to the development and adoption of the standard.

2.4 Savings Calculations

Cadmus calculated the total energy savings influenced by NEEA's efforts from adoption of the small electric motor standard using two variables—the incremental improvement in savings and the regional savings potential from the Bonneville Power Administration's (BPA's) Sixth Power Plan Energy Conservation Standards Savings Model.

Cadmus determined the total percentage of NEEA influenced savings by dividing the kWh savings from the adopted TSL to the next lowest TSL by the savings between the adopted TSL and the baseline (Equation 1). For example, the final TSL for CSCR motors was 7, and the next lowest was TSL 6, so the percentage of attributable savings would be this difference divided by the savings from baseline to TSL 7.

Equation 1. NEEA Influenced Savings Calculation

$$NEEA\ Influenced\ Savings\ (\%) = \frac{Incremental\ Savings\ \left(\frac{kWh}{unit}\right)}{Savings\ from\ baseline\ \left(\frac{kWh}{unit}\right)}$$

NEEA's share of influenced savings is the savings (%) share multiplied by the influence score. The final claimable savings are NEEA's share of savings (%) multiplied by the regional potential 2010-2034 (aMW) savings. This calculation yielded the total regional savings that NEEA can claim for the small electric motors standard adoption.

3 Findings

3.1 Overview of NEEA's Approach to Standards

Through its efforts in standards, NEEA supports adoption of standards using a variety of techniques such as participating in official meetings, writing comments and letters, conducting technical analysis, and participating in coalitions. The small electric motors standard was an early effort by NEEA to influence standards; the process and NEEA's role in supporting standards have changed considerably since. NEEA's specific role in the small electric motors standard rulemaking is discussed in Section 3.3. This section describes NEEA's overall approach to standards.

NEEA's senior codes and standards engineer said NEEA's involvement in the rulemaking process for efficiency standards is dependent on NEEA's knowledge and expertise about the specific standard:

- **NEEA is not expert on the technology or test procedure:** NEEA may participate in conversations or meetings with other efficiency stakeholders and offer opinions about the rulemaking, but its formal involvement is typically limited to participating as a signatory on comment letters to the DOE from a coalition of stakeholders. This coalition of energy efficiency stakeholders often includes the Appliance Standard Awareness Project (ASAP), the Natural Resources Defense Council (NRDC), American Council for an Energy Efficient Economy (ACEEE), the California investor-owned utilities (IOUs), and NEEA. ASAP is usually the primary author, which drafts the comment letter then seeks feedback and edits from the larger group of stakeholders. According to the senior codes and standards engineer, some stakeholders, such as the CA IOUs and NRDC, typically choose to draft their own comments.
- **NEEA is knowledgeable about the technology or test procedure**: If NEEA has access to data on the specific technology or market (e.g., field data, original analyses, or reports), it may provide data to the energy efficiency stakeholders coalition. NEEA may also synthesize, review, and critique others' research, data sources, or analysis. In some cases, NEEA's perspective does not completely align with the broader group of energy efficiency stakeholders, so NEEA will draft its own comments on the proposed standard. NEEA may also solicit feedback from other stakeholders, such as the Northwest Power Conservation Council (NPCC), which may make additions and edits and sign as a second representative from the Pacific Northwest.
- **NEEA is expert on the technology or test procedure:** NEEA staff includes experts on the proposed technology or standard, and NEEA is the most technically knowledgeable and experienced member of the energy stakeholder coalition. NEEA leads the development and drafting of comment letters to DOE, and the coalition of stakeholders (which could include ASAP, the NRDC, and ACEEE) may review, comment, and sign the formal comment letter.

According to NEEA's logic model for standards development and adoption, to fulfill the primary goal of supporting adoption of the highest standards that are technologically feasible and economically justified, NEEA's efforts may lead to several possible outcomes, including:

- Decrease disparity in positions between parties
- Add valuable information or analysis at each stage of the rulemaking process

- Provide information or analysis that is referenced in rulemaking proceedings and documentation
- Demonstrate utility support of new standards

As part of its reporting process, internal goal tracking, and external reporting to funders, NEEA tracks the energy savings related to its standards work. Cadmus interviewed a NEEA planning analyst to gather information about NEEA's process for calculating, applying, and reporting on energy savings derived from its standards development and adoption efforts.

According to the planning analyst:

- The BPA provided NEEA with savings estimates for a variety of energy efficiency standards.
- NEEA ensures that the baselines for the models are appropriate.
- NEEA uses this information to report first-year incremental energy savings to funders.
- NEEA will use the influence value to estimate Net Market Effects from the small electric motors standard.

3.2 Stakeholder Roles and Perceived Influence in the Small Electric Motors Rulemaking

Cadmus interviewed nine stakeholders (eight manufacturer representatives and one energy efficiency stakeholder) about their role in the rulemaking process and their opinion on the efficacy of those activities.

3.2.1 Stakeholder Roles and Activities

During the small electric motor rulemaking process, DOE held two public meetings for participants to lend their expertise, deliberate on the possible implications of the NOPR, and negotiate with each other and DOE to influence the outcome of the rule. Eight of nine respondents said they had attended at least one DOE meeting for the rulemaking, and all of the organizations they represented, either individually or jointly with other stakeholders, had submitted comments to DOE.

Stakeholder interviewees described three main issues discussed during these meetings:

- **Technical Feasibility:** According to interviewees, as part of the rulemaking process for the small motors standard, DOE contracted with a technical motor design expert to evaluate hypothetical motor design options, changes, and performance outcomes. This DOE expert identified several motor design changes with the potential to impact motor efficiency performance, including modifications to core materials, density of windings, wire diameter, and gap width. The expert then used these findings to propose options for a federal efficiency standard. Two of the manufacturer representatives interviewed expressed concerns about the engineer DOE hired to model the motors. They believed the DOE engineer made several unrealistic assumptions in his motor models, such as using one motor and extrapolating performance over multiple types of frame speeds and enclosures. They said that DOE calculated 72 levels of efficiency for all types of efficiency (pole, speed, and horsepower) using motors designed off a single motor, resulting in motor designs that were not technically feasible. They were also concerned that DOE was not adhering to industry standards. For example, one manufacturer pointed

out that the DOE used an average efficiency instead of the industry standard nominal efficiency and that DOE failed to define average efficiency for the stakeholders.

- **Economic Feasibility:** All of the manufacturer interviewees expressed concerns that DOE proposed to apply the standard to three different product classes (CSCR, CSIR, and polyphase motors), which all have distinct consumer end uses and are not directly comparable. One respondent said these issues were never fully resolved and explained that CSIR motors could not meet the prescribed levels of efficiency. As a result, he believed that he would now have to manufacture more expensive CSCR motors, and that CSIR motors would have to be repaired, instead of replaced, in motor applications that could not be retrofitted for CSCR motors.
- **Small Motors Classifications:** Respondents said DOE had not properly used the terminology and standard metric for small motors classification, which had been used since the creation of NEMA. Although DOE stated in the ruling that it followed the NEMA definition for motor classification, another manufacturer believed that "DOE was not interested in following any tight definitions that NEMA had created."

3.2.2 Stakeholders Perception of their Influence on the Rulemaking

The stakeholder interviewees' opinions differed about the level of influence of individual stakeholders on the development and adoption of the small electric motors standard, but all stakeholders said ACEEE had a particularly strong influence. One respondent said, "ACEEE was very very [sic] influential. They changed into a leader. ... They sat everyone down and listened to why this rule would ruin their lives, and brought industry back to the table after explaining the overall goals." One respondent, who thought the rulemaking process had gone well, said, "I think everybody [was influential]... We all had the opportunity to talk. … We were listened to where we had weight." DOE meetings provided an opportunity for participants to discuss their concerns about the rule.

Although these interviewees generally believed stakeholders had some impact on the rulemaking, some were dissatisfied with their own impact and believed that the stakeholders, both manufacturers and energy efficiency stakeholders, had little influence on the rulemaking. As one interviewee recalled, "We felt that we had no influence; our positions were disregarded by DOE." Another manufacturer pointed out that DOE offered only simple acknowledgement of written comments, instead of explicitly addressing their concerns. As he explained, "When we made comments, typically the response that we got was like 'This comment regarding NEMA… we disagree.'"

After the small electric motors rulemaking, NEMA challenged DOE's interpretation of a small electric motor in a lawsuit; the court ruled in favor of DOE. NEMA appealed, but the court again ruled in favor of DOE. Several manufacturers believed the rulemaking resulted in an unfavorable decision for both energy efficiency stakeholders and manufacturers.

While most stakeholders were unsatisfied with the outcome of the rulemaking, during the interviews, several respondents pointed out that this rulemaking helped them formulate new strategies for future rulemakings. One strategy included creating a formal motors coalition,

consisting of both manufacturer representatives and energy efficiency stakeholders.[4] The coalition now proposes language and test methods to DOE prior to a standard's NOPR release. Stakeholder interviewees explained they did not have a formal coalition during this small motor standard rulemaking, but that this rulemaking helped form a motors coalition, which was influential in the two subsequent motors rulemakings. All respondents agreed that the new style of coalition building and cooperation was effective in later rulemakings. As one said,

> "Back then there was too much distrust and everyone was too adversarial. We've come full circle, and by working together we get a lot more done. DOE isn't going to trust just the manufacturers, but if we all come in together with the advocates it's more likely to be smooth and get better regulations."

3.3 NEEA's Role and Perceived Influence in the Small Electric Motors Rulemaking

During the interviews with NEEA staff, the senior codes and standards engineer said he participated in three main activities during the small motors rulemaking:

- He attended two public meetings held by the DOE on January 30, 2009 and December 17, 2009. The purpose of these meetings was to clarify the language in the proposed rule and identify any aspects that required further investigation, such as the small motors definitions and proposed test procedures.
- He analyzed and critiqued rulemaking documents from the efficiency stakeholders, manufacturers, and DOE. With the NPCC, NEEA submitted two formal comments to make recommendations regarding test procedure and modeling practices, propose that the DOE narrow its small motors definitions to the NEMA's classifications, and indicate support for DOE on its proposed product classes.
- He also acted as an intermediary, discussing issues and concerns with a variety of key stakeholders in the rulemaking process.

The senior codes and standards engineer reiterated manufacturers concerns about the reasonability of the DOE's assumptions regarding motor design changes and efficiency levels. He said his objective in the rulemaking was to support the development of the most stringent energy efficiency standard possible that was still technically feasible within the market and would avoid future litigation or other complications with compliance. To support his position, he relied on his technical expertise, reputation, and relationships with manufacturers to ask about their concerns and to explore technically and economically viable options from their perspectives. He also thoroughly reviewed DOE's technical materials (e.g., the proposed TSL and results of small motors test procedures) and other industry literature and studies on small motors and motor components. He then submitted comments to the DOE in support of the adoption of the highest justifiable efficiency level that he believed would be acceptable to manufacturers. These comments balanced some of the technical and economic concerns of the manufacturers, while supporting DOE on other aspects of the proposed standard (NEEA's specific arguments are discussed in more detail in section 4.4).

[4] Coalition members include ACEEE, Alliance to Save Energy, ASAP, Earthjustice, NRDC, NEEP, NEEA, NEMA, and PG&E

Cadmus asked stakeholder interviewees about the specific role NEEA played in the rulemaking and how effective they believed NEEA was in the standard development and adoption process. One manufacturer representative said NEEA understood the technical issues and frequently supported the manufacturers during the process. Another manufacturer thought that the energy efficiency stakeholders (including NEEA) affected the rulemaking and were more effective than the manufacturers, saying, "The energy advocates had a strong position and were more influential to the DOE on efficiency levels and scope."

Cadmus asked manufacturer representatives to provide quantitative ratings of NEEA's effectiveness in supporting the standard adoption. Table 5 shows their responses.

Table 5. Stakeholder Perceptions of NEEA's effectiveness overall in supporting the standard adoption

How would you rate NEEA's effectiveness overall in supporting the standard adoption?	Number of Responses
Very Effective	2
Somewhat Effective	3
Not Very Effective	-
Not Effective at All	1
Total	**6**[1]

[1] Only six of the nine stakeholder respondents answered the question.

The majority of the responding stakeholders (five of six) said NEEA was "somewhat effective" or "very effective" in supporting the small motors standard adoption. They believed NEEA's representative in the DOE meetings was very knowledgeable about motors, and that the technical expertise NEEA provided was an important contribution for the efficiency stakeholder groups. One respondent recalled, of all the supporters, "…he was the guy that knew the most about motors other than ACEEE. He made good points. His voice was accepted." The one dissenting respondent offered a different perspective, saying that NEEA was "strong in efficiency, but not in motors" and that NEEA did not have the technical expertise necessary to be more influential.

According to the stakeholder interviewees, NEEA's role at the DOE meetings extended beyond providing technical expertise. The respondents agreed that NEEA had an important role as a facilitator and as a peacekeeper. Specifically, one of the manufacturer representatives said that to successfully develop and adopt efficiency standards "…you have to have the industry and everyone on board. It is not people beating each other up. NEEA was in charge, experienced enough, smart enough to navigate industry."

Cadmus provided a list of all 13 documented stakeholders who participated in the DOE meetings and asked respondents to identify who they believed were most influential in the rulemaking process. Three of the respondents ranked NEEA's influence in the top five stakeholders. Those who ranked NEEA as less influential thought that the manufacturers were most influential because they, as one respondent said, "had much more at stake."

3.4 Influence

3.4.1 Influence Score

Cadmus identified the most influential discussions on the final rule from publicly available comment letters from NEEA and NPCC and other stakeholders, the final rule, and DOE public meeting transcripts. The influence panel deliberated on three primary topics identified in the document review:

- Small motors classification
- Technical feasibility
- Economic feasibility

The following three principles guided the determination of credit:

1. Influence would be determined by disinterested technical experts who did not have a stake in the amount of credit that was awarded.
2. Credit would be awarded on the basis of evidence about NEEA activities obtained from written sources and interviews.
3. The scoring process would be transparent, documented, and repeatable.

To the panel, Cadmus explained the influence scoring protocol and instructed the panelists about the kinds of evidence they should consider and the determination of the scores. Cadmus told the panelists that NEEA's contribution was to be judged relative to the contributions of other stakeholders such as industry members, efficiency stakeholders, and the DOE.

Small Motors Classification

When discussing small motors classification, NEEA supported DOE's position that the motors classes under consideration were appropriate for the standard. The panel discussed how a narrow standard results in complimentary products and loopholes that make circumvention easier. NEEA worked for the inclusion of a broader range of insulation classes (A, B, F, and H), along with the California Independently Owned Utilities (CA IOUs). The panel discussed how this support effort was indicative of NEEA having a strong reputation, and being able to stand against manufacturer opinion.

Technical Feasibility

The panel considered evidence that NEEA supplied information on technical feasibility including baseline modeling, stray current loss assumptions, and electrical steal performance. The panel again came to the conclusion that NEEA played a critical intervention and validated DOE's assumptions. They discussed how NEEA took a collaborative and balanced approach to presenting the information on the technical feasibility of the standard, and acted as peacemaker.

Economic Feasibility

Regarding economic feasibility, NEEA provided end use and penetration data, compliance and enforcement, life-cycle cost analysis, and shipment assumptions. NEEA took the side of the manufacturers more frequently with regards to economic feasibility, urging DOE to collect more data, and supporting the manufacturers in their concerns that offshore motor manufacturers would gain an unfair advantage. The panel thought that NEEA's biggest contribution was NEEA's support of the manufacturers in arguing motor demand was more sensitive to price increases than DOE had estimated, where NEEA provided additional analysis regarding the incremental cost of the higher TSL motors. The panel also added, additionally, that challenging DOE to do due diligence is an important role played by NEEA.

During the discussion, the panelists gave each primary issue a score based on NEEA's effectiveness in making a more stringent standard and on the difficulty of the role. After reviewing the primary issues scores they had assigned, the panel agreed that NEEA should receive one-third of the total credit for the standard, resulting in an influence score of 33%.

3.4.2 NEEA's Net Market Effects Savings

Cadmus used the influence score to determine NEEA's Net Market Effects savings. The associated energy savings were based on DOE's TSL determination. For polyphase motors, DOE assessed motors starting from the highest technically achievable efficiency, TSL 7, and incrementally decreased the efficiency until it deemed that the benefits for both energy savings and emissions outweighed the burdens on manufacturers and consumers (which occurred at TSL 4b). DOE chose TSL 7 for both CSIR and CSCR following the same reasoning. The average annual per-unit energy savings for polyphase, CSIR, and CSCR motors as calculated by DOE for each TSL are shown in Table 6.

Table 6. Trial Standard Levels Considered in the Rulemaking

Trial Standard Levels (TSL)	Polyphase Average Annual Energy (kWh)	CSIR Average Annual Energy (kWh)	CSCR Average Annual Energy (kWh)
Baseline	1,892	1,250	1,425
TSL 1	1,729	1,170	1,360
TSL 2	1,686	1,116	1,250
TSL 3	1,630	1,064	1,205
TSL 4	1,615	976	1,214
TSL 4b	**1,540**	-	-
TSL 5	1,508	951	1,201
TSL 6	1,488	920	1,179
TSL 7	1,462	**860**	**1,146**
TSL 8	-	-	1,115
Final TSL	**TSL 4b**	**TSL 7**	**TSL 7**

Source: Tables VI.6, VI.7 and VI.8 from the final rule.
Note: All kWh annual averages are for 1 horsepower motors.

The savings shown for each motor type (Table 8) are the improvement from the baseline level to the final TSL, which is TSL 4b for polyphase motors and TSL 7 for CSIR and CSCR motors. The incremental savings are the energy savings possible by going from the final TSL to the next less efficient TSL. The percentage of the regional savings available for Net Market Effects is the ratio of the incremental savings to the standard savings.

Table 7. Savings Allocation for Each Motor Type

	Polyphase	CSIR	CSCR
Savings from Baseline (kWh/Unit)	352	390	279
Incremental Savings (kWh/Unit)	75	60	33
Percentage of Attributable Savings	**21%**	**15%**	**12%**

For polyphase motors, the share of the savings available to allocate to all efficiency stakeholders is 21%, 15% for CSIR motors, and 12% for CSCR motors (Table 9).

Table 8. NEEA's Savings Calculations

Motor Class	NW 2010-2034 Potential (aMW)	Incremental Improvement in Savings	Influence Score	Share of Savings	Claimable Savings 2010-2034 (aMW)
Polyphase	8.6	21%	33%	7%	0.61
CSIR	49.4	15%	33%	5%	2.54
CSCR	1.7	12%	33%	4%	0.07
Small Electric Motors Total					**3.21**

The total Net Market Effects savings due to NEEA's work in the Small Electric Motors standard process is 3.21 aMW.

4 Conclusions and Recommendations

Based on the study findings, Cadmus made the following conclusions and recommendations.

4.1 Conclusions about NEEA's Role in the Small Electric Motors Standard Rulemaking

Although some stakeholders described the rulemaking as adversarial, and expressed doubts about their impact on the outcome, NEEA was considered effective for its ability to balance higher efficiency levels and manufacturers concerns.

NEEA served two key roles in the small electric motors standard rulemaking process:

- NEEA participated as a technically knowledgeable representative.
- NEEA served as an intermediary, discussing issues and concerns with a variety of opposing stakeholders and exploring technically and economically viable options from their perspectives.

4.1.1 Recommendation

NEEA should continue to support standards using representatives who have technical knowledge and existing relationships with manufacturers, DOE, and energy-efficiency stakeholders. Continue prioritizing support efforts for standards where NEEA can:

- Serve as technical expert on the specific market, technology, or test procedures, and/or
- Provide technology or market data (e.g., field data, original analyses, or reports)

While the small electric motors rulemaking did not include a formal coalition of manufacturer and energy stakeholders, subsequent motors rulemakings have involved a motors coalition which stakeholders believed has given them more of an impact in standard development and adoption. Even when NEEA staff are not technical experts, NEEA may serve an important role as an intermediary between stakeholders. In addition, NEEA could consider using an outside consultant to support NEEA for standards with significant potential energy savings where NEEA does not have technical expertise.

4.2 Conclusions about Future Study Improvements and Limitations

Cadmus conducted the small electric motors influence assessment nine years after DOE released its intent to rule on the small electric motors standard and five years after DOE's final ruling. While stakeholders spoke frequently about subsequent motors rulemakings, they had difficulty recalling specific details of the small electric motors rulemaking. This included activities they and other stakeholders engaged in, important discussions, and technical information. In addition, documentation, such as email exchanges and personal meeting notes, was frequently unavailable. This narrowed the availability of evidence for the determination of influence.

4.2.1 Recommendation:

Consider dedicating additional resources for documenting support efforts and preparing for evaluations. As a first step, NEEA could identify a methodology and/or key metrics for the

evaluation. Then, NEEA could explore methods for formally documenting NEEA's activities that contributed to these key metrics. NEEA's existing logic model may provide a useful template for documenting these activities. NEEA should also consider encouraging its representatives to save all written communication among stakeholders, such as e-mails and meeting notes, for future review. With the increasing prevalence of coalitions, it may be increasingly difficult to single out the specific efforts of individual actors and groups. To provide additional justification for NEEA's individual influence score, NEEA could also provide a summary of their involvement that makes the case for the significance of their contribution.

Cadmus recognizes that the compliance year for many federal standards is far removed from the actual rulemaking. NEEA could facilitate future evaluations by conducting the evaluation in two phases.

- The first phase would consist of stakeholder interviews, which would be more accurate and informative soon after the rulemaking has been completed.
- The second phase would consist of document reviews, which are not constrained by time.

This two-phase process would allow NEEA to gain an early understanding of its effectiveness from other stakeholders while the experience is fresh.

Appendix: NEEA Interview Guides

Senior Manager of Codes and Standards

Introduction and Overview of NEEA's role

1) What is your role at NEEA?

2) At a high level, how would you describe NEEA's role in the development and adoption federal standards? [*Note: We are just asking for a broad overview here. We will probe on the specifics of NEEA's role in the "Small Motors Activities" section]*

3) What are you responsible for producing and or delivering as it relates to the standards program?

    a. Who are your customers for these deliverables?
    b. How are the needs of your customers similar and different with respect to what you deliver and what they need?

4) Can you talk about how NEEA estimates savings from the adoption of standards?
    a. What are the factors you have selected to use in estimating savings and why have they been selected?
        i. What is the baseline? Are any factors for compliance taken into consideration? What do you use for a measure life? Are there differences between long term and short term estimates?

5) What factors do these savings estimates take into account?
    i) What is the baseline? Are any factors for compliance taken into consideration? What do you use for a measure life? Are there differences between long term and short term estimates?

6) How do these savings play into NEEA's long term strategy/plan?
    a. What percentage of savings from NEEA's work do standards currently account for?

Influence

7) Cadmus will be calculating energy savings based on the incremental difference between the proposed and adopted Trial Standard Levels (TSL)s. We will then apply an influence score to those savings to determine the savings that can be claimed by NEEA.
    a. What are your thoughts on this approach?
        i. Since these savings will be used by you in the future, what information (specifically) will you need from our analysis for future savings estimates?
        ii. Are there any factors we should keep in mind when estimating these savings?

Senior Codes and Standards Engineer

Introduction and Overview of NEEA's role

1) What is your role at NEEA?

2) At a high level, how would you describe NEEA's role in the development and adoption federal standards? [*Note: We are just asking for a broad overview here. We will probe on the specifics of NEEA's role in the "Small Motors Activities" section]*

Small Motors Activities

Next we'd like to talk about the specific activities that you/NEEA undertook as part of the small motors standards rule making process. From our preliminary review of the materials we know that NEEA and the NPCC jointly made several official comments to the DOE. We also know that you attended the DOE Small Motors Test Procedure & Standards Proceedings in January, 2009.

Currently we have copies of the following materials:

- DOE's final ruling, which references NEEA and NPCC's comments on the small motor standard, including comments on the definition of small motors, engineering and impact analyses, and market assessment. *[Note: We will reference our existing documentation and detailed summaries of each of NEEA's comments]*
- Your report on the USDOE Small Motors Test Procedure & Standards Proceedings in January, 2009.

3) Please walk us through the activities you/NEEA engaged in regarding the development and adoption of the small motors standard.

Probe for:

a) Background on NEEA/NPCC's process for developing comments
b) Participation in committee meetings to formulate an official position (e.g., DOE committee meetings and/or advocacy and stakeholder groups)
c) Data collection and/or analyses conducted by NEEA or NEEA's consultants
d) Negotiations with stakeholders, including manufacturers
e) Decision making process on what TSL to advocate for
f) Other activities not identified in the existing materials
g) Documentation of NEEA's activities, including:
    i) Meeting notes
    ii) Meeting Transcripts
    iii) Email threads
    iv) Records of conversations held in other ways
    v) Meeting records: who was where, when, why?]

[Note: Where appropriate, we will use the logic model as a guide/outline to probe further on NEEA's involvement in the small motors standards]

4) Were there any activities that you/NEEA wanted to be involved in, but were not?

5) From your perspective, what were the most significant barriers in the small motors standards rulemaking process?

6) Which of these activities were most influential in the development and adoption of the small motors standard?

7) Which of these activities were least influential in the development and adoption of the small motors standard?

8) What were the key outcomes of these activities?

9) What do you see as your/NEEA's most significant contributions to the development and adoption of the small motors standard?

Main Actors/Stakeholders

Next, we want to review some of the known stakeholders who were involved in the small motors standard rule making process, and discuss how influential you believe these entities were in standard adoption.

We have identified the following groups through our review of the DOE's final rule:

- NEEA
- NPCC
- CA IOU C&S Program (PG&E, SCE, SDG&E, consultants)
- Emerson
- NEMA
- Earth Justice
- Underwriters Laboratories
- Baldor
- Advance Energy
- WEG Electric
- A.O Smith
- Regal-Beloit

10) What other groups, if any, would you add to this list?

11) Of these groups, who were the top three most influential groups in supporting the development and adoption of the small motors standard? What are your reasons for identifying those groups as most influential?

Influence Scoring

Finally, Cadmus will be determining the savings for the Small Motors Standard by looking at the percentage of total standard savings that can be attributed to the incremental change between the adopted TSL and the next lowest TSL. What is the impetus for this method? What do you think the strengths are of this approach?

Planning Analyst III

Introduction and Overview of NEEA's role

1) What is your role at NEEA?

2) At a high level, how would you describe NEEA's role in the development and adoption federal standards? [*Note: We are just asking for a broad overview here. We will probe on the specifics of NEEA's role in the "Small Motors Activities" section]*

3) What are you responsible for producing and or delivering as it relates to the standards program?

    a. Who are your customers for these deliverables?
    b. How are the needs of your customers similar and different with respect to what you deliver and what they need?

4) Can you talk about how NEEA estimates savings from the adoption of standards?
    a. What are the factors you have selected to use in estimating savings and why have they been selected?
        i. What is the baseline? Are any factors for compliance taken into consideration? What do you use for a measure life? Are there differences between long term and short term estimates?

5) What factors do these savings estimates take into account?
    i) What is the baseline? Are any factors for compliance taken into consideration? What do you use for a measure life? Are there differences between long term and short term estimates?

6) How do these savings play into NEEA's long term strategy/plan?
    a. What percentage of savings from NEEA's work do standards currently account for?

Influence

7) Cadmus will be calculating energy savings based on the incremental difference between the proposed and adopted Trial Standard Levels (TSL)s. We will then apply an influence score to those savings to determine the savings that can be claimed by NEEA.
    a. What are your thoughts on this approach?
        i. Since these savings will be used by you in the future, what information (specifically) will you need from our analysis for future savings estimates?
        ii. Are there any factors we should keep in mind when estimating these savings?

Stakeholder Interview Guide

The purpose of this interview is to explore the actions taken by NEEA in the development of the Small Electric Motors Federal Standard. The Energy Policy and Conservation Act defines a small electric motor as:

> "The [A] NEMA [National Electrical Manufacturers Association] general purpose alternating current single-speed induction motor, built in a two-digit frame number series in accordance with NEMA Standards Publication MG1–1987."

We are asking about the rulemaking process that led to the March 9, 2010 Federal Standard for Small Electric Motors, specifically in trying to identify the role of NEEA in the rulemaking process, and the impact of NEEA's actions.

Introduction

1) What is your role at [COMPANY NAME]?
    a. Is this the same as role you had at [COMPANY NAME] during the 2009 small motors standard rulemaking process? If no, what was your role at that time?

2) What role did you play in the Small Electric Motors federal rulemaking?

    Probe for:
    a. Background on developing comments
    b. Participation in committee meetings to formulate an official position (e.g., DOE committee meetings and/or stakeholder groups)
    c. Data collection and/or analyses
    d. Negotiations with other stakeholders
    e. Decision making process on what TSL to advocate for
    f. Other activities not identified in the existing materials

We want to identify what aspects of the rulemaking process you thought were important. From your perspective…

3) Which of [ACTIVITIES MENTIONED IN QUESTION 2] were most influential in the development and adoption of the small motors standard?

4) Which of [ACTIVITIES MENTIONED IN QUESTION 2] were least influential in the development and adoption of the small motors standard?

5) From your perspective, what were the most significant issues/points of consideration during the small motors standards rulemaking process?

NEEA's Role

Next, we want understand your perspective on NEEA's participation in the small motors standard rule making process, and get your opinion on their contributions.

6) From what you know about the Small Electric Motors rulemaking process, what can you tell us about NEEA's role?

7) What were the key outcomes of NEEA's involvement?

8) How would you rate NEEA's effectiveness overall in supporting the code adoption?
    a. Very effective
    b. Somewhat effective
    c. Not very effective
    d. Not effective at all

9) Please tell me more about why you said that.

10) Please tell me which NEEA activities and support have been most effective.

11) Which NEEA activities and support have been less effective?

12) How could NEEA have been more involved? Do you think they should have lent more/different support in other ways?

13) What do you see as NEEA's most significant contributions to the development and adoption of the small motors standard?

Main Actors/Stakeholders

Next, we want to review some of the known stakeholders who were involved in the small motors standard rule making process, and discuss how influential you believe these entities were in standard adoption.

We have identified the following groups through our review of the DOE's final rule:

- NEEA
- NPCC
- CA IOU C&S Program (PG&E, SCE, SDG&E, consultants)
- Emerson
- NEMA
- Earth Justice
- Underwriters Laboratories
- Baldor
- Advance Energy
- WEG Electric
- A.O Smith
- Regal-Beloit

14) What other groups, if any, would you add to this list?

15) Of these groups, who were the top three most influential groups in supporting the development and adoption of the small motors standard?
    a. What are your reasons for identifying those groups as most influential?

16) [If NEEA not in top three ask] Where would you rank NEEA in this list of stakeholders in terms of impact/influence in the development and adoption of the small motors standard?