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SEAD | SUPER-EFFICIENT EQUIPMENT AND APPLIANCE DEPLOYMENT INITIATIVE

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Policy Report: Linking Energy Management Systems and Motor Efficiency Incentive Policies

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Linking energy management systems and motor efficiency incentive policies.

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With thanks to our project partners at the Collaborative Labeling and Appliance Standards Program (CLASP), the Super-efficient Equipment and Appliance Deployment (SEAD) Initiative and the IEA 4E Electric Motor Systems Annex (EMSA) .

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1. List of Abbreviations

4e	Energy Efficient End-Use Equipment
APDP	Automotive Production and Development Programme
CEM	Clean Energy Ministerial
CIPEC	Canadian Industry Program for Energy Conservation
CLASP	Collaborative Labeling and Appliance Standards Program
DOE	U.S. Department of Energy
DSM	Demand-side management
DTI	South African Department of Trade and Industry
EMDS	Electric motor driven systems
EMSA	Electric Motor Systems Annex
EMWG	Energy Management Working Group
EnMS	Energy management systems
EnPI	Energy Performance Indicator
EPACT	Energy Policy Act
IEA	International Energy Agency
IEE	Industrial Energy Efficiency Project
IESO	Independent Electricity System Operator
IPEEC	International Partnership for Energy Efficiency Cooperation
kW	Kilowatts
kWh	Kilowatt-hours
MCEP	Manufacturing Competitiveness Enhancement Programme
MEPS	Minimum energy performance standards
MMBTU	Million British Thermal Units
MW	Megawatts
NCPC-SA	National Cleaner Production Centre of South Africa
NERSA	National Electricity Regulator of South Africa
NRCan	Natural Resources Canada
OHSAS	Occupational Health and Safety Assessment Series

ESCO	Energy service companies
ESO	Energy systems optimization
GW	Gigawatts
GWh	Gigawatt-hours
IAC	Industrial Assessment Center
IAP	Industrial Accelerator Program
SEAD	Super-efficient Equipment and Appliance Deployment
SEP	Superior Energy Performance
UNIDO	United Nations Industrial Development Organization
U.S. CEEM	U.S. Council for Energy Manufacturing
VFD	Variable frequency drive

2. Executive Summary

Background

Electric motor driven systems (EMDS) are estimated to account for about 70 percent of all industrial sector electricity consumed worldwide. Strategic energy management systems (EnMS), such as ISO 50001, seek to discover and implement energy-saving opportunities within an industrial facility. The current project studied the potential links between EnMS and use of incentives for EMDS efficiency implementations. The project focused on three countries – South Africa, the United States, and Canada – in which to examine these links and their benefits and obstacles.

Information and data were gathered through an online survey, case studies from energy management support programs, and interviews with project partners, facility employees, and program employees. The information was then used to create the three case studies presented below.

Findings

Despite our multifaceted approach, we encountered difficulties obtaining sufficient relevant data and relied predominantly on case studies and three phone interviews with facility or EnMS program managers. Still, our research demonstrates that pursuing an EnMS and taking advantage of training and awareness opportunities afforded by national and federal programs encourage energy efficiency more generally and can promote the implementation of EMDS improvement measures. An EnMS enables systematic identification of efficiency opportunities that have been found to often be low- to no-cost operational and process-based improvements that require little capital and produce short paybacks. When more costly capital projects are identified, financial incentives, particularly from local avenues, are sought out and can make EMDS opportunities more feasible and a higher priority; however, it is unclear how frequently they are actually used.

Recommendations

Although investing in an EnMS requires time and effort, the benefits of this continual improvement model go a long way toward promoting energy efficiency and realizing energy savings. Therefore, we provide the following recommendations for EnMS and EMDS program designers and administrators to consider:

- Program designers should include mechanisms with which to receive feedback about the types of projects being implemented by their program group. This information could enable program refinement and lead to a program better tailored to the needs of its market.
- Trainings and workshops that promote energy management and technical knowledge give employees the tools, wherewithal, and confidence to positively impact their energy usage.

- At least initially, low-cost operational and process-based opportunities generated through an EnMS appear to be very common, but as an EnMS matures, access to and awareness of local incentives boost the business case for larger capital projects.

3. Project Objective

The primary objective of this project is to use policy-level case studies to identify potential links between energy management systems (EnMS) and awareness and use of financial incentives for electric motor driven systems (EMDS) efficiency. The case studies will focus on three countries in which to examine the benefits of such links and any obstacles that make them difficult.

4. Project Partners

The Collaborative Labeling and Appliance Standards Program (CLASP) is an international not-for-profit organization that seeks to improve the environmental and energy performance of appliances and related systems. CLASP serves as the operating agent for the Super-efficient Equipment and Appliance Deployment (SEAD) Initiative, a voluntary collaboration of governments working to promote the manufacture, purchase, and use of energy efficient appliances, lighting, and equipment.

The Electric Motor Systems Annex (EMSA) is an annex of the 4E Energy Efficient End-Use Equipment Technology Collaboration Programme under the International Energy Agency (IEA). The goal of EMSA is to support governments to develop and implement policies for efficient electric motor systems. EMSA provides a platform for an in-depth technical and policy exchange and disseminates best practice information worldwide.

Advanced Energy is a planning, technical, and engineering services firm headquartered in Raleigh, North Carolina, that provides market-based energy solutions. Advanced Energy works with electric utilities, state, federal, and local governments, manufacturers, and a variety of public and private partners. Advanced Energy offers program design and implementation, consulting, training, testing, and research services in five markets: residential, industrial, motors and drives, solar, and electric transportation.

5. Methodology, Target Candidates, and Outreach

To meet the project objective, we identified facilities that had implemented an EnMS and performed some form of EMDS efficiency measure. We then researched the facilities and interviewed facility EnMS representatives to understand how efficiency projects were selected and what links existed between EnMS experiences and EMDS efficiency incentives.

Our goal was to prioritize three countries in which to study the link between EnMS and EMDS incentives. Through online research and project partner support, we were able to find relevant facilities in a number of countries; however, based on the availability of data and access to interviewees, we chose to focus on South Africa, the United States, and Canada. Data collection occurred over several months through a mix of an online survey that we developed (tailored to specific countries; see Annex), case studies provided by energy management and efficiency support programs, and interviews with facility and program employees.

For South Africa, our information stemmed primarily from approximately 30 case studies and one phone interview with the national project manager of the Industrial Energy Efficiency (IEE) Project. For the United States, we reviewed nine case studies and conducted a phone interview with the manager of environmental sustainability at one facility. We also received bottom-up efficiency improvement project breakdowns for 18 facilities in the U.S. Department of Energy's (DOE's) Superior Energy Performance (SEP) program. For Canada, we relied on 10 case studies, four thorough and complete surveys, and one phone interview with the president of a metal fabrication company.

6. South Africa

The information gathered about South Africa came from case studies from an energy management support program and a phone interview with the program's national project manager. South African facilities have been greatly assisted by energy management support programs that help spread knowledge and awareness about energy efficiency and systems optimization. Through trainings and workshops, these programs allow facilities to better identify efficiency improvement opportunities that can be implemented even when direct motor-based financial incentives and rebate programs do not play a big role.

In South African industries, motor systems account for approximately 60 percent of consumed energy.[1] There are more than 100,000 installed electric motors in South African industrial plants, representing approximately 10 gigawatts (GW) of installed capacity.[2] However, unlike the other countries being discussed, South Africa does not have minimum energy performance standards (MEPS) for its motors.

Starting in January 2008, South Africa experienced severe energy problems. Unplanned blackouts plagued the country as the gap between energy generation and demand dropped to dangerous levels. Eskom, South Africa's largest state-owned utility company that generates approximately 95 percent of the electricity used, rationed and rotated electricity to try to manage the situation. Although energy had been a concern in the years prior, the 2008 situation provided the turning point. Measures needed to be taken, and energy efficiency and demand-side management (DSM) became a main focus for the country.

Even before the energy crisis occurred, though, steps were in place to promote energy efficiency. In 2005, South Africa developed the National Energy Efficiency Strategy – its first one – which set total targets for final demand reductions for a variety of sectors. Specifically, it set a national target for energy efficiency improvement of 12 percent over a 10-year period. Additionally, the National Electricity Regulator of South Africa (NERSA), realizing the potential issue of meeting electricity demand, required energy efficiency and DSM planning and implementation for licensing for all major electricity distributors. Eskom then offered a DSM incentive program. However, these early programs suffered from a number of issues and failed to meet expectations.

In light of the shortcomings of the prior programs, Eskom shifted focus to emphasize implementations that could be achieved on a shorter timescale. This new approach sought to provide a more transparent, simple, and standardized process. The Standard Offer model, funded by a tariff levy approved by NERSA, was developed as a mechanism to pay customers and energy

1 http://financialresults.co.za/2011/eskom_ar2011/014.html
2 http://www.eskom.co.za/sites/idm/Documents/117102ESKD_DSM_EE_Motors.pdf

service companies (ESCOs) a predetermined amount for delivered, and verified, energy or demand savings. Customers or ESCOs could propose energy-saving projects that if approved and successful (i.e., delivered energy savings between 50 kilowatts [kW] and 5 megawatts [MW]) would recover a fixed amount per kilowatt-hour (kWh); however, the Standard Offer model had its greatest success with lighting interventions.[3]

Part of Eskom's energy efficiency/DSM programs was an energy efficient motor program, which ran from 2008 to 2012. (Because of financial constraints, Eskom discontinued all DSM incentive programs, in particular the Standard Offer and Standard Product rebate programs, by late 2013.) Through this program, industries could trade in their old inefficient motor for a new high efficiency one, and they would receive an instant one-off rebate. This program was applied to motors of 1.1 kW up to 90 kW, with a goal of replacing more than 5,000 and reducing demand by 2.4 MW. However, at the time the program was discontinued, only approximately 1,200 motors were collected, the majority of which ranged from 1.1 kW to 30 kW.

In 2010, the National Cleaner Production Centre of South Africa (NCPC-SA) decided to implement the first-of-its-kind Industrial Energy Efficiency (IEE) Project to support national energy demand by seeking opportunities in industry. The endeavor was supported by the United Nations Industrial Development Organization (UNIDO), the South African Department of Trade and Industry (DTI) and Department of Energy, the Swiss State Secretariat for Economic Affairs, and the UK Department for International Development. The IEE Project was created to transform South African industry energy-use patterns to promote a more sustainable environment. A priority of the IEE Project has been to help industries implement EnMS and energy systems optimization (ESO) through awareness and technical support, which would contribute to the NCPC-SA's goal of using resource efficiency and cleaner production methodologies. The IEE Project works through a subsidized service model, meaning that participation for industries is free or highly reduced.

Industrial Energy Efficiency (IEE) Project

Between 2010 and 2016

- Conducted approximately 230 energy assessments
- Assisted over 60 plants save more than 2,100 GWh
- Equated to savings of more than ZAR 1.7 billion
- Contributed to a reduction of 2 million metric tons of CO2

http://ncpc.co.za/home-iee

South African facilities sought out the IEE Project to reduce energy consumption and save costs, which increase business sustainability and market competitiveness. To meet these needs, the IEE Project's primary role has been to offer technical support, generate awareness, and promote the adoption of energy management standards, such as ISO 50001. The IEE Project offers free energy audits (primarily to small- and medium-sized enterprises), one-day awareness workshops, two-day

[3] https://eta.lbl.gov/sites/all/files/publications/south_africa_country_study_lbnl_report_final.pdf

advanced end-user courses in EnMS and ESO, and longer-term expert level training courses. As of 2016, over 3,000 professionals have been trained at the advanced level, and more than 150 South Africans have become experts in EnMS/ESO.[4]

The one-day awareness workshops focus on disseminating information to encourage facilities to buy into EnMS and the IEE Project. Two-day advanced end-user programs emphasize more in-depth technical information on pursuing an energy assessment. Finally, the experts training program delivers hands-on experience for a variety of systems, including pumps, compressed air, steam, motors, and fans.

To further promote knowledge, facilities have the option of becoming a host or demonstration plant. A host/demonstration plant offers to host the expert level training course at its facility. Before the training course, the plant receives a full energy audit on its energy intensive processes. Findings from this audit are then used in the training course, providing hands-on examples of energy-saving opportunities. These experiences improve facilities' understanding of energy conservation, promote implementation of measures, and motivate facilities to proceed with an EnMS and ESO interventions. The IEE Project then works with the facility to complete a case study of the process and savings incurred.

Among the IEE Project's ESO workshops, it appeared that steam optimization has been the most attended by facilities. Although there is a specific motor systems optimization course, it was delayed because of a lack of available experts and has ended up less popular than the others. Other courses, such as fan and pump systems optimization, include aspects of motor training but not to the same extent as the standalone course does.

Upon attending the trainings and workshops, many facilities expanded their policies and procedures to include energy-specific goals and appointed energy teams to help monitor progress. The IEE Project has been able to help facilities monitor and analyze their energy use in a more systematic and holistic manner. It was evident from facility case studies that one of the greatest barriers and challenges facing South African facilities has been a lack of awareness. Many facilities reported not knowing the true benefits of an EnMS and the potential for savings. They did not realize how much of an impact even small changes in their day to day operations had on their energy usage. Therefore, the IEE Project's promotion of skill development and general spreading of awareness has been a critical first step.

The workshops and trainings' ability to capacitate facilities with information and understanding of energy savings encouraged facility employees to pursue upgrades, and many learned where and how to look for opportunities. The case studies we reviewed emphasized the operational changes that facilities undertook, which often required little or no capital and had shorter paybacks (most on the scale of a few months to a couple of years). For example, Durbanville Hills Winery introduced automatic shutdowns for its cooler pumps, and Distell Adam Tas had its air compressors turn off over the weekend. Indeed, a major

[4] http://ncpc.co.za/home-iee

lesson learned by these facilities has been that energy savings are attainable without major capital investment. System optimization (compressed air and boilers in particular) was also frequently reported.

For larger capital projects, the most common intervention was the installation of variable frequency drives (VFDs) on equipment. Consol Glass, for example, performed fan optimization and installed VFDs on fans throughout its facility, and Polyoak Packaging did something similar. However, we were unable to identify any consistent link between EMDS projects and financial incentives. The IEE Project focuses on providing technical support, promoting awareness of potential energy savings, and capacitating facilities with the necessary tools, but it does not give money to fund projects, and South Africa in general does not currently have any government tax incentives specific to motor driven systems.

Certain broader incentives do exist, but it was unclear how often they were pursued. These incentives include the DTI's Automotive Production and Development Programme (APDP) and Section 12L tax allowance incentive, as well as the Manufacturing Competitiveness Enhancement Programme (MCEP). Some of Eskom's DSM incentive programs, such as the Standard Product rebate offer, have been applied to implementations, but these typically went toward lighting-based projects, such as retrofitting. In general, the case studies did not reveal any consistent relationship between incentives and EMDS improvements, but certain facilities reported interest in pursuing funding mechanisms for future projects.

The IEE Project has been essential for promoting general energy efficiency in South African industries and facilities. Regarding EMDS efficiency implementations, it provides the technical knowledge and awareness to encourage companies to seek out energy-saving opportunities and improve their equipment. A major obstacle for many of South Africa's industries is their lack of information about EnMS, ESO, and the potential for savings. Through the IEE Project's workshops and courses, facility employees know where and how to find savings opportunities, and high-level management is often brought on board. The company begins to realize the ways an EnMS can help identify future savings opportunities.

Many of the projects that South African facilities pursue appear to be operational in nature that do not require substantial capital investment or have quicker paybacks. It is unclear whether facilities actively seek out or receive financial incentives for their projects. The training courses and workshops and their ability to promote energy savings seem to be sufficient for identifying and implementing EMDS efficiency improvement opportunities. Therefore, the continued success of the IEE Project shows that policies supporting EnMS implementation can lead to EMDS opportunities even when specific financial incentives do not play a major role.

7. The United States

The insight we obtained for the United States came primarily from case studies, a phone interview with one facility, and bottom-up efficiency improvement project breakdowns from an energy management support program. The United States has been a leader in electric motor efficiency performance standards since 1992, with the Energy Policy Act (EPACT) regulation. From our research, it appears that energy management support programs greatly encourage EnMS implementation in industrial facilities by offering trainings, tools, workshops, and more to help build the business case for energy improvement. This assistance leads to the identification and implementation of many low-cost projects that do not require substantial capital. For capital projects, facilities seem to seek out financial incentives; however, it is unclear how much of a role they play in improving EMDS projects specifically.

The U.S. Department of Energy (DOE) provides various opportunities to help facilities engage in energy management and efficiency. One particular program that a number of facilities have pursued is the Superior Energy Performance (SEP) program. This program was developed with the support of industry members from the U.S. Council for Energy-Efficient Manufacturing (U.S. CEEM). Its goal is to reduce energy use and carbon emissions by enhancing systematic energy performance improvement in manufacturing and commercial building sectors across the country. It achieves this goal by providing a large network of tools, guidance, incentives, and a general roadmap to continually progress energy efficiency.

Within the SEP program, facilities must implement an EnMS that meets ISO 50001 and produces verifiable energy savings. Specifically, facilities need to improve their energy performance by a minimum of 5 percent over the reporting period, which is typically three years after a determined baseline. Savings are verified through both a top-down approach with bill modeling and an Energy Performance Indicator (EnPI), and a bottom-up approach with metered data. In all, the SEP program requires that facilities set an energy baseline, establish an energy team, and identify and

Superior Energy Performance (SEP) Program

Pursuing SEP certification requires extra work and effort, but the benefits of achieving it are numerous.

- Annual savings can reach close to $1 million, often using no- or low-cost measures
- Energy costs are reduced by an average of 12 percent within 15 months of implementation
- Paybacks typically occur under 1.5 years (for facilities with energy costs greater than $2 million annually)

https://www.energy.gov/eere/amo/superior-energy-performance

pursue energy efficiency measures that lead to savings. Therefore, it uses a multifaceted approach to promote widespread energy management awareness.

Based on the amount of verified energy savings, the SEP program offers different levels of certification: Platinum, Gold, and Silver. Currently, 18 U.S. facilities have Platinum certification, 10 have Gold, and 15 have Silver (facilities in Mexico and Canada have received SEP certification as well).

Many facilities that have enrolled in the SEP program reported doing so for environmental reasons and to reduce the use and cost of energy. These facilities want to be seen as leaders in promoting energy efficiency and environmental stewardship. Implementing an EnMS and becoming certified by the SEP program are an ideal way to achieve these objectives. Another motivating factor is more general corporate goals for energy management, which can be observed by the fact that certain facilities had already participated in other DOE programs, such as the Better Buildings, Better Plants Program that asks companies to reduce their manufacturing energy intensity by 25 percent or more within 10 years. Companies enrolled in this program set goals, establish energy management plans, and report progress annually to the DOE. They can later implement SEP as a strategy for meeting these goals.

In addition to providing recognition for energy savings, the SEP program and DOE more generally offer access to practitioners who can perform audits, as well as trainings and workshops for facilities and their employees to support technical expertise. For example, certain facilities worked with Industrial Assessment Centers (IACs) to receive energy audits at little to no cost. These IACs consist of teams located at 24 universities around the country. They provide audits on compressed air, steam, pumping systems, and more. Additionally, facilities have taken advantage of trainings in various technical areas, including motors, fans, and pumps; compressed air; ESO; and general energy management. These trainings, plus workshops about the SEP program and ISO 50001 more generally, help spread awareness and knowledge that are critical to successfully implementing an EnMS and realizing energy savings.

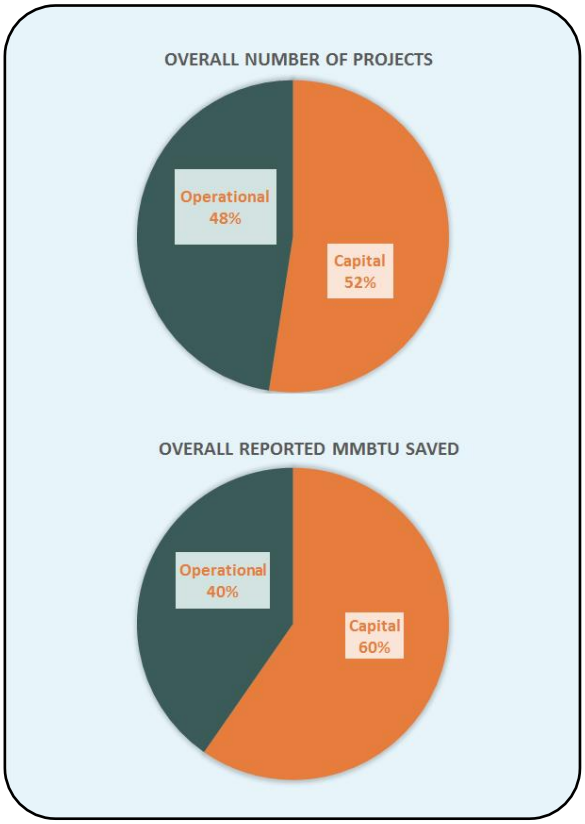
To assist facilities with measuring and verifying their improvements, the DOE offers an EnPI tool. Many facilities that we reviewed reported using this tool as they progressed through SEP certification. The tool provides a facility-wide energy profile and allows facilities to better track energy performance over time. Obtaining SEP certification also often requires additional sub-metering. Many facilities we studied did not previously have extensive metering and needed to add more, which allowed them to better understand their energy profile and significant energy users. The information obtained from this monitoring helps facilities focus their energy efficiency efforts on areas that should be targeted and makes energy conservation part of facilities' day to day business.

Most of the facilities that have joined the SEP program already had management systems in place, such as ISO 9001, ISO 14001, and Occupational Health and Safety Assessment Series (OHSAS 18001), so the background knowledge and experience

were present. These existing processes, people, and procedures streamline the addition of ISO 50001 and make it easier to achieve success. Taken together, the features of the SEP program greatly promote sustained energy management and efficiency awareness and make it easier for facilities to recognize opportunities for savings.

Through the SEP program, some facilities voluntarily provided data on the number and type of projects they implemented. Specifically, 18 facilities supplied details on 263 projects that helped them achieve certification. With each facility averaging more than 14 individual energy-saving projects, it is clear that a strong EnMS program will find energy improvement opportunities and can build the business case for them.

Although the SEP program has been vital at promoting technical expertise and awareness in EnMS, it does not provide funding for capital investment in EMDS or other energy efficiency projects. However, 48 percent, almost half, of the projects reported voluntarily to the SEP program could be considered non-capital or process-based energy improvements, and these projects accounted for approximately 40 percent of the estimated reported energy savings. This pattern holds true for EMDS implementations as well: approximately 48 percent of the EMDS projects that were driven by the EnMS were operational in nature and tended to be low- or no-cost low-hanging fruit projects, such as more effective shutdown procedures for equipment. It is evident that a beneficial aspect of an EnMS is its ability to help identify these lower-cost improvements.

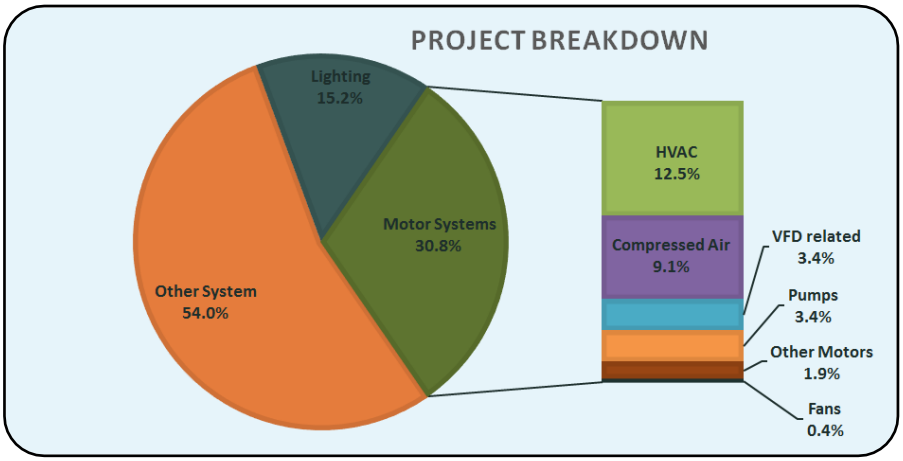


Project breakdown by type from data reported to SEP program

From the voluntary data, EMDS energy improvement implementations accounted for approximately 31 percent of the total implemented projects and 20 percent of the total estimated energy savings. Capital-based EMDS projects included adding VFD installations on HVAC, pump, and fan systems. The majority of the energy-savings projects (69 percent) focused on lighting and non-motor driven processes, such as boilers.

When capital projects are sought out, utility and government rebates and incentives play a role where they are available; however, it was unclear from our research how frequently they have been applied to EMDS projects. Nissan, for example,

received a $1.1 million custom incentive from the Tennessee Valley Authority for a project being implemented at the company's painting plant. Furthermore, one pharmaceutical research and development facility reported frequently exploring incentives to make projects more viable and bring down cost, which would support the business case for pursuing upgrades.



Project breakdown by system from data reported to SEP program

The development of an EnMS and verified savings from the SEP program have helped support energy efficiency budgets in some facilities (and corporations), and many have a proposal process for potential implementations. The proposals provide the cost-benefit analysis of various projects, which are then analyzed (sometimes competing with more general company projects), and a decision about fund allocation is made. Implementing an EnMS helps bring executives and other employees on board, making them realize their impacts on energy use. The staff becomes more receptive to funding projects because savings are externally verified, and a positive sustained cycle of energy management is created.

The SEP program and DOE more generally have been essential in promoting general energy efficiency and EnMS implementation in U.S. industries and facilities. Regarding EMDS efficiency projects, this program has helped spread the technical knowledge and awareness to encourage companies to seek out energy-saving opportunities and improve their equipment. The SEP program's verified savings help motivate high-level management and leadership, as well as other employees, to pay more attention to energy management and invest more time, effort, and capital into energy efficiency. This, in turn, makes the decision to move forward with EMDS capital expenditures easier. The company begins to realize the ways an EnMS can help identify future savings opportunities.

A large benefit of an EnMS is its ability to identify low- and no-cost operational improvements. Indeed, nearly half of the EMDS projects reported to the SEP program were process-based and required little capital investment. For capital-based projects, it is unclear if all facilities seek out financial incentives, but some reported actively exploring incentive options. Therefore, the continued success of the SEP program shows that policies supporting energy management and increased awareness of EMDS performance can be extremely beneficial.

8. Canada

Our review of Canada stemmed primarily from case studies, a few completed surveys, and a phone interview with the president of a metal fabrication facility. From this research, it appears that Canadian industries integrate a mix of federal-level programs and utility-level incentives to help implement an EnMS and EMDS projects. The EnMS and associated trainings and workshops provide knowledge and awareness that help identify low-hanging fruit projects, while local financial support strengthens the business case for moving forward with capital implementations.

The Canadian facilities we studied pursued an EnMS and related support systems for a variety of reasons. Primary motivations reported in case studies included wanting to have a positive environmental impact and reduce the use and cost of energy. These facilities wanted to be seen as leaders in promoting energy efficiency and environmental stewardship. A number of facilities had general corporate goals for energy management and a culture and history of energy efficiency, and therefore implementing an EnMS was an ideal and logical way to continue down this path. Furthermore, these facilities frequently already had management systems in place, such as ISO 9001 and ISO 14001, so the background knowledge and experience were present. These existing processes, people, and procedures streamlined the addition of ISO 50001 and made it easier to achieve success in a timely and cost-effective manner.

Facilities in Canada have relied on a number of resources to support their EnMS implementation and EMDS efficiency measures, stemming from international, federal, and local (utility-based) avenues. One resource has been the Energy Management Working Group (EMWG), which was launched in 2010 by the Clean Energy Ministerial (CEM) and International Partnership for Energy Efficiency Cooperation (IPEEC). The EMWG consists of member government officials worldwide that share best practices, knowledge, and experience to create high-impact national programs that promote EnMS in industry and commercial buildings. The EMWG helps build the business case for energy management, provides support and tools, and assists in setting energy management policies.

Within Canada specifically, Natural Resources Canada (NRCan) is a federal ministry that offers assistance through its Energy Efficiency for Industry program. This program helps industrial companies implement energy management projects, including ISO 50001. It spreads awareness by publishing newsletters, reports, guides, and manuals, and also licenses Dollars to $ense workshops, which include training and tips on topics such as energy management information systems, energy management planning, identifying energy-saving opportunities, and more. NRCan provides financial assistance as well, offering up to 50 percent of eligible costs for energy management projects (including tools and resources, trainings, and assessments) up to a maximum of $40,000.

The Canadian Industry Program for Energy Conservation (CIPEC) is a voluntary partnership between industry and NRCan and has been helping organizations improve energy efficiency since 1975. It seeks to promote energy efficiency in the industrial sector and supplies cost-shared tools and services. Facilities can become CIPEC Leaders by showing their dedication to energy efficiency and, in doing so, gain recognition for their efforts and receive discounts on various webinars and workshops. Furthermore, facilities can secure Leadership Awards.

Certain Canadian plants also took advantage of programs based out of the United States, such as the DOE's SEP program (see above), mainly with the help of NRCan and the EMWG. Currently, 2 Canadian facilities are certified through the SEP program.

In one form or another, the programs described above support facilities with workshops, webinars, trainings, audits, and more to promote EnMS and energy efficiency. Facilities have relied on these resources for spreading awareness, promoting expertise, and assisting with carrying out assessments and gap analyses. VeriForm, for example, was one of several facilities that received a grant from NRCan for adopting ISO 50001. Additionally, employees at many facilities attended NRCan's Dollars to $ense energy management workshops and area-specific trainings, including ones in motors, fans, and pumps, and compressed air. Taken together, these various resources proved invaluable at helping implement an EnMS and supporting energy efficiency.

To complement the trainings, workshops, and assessments, facilities took advantage of a variety of tools that assisted with incorporating an EnMS and measuring and verifying energy savings. For example, certain facilities adopted the DOE's EnPI tool, and many relied on sub-metering and other forms of energy monitoring equipment to better understand their energy profile and significant energy users. Some facilities used an energy management dashboard that depicted and tracked energy uses. VeriForm in particular greatly benefited from its energy monitoring system. The information and data let VeriForm know where to focus its energy efficiency efforts and which aspects of its business should be targeted.

When it came time to follow up with implementations, facility-directed energy management teams helped identify energy efficiency upgrades throughout the plant and for all energy uses, including natural gas, propane, steam, and, of course, electricity. Having support from management and leadership was critical for making projects more feasible. Certain facilities had energy-specific budgets, while others incorporated energy projects into broader aspects of their company. Similar to U.S. facilities, Canadian facilities frequently used a proposal process to determine fund allocation for projects.

With an EnMS, a focus is on pursuing energy savings in general. Therefore, as with South Africa and the United States, many implementations in Canadian facilities appeared to be operational and lower cost in nature and particularly dealt with boilers, HVAC, air compressors, and lighting. These opportunities were driven by the EnMS and the increased awareness that was provided by the trainings and workshops. Other low-hanging fruit projects, such as more effective shutdown procedures for idle equipment, were prioritized as well.

For capital energy efficiency and EMDS projects, utility-based resources were very supportive. In general, EMDS projects included investing in VFDs for motors, pumps, and fans; optimizing HVAC and boiler plants; and replacing and upgrading compressed air systems. Some of the utilities that contributed to facilities' energy efficiency pursuits included Hydro One, FortisBC, and BC Hydro. As a specific case, BC Hydro's Power Smart Program offers incentives for replacing and upgrading old technologies, such as adding a fan or pump with a VFD. Additionally, the Ontario-based Industrial Accelerator Program (IAP) is run by the Independent Electricity System Operator (IESO) and assists with capital investments for major energy projects. Its retrofit initiative provides financial incentives for motors, VFDs, compressors, and more. The IESO also supports Save on Energy, which is offered by local hydro companies and has financial incentives for businesses across Ontario. Its energy retrofit incentives provide financial mechanisms to encourage a variety of projects, including HVAC redesign, chiller replacement, and VFDs.

VeriForm is one facility that has taken advantage of Save on Energy's incentives for motor measures. When VeriForm's energy use was initially evaluated, motor systems were not found to be the largest source of energy savings. Instead, the natural indoor gas heating proved to be the easiest place to save, and a project was pursued in part through simple employee awareness. Furthermore, VeriForm's capital for energy efficiency was rolled into its broader annual maintenance budget. With multiple projects competing for funds, the Save on Energy incentives were essential for motivating motor-based projects. VeriForm used the incentives for a number of upgrades, including installing a VFD and rebalancing the fan on its dust collector.

Canadian facilities and industries appear to have successfully integrated federal and local resources to foster EnMS implementation and EMDS efficiency projects. Through their training courses, workshops, tools, and assessments, federal programs help promote the awareness and expertise necessary to successfully complete an EnMS, which then encourages facilities to look at and understand their energy uses. Developed technical knowledge and know-how allow companies to seek out a holistic system of energy-saving opportunities and improve their equipment. In turn, high-level management and leadership, as well as other employees, pay more attention to energy and invest more time, effort, and capital into energy efficiency.

Many energy-saving opportunities appear to be low-hanging fruit, operational, and process oriented; these are more cost-effective early on with an EnMS. However, local utility-based programs have proved critical for financially supporting capital EMDS projects. These programs make the financial barriers of such investments easier to overcome and help progress the business case for pursuing them. Therefore, Canadian facilities' successes can be traced to the blending of federal and local programs. Policies supporting energy management and EMDS opportunities can be extremely beneficial when navigated together. Future research should examine how EnMS and financial incentives intersect as an EnMS matures.

9. Summary

The three countries studied – South Africa, the United States, and Canada – demonstrate that adopting an EnMS in industrial facilities can promote EMDS efficiency interventions and energy efficiency more generally. Most of the facilities in these countries reported not appreciating the financial impact of managing, or even just monitoring, their energy usage, and an EnMS engages all employees to buy into the culture of energy efficiency and become aware of how their actions affect energy use.

EnMS implementation in the three countries focused heavily on providing education and technical assistance to facility managers, engineers, and personnel. In the United States, the SEP program is market based, relying on the merits of energy management and verified savings to justify the efforts of implementing a formal system. Canadian facilities have access to federal programs and cost-share financial assistance for EnMS implementation, which often goes toward the salaries of employees tasked with developing the EnMS. In South Africa, EnMS adoption is facilitated by heavily subsidized EnMS and technical training courses, through the IEE Project, that provide hands-on instruction and demonstrate real-world energy-saving projects.

A common message reported by facilities was that developing a sound business case for the efficiency projects was very important. The knowledge and awareness gained through EnMS implementation and the technical training courses and workshops provide confidence and act as a foundation on which to build this case. From there, it becomes easier to bring high-level management on board and get other employees to buy into improvement projects. Therefore, it is clear that an EnMS and its ability to promote awareness and expertise is a critical step in getting the most out of energy management.

A large portion of the energy efficiency upgrades that were pursued were lower cost, operational, and process based. In the United States, for example, nearly half of the energy efficiency projects reported to the SEP program could be classified in this way. This pattern is not surprising, as early on an EnMS will encourage general energy-saving opportunities, and operational changes with little to no capital costs can easily be prioritized. When U.S. and South African facilities examined their production processes and found opportunities for EMDS improvements, it was unclear how regularly additional funding incentives were used, though at least in the United States they were sought out. The ability to generate energy savings through low- and no-cost improvements may have made it more feasible to rely on internal budgets.

As a facility's EnMS matures and more capital investment measures are identified, EMDS incentive programs may make the financial barriers of energy efficiency investments easier to overcome. If that's the case, the accessible incentives in Canada show that policies supporting energy management and EMDS opportunities can be extremely beneficial when navigated

together. Therefore, it will be important to continue to explore this topic as an EnMS further develops. With the adoption of a holistic approach to managing energy use, facilities are seeing the potential for future energy savings and paving the way for a more energy efficient and competitive future.

The following are some recommendations for EnMS and EMDS program designers and administrators to consider:

- Program designers should include mechanisms with which to receive feedback about the types of projects being implemented by their program group. This information could enable program refinement and lead to a program better tailored to the needs of its market.
- Trainings and workshops that promote energy management and technical knowledge give employees the tools, wherewithal, and confidence to positively impact their energy usage.
- At least initially, low-cost operational and process-based opportunities generated through an EnMS appear to be very common, but as an EnMS matures, access to and awareness of local incentives boost the business case for larger capital projects.

10. Annex

Annex A: Resources Consulted

Canadian Industry Program for Energy Conservation (CIPEC)

Clean Energy Ministerial (CEM)

Energy Management Working Group (EMWG) Case Studies – Canada

Energy Management Working Group (EMWG) Case Studies – United States

Industrial Energy Efficiency (IEE) Project in South Africa Case Studies

International Partnership for Energy Efficiency Cooperation (IPEEC)

Natural Resources Canada (NRCan)

U.S. Department of Energy (DOE) Superior Energy Performance (SEP) Case Studies

Annex B: Generic EnMS and EMDS Sample Facility Survey

Energy Management Background

1) Did your company receive assistance or guidance on how to establish an energy management program? If yes, choose all that apply.
    a. Federal Government Program
    b. State Government Program
    c. Utility Programs
    d. Consultants
    e. Other
2) Does your company have a dedicated budget or financial system for funding energy efficiency improvements? If yes, can you describe them?
3) Does your company have defined energy goals and what are they?

General Facility Questions

4) What are the major challenges your energy program faces?
5) What is your company's approximate annual energy expense?

a. Less than $1M
b. $1M to $10M
c. $10M to $50M
d. $50M to $100M
e. $100M to $200M
f. More than $200M

6) Electricity accounts for roughly what percentage of your total energy expense?

Motor System Background

7) What are your top five significant energy using systems and where do your motor-driven systems rank among them?
8) Did employees receive motor-driven system improvement training, and if so what systems did they study?
9) Since establishing a formal energy management program, how many motor-driven system efficiency opportunities have been or are currently being implemented in your facility?
10) Of those motor-driven system opportunities, how many have been implemented or are currently being implemented in your facility? Please list the opportunities below.
11) Can you describe the tools and services that best helped you to identify and implement motor system efficiency opportunities?

Program Incentives

12) Were financial incentives or rebates explored for each type of motor-driven system opportunity identified?
13) Do any of the identified motor-driven system efficiency improvement opportunities qualify for financial incentives or rebates, for example, from a government program or local utility? If yes, please describe them and which ones were used.
14) Has your company used any other funding program or service to finance the implementation of motor-driven system efficiency projects? If so, please briefly describe it.

15) How did financial incentives or rebates influence your decision to implement identified motor-driven system efficiency opportunities?