Pollution Prevention and Energy Efficiency a Case Study in Southwest Border Region

Jalal Rastegary, **Patricia Sullivan**, **Chris Campbell**, **Edward Rojas**
The Engineering New Mexico Resource Network, College of Engineering
New Mexico State University

ABSTRACT

Companies now more than ever understand that being environmentally conscious not only benefits everyone around them but can also save them on operating costs and increase their efficiency. Several companies have requested the expertise of the staff at the Engineering New Mexico Resource Network (ENMRN) at New Mexico State University (NMSU) for advice on how to improve their operating efficiency. The staff at ENMRN focuses on reducing costs by reducing electric energy consumption, solid and liquid waste, and carbon dioxide emissions and by implementing more efficient operating procedures that include creating concise work areas and implementation of standard green practices such as implementation of a recycling program. A recent assessment was performed at a local business focused on metal stamping and metal fabrication to determine if any improvements could be made concerning consumption and waste creation. The staff, composed of students and faculty members, developed a report offering recommendations and the benefits of enacting them after conducting an on-site walkthrough of the premises. It was advised that management should convert all propane powered forklifts to electrical forklifts to eliminate costs of propane handling, increase maintenance on evaporative coolers installed to minimize the chance of water leaks and water waste, and convert all lighting to an energy efficient system along with shutting down equipment when not in use. The business would be able to save about $58,000, just by changing the lighting system and shutting down unused machinery; creating a substantial reduction in operating costs. Other recommendations were suggested that were low cost and easy to implement. Increasing the amount of natural lighting was recommended by installing skylights in certain areas, leading to additional savings of about $2,000 per year. Unused sawdust could be collected and sold for nearly $20,000 per year, whilst also reducing cost in disposing this waste. The development of a more efficient storage system for tools and materials would reduce setup time and increase productivity, and increasing thermostat temperatures by a few degrees would save an additional $14,000 per year in energy costs. Through the help of the ENMRN this business found ways to reduce operating costs and even turn waste into a source of income. The ENMRN not only helps local industry develop a better and more efficient business model, it also helps businesses focus on how they impact the environment and introduces them to greener practices leading to a win-win scenario with businesses and the environment.

Introduction

The Engineering New Mexico Resource Network (ENMRN) at New Mexico State University (NMSU) has been working with local businesses and organizations to reduce pollution and increase energy efficiency in an effort to decrease operating costs and decrease environmental impact of commercial industry.[1] The Pollution Prevention (P2) and Economy, Energy and

Environment Best Practices (E3) programs were created in 1999 through funding from the U.S. Environmental Protection Agency (EPA) Pollution Prevention Grants (PPG) program.[2–4] In 2016, the program merged with ENMRN and now serves as NMSU's formalized outreach unit.

The P2 and E3 programs focus on providing small- and medium-scale businesses with greener methods of operating their companies by focusing on reducing energy consumption and decreasing pollution generation. These programs encourage companies to go beyond the baseline requirements and educate them in the advantages of a greener operation. Many of the methods proposed by advisors in these programs usually have little to no cost in implementation with most current work models allowing seamless integrations, allowing management the flexibility of incorporating a new system with almost no negative feedback.

Studies have shown that the influence of pollution prevention programs tends to improve overall levels of pollution; companies that voluntarily focus on reducing their pollution creation usually find improved cost saving measures, a move that both environmentalists and company owners would support.[5] This should encourage not only independent organizations but also academic institutions to improve their local environment by working with businesses. NMSU is one of several institutions that provide educational awareness and outreach services to industry and commercial entities through the funding received by the EPA. The other institutions participating in similar programs across the country have shown positive results in their efforts saving hundreds of thousands of gallons of water, eliminating tens of thousands of pounds of waste and saving millions of dollars for companies. A list of previous pollution reduction results can be found at the EPA website according to year of measurement.[3]

Through these programs, many aspects of industry can be changed without the need for creating new laws that could take many years to be ratified. Cutting through this red-tape not only allows quick and easy changes to enacted, but also reduces payback time for the participant. These programs always improve a businesses' operating procedures, leaving no reasons for a business to not participate in the program.

Sustainable Programs at ENMRN

P2 and E3 Program

The ENMRN is focused on shifting small-business operating procedures to a more economical and environmentally friendly model; the P2 and E3 programs help businesses reach a more sustainable operation through the implementation of greener practices that can also decrease operating cost. These programs work to achieve the AWARE goals:

1) **Assist** small-scale operations in adopting or improving pollution and energy efficiency Best Practices within their ongoing operations.
2) **Work** with like-minded organizations to increase environmental awareness and educate business owners on the benefits of greener practices.
3) **Assess** and evaluate current operating procedures and regulations to determine areas that need improvement along with recommendations to increase sustainability.

4) **Report** all findings and advisable programs to the company and all results of implemented recommendations for their final approval and assure that assessments are non-regulatory.
5) **Educating** current industry and the future of industry, *i.e.* students, on energy efficient and pollution prevention practices by incorporating them in all steps in assisting a small businesses conversion to environmentally friendly practices.

Candidate Selection Procedure

Staff members at ENMRN, over many assessments, have developed a simple procedural method, the five-stage Best Management Practice (BMP), to gauge which businesses are most likely to benefit from greener practices.[6] Through this framework businesses that either pose the most risk to their local environments, consume extensive resources, or create large volumes of waste are selected and considered to be assessed. A business that is considered and participates in the programs must undergo and adhere to the following criteria:

1. *Need:* The business must display operating procedures and business models that need improvement. The staff looks for areas of industry that usually have little to no environmental standards, high rate of waste generation plus power and water consumption. Staff will consider businesses that can and should reduce hazardous material use and waste creation, consume large amounts of electrical energy, consume extensive amounts of water or generate large volumes of waste water.
2. *Recruitment:* If a business has any needs that match the above criteria, the staff will contact management to inform them of the benefits of the programs along with previous successes. Improvements in cost-savings and performance are highlighted along with implementation and utilization of no-cost services.
3. *Commitment:* The business then must agree to have upper management be involved throughout the entire process and allow other employees to accommodate the assessment staff. Management is encouraged to implement changes given by the assessment team and allow future assessments to track the effects of the implemented changes and offer further improvements.
4. *Implementation:* A training room must be provided by the business during inspections and management must provide access to all areas of the business during a walkthrough and allow pictures and videos to be taken for use in the final report and presentation. All machinery and appliances will be investigated; therefore, employees that can access hazardous areas should be available to conduct a thorough inspection.
5. *Recommendations and Evaluation:* The final report and final presentation will be presented to management and employees who participated in the inspection. The report will detail all changes and their beneficial impact. Any results and recommendations that are implemented by the business should be reported to the U.S. EPA where applicable.

All participating businesses follow and perform these steps; the on-site inspections and assessments vary from business to business but follow a simple procedure detailed in the next section. By using this five-step method, staff members can efficiently recruit and inform businesses of areas in need of improvement while leaving management in control of what procedures should be changed.

On-site Assessments and Methodology

Many clients that request the help of the P2 and E3 programs can either be large industrial sites with large workspace areas or small businesses; in either case ENMRN has developed and implemented a general assessment procedure that can be utilized for any client. The assessment is done by a team composed of several members:

- Project Leader: A senior staff member with significant experience that oversees the assessment and communicates with the client directly. Presents the final report to upper management and decides which recommendations should be included in the report.
- Project Advisor: A senior staff member that is present for on-site inspections and is responsible for investigating programs that a client can join to increase sustainability. Also responsible for examining machinery that would be unsafe for students to inspect. The leader and advisor have nearly the same responsibilities and are largely the same role.
- Assessors: Responsible for inspecting all machinery, within safety guidelines, and conducts a search for more efficient equipment along with calculating the effect recommendations have on the business. In charge of writing the final report, with the leader making edits as necessary. Usually a student with an engineering background or entry level staff member.

Graduate and undergraduate students are involved in the whole process of assessment from collecting data to helping with calculations to finding and suggesting more energy efficient equipment and preparing reports. The assessment provides hands-on experience to students and will help them to better understand the process and can use the experience in a real word when they graduate. Students, hired by the staff at ENMRN, learn important sustainable practices that can increase their awareness for the environmental considerations of their school projects, usually undergraduate senior design projects. Students are instructed using the INFO method developed by the staff at ENMRN that allows them to assess a client's workspace efficiently. The process is enacted during a walkthrough of the client's work space and follows the simple step-by-step process starting from inspection and ending with reporting.

1. **Inspect**: Students and staff must examine all aspects of the work area, everything from machinery to operating procedures to building conditions must be examined and recorded
2. **Note**: All sources of waste, appliances with high usage or high rate of consumption, and water usage must be recorded. All operating costs relating to water, waste, and electricity should be obtained from the client.
3. **Find**: This occurs after the inspection and is part of the creation of the final report; the team must investigate all possible methods the client can increase their sustainability. This includes finding alternative appliances that will use less power or joining a program that can reduce their waste creation.
4. **Offer**: The team then presents all their findings and recommendations to management in a final report and presentation. The team then answers any questions that the business could have and advises which recommendations would be the most beneficial to enact immediately.

The simple method not only allows students an easy way to determine how a business should be assessed but is also easy enough to implement in a wide array of businesses, allowing the staff and students to assess numerous businesses without having to develop a different method of inspection for each type of business. The specifics of inspections do range, with certain safety considerations that should be accounted; a general procedure is difficult to create to account for everything in a client's workspace. Though the INFO procedure is general enough to encompass any type of business, a specific assessment must be described to fully detail the type of advisements that the staff would give management.

Industrial Assessment

A sheet metal and fabrication company recently asked for assistance in increasing their sustainable operating methods. The company agreed to adhere to the best management practice outlined previously and was willing to enact recommendations based on the team's findings. The students followed the INFO guideline; during the inspection a few positive aspects were noted:

- TEWA practices allowing employees to suggest any new ideas or provide feedback to increase sustainability.
- Nearly 100% of raw wood material is imported from renewable forest sources
- Efficient and green product lines in place
- Sawdust collected and sold instead of disposed with a return of about $20,000 per year.

This company can be categorized as one that wishes to increase their sustainability, but not knowing exactly how else it could do it, a perfect candidate and client for the programs offered by the ENMRN. Allowing employees to suggest new ideas is indicative of management needing guidance, and the implementation of efficient product lines shows it willingness to increase their sustainability. After noting the positives, the team then analyzed all aspects that could be improved and noted any areas that would benefit from a green practice operating procedure.

The company recycles materials using the local waste utilities available in the area; however, decreasing the amount of recyclable material, such as cardboard, metal, and wood pallets by about 25% percent could reduce cost in waste management. It currently costs $6500 per year to have three recycling bins, but by reducing recycling materials one bin could be returned, reducing waste costs by $2100 per year. Cardboard can be reused or repurposed in many office spaces or can even be pressed to reduce their volume when recycled. If enough cardboard is produced the company can sell large amounts of cardboard for a profit, increasing their cost savings to a higher degree. It is even advised to let employees take recycling materials for their own needs if any would want it. Although sawdust is collected and sold, some areas of the business do show large amounts wasted and thrown away; some is left on the floor which is disposed. Increasing employee awareness and enacting better collection procedures would decrease waste, allowing the company to more easily eliminate the third waste bin.

Employees and shift rotations were examined and noted, with a few advisements given. The team advised management that employees should be rotated and trained on all equipment during slow operating seasons; currently employees are specialized on their own workstations and absenteeism

is an issue. Enacting this recommendation would increase productivity and would allow workers to be more fluid and able to transition into different work stations. This would also give employees the motivation to help all areas of the business and create a more efficient environment for everyone, instead of only focusing on their own areas, which could create conflicts within other areas of sustainability was only increased in one area with no regard of the operating methods of another workstation.

Electrical energy conservation proved to create the best opportunity to increase the company's cost saving goal. Several notes were made based on the current state of machinery and lighting with several advisements presented. Certain areas of the building were lighting using electrical fixtures, however natural lighting in these areas would be better since all operations are done during the day and the location of the building experienced more lighting throughout the afternoon. Replacing this area with natural lighting, *e.g.* skylights, would save the company about $2200 per year. Some appliances, such as a shaker, were noted to always draw power but were hardly used throughout the day; attaching a sensor that would cut off power during downtime would save on electric costs or purchasing a more efficient machine was advised to save on costs. The temperature in the production area was recorded to be between 67-73 degrees; if the thermostat was set 3 degrees higher, then the company could see cost reduction on cooling of about $14,000. This would also reduce demand for power, and would hence reduce costs throughout the business; the electric company charges not only for how much energy one uses, but charges more based on the demand for energy during certain hours of the day. If demand decreases cost decreases which could reduce the electric bill for the entire area. Forklifts currently on-site are propane powered, but management was advised to purchase battery powered lifts to reduce costs in propane handling, and reduce carbon emission due to the use of propane.

The largest area that business could save the most money was in converting current electric lighting to LED lighting. Currently the business uses fluorescent lighting; however, the local utility company offers a rebate, and in some cases a full imbursement, to convert to LED lighting. This change would not cost the company any money and would save the company about $58,000 per year on electric costs. Therefore, the total amount the company could save per year on electric costs could be nearly $75,000 a large improvement since any costs in implementing any of the above advisements could be recouped within a fiscal year. Although these methods would provide the best cost saving methods for the company other methods can be enacted that have almost no cost and only require a commitment by the employees and management. These methods can save the company in many ways, most in ways that are not quantifiable during an on-site inspection or within a small time frame.

Employees and management were advised to develop more efficient work procedures, not only by rotating workers, but also by reducing operating and set-up times for certain machines. A particular machine in use requires about an hour to set-up; this leads employees to use the machine excessively so that it would not have to be set-up again within a given day. This leads to an overproduction of this material, which then overcrowds the storage space for the company, leading to less space for other material. The team advised management to create a work procedure so that the machine could be set-up quickly, to reduce over production, and hence less lost time on

unnecessary tasks. This lead the team to advise a standardized operating procedure for all employees, so that no time is lost on time consuming tasks. An example given was to create a procedure so that all used tools were cleaned an organized by anyone who used it previously to reduce the time the next user needs to find and clean the tool. This can create a more productive work space, and a more sustainable space if everyone does their part.

Overall the final report detailed the recommendations given above and advised the company not only to look for greener methods in the appliances used, but also in the workers so that a sustainable workspace could be created that reduced operating costs, increase productivity, and gave workers a bigger stake in how their job could impact the environment for the better.

Conclusion

The staff at ENMRN at NMSU works towards increasing the sustainability of businesses including industrial, commercial, and medical. The staff has developed and implemented both a method to select willing clients, and a method that students can learn to assess and advise managers and owners to increase their environmental impact. Students not only learn how to assess businesses, but also learn how to apply the methods of inspecting a workspace to their own personal projects, including their senior design capstone projects. Students then apply what they learn during inspections apply it their future careers, creating a future where more entry candidates, and future managers can more easily apply and understand the importance of green practices. An application of these procedures was detailed, along with all advisements and their benefits; in this case a local manufacturing company was advised to enact certain sustainable practices, most not requiring substantial monetary investments, that could save the company nearly $75,000 per year, most of the savings seen on reducing energy consumption while others focused on decreasing the waste production. The company appreciated the assessment given by the team and seemed to be willing to enact all recommendations given. Many other businesses have had similar responses, showing the impact that these programs have and their ability to help client's see the importance of creating a sustainable work area.

References

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