"Lean and Green" Assistance for Businesses in the U.S.-Mexico Border Region: A Retrospective

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Chris has authored and managed sixteen EPA Pollution Prevention grants since 1999 (totaling over $2.8 million) providing outreach and training on rural and Borderland P2 issues. Chris implements on-site presentations and training for a variety of industrial sectors on pollution prevention, energy efficiency and Lean & Green manufacturing; he collaborates with State agencies and non-profits in promoting pollution prevention efforts throughout New Mexico and the region.

He co-instructs an on-line course on pollution prevention at NMSU and has contributed to waste minimization and environmental education efforts in India through US-AEP and the Council of State Governments. Chris received his BA degree at Columbia University and a Master's at the University of Michigan. He served as a Senior Environmental Planner with the Rhode Island Environment Department for 16 years before joining the U.S. Peace Corps in Hungary where he served as an environmental volunteer. Before joining the staff at NMSU, Chris initiated the Source Water Protection Program for the New Mexico Rural Water Association from 1997-1999.

"Lean and Green" Assistance for Businesses Operating within the Paseo del Norte, U.S.-Mexico Border Region

Abstract

Under the auspices of Engineering New Mexico Resource Network (ENMRN) at New Mexico State University (NMSU), small businesses operating within the Paseo Del Norte U.S.-Mexico border region, an area geographically comprised of southern New Mexico, El Paso, Texas, and northern Chihuahua, Mexico, have been provided access to services that support implementation of pollution prevention (P2) and energy efficiency and economy (E3) Best Practices. Over the past two years, over a dozen businesses, operating on the U.S. side of the border, have benefited from expanded one-on-one outreach services focused on minimizing waste and reducing water and energy use. The ENMRN Paseo Del Norte P2/E3 initiative supports educational awareness among agricultural, industrial, and consumer sectors operating in the region with an expressed interest in adopting "green" practices or are focused on realizing cost-savings through improved environmental and energy performance. The initiative was specifically designed to share Best Practices, while respecting the small-business culture often inherent along the respective border region.

Additionally, by leveraging the broader ENMRN P2/E3 state-wide program, undergraduate students from across the U.S. have gained real-world experiences through participation in an annual environmental design competition. Hosted by NMSU and developed in collaboration with industry partners, participating students are tasked with identifying innovative solutions to ongoing and emerging environmental challenges, many of which have direct application to the Paseo Del Norte region.

Introduction

Since 1999, NMSU's College of Engineering has led efforts to foster educational awareness through on-site technical assistance to businesses and industry, with a focus on adoption of Best Practice for pollution prevention and energy efficiency. For more than 17 years, NMSU has received funding from the U.S. Environmental Protection Agency Pollution Prevention Grants (PPG) program to support the delivery of P2 and E3 assessments to a wide variety of commercial and industrial sites statewide. In 2016, the program merged with ENMRN, which serves as the College's formalized outreach organizational unit.

NMSU is among a group of academic institutions across the country that provides such educational awareness and outreach services to the business community, with EPA having funded several university- and community-college-based technical assistance programs since the passage of the P2 Act in 1990 [1]. In states with a large manufacturing presence (where the reduction of chemical and hazardous materials is most needed), EPA's funding has been especially beneficial. Nationally, the program leverages engineering faculty, staff and students to assist various business and industry sectors "go beyond compliance" and incorporate P2 and E3 reduction practices into their ongoing operations.

In 2015-16, fifteen academic institutions across the U.S. were engaged in P2 outreach and educational efforts, with positive results reported for pollution reductions. In EPA Region 6 alone (which includes Arkansas, Louisiana, New Mexico, Oklahoma, Texas and 66 Tribes), P2 programs contributed to the elimination of over 83,000 pounds of hazardous emissions and materials, and saved 145,500 gallons of water at an estimated combined cost savings of over $3.65 million [2].

Additionally, the EPA P2 program has effectively promoted research and implementation of Green Chemistry programs in schools and universities across the country, which can help reduce chemical contamination sources if properly applied to industrial and manufacturing settings [3]. At NMSU, P2 aspects of the Green Chemistry program has been adopted in the annual WERC Environmental Design Contest, where participating students are judged by industry professionals for successful integration of Green Chemistry practices.

ENMRN P2/E2 Program

The goals of the broader ENMRN P2/E3 program at NMSU are threefold:

> (1) Provide technical business assistance for small and medium-size businesses to improve and/or adopt pollution prevention and energy efficiency Best Practices within their ongoing operations.
>
> (2) Partner with relevant organizations that operate within the Paseo Del Norte border region through educational awareness of "Lean and Green" practices and on-site outreach services among shared stakeholders.
>
> (3) Develop an informed workforce by educating university students on the various aspects of pollution prevention and energy efficiency practices through real-world applications experienced through an annual environmental design competition.

Based on outcomes from services provided under the broader ENMRN P2/E3 statewide program, a five-stage Best Management Practice (BMP) model was developed and has been utilized when conducting on-site assessments for business and industry. Components of the developed BMP include protocols for identifying potential businesses that would benefit from the P2/E3 services, processes to ensure organizational commitment and process buy-in, a willingness to share and become part of an engaged assessment process, and a commitment to adopt proposed recommendations and evaluations. A review of the Literature supports the adopted BMPs components, particularly those that build on a culture of sustainability and wide-spread improvements and environmental awareness [4]. The following is a brief description of the developed five-stage BMP:

I. Need—Staff works with professional associations and business contacts statewide and in the border region to identify industrial sectors in need of on-site assistance; this evaluation is often based on the need for reductions in chemical and/or hazardous materials use, high electricity use or regulatory issues associated with a particular business sector.

II. Recruitment—Staff focuses on recruitment of businesses by reaching out to explain the benefits of P2/E2 assessments, past history of success with other companies, typical improvements in performance and cost-savings, and awareness of the no-cost services.

III. Commitment —Client business is asked to commit to the assessment process by agreeing that upper management will be involved in the entire process, and that the appropriate staff be committed to the total length of the process (generally two to three days plus preparation and evaluation time before and after the actual on-site visit); the company is also asked to implement the recommendations from the assessment team, wherever and whenever possible, and to be available for follow-up visits to further improvements.

IV. Implementation —Participating business is asked to provide a "training" room, as well as access to the production or activity areas for the duration of the assessment; with permission, the assessment team will be free to take photos or videos of the process to include in the final presentation to staff and management. The final presentation and feedback reporting is to be attended by upper management and all staff involved in the process at the conclusion of the assessment.

V. Recommendations and Evaluations—as part of the feedback reporting, staff recommends procedures to improve Lean, environmental and energy performance at the facility. These recommendations often include estimated cost-savings related to implementation of the recommendations as well as other benefits to create efficiencies; the company is also asked to help evaluate the assessments, suggest improvements to the process, and agree to return visits from the team to evaluate any implementation of the recommendations. The company is urged to promote the benefits of these services and agrees that the federal funding agency, U.S. EPA, be informed of all assessment results.

Paseo Del Norte P2/E3 Initiative

The Paso Del Norte region is noteworthy among the U.S.-Mexico border regions for its enormous size and importance as a manufacturing platform. For example, Ciudad Juárez was the site of the first maquiladoras, which are foreign-owned factories where imported parts are assembled for export purposes. Ciudad Juárez boomed with the arrival of these factories, first doing simple tasks like sewing jeans and sorting coupons, but now thriving in much more advanced industries like aerospace, electronics, and autos. El Paso and southern New Mexico also benefit from this growth, sometimes as suppliers but more often as service providers offering legal, financial, and logistical support to industry. Defense, healthcare, education and tourism have all grown to become key sectors in the regional economy, particularly with the recent expansion of the Fort Bliss Army installation and major investments in the biomedical science and healthcare industries [5]

In support of regional economic development, small and medium-sized businesses operating within the Paseo Del Norte border region have benefited from the P2/E3 technical business assistance services offered by ENMRN. The Paseo Del Norte initiative was specifically designed

to assist businesses with an expressed interest in adopting "green" practices and/or are focused on realizing cost-savings through improved environmental and energy performance, while being cognizant of the small business culture often inherent of businesses operating along the border region. Opportunities to influence the business culture within the Paseo Del Norte region required staff that were keenly aware of opportunities for reduction of the use of chemicals, hazardous materials, fuels and solvents that could adversely affect the border region's environment [1, 6]. Further, the arid topography of the region, coupled with ongoing drought, has elevated interest in adopting water and energy conservation practices among the business community.

The Paseo Del Norte P2/E3 initiative utilizes a systematic one-on-one five-stage BMP model that was previously developed through the broader ENMRN P2/E3 statewide program, retaining direct interaction between program staff and the respective business management and operations team [7]. The ENMRN P2/E3 assessment team, which is comprised of highly experienced faculty and staff who are highly adept at evaluating known areas for P2/E3 concerns and/or opportunities for adoption of Best Practices, are also familiar with the business culture of the Paseo Del Norte region.

Environmental issues addressed during the respective assessments are similar to those considered during a typical P2/E3 audit with a focus on concerns such as solid waste (proper reduction, re-use, recycling and disposal), liquid waste (storage, re-use and recycling of wastewater, chemicals, and solvents), hazardous waste (reduction, storage and proper disposal of chemical and used oils), air quality (reduction and treatment of particulate matter and noxious fumes), pollution prevention (reduction and elimination of all waste streams on-site), electricity reductions (reduction of lighting, HVAC use and power surges), energy efficiency (renovation or replacement of high energy-use machines and equipment), and renewable energy sources and/or opportunities (valuation of potential use of wind, solar, geothermal sources).

Additionally, the Paseo Del Norte initiative leverages the delivery of Lean Manufacturing services offered by the NM Manufacturing Extension Partnership and the TX Manufacturing Assistance Center. This unique collaboration with the respective MEP operations enhances the ability to foster educational awareness among the various stakeholders in a comprehensive three-day assessment that emphasizes the benefits of Lean manufacturing practices while fostering improved environmental and energy performance. Dubbed "E3" (for "Energy, Environment, Economy") by the EPA, these bi-state assessments strive to improve manufacturing efficiencies and reduce threats to the shared air and water resources in the respective region [6]. The cost-sharing measures provided by partnering with the MEP program has enabled the ENMRN team to expand services to small businesses to increase productivity and support job creation/retention [8]. One of the major goals of Lean training is to quantify the effects of Lean wastes and evaluate how to make the manufacturing process more efficient and fiscally sound [9]. These added benefits have provided a positive impact on the job market and economy of the region [10]. The environmental health of the area is also enhanced through awareness and adoption of long-term P2 and E3 practices.

Since 2015, ten such E3 assessments have been conducted in the Paseo Del Norte region among apparel, electronics, machine tool, woodworking, and healthcare industries sectors. As shown in Figure 1-4 below, recommendations made to participating businesses within the Paseo Del Norte region over the past three years, if fully implemented, will contribute to water savings, pollution reduction, energy savings, and operational cost savings, each of which enhances the environmental ecosystem of the region.

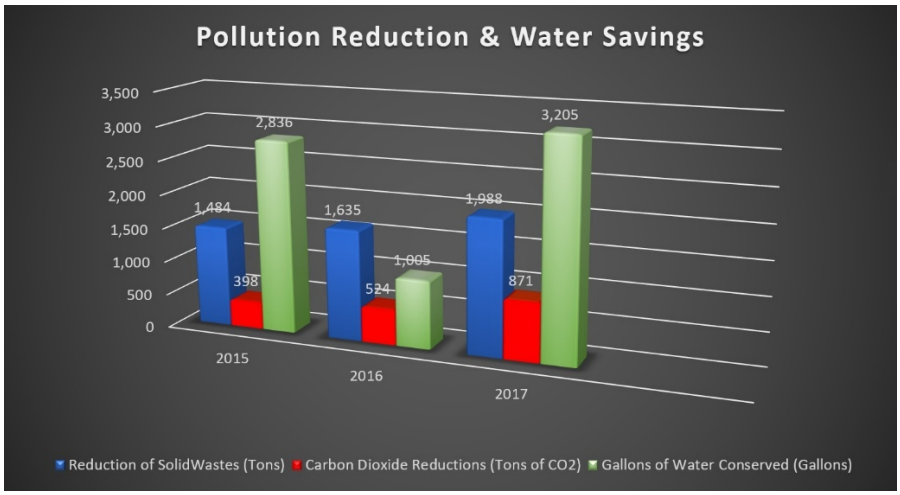

Figure 1

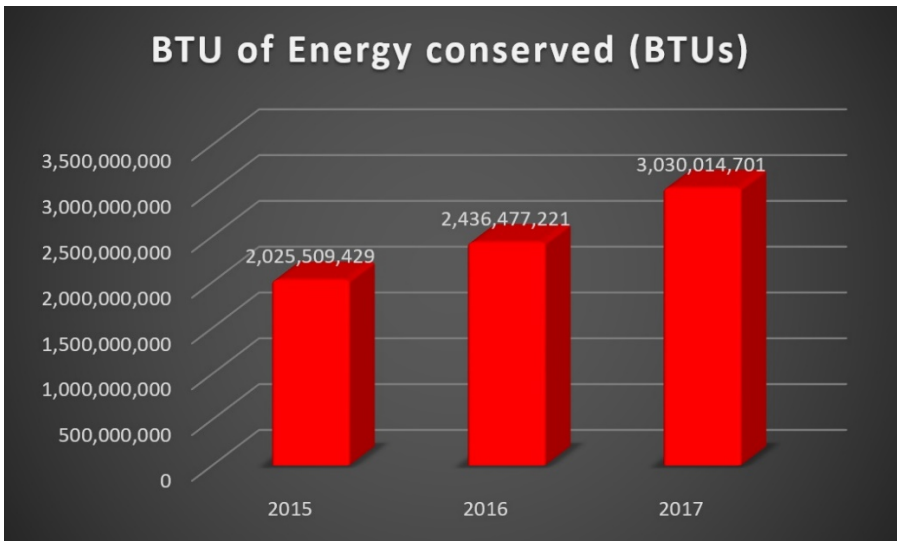

Figure 2

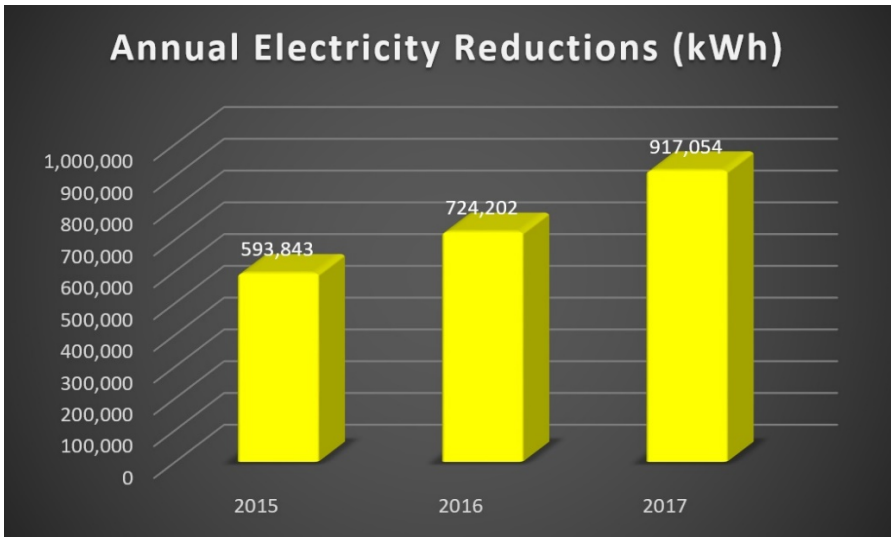

Figure 3

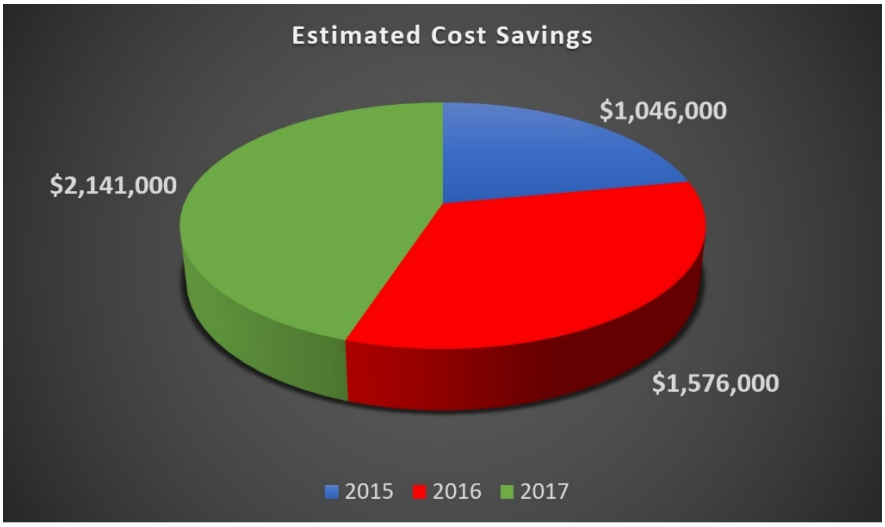

Figure 4

Educational Awareness: WERC Environmental Design Contest

An important goal of the P2/E2 program is to support development of an informed workforce by educating university students on the various aspects of Pw and E3 practices. One of ENMRN's signature events is the annual WERC Environmental Design Competition [11]. Established in 1991, the Design Contest is a unique design competition that brings industry, government, and academia together in search of improved solutions to environmental challenges. Drawing hundreds of college students from across the U.S., student teams are tasked with designing solutions for real-world problems by developing fully operational bench-scale models of their developed technologies. Additionally, participating student teams are required to communicate their work through a conference-style poster, and both written and oral presentations, which they showcase alongside their bench-scale model before a panel of environmental professionals who judge the contest.

Crucial to the students' final project design and bench-scale models are P2 and E3 considerations, with a particular focus on solutions that conserve environmental and energy resources. Judged on various aspects of the EPA Green Chemistry program, judges annually present a Pollution Prevention Award to the team that best exemplifies P2 and E3 practices in their design contest solutions.

Of relevance to the Paseo Del Norte region, ENMRN staff work with business and industry partners to identify regional environmental challenges to present to the student teams. Examples of past task challenges include desalination, water purification using solar applications, air quality concerns, and removal of metal contaminants from manufacturing processes. With Design Contest tasks announced each fall, students spend up to five months developing and testing their respective prototype solutions. Examples of student team projects developed over the past three years with relevance to the Paseo Del Norte region include:

- Photocatalytic Water Treatment of Arsenic-Contaminated Groundwater
- Hybrid Membrane Module Solar Distillation
- An Integrated Algal- and Membrane-Based System for Wastewater Treatment and Potable Water Recovery
- GreyDrop Grey Water Heat Exchanger

Over the past three years, over 600 students have participated in the annual event, with over 32 industry professionals serving as judges each year. As testament to the Design Contest's success in fostering environmental education awareness, students commonly state that it is the best experience of their time at College.

Further, faculty advisors note the rigor of the competition, alignment and invaluable contributions to ABET accreditation needs, and access to direct feedback from industry and government agency professionals, who serve as judges. The WERC Environmental Design Contest has become the main engineering capstone project for a number of universities such as Louisiana State University, Montana Tech, University of Arkansas, the University of California Riverside, University of New Hampshire, and the University of Idaho.

Lastly, environmental professionals, who serve as judges for the competition, relay how the Design Contest keeps them on top of emerging trends in technology development and innovation, while others use it as a means of professional development for mid-level managers.

Conclusions

ENMRN and its partners have provided valuable P2 and E3 services within the Paseo Del Norte border region. Access to BMPs and Lean and Green assessments offered to local businesses, coupled with a highly regard university-based design competition, have contributed to an environmentally-conscious culture of varied stakeholders, resulted in the reduction of contributing pollutants, and provided cost-savings that further bolster the local economy.

Through the WERC Environmental Design Contest, ENMRN has extended educational awareness for technology development and innovation to a diverse group of stakeholders

(students, faculty and industry professionals), while addressing current and emerging environmental challenges.

In conclusion, the Paseo Del Norte P2/E3 initiative at NMSU has proven effective in promoting a culture of sustainability and environmental stewardship among a diverse group of stakeholders in the region, and has broadened educational awareness among others through real-world environmental issues facing the U.S.-Mexico border region. Programmatic outcomes realized through the respective P2/E3 services for business and industry, coupled with an innovative environmental design contest, demonstrates diverse opportunities for addressing both short and long-term environmental sustainability in the Paseo Del Norte border region.

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