Pollution Prevention Activities in Ohio under PPIS Grant

2003-2006 Progress Report
for a grant awarded by the

U.S. Environmental Protection Agency

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In cooperation with the following Ohio Edison centers

EISC
TechSolve

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Keywords

Keywords	P2 Assessments, Workshops, General Technical Assistance and Training, Computer Software
Product(s) produced	This PPIS proposal consists of the following activities that will supplement OSEN's existing pollution prevention efforts: • Coordination of the Ohio Statewide Environmental Network to provide comprehensive pollution prevention planning and implementation efforts statewide. • Training in source reduction techniques: Presentation of four OSEN seminars and one UT workshop to provide outreach to Ohio Manufacturers, providing follow-up measurements of the impact of these seminars on pollutant generation within the manufacturing sector. • Technical Assistance targeted to small and medium size manufacturers: Source reduction through pollution prevention, environmental management systems, and energy consumption assessments. Also, measure the success of the program using different indicators.
Brief Description of product(s)	OSEN meetings are conducted in Columbus, OH. Seminars are given through out Ohio to cover various aspects of pollution prevention and energy assessment activities. Assistance is provided in conducting P2 and energy assessments for small and medium size manufacturers.
Quantity of Product(s) produced	During Oct., 2005 to Sept., 2006, the following products have been produced: 1. Four OSEN meetings (Dec./March/June/Sept.) were conducted. 2. Twenty seminars have been presented to Ohio manufacturers. 3. Assessments from year 1 and 2 are almost complete. Four assessments are on going.

Abstract

Ohio Edison Centers along with the University of Toledo (UT) provided technical assistance to small and medium size manufacturing plants in Ohio. During this year of the grant, assessments were completed in the areas of pollution prevention, energy efficiency, and environmental management systems. The pollution prevention benefits of these assessments were reduced waste materials and reduced generation of polluting emissions.

During this study, numerous helpful recommendations were made to the various industries. Implementation of these recommendations will lead to the enormous benefits, some of which are listed below:

2003-2004

1. A cost saving of $134,834/yr and a potential reduction in CO_2 emissions by 4,733,677 lb/yr for a Columbus based producer of industrial resins and catalysts.
2. Potential saving of $41,919/yr for an Ohio based flexible permanent magnet manufacturer.
3. Reduction in CO_2 emissions by 2716208 lbs/yr.
4. Beneficial reuse of waste from a doughnut corporation in Ohio to reduce the surcharges on its wastewater.
5. Estimated potential water recycling of 50-70% for a turkey processing plant in Ohio.

2004-2005

6. A total reduction in the amount of waste equivalent to $ 30,000- $50,000 by XYZ Chrome.
7. Waste recycling opportunities were identified for an aerospace parts manufacturer.
8. Energy savings of $3850/year for a stamping and welding company in Wauseon, Ohio.
9. A total projected energy cost related savings of $51,000/year for a Greenhouse remodeling project at Sandusky, Ohio.
10. A total of $166,013/year savings in E2 related improvements for a Greenhouse vegetable grower in Milan, Ohio.
11. A savings of $ 16, 983 per annum and a indirect reduction of 203, 806 lbs of CO2 emission for a Stamping and Welding company.

2005-2006

11. Potential decrease of 50, 000 lbs of lead containing rubber for automotive supplier.
12. Elimination of 400 lbs/yr of lead for a solenoid, actuator, and switch manufacturer.
13. More than 25K potential savings in energy management planning for two Cincinnati based companies.
14. Potential savings of $235,000 and a 55% or 22,800 MMBtu per year natural gas are estimated for an Aluminum Casting Company.
16. Potential savings of $18 to $27 K or between 17 and 25 percent of their energy expenditure for an Ohio Coining Company.

The above results demonstrate that it is possible to implement pollution prevention initiatives at the small and medium size companies in Ohio.

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Project Activities

Amendments

Scope of change	
Dates affected by change/amendment	
Funding	

Partners (associated with the grant)

The University of Toledo is working with NIST Centers and other OSEN members to complete the activities. Details on the partners are as follows:

TechSolve*; Ohio EPA (Small Business Assistance Program, Industrial Relations, Office of Pollution Prevention, and Small Business Assistance Office); EISC, Inc; Ohio Department of Development (Edison Program, Small Business Development Center, and Office of Energy Efficiency); and The University of Toledo, Department of Civil Engineering.

(* These Edison Centers are either NIST/MEP Centers or affiliated with NIST/MEP Centers. Due to their existing strong relationships with small and medium sized manufacturers, they are in a unique position to serve as a link.)

OhioEPA partnership will be strengthened through their involvement in OSEN meetings.

Sectors
Small businesses, Manufacturers, State government

Progress on Individual Tasks

The following activities were completed during the third year of the PPIS grant.

Task A: Coordination of OSEN:

We have coordinated 12 meetings and received information from different agencies (Ohio EPA, and ODOD) on available resources. Referral system for pollution prevention services is working fine. The OSEN Hotline was designated to be the Tech Resources' Questline number, 800-824-0488 as agreed during fall, 2000.

Meetings and e-mails were used to plan the activities under the grant. UT resolved the questions related to the sub grants. Every one was clarified about their role in the project discussion and brainstorming sessions were held to establish a baseline of practical knowledge and experience in pollution prevention principles, definitions and practices. Each participant gives a project update during the meeting. Comments received are incorporated in the rest of the activities of the grant. UT handled all the questions related to the grant throughout the year.

The following information was distributed during the meetings to exchange information:

1. Ohio EPA Publications for Small Businesses – Fact Sheets and Web site addresses
2. Ohio EPA Prevention Quarterly
3. The Small Business Resource by OhioEPA
4. Energy loans and energy efficiency programs
5. Ohio's Materials Exchange (OMEx)
6. P2 session during GLRPPR conference
7. Ohio Air Pollution Research Symposium
8. Consortium for Energy Efficiency
9. OAQDA loans

In addition to the above each organization provides an update on pollution prevention related projects carried by the organizations during the last three months.

Measurement and Evaluation

7 people attended the quarterly OSEN meeting in December 12, 2003 from 7 different organizations.

8 people attended the quarterly OSEN meeting on March 19, 2004 from 7 different organizations. All attendees presented an update to the group on their pollution prevention related initiatives and activities.

--- people attended the quarterly OSEN meeting on June 18, 2004 from --- different organizations. EWI announced that they are phasing out the environmental assessment work and will not participate in next years funding.

---- people attended the quarterly OSEN meeting on Sept. 22, 2004 from ----different organizations. We discussed GLRPPR conference and other pollution prevention topics. OSEN members also joined the GLRPPR Steering Committee meeting after OSEN work.

5 people attended the quarterly meeting on Dec. 10, 2004 from 5 different organizations. All attendees presented the activities related to P2 in their organizations. We learnt about the reorganization of P2 section at OhioEPA.

5 people attended the meeting on March 11, 2005 from 5 different organizations. OhioEPA discussed about compliance assistance.

4 people attended the meeting on June 9, 2005 from 4 different organizations. OhioEPA discussed about the changes in pollution prevention program.

6 people attended the meeting on Sept. 16, 2005 from 6 different organizations. Akron SBC discussed about involvement with small businesses.

4 people attended the meeting on Dec. 9, 2006 from 4 different organizations.

4 people attended the meeting on March 18, 2006 from 4 different organizations. ODOD discussed the projects on alternative energy.

4 people attended the meeting on June 9, 2006 from 4 different organizations. Hospital Assessment Tool was reviewed during the meeting.

4 people attended the meeting on Sept. 14, 2006 from 4 different organizations. ODOD discussed the new several million dollar program for alternative energy.

Task B: Seminars:

The following sixteen seminars have been conducted by NIST Centers.

1. TechSolve presented a seminar on Wednesday, February 18, 2004 from 8:30 am to 2 pm at the TechSolve facility with a follow-on visit to Douglas Machine. They had 17 participants from industry, government and vendors. The focus of the seminar was to improve energy efficiency of various industrial processes. Mr. Brian Olson, U.S. Department of Energy, Chicago Regional Office presented an overview of industrial energy efficiency technologies and programs.

2. EISC Inc. presented a seminar on "Energy Efficiency and Renewable Energy Grants Workshop" on April 8, 2004 in Toledo. The details are as follows:

   Hosted By: CIFT (EISC), USDA Rural Development, ODOD, Ohio Rural Development Partnership

   Sessions: 8:30 am – 3:30 pm

   Guest Speakers: Congresswoman Marcy Kaptur and 8 speakers (USDA Rural Development, CIFT/EISC, USDA, ODOD)

   Attendees: 27 (excluding speakers)

   Companies/Organizations Represented: 15 (excluding hosts)

   Brief Description: Information on energy efficiency improvement and renewable energy grants were presented at this workshop. Several speakers from USDA Rural Development explained the grants available from USDA and their application process. Also presented was information on the grants available from ODOD Office of Energy Efficiency.

3. EISC Inc. presented a seminar on "Efficiently Managing One Of Your Most Expensive Operating Costs … Energy" in Toledo on May 14, 2004. It was hosted by EISC, ODOD, Marathon Electric Motors, Whelco Industrial LTD. The other details are as follows:
   Sessions: I (8:00 am – 11:30 am); II (Repeat of I) (12:00 pm – 3:30 pm)
   Guest Speakers: 6 (Whelco Industrial, Marathon Electric, Fincor Automation, ODOD, EISC)
   Attendees: 21 (excluding speakers)
   Companies/Organizations Represented: 14 (excluding hosts)

   Brief Description: This was a free seminar for educational purposes that addressed various energy efficiency issues in the industry. In particular, information on premium efficiency motors and their cost-effectiveness, sophisticated motor rewinding technologies, innovative application of variable frequency drives was presented by three separate speakers. One presentation covered various energy-related issues like power factor, kilowatt demand, and efficient lighting. One speaker presented the concept of

plant-wide energy audits and the software and management tools for it, while another presented the loans and grants available for energy efficiency improvements.

4. TechSolve held an 8-hour workshop on March 17, 2004. The topic covered was the DOE pump system assessment tool training that looks at a system approach to improving energy efficiency of pumps and associated equipment. There were 11 people in attendance from academia, government and industry at this session.

5. TechSolve held a 2-hour seminar on Energy Efficiency on June 29, 2004. 30 participants from government, industry, and the private sector attended the meeting. The topics covered include: "Demonstration of Cinergy's EnFocus Energy Usage Tracking Software", "Energy Efficient Lighting", "The Future of Managing Your Electric and Natural Gas Costs", and GLRPPR conference.

6. EWI offered a daylong seminar entitled "Lean Manufacturing" at the Ohio State University on April 15, 2004. 14 professionals attended the seminar.

7. EWI offered a daylong seminar entitled "Lean Manufacturing" in June 2004. ------- professionals attended the seminar.

8. TechSolve held a 2-hour energy workshop on October 12, 2004 covering motor efficiency improvement and general energy efficiency. They had 14 people in attendance from industry and government.

9. TechSolve held a second 2-hour energy workshop covering industrial energy efficiency project case studies and electric demand reduction on Jan. 11, 2005. They had 30 people in attendance from government, industry, and other businesses.

10. TechSolve held a Facility Efficiency Expo on March 15, 2005 (2 to 6 pm) with the local chapter of the Association of Facility Engineering. They had 21 vendor booths and four speakers discussing energy efficiency, Six Sigma, thermography, and training. Over 50 people were in attendance.

11. EISC co-hosted a 6-hour workshop at the EISC facility in Toledo on March 24, 2005 partnering with USDA and the Ohio Department of Development Office of Energy Efficiency on Renewable Energy and Energy Efficiency for small rural businesses. 33 people attended it from 21 different organizations. The objective was to promote Energy Efficiency and Renewable Energy projects in the State of Ohio and make businesses aware of the financial and technical assistance available.

12. TechSolve held an 8-hour workshop at the end of Sept. 2005 on Clean Manufacturing. There were 8 from government and 8 from industry in attendance. They covered pollution prevention topics and had a hands-on exercise.

13. TechSolve completed 3 Clean Manufacturing and Clean Government 6-hour seminars. On Nov 17, 2006 focused on Cleaner Manufacturing. There were 5 manufacturers and one government person in attendance. The 6 hour session covered P2, green chemistry, green building, resources, case studies, and examples. The seminars on October 20 and Dec 8 were on Cleaner Government. There were 50 and 42 individuals from government, respectively. The 6 hour sessions covered P2, EPP, recycling, green building, resources, case studies, and examples.

14. TechSolve conducted a 4-hour Energy Workshop with ODOD on March 22, 2006 at the Piketon OSU Extension Center. The workshop was attended by 27 people from government and industry. The topics included motor systems, energy management and grant and loan funds.

15. EISC organized two, 4-hour Energy Efficiency workshops for all interested companies at Toledo Plaza on Reynolds Road in Toledo on Thursday, November 17, 2005 in cooperation with the ODOD Office of Energy Efficiency. 31 people including representatives or presenters from UT, ODOD OEE, and EISC attended the seminars. There were 23 representatives from 16 different companies.

16. EISC organized an Industrial Energy Efficiency Initiative seminar on March 9, 2006 in Sandusky, OH. This teleconference seminar held in conjunction with the Northwest Food Processors Association. This was a nationally broadcast seminar based in Oregon. The total attendance was 8 people including 5 representatives from EISC and ODOD OEE. Industrial attendees were 3 people from 3 different companies.

17. TechSolve held a DOE Compressed Air Workshop on June 20 from 8 am to 4:30 pm. There were 25 from industry and 4 from government/non-profits in attendance.

Each NIST Center was involved in the publicity for the seminars. ODOD and OhioEPA did additional publicity for the seminars.

NOTE: We intended to conduct ---1-day seminars by Sept. 2006. Each center is allowed to offer several seminars of short duration to cover more manufacturers. We did meet our commitment to conduct the seminars.

Measurement and Evaluation – A summary is given in Table I.

Table I: Measurement and Evaluation Statistics for Seminars

Center	Number of seminars conducted	Number of attendees	Number of request for assistance	Number of facilities expanded/ started P2 type work	Summary of evaluations
TechSolve (Year 1)	3	58	2	1	4.4 out of 5 rating
EISC (Year 1)	2	48	3	2	N/A
EWI (Year 1)	2	14+			
TechSolve (Year 2)	4	91+	2	1	4.4 out of 5 rating
EISC (Year 2)	1	33	4	2	N/A

TechSolve (Year 3)	4	141	3	1	4.6 out of 5 rating
EISC (Year 3)	4	68			

Task C: Assessments and Computer Tools:

Ohio Edison Centers identified several different opportunities for pollution prevention, lean manufacturing, and energy assessments. Work has started on four different assessments. Each center has submitted several proposals to manufacturers for conducting P2 assessments. The University of Toledo students are participating in the assessments based on the needs of each center. Ohio Edison Centers committed for eight assessments per year. The current status on assessments is given below:

1. EISC: EISC is working towards reducing wastewater effluent quantity from a Large Turkey processor in Ohio. After a thorough study of the current initiatives in the plant, EISC has come up with future initiatives that include bench top testing with membrane filtration and UV and ozone disinfection techniques. The effectiveness of this pilot testing in treating wastewater would eventually lead to designing a real time full scale recycling system. The details of this ongoing project are given in Appendix A.

2. EISC: Electrical energy efficiency assessment was carried out for an electrical energy intensive Large Plastic Injection Molding & Extrusion Company in Ohio, with annual bills of $650,000 to $700,000. The assessment involved a trend analysis of the kWh usage and peak kVA demand, and an electrical usage distribution model among major areas like motors, HVAC systems, compressors, lighting, etc. After the company installed a small section of high efficiency fluorescent lighting on the shop floor but did not complete the lighting for the entire plant. They did change their operation routines to reduce their peak KW demand. EISC estimates that they reduced their KW demand by 5-10% which also reduces their KWH by about 5-10% which reduces their bill by about the same amount. A summary of the assessment and the different opportunities to save energy is given in Appendix B.

3. TechSolve: TechSolve conducted a pollution prevention assessment to determine the measures to reduce the waste being disposed down the sewer in order to reduce surcharge for a doughnut corporation. The Corporation had been receiving surcharges for its wastewater because of the high biological oxygen demand (BOD) and chemical oxygen demand (COD). Details are presented in Appendix C.

4. TechSolve: TechSolve assisted with the implementation of an ISO 14001 management system for a small Blanchester, OH company. They reviewed the operations and performed cursory regulatory compliance audit to prioritize waste. A summary of the work is provided in Appendix D.

5. EWI: The center worked with a company in Columbus, which is a leading domestic producer of industrial resins and catalysts as well as specialty intermediates and additives. Six recommendations were suggested that include descriptions of specific conservation measures along with the estimates of the savings and cost of each recommendation. Implementation of these recommendations could save $134,834/year for the company. Details in Appendix E.

6. EWI: EWI helped one of the nation's leading manufacturers of flexible magnets in their effort to reduce their waste, energy and production costs. A summary of the findings and recommendations made is presented in Appendix F.

7. CAMP: They completed one PPIS project at XYZ Chrome (a $4000 project with sufficient match from the company; refer Appendix G). They reviewed the EMS of the company and helped the company in identifying pollution prevention and waste related actions in routine operations and energy related initiatives. Due to a fire in the plant the completion of the project was delayed.

8. TechSolve helped a local machine shop with identifying alternative material reuse of aluminum and chromium-containing wastes, and computer wastes (Appendix H).

9. TechSolve: TechSolve assisted a re-manufacturer of silicone wafer processing equipment to implement ISO 14001 and with pollution prevention. Waste streams being investigated include lead solder, mercury fluorescent lamps, and solvents. The track system re-manufacturer for the semiconductor industry has completed their ISO 14001 program and has received certification (Appendix I).

10. EISC Inc.: The latest PPIS project is at Wauseon. The company is an auto metal parts fabricator with stamping and welding as their main operations. The work planned includes a plant-wide energy audit, followed by specific energy efficiency opportunities (Appendix J).

11. EISC Inc.: An energy efficiency assessment and feasibility study project began in April 2005. A greenhouse operation in Sandusky is interested in replacing an aging greenhouse and heating system with an energy efficient new greenhouse and heating system. The objective is to optimize the new greenhouse and heating system for solar, electrical and natural gas energy performance and to significantly reduce consumption of the non-renewable electric and gas resources (Appendix K).

12. EISC Inc.: The goal of this project at a greenhouse vegetable grower at Milan, Ohio is to replace four old growing greenhouses plus one central utility greenhouse with more energy efficient and productive greenhouses. The existing greenhouses will be removed and new greenhouses of approximately the same size and in the same location will be constructed. The entire greenhouse facility consists of about 30 separate greenhouse units and several open farm fields used during the growing season (Appendix L).

13. TechSolve: A Company in Southeast District Area of Ohio needed ISO 14001 certification. They have approximately 220 employees and are an automotive supplier to Visteon. The significant aspects were identified and projects developed to reduce waste and minimize the impact to the environment. The company is also initiating a recycling program for their paper, aluminum cans, and cardboard. The company was ISO 14001 certified in early 2006. Details are provided in Appendix M.

14. TechSolve: They worked with a 310 person company located in Vandalia, OH that wishes to become ISO 14001 certified for their client, Eaton Corporation. The company manufactures solenoids, actuators, and switches for the automotive, US Post Office, and other entities. The company is currently working on projects to reduce waste generated from parts washers, and raw material overstock. The company has currently eliminated all non-military required lead solder from their products. The company received ISO

14001 certification in July 2006. P2 work was also done. Details are provided in Appendix N.

15. TechSolve: They worked with an aluminum casting company located in Dayton, OH under the ODOD Envinta energy program. They received grant money and is participating in the loan fund to install a $440K new casting furnace that will improve energy efficiency by 63%. Details are provided in Appendix O.

16. EISC Inc.: EISC provides assistance to the staff in developing improved methods to manage hazardous chemicals used in production and stored at this facility X. The work is primarily with the Environmental Manager and the work extends to maintenance and production staff, student interns as well as the management staff. The environmental issues to be reviewed are spill prevention, proper storage and handling and response plans to manage other potential environmental conditions. Work is in progress (Appendix P).

17. TechSolve: TechSolve assisted a Cincinnati manufacturer with energy management planning through ODOD's Envinta program. Details are provided in Appendix Q.

18. TechSolve: TechSolve assisted a Cincinnati manufacturer with energy management planning through ODOD's Envinta program. Details are provided in Appendix R.

19. TechSolve: TechSolve began assisting local manufacturer with development of combined ISO 14001/Safety Management System. Details are provided in Appendix S.

20. EISC Inc.: EISC is working on Improved Material Handling Practices at a mid size injection molding company with a goal of preventing oil from entering the sewer system in the plant from October 2005 through current. This company had in place a mature ISO 14000 EMS but was still encountering some pollution problems in their oil water separator system. EISC participated in a meeting with the plant pollution prevention team to identify the causes of the spillage and develop practices to prevent the spills from polluting the water discharged to the sewer system and the existing oil water separator. Based on the investigation, the source of the oil appeared to be used machine lubricating oil coming from poor handling practices in the maintenance department. Procedures to eliminate these poor practices were developed and implemented (Appendix T).

    As part of this project, the operation and effectiveness of the existing oil water separator was investigated and it was determined that is was operating effectively according to the design specifications. In order to determine if the revised work practices in the plant were effective, the installation of an oil skimmer on the oil water separator was investigated. It was determined that an oil skimmer would provide the staff with feedback necessary to properly address this situation on an ongoing basis. A skimmer is in the process of being installed and the oil skimmed will be monitored for quantity and type in order to help determine the source of the oil. The oil skimmer will be a tool utilized to assist in determining how to prevent oil spills and leaks at this plant

    The appropriate sections of the ISO 14000 EMS are being modified to incorporate these improved practices and procedures. The project is in progress.

21. EISC Inc.: EISC is working with a ketchup company in Freemont area. They want us to find ways to reduce the waste of ketchup while cleaning the pipes at night time. Significant amount of ketchup goes to sewer system. EISC and UT staff met with the

plant manager and reviewed the drawings. The efforts will be focused on determining the amount of ketchup that could be saved and used next day. Initial estimates are that over 30% could be diverted from the waste stream and used in producing the product. (Appendix U).

22. EISC Inc.: EISC is with a turkey farm to reduce waste. UT students received data about the load, suction, discharge, oil, inlet temperature, discharge temp, suction temp and compressed air for various compressors. The data were entered into an excel sheet for analysis. The missing data points were linearly interpolate. Individual regression of load versus various parameters was done to obtain a relation between them. But since the relation for all the parameters could not be obtained a multiple regression analysis was performed. The graphs showing the variations of each parameter for a particular month were drawn. Motor data are being analyzed (Appendix V).

23. TechSolve: TechSolve was hired by a local surface finishing company to assist with improvement of their existing ISO 14001 program to the 2004 Standard and to conduct a pollution prevention assessment. The results are given in Appendix W.

Examples of environmental programs identified in the above assessments are given in Table 1 A.

Table I A: Examples of Environmental Programs identified in Assessment No. 3

Issue	Objectives	Targets	Responsibility	Program
Waste reduction	Reduce waste	Addressing the problem of high BOD and COD in waste water	1) Facility Manager 2) Employees	1) Training of employees in using dry cleaning methods 2) Designing a packaged waste water system

Measurement and Evaluation - The measurement and evaluation of this effort are shown in Tables II.

Table II: Measurement and Evaluation Statistics of Assessments Conducted

No.	Center	Variety of Assessment	Environmental Impact Considered	Types of Pollution Prevention Addressed	Match by Company	Action by Company (Environmental Improvement)	Reduction in Amount of Waste
1	EISC	P2	High levels of BOD and COD in the waste generated	Waste	Yes	Work in progress to lead to full implementation	Short-term goal: 20% Long-term goal: 50-70%
2	EISC	E/P2	Reduce energy use and indirect air pollution	Energy related air emissions	Yes	Implementation considerations in progress. They installed a small section of high efficiency fluorescent lighting on the shop floor but did not complete the lighting for the entire plant. They did change their operation routines to reduce their peak kW demand.	EISC estimates they reduced their KW demand by 5-10% which also reduces their kWh by about 5-10%.
3	TechSolve	P2	Impact on all media	Waste Reduction	Yes	Working on implementing the suggestions	Estimated $31 K savings
4	TechSolve	P2/ISO	Health risk	Waste minimization	Yes	Will be implementing the recycling	*N/A*

						programs as part of ISO	
5	EWI	E/P2	Reduce energy use and indirect air pollution	Hazardous and non-hazardous wastes	Yes		Reduced annual CO_2 emissions of 4,733,677 lbs
6	EWI	E/P2	Reduce energy use and indirect air pollution	Energy related air emissions	Yes		Reduced annual CO_2 emissions of 2,716,208 lbs
7	CAMP	P2	Reduce waste and energy	Waste and energy	Yes	Company has implemented all the findings and received ISO14001certification in July 2005	$30,000-$50,000
8	TechSolve	P2	Alternate material reuse	Waste minimization, Resource management	Yes	Company examining alternative waste disposal options	N/A
9	TechSolve	P2/ISO	Health risk	Waste minimization	Yes	Company currently implementing lead-free solder	Elimination of 100% lead
10	EISC	E/P2	Reduced energy use and indirect air pollution	Energy efficiency and air pollution	Yes	Assessment in progress	Estimated 203, 806 lbs/year CO_2 savings
11	EISC	E/P2	Reduce consumption of non-renewable electric and gas resources	Inefficient energy usage	Yes	Assessment in progress: The Sandusky greenhouse new construction is delayed again until 2007 due to	Estimated $51,000/year energy cost savings in

						financial considerations	
12	EISC	E/P2	Reduce consumption of non-renewable electric and gas resources	Inefficient energy usage	Yes	Assessment in progress	Estimated $166,013/yr savings in E2 related improvement
13	TechSolve	EMS	Environmental management	Waste minimization	Yes	Developed ISO 14001 program	Potential diversion of 50,000 lb lead containing rubber
14	TechSolve	P2	Waste water	Waste minimization	Yes	Developed ISO 14001 program	Elimination of 400 lb/yr lead
15	TechSolve	E/P2	Reduced energy use and indirect air pollution	Energy efficiency and air pollution	Yes	Assessment in progress	Projected resultant savings of 55% or 22,800 MMBtu per year natural gas
16	EISC	P2	Spill prevention	Hazardous Waste Management		Assessment in progress	*N/A*
17	TechSolve	E/P2	Energy Management Planning	Energy Efficiency	Yes	Assessments complete, implementation in progress	Reduce electric consumption by approximately 50,000 kWh per year
18	TechSolve	E/P2	Energy Management Planning	Energy Efficiency	Yes	Assessments complete, implementation in progress	Potential 90,000 lbs/year of reduction in CO_2 emissions
19	TechSolve	P2 / ISO / SMS	Safety Management & Pollution Prevention	Waste minimization	Yes	Assessments in progress	Potential 176, 400 lbs/year reduction in CO_2 emissions

20	EISC	P2	Spill	Spill Prevention	Yes	Assessments in progress	in progress
21	EISC	P2	Waste Management	Waste Reduction	Yes	Assessments in progress	Over 30% of ketchup could be diverted from becoming waste
22	EISC	P2	Waste and Energy Management	Waste Reduction and Energy Savings	Yes	Assessments in progress	in progress
23	TechSolve	ISO/P2	Safety Management & Pollution Prevention	ISO Review and Hazardous Chemicals Elimination	Yes	Assessments in progress	in progress

Table III: Progress made on Assessments Conducted

	Center	Assessment	Number of recommendations made	Recommendations implemented by the company	Percent of recommendations implemented	Amount of waste eliminated
1	EISC	P2	3	In progress	0	N/A
2	EISC	E/P2	3	In progress	0	N/A
3	TechSolve	P2	3	Implemented	100	$36,000/yr
4	TechSolve	P2/ISO	3	Pending	0	Pending
5	EWI	E/P2	6			
6	EWI	E/P2	4			
7	CAMP	P2	Several	All	100	$30,000-$50,000
8	TechSolve	P2	4	Implementing	20	Pending
9	TechSolve	P2/ISO	3	3	60	100 lb/yr lead
10	EISC	E/P2	Several		N/A	203, 806 lbs/year CO_2
11	EISC	E/P2	Several		N/A	$51,000/yr
12	EISC	E/P2	Several		N/A	$166,013/yr
13	TechSolve	EMS	4	In progress	20	Diversion of 50,000

						lb lead containing rubber
14	TechSolve	P2	4	In progress	20	400 lb/yr lead
15	TechSolve	E/P2	Complete	1	100	22,800 MMBtu per year natural gas
16	EISC	P2	In progress		N/A	N/A
17	TechSolve	E/P2	4	In progress	N/A	50,000 kWh/ year
18	TechSolve	P2 / ISO / SMS	3	In progress	N/A	90,000 lbs/year CO_2
19	TechSolve	P2	In progress	In progress	N/A	176,400 lbs/year CO_2
20	EISC	P2	In progress	In progress	N/A	Pending
21	EISC	P2	In progress	In progress	N/A	30% savings in ketchup
22	EISC	P2	In progress	In progress	N/A	Pending
23	TechSolve	ISO/P2	In progress	In progress	N/A	Pending

Table IV: Potential Pollution Prevention Benefits from Assessments 1-10

Benefit	EISC	EISC	TechSolve	TechSolve	EWI	EWI	CAMP	TechSolve	TechSolve	EISC
	1	2	3	4	5	6	7	8	9	10
Raw materials savings by recycling	Yes	No	No	N/A	No	No	Yes	Yes	N/A	No
Material substitution savings	No	No	N/A	N/A	N/A	N/A	Yes	Yes	N/A	No
Elimination of pollution control equipment	No	No	N/A	N/A	N/A	N/A	No	N/A	N/A	No
Improved	Yes	Yes	N/A	N/A			Yes	N/A	Yes	Yes

process productivity										
Better product quality	Yes	No	N/A	N/A	N/A	N/A	Yes	N/A	N/A	Yes
Reduced labor from pollution elimination	No	No	N/A	N/A			Yes	N/A	N/A	No
Reduction of permitting requirements	No	No	N/A	N/A	N/A	N/A	Yes	N/A	N/A	No
Reduction and /or elimination of off-site waste disposal	Yes	No	N/A	N/A	N/A	N/A	Yes	N/A	N/A	No
Reduction and /or elimination of off-site waste storage	No	No	N/A	N/A	N/A	N/A	No	N/A	N/A	No
Reduction of personal injury risks under OSHA	No	No	N/A	N/A	N/A	N/A	Yes	N/A	N/A	No
Permitting requirements minimized	No	No					Yes	N/A	N/A	No

Table IV (Contd.): Potential Pollution Prevention Benefits from Assessments 11-19

Benefit	EISC 11	EISC 12	TechSolve 13	TechSolve 14	TechSolve 15	EISC 16	TechSolve 17	TechSolve 18	TechSolve 19
Raw materials savings by recycling	No	No	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Material substitution savings	No	No	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Elimination of pollution control equipment	No	No	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Improved process productivity	Yes	Yes	Yes	Yes	N/A	N/A	Yes	N/A	Yes
Better product quality	Yes	Yes	N/A	N/A	N/A	N/A	Yes	N/A	N/A
Reduced labor from pollution elimination	No	No	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Reduction of permitting requirements	No	No	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Reduction and /or elimination of off-site waste disposal	No	No	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Reduction and /or elimination	No	No	N/A	N/A	N/A	N/A	N/A	N/A	N/A

of off-site waste storage									
Reduction of personal injury risks under OSHA	No	No	N/A	N/A	N/A	Yes	N/A	Yes	N/A
Permitting requirements minimized	No	No	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table IV (Contd.): Potential Pollution Prevention Benefits from Assessments 20-23

Benefit	EISC	EISC	EISC	TechSolve
	20	21	22	23
Raw materials savings by recycling	No		N/A	N/A
Material substitution savings	No	No	N/A	N/A
Elimination of pollution control equipment	No	No	N/A	N/A
Improved process productivity	N/A	Yes	Yes	Yes
Better product quality	N/A	No	N/A	N/A
Reduced labor from pollution elimination	No	No	N/A	N/A
Reduction of permitting requirements	Yes	Yes	N/A	N/A
Reduction and /or elimination of off-site waste disposal	No	No	N/A	N/A
Reduction and /or elimination of off-site waste storage	No	No	N/A	N/A
Reduction of personal injury risks	No	No	N/A	Yes

under OSHA				
Permitting requirements minimized	Yes	Yes	N/A	N/A

Computer Tools Developed by the University of Toledo

Over the years, UT students have worked on the development of ten tools for the use of small and medium size companies. These are: 1) Gap Analysis tool, 2) MSDS Manager for P2, 3) Emission reduction calculator, 4) Lean Manufacturing, 5) HVAC Checklist, 6) Energy Assessment Spreadsheet, 7) Hybrid HVAC system Design Tool, 8) Building Sustainability Tool, 9) Pollution Prevention Tool For Hospital Assessment, and 10) Database of Green Products. The first seven tools are described in the earlier PPIS report (Kumar et al., 2005). Product descriptions of the Building Sustainability Tool, Pollution Prevention Tool for Hospital Assessment and Database of Green Products are given below.

- **Hybrid HVAC System Design Tool**

This spreadsheet tool helps to determine the time periods best suited for natural ventilation so as to save energy and improve energy efficiency. The spreadsheet is used for the design of hybrid HVAC systems for a manufacturing facility and associated office building. It is easy to use and could be modified for a specific plant. It is hoped that the spreadsheet will be helpful in improving energy efficiency at your plant. The tool was applied to one of the assessments to improve energy efficiency of the current HVAC system at the plant.

- **Tool for Sustainability Analysis of Buildings**

The tool helps in evaluating the sustainability of the building elements, indoor environment and the occupant behavior, which affects the indoor living quality. The tool utilizes the concepts of energy efficiency, water efficiency, building envelope and indoor environment quality, and occupant behavior to analyze the performance offered to the occupants. The user is given a comparison between the various sustainable options available that provide an opportunity to make an informed judgment. The tool also formulates a Sustainable Building Score (SBS) that helps in identifying the extent to which the living standards can be improved. Graphical display of the results makes the interpretation of the results from the tool easier. This tool was made for analyzing residential buildings and is now being value-added for assessing the industrial/office buildings as well. Two papers on this topic were published in the Environmental Progress in the past year.

- **Pollution Prevention Tool For Hospital Assessments**

The objective of this project was to create a computer based tool for assessment of pollution prevention initiatives in hospitals. The tool grades the hospitals qualitatively and quantitatively and awards a comparative index which can help in understanding the avenues for improvement by using cleaner alternatives.

Various existing tools have been reviewed and a questionnaire based on various sectors of the hospital like storage, wastes, training, red bag wastes, equipment, mercury and treatment has been prepared. Incorporation of suggestions on cleaner alternatives that assists the hospital management on selecting remedial measures to prevent pollution and maintain a healthy environment has been completed. The tool has been reviewed during two OSEN meetings. Changes have been incorporated and a paper was published in the July issue of the Environmental Progress. The tool can is available to the public at http://p2tools.utoledo.edu/pptools.htm#HAT.

- **Database of Green Products**

The objective of this project was to create a database of green products. This database will be helpful for users to get detailed information on sustainable alternatives including their cost, product description, and different sources to check the availability. Products selected for DGP are made with salvaged, recycled or agricultural waste content, conserve natural resources, avoid toxic emissions, save energy or water, and contribute to a safe, healthy built environment. Current work includes completion of the database for different green products in Microsoft Access, along with their comparison with popularly used products.

The above tools except the tool for green products is available for download to small and medium size companies from the Internet site maintained at the University of Toledo http://www.p2tools.utoledo.edu/. A user's guide is provided for each tool along with a PowerPoint presentation. These slides have been prepared so that user could learn the tools' operation online.

Educational Material Related to P2

Green Engineering and Clean Manufacturing as it relates to pollution prevention are the two topics that were selected. UT students prepared PowerPoint presentations on both topics for the use of OSEN members. PowerPoint presentations have been posted on the web site.

Technical Session at GLRPPR

UT and Ohio Edison Centers participated in the development of a technical session on "Industry Case Studies" and a student poster session in 2004. Both the sessions went very well. Technical session ended with a lot of questions and the students from OSU and UT participated.

Student Posters on P2 at A&WMA Meetings

Students working on this grant presented the following posters at different A&WMA meetings:

1. Cleaner production: A Move towards Sustainability
2. Green Buildings for a Sustainable Future
3. Pollution Preventions Assessments for Small and Medium Scale Industries in Ohio
4. Development of a Tool for Analyzing the Sustainability of Residential Buildings in Ohio
5. Development of a Pollution Prevention Tool for Assessment of Hospital Waste

One of the posters "Cleaner Production: A Move towards Sustainability", received the best poster award for sustainability sponsored by the EPA during the conference.

Technical Publications

The following papers have been published to share the results obtained during the grant:

1. R. Pendse, A.Kumar, and A. Vijayan, Development of a Spreadsheet to Determine Natural Ventilation Cooling Hours for a Commercial Hybrid HVAC System, Environmental Progress, 24(1), 16-23, 2005.

2. A. Vijayan and A.Kumar, A Review of Tools to Assess the Sustainability in Building Construction, Environmental Progress, 24(2), 125-132, 2005.
3. A. Kumar, H.G. Rao, A. Vijayan, and C. Varadarajan, Pollution Prevention, Encyclopedia of Chemical Processing, Taylor & Francis, 2006.
4. A. Vijayan and A.Kumar, Development of a Tool For Analyzing the Sustainability Of Residential Buildings in Ohio, Environmental Progress, 24(3), 2005.
5. N. Raman, A. Vijayan, A. Kumar, Development of a Pollution Prevention Tool For Assessment of Hospital Waste, Environmental Progress, 25(2), 93-98, 2006.

Sustainability and Pollution Prevention Tools Guide

The P2 tools guide was updated for the use of manufacturers and is now available for download from http://p2tools.utoledo.edu/ppistools.htm. This guide provides links for understanding different pollution prevention avenues, and includes detailed information on available tools on the Internet for pollution prevention assessments. The guide along with its appendices also provide information on the tools developed by the University of Toledo, their user's manuals and PowerPoint slides for understanding the operation of the tools. This site also provides links to other useful tools developed elsewhere.

CONCLUDING REMARKS

The University of Toledo is working with Ohio Edison Centers, OhioEPA, and ODOD. The activities led to the reduction of waste during the grant period and have the potential of reducing waste in the coming years by small and medium size manufacturers. A summary of waste reductions during the study are given in Table X-1, Appendix- X. Nine computer tools have been posted on the website to assist in pollution prevention work.

APPENDIX-A
Assessment 1: Turkey Plant Wastewater Recycling/Reuse

Objective
The goal of this project is to examine the feasibility of reducing the wastewater effluent quantity Company A discharges to the Village lagoon wastewater treatment system.

Background
Company A in Ohio processes 17,000 turkeys daily (5 days a week), discharging about 550,000 gallons of wastewater per day to the Village. Water & sewer cost for Cooper is $2.25 per 1000 gallons, which is considered very economical.

Project Activities
- The first task was to profile the water usage at the facility. This was accomplished through interviews with plant personnel, plant surveys, water-meter monitoring, review of reported information from industry, and through some selective water sampling and testing. Major water usage at the facility was found in the following operations.
  Scalding - 45,000 gallons/day
  Evisceration - 85,000 gal/day
  Bird Washing - 70,000 gal/day
  Chilling - 110,000 gal/day
  De-boning - 30,000 gal/day
  Clean-up - 100,000 gal/day

- A review of wastewater reduction and recycling initiatives pursued in the past by the meat-processing industry was conducted. Wastewater reduction initiatives reported by the industry included use of flow restrictors, efficient clean-up operation including partial dry cleaning, usage reduction in boiler blow-down, softener system back-flush, closed loop cooling system, and continuous usage monitoring. As for water recycling/reuse, USDA regulations and guidelines on recycling of process wastewater from such a facility were studied. It was found that there exists no set industrial protocol today for such recycling application. USDA has recycling standards with respect to coliform levels, aerobic plate count, turbidity, and residual disinfectant, and only site-specific recycling systems are approved through pilot testing.

- It was found that reconditioning chiller water has been pursued successfully by the poultry processing industry because of the large volume involved and the relatively less contaminant loading. The standard techniques used for reconditioning process water include screening, filtration and/or sanitization. Filtration can be effectively accomplished using membranes (micro/ultra/nano), sand or diatomaceous earth (DE). Chlorine/Chlorine dioxide or ozone has been utilized to sanitize the water.
  Ultra-filtration with membranes as well as sanitization alone has been found to treat water sufficiently to meet recycling requirements.

Current Recycling Initiatives
- Chiller and bird-wash water from the facility have been sampled and tested. Presence of organic solids, fats and micro-organisms (coliform and bacteria) has been confirmed. Also it was found that Chiller 2 and Bird Washer 1 have relatively cleaner effluent.

- Treated effluents can be reused for the same application or for other processes. The need now is for a system of collecting, transporting and treating the water. Pilot testing needs to be conducted to demonstrate effectiveness of treatment and conformation to standards.

- Side-stream trials to filter and sanitize bird-wash and chiller water have been conducted in the first week of October, 2004. Chlorine dioxide has been used as the sanitizer and trials included use of bag, cartridge, and DE filters. Water samples have been collected and sent for testing. Test results are awaited.

Future Initiatives

- Bench-top testing with membrane filtration (ultra or micro filtration) is being planned. Attempt will also be made to incorporate more process-effluents in testing.

- UV and ozone disinfection are being investigated as alternatives to chlorine dioxide and their relative advantages and disadvantages are being evaluated.

- Depending on the effectiveness of this pilot-testing in treating the wastewater to meet USDA standards, the next step would be to design a real-time full scale recycling system. This would potentially include the following:

1. Reuse chiller over-flow water during processing as chiller make-up water.

   Volume: < 17,000 – 20,000 gal/day
   - This would be a continuous operation during processing. The over-flow would be collected separately (would require plumbing redesign), treated, chilled, and reintroduced into the chiller as make-up.
   - The capacity of the treatment system has to be designed to handle the necessary gpm. At present, approximately 40 gpm of fresh chilled water provides the make-up during 7/8 hours of processing time per day.

2. Reuse bird-wash water during processing in a closed loop.

   Volume: < 67,000 gal/day
   - Collection, treatment and reuse of the bird-wash water would also be a continuous operation during processing.
   - The two bird-wash stations use 160 gpm together for about 7 hours during processing. The fresh water used is at 56-57 F and does not require chilling. This is a one-pass operation; fresh water from nozzles in a enclosed cabinet gets sprayed onto the moving line of carcasses, and drain out the bottom as wastewater.

3. Reuse chiller water from Chiller2 for initial fill of Chiller1/Pre-Chiller at the end of processing and for the next day.

   Volume: <45,000-50,000 gal/day
   - The two chiller baths are in series and Chiller2 gets less contaminant load than Chiller1. At present, chillers are drained together during 5-7 pm, cleaned and sanitized, and refilled with fresh chilled water during midnight-2 am for the next day.
   - Treating this large volume of water could require a large holding tank, which needs additional space and capital. The plan is to use one of the chillers as the necessary intermediate holding tank.

- At the end of the day, the chillers would have to be drained and cleaned in stages. Chiller1 would be drained and cleaned first. Water from Chiller2 would then be introduced into the clean tank, treated as necessary and sent through the ammonia chiller. Chiller2 has to be cleaned and sanitized by this time and chilled recycled water can be reintroduced into Chiller2 as the initial fill for next day.

The above operation would require detailed planning. The chillers are located side-by-side, and cleaning them in separate stages would require barriers between the two.

Also, the capacity of the treatment system in gpm is crucial as the whole operation has to be completed between the end of one day's processing and the beginning of the next day's activities.

Conclusions

An average of 5% water usage reduction opportunities has been identified in vaccum pump and compressor cooling operations by using a closed loop cooling system (single pass cooling system is used today), and another 5% in the hand-washing line operation by adapting each station with trigger activation flow control (as opposed to today's constant flow). A mid-term goal of 5-20% chiller water reuse and 5-10% bird-wash water reuse has been set. This could lead to a long-term goal of 50-70% water recycling at the facility.

APPENDIX-B
Assessment 2: Electrical Energy Efficiency Assessment for a Large Plastic Injection Molding & Extrusion Company

Objective
Electrical energy efficiency assessment for an electrical energy intensive Large Plastic Injection Molding & Extrusion Company in Ohio, with annual bills of $650,000 to $700,000.

Findings
Data on major electrical equipment was collected with the assistance of plant personnel through surveys and interviews. Information on individual operating hours, loading pattern and duty cycle of the appliances were also collected. Electrical consumption of 10.8 million KWH (at a cost of $750,000) is projected for a 12-month period.

Monthly electricity bills for the period Nov 2003 - Mar 2004 were analyzed. Detailed unit breakdown of the bills were obtained from The Ohio Edison Company and utilized in the analysis. The following are some of findings.

- Average peak demand per month is 2100 KVA (Nov 2003 – Mar 2004).
- Demand cost constitutes 50% of total cost of electricity. At $16.50 per KVA, annual demand cost totals to $415,800 ($16.50 * 2100 * 12).
- $375,000/yr would be a more conservative estimate.
- The KVA demand is not uniform over the production hours and peaks intermittently for short periods. The peaks occur in the first shift between 6 am and 2 pm. Some of these peaks seem to be due to early morning startup on Mondays.
- It seems possible to avoid these intermittent peaks for short periods with better equipment management. A 200 KVA (about 10 %) reduction in the peak demand per month could save $39,600 annually (200 * $16.50 * 12) in electrical charges. A mere 5 % reduction or 100 KVA per month will result in savings of $19,800.
- On peak and off peak electrical usage are almost equal at 50 % of the total.
- The average on-peak load factor is above 0.8, which is considered good. Off peak average load factor of 0.53 brings down the total load factor to an average of 0.6.
- The average power factor for the period Nov 2003 – Mar 2004 is 0.98. Though 1 is an ideal value for the power factor, 0.98 is fair.

Shop Lighting
- The general shop lighting is with Sylvania M59 400 W metal halide lamps in Lithinoa Hi-Tek fixtures. In addition, there are some 1000 W metal halides in the warehouse.
- Fixture placement is irregular with little grid pattern and the fixtures are also at different heights from the floor.
- For task lighting in inspection tables, unloading tables and work benches, etc, 4 ft 34W T12 (Sylvania F34/CW/SS) fluorescent lamps are used in 2 or 4 lamp fixtures. There are also some 8 ft 60W T12 (Sylvania F96T12/CW/SS) fluorescent lamps in 2 lamp fixtures.

- The foot-candles measured in general shop areas vary from 10 to 30 fc and task-lighted workbenches/inspection tables and unloading areas have a lighting level of 30 to 60 fc in general. A few Inspection tables are without task lighting with levels as low as 16 fc.
- The color inspection area between Injection Molding Machines 5 and 6, lit with 40W GE F40/SP65 fluorescent lamps have 250 fc lighting level, while the unloading table beside Machines 1 and 2 have a 160 fc lighting level. The Hot Room has a 8-12 fc lighting level and the warehouse has a 2-10 fc lighting level.

- In general, most parts of the shop are sufficiently lit for the required work. It is not 'essential' to increase the general lighting level in the shop. However, increasing the lighting level to a uniform 35-40 fc with proper task lighting on a 'need-to-light basis' would enhance the ambience greatly.

Table B-1 shows the economics of replacing the 190 400W metal halides in the shop (including the Hot Room but excluding the Warehouse) with 4 and 6 lamp hi-bay fluorescent fixtures.

Table B-1: Replacement of Metal Halides with Multi-Lamp Hi-Bay Fluorescent Fixtures

I	Fixture Description		**MH**	**Hi-Bay FL**	**Hi-Bay FL**
II	Quantity of Fixtures		190	190	190
III	Lamps/Fixture		1	6	4
IV	Lamp Type		400 W MH	32 W T8	54 W T5 HO
V	Watts/Fixture (incld. Ballast)		450	224	234
VI	Cost/Fixture ($)		0	300	300
VII	Cost/Lamp ($)		40	5	10
VIII	Cost per kWh ($)		0.035	0.035	0.035
IX	Cost per kVA Demand ($)		16.500	16.500	16.500
X	Operating Hr/yr		6400	6400	6400
XI	Installation Time/Fixture (hr)		1	1	1
XII	Installation Labor ($/hr)		35	35	35
XIII	Re-lamp Time/Lamp (min)		15	15	15
XIV	Re-lamp Labor ($/hr)		25	25	25
XV	Expected Lamp Life (hr)		20000	20000	20000
XVI	Lamp Changes/yr	(II) * (III) / { (XV) / (X) }	61	365	243
XVII	Initial Fixture & Lamp Cost ($)	(II) * (VI) + (II) * (III) * (VII)	0	62700	64600
XVIII	Installation Cost ($)	(II) * (XI) * (XII)	0	6650	6650
XIX	Total Initial Cost ($)	(XVII) + (XVIII)	**0**	**69350**	**71250**
XX	Lamp Cost/yr ($)	(XVI) + (VII)	2432	1824	2432
XXI	Re-lamp Cost/yr ($)	(XVI) * (XIII)/60 * (XIV)	380	2280	1520
XXII	KW	(II) * (V) / 1000	86	43	44
XXIII	KVA	(XXII) / 0.98 ; PF=0.98	87	43	45
XXIV	kWh/yr	(II) * (V)/1000 * (X)	547200	272384	284544
XXV	Electricity Cost/yr ($)	(XXI) * (VIII)	19152	9533	9959
XXVI	Demand Charges/yr ($)	(XXIII) * (IX) * 12	17274	8599	8983
XXVII	Total Annual Cost ($)	(XX) + (XXI) + (XXV) + (XXVI)	**39238**	**22236**	**22894**
XXVIII	Initial Cost Premium ($)		-	**69350**	**71250**
XXIX	Annual Savings ($)		-	**17002**	**16345**
XXX	Simple Payback (yr)			**4.1**	**4.4**

Variable Frequency Drives on Injection Molding Pump Motors

The existing VFDs on the hydraulic pumps of the large injection molding machines have been found to be broken and taken off-line or not optimized for maximum electrical savings.

The following is the list of existing VFDs for the molding pump motors.

1. Injection Molder 4, 150-hp pump motor, VFD not working

   Electrical consumption without VFD = $23,100 per year
   (assuming 5000 working hours, 20% duty @ 95% load and 80% duty @ 50% load)

   From studies done by Magnum AC Drive Systems at Carlisle Engineered Plants, an average of 40% savings is possible with properly programmed VFDs.

   Savings Potential = $9250

2. Injection Molder 6, 150-hp pump motor, VFD not working

   Electrical consumption without VFD = $23,100 per year
   (assuming 5000 working hours, 20% duty @ 95% load and 80% duty @ 50% load)

   Assuming an average of 40% savings, **Savings Potential = $9250**

3. Injection Molder 5, 2 150-hp pump motor, 2 VFDs working
   VFD has been programmed to operate pump between 30 and 100% load. The load does not fall below 30%.

   Electrical consumption with existing VFDs = $16,600 each per year
   (assuming 5000 working hours, 10% Duty @ 95% Load, 30% Duty @ 50% Load, 60% Duty @ 30% Load)

   Electrical Cost without VFDs = $23,100 each per year (from 1 & 2 above)

   Savings achieved = $23,100 - $16,600 = $6,500 each (28%)

   Assuming that a potential 40% savings is achievable with optimizing the operation of the VFDs,

   Additional Potential Savings = $9,250 - $6,500 = $2,750 each

   Potential Savings for both = $5,500

4. Injection Molder 6, 100-hp pump motor, VFD set at 75%

   Electrical consumption with existing VFD = $19,582 per year
   (assuming 5000 working hours, 100% Duty Cycle @ 75% Load)

   Assuming an average of 40% savings with proper programming,

   Savings Potential = $7,800

5. Injection Molder 16, 100-hp pump motor, VFD working

Electrical consumption with existing VFDs = $11,100 per year
(assuming 5000 working hours, 10% Duty @ 95% Load, 30% Duty @ 50% Load, 60% Duty @ 30% Load)

Electrical Cost without VFDs = $15,400 per year
(20% duty @ 95% load and 80% duty @ 50% load)

Savings achieved = $15,400 - $11,100 = $4,300 (28%)

Assuming that a potential 40% savings is achievable with optimizing the operation of the VFDs,

Additional Potential Savings = 40% * $15,400 - $4,300 = **$1,860**

Total Potential Savings with repairing and optimizing all the 5 VFDs = $33,600 approx

APPENDIX-C
Assessment 3: Waste Reduction Opportunities for a Doughnut Corporation

Objective
Pollution prevention assessment to determine the measures to reduce, the waste being disposed down the sewer for a Doughnut Corporation in Columbus

Issue
In the last 12 months, Company C has received surcharges for its wastewater because of the high biological oxygen demand (BOD) and chemical oxygen demand (COD) levels. TechSolve was hired to conduct a pollution prevention assessment to determine what measures could be taken to reduce the waste being disposed down the sewer in order to reduce the surcharges.

Since TechSolve was hired, the cost of the surcharges increased due to the fact that the water supplier was incorrectly calculating the facility's water usage by a factor of 10. Despite improvements in the wastewater treatment units and reconfiguration of the manhole used for sampling, the surcharge amounts increased by four-fold because of the increased water usage used to calculate the surcharge amounts.

Current P2 Practices
Prior to TechSolve's assistance, Company K had implemented some pollution prevention measures to reduce the waste being generated during production. These activities include:

- Dry sweeping floors before water washing;
- Donating excess doughnuts to local charities and farmer;
- Recycling the cooking oil;
- Scraping the mix bowls before water washing;
- Placing catch pans under the conveyor system to prevent food from dropping to the floor;
- Operating key fill pumps to recirculate icing;
- Minimizing the on-site raw materials to one week's supply; and
- Recycling the icing that is used to top the doughnuts.

Implementing these P2 measures have reduced the waste quantities that are either landfilled or washed down the sewer, but more can be done to further reduce waste.

Recommendations
The following are the recommended actions of Company C to reduce surcharge levels in their wastewater:

1) If the employees can be better trained and trusted to maintain the cleanliness of the production floors, this would be the cheapest, although not likely the most reliable way of reducing the surcharge due to doughnut dough and sugars in the wastewater.

Improving the catch pans to prevent the toppings and doughnuts from reaching the floor would help to prevent this from reaching the sewer and would facilitate clean-up. Preventing this material from even falling off the conveyor system in the first place would be the optimal approach. Also, ensuring the maintenance of the grease interceptors will help to reduce the surcharge.

Segregating food waste and packaging and other non-food waste will increase the opportunity for the waste food to be used by the hog farmer. It will need to be determined if the farmer will accept food that is cleaned up from the floor and the conveyor systems.

Providing an incentive program and promoting one of the long-time production workers to supervise the more junior workers will help to reinforce the need for cleanliness. It is critical that Company C explain the need for the additional cleanliness such that it has an impact on the financials and is not only for sanitation purposes. Providing the tools necessary for the workers to complete their jobs at the source would also help promote the need for cleanliness. The food waste totes and cleaning station should be clearly marked and signage should be placed in the work area to remind employees of the need to dry clean. Promoting a senior worker to a supervisory position to help reinforce the cleaning rules will provide the floor supervision that is needed to maintain housekeeping practices.

2) At the same time the employees are being trained to use dry cleaning methods, the use of water only as a final clean-up step should be reinforced. The HVLP nozzles or water brooms should be introduced at this point to reduce the overall clean-up water. Training of the tray washer to wipe dirty trays before placing them in the washer should also be done at this time. Company C should continue its efforts towards collecting the most concentrated sugar streams such as from equipment clean-up using the totes. A decontamination step needs to be enforced to ensure that the totes brought back in to the production area are sanitized. This can be accomplished using a bleach solution and a portable pressure washer followed by a final water wash.

3) The last option that should be considered is a wastewater treatment system. Because Company C has limited space at their facility; a packaged wastewater treatment system would be one possibility. These units can be customized to treat the effluent in a relatively small space. If this option is implemented, it is recommended that water usage be minimized first to decrease the size needed for the wastewater treatment system. It is also recommended that the designer visit the facility to determine best placement and configuration. The packaged reverse osmosis system would likely be the most effective treatment for this waste stream. Tests would need to be performed to confirm this. Concentrated sugar water from the system could be collected for the cattle farmer feed in the totes. Treatment of the wastewater is only advised after all other attempts to reduce the sugar water has failed.

APPENDIX-D
Assessment 4: ISO 14001 Implementation for a Transmission Parts Supplier

Company Profile
Company J located in Blanchester, Ohio requested that TechSolve assist with the implementation of an ISO 14001 management system. The company has approximately 60 full-time personnel that manufacture transmission parts for Ford. Because the company has recently been designated as a Tier I supplier, Ford is requiring Company J to become ISO 14001 certified.

Approach
TechSolve first reviewed the operations and the property to determine what aspects would apply to the activities, processes and services provided at the company. In addition, TechSolve performed a cursory regulatory compliance audit to determine what wastes should be prioritized for consideration as a significant aspects.

Significant aspects were prioritized based on their severity of impact if released, the degree of impact, the quantity generated, and whether the waste is regulated. Based on this criteria, the following wastes or potential wastes were deemed to be significant:

- Electronics,
- Universal waste (fluorescent lights and batteries),
- Stormwater, and
- Ozone depleting substances.

Solutions
Because ISO 14001 requires that companies investigate possibilities for prevention of pollution whenever feasible, for the significant aspects identified based on available resources, the following solutions were suggested.

1) Electronics
On occasion, Company J will need to replace outdated computer hard drives, monitors, fax machines, and copy machines. Currently, Company J has outdated computer equipment that is unusable. Since electronic equipment can contain mercury and lead, electronic equipment was designated as a significant aspect. The amount of current electronic waste is unknown and the quantity that will be generated in the future cannot be estimated.

TechSolve located an electronics recycler that would be able to pick up their electronic waste and dismantle the parts and recycle them in an environmentally responsible manner.

2) Universal Waste
Fluorescent lights are occasionally changed out. The lights being used by the company are the higher mercury fluorescent lights. TechSolve is recommending the future use of low mercury lights. Also, Rumpke will recycle the fluorescent lights. No quantity of spent lamps was known at the time of this report.

Used batteries are generated from the forklifts and from the floor scrubber. A contractor replaces the forklift batteries. Company J, as part of the ISO program, will be requiring that the contractor fill out a Contractor Package that will ensure the contractor manages the battery waste properly. Floor scrubber batteries will be recycled when spent.

3) Stormwater
Company J is putting together a Spill Plan and Stormwater Pollution Prevention Plan to be able to react to any spill or potential contamination of the ground or stromwater. In addition, Company J will train its employees to be able to respond to spills in order to mitigate any environmental impact.

4) Ozone Depleting Substance
Company J has a few air conditioning units containing Class II freons. Because these substances are regulated, TecSolve recommended that Company J hire a certified contractor whenever work needs to be performed on these units. This will help prevent the unnecessary release of these substances to the air.

APPENDIX-E
Assessment 5: Energy Assessment for a Plastic Materials and Resin Manufacturer

Objective
Energy assessment for company E, a leading domestic producer of industrial resins and catalysts.

Findings
Detailed analysis of the different systems consuming electrical energy was conducted. The total annual power consumed from electrical equipments and lighting was determined from the electricity bills. The Total Annual Power Consumed for Electrical equipments and lighting are 5,477,952 kWh and 984,401 kWh respectively.

Utility analysis involved the analysis of the utility bills with the help of graphs and tables to identify trends, anomalies and billing errors. The following were identified from this analysis.

- Average price of electricity for this industry is 5.32 cents/kWh. The national average for industry is about 7.26 cents/kWh.

- Energy costs comprise about 0.8% of sales. The average for Company E is about 1.5%.

Average Avoided Cost

Demand = $11.60/kW

Energy = $0.033/kWh

Avoided cost represents the cost savings that can be achieved by modifying the usage by a given amount. It is based on the historical data provided by the City of Columbus outlining the plant's recent usage. The avoided cost was used to calculate savings in all of the recommendations provided below.

Recommendations

AR 1: Reduce Compressed Air Energy Requirement: Distribution System
Company E is presently using two (2) 75 HP screw compressors. During the assessment all air compressors were observed to be running. All were very hot to the touch, indicating full (or near full) load. Leaks and other compressed air distribution problems may be causing Capital Resin to create more compressed air than is needed. EWI estimated that this recommendation will save $10,393/year and have a payback of 8.7 months.

AR 2: Reduce Compressed Air Energy Requirement: Air Pressure
Once the air distribution system is buttoned up, it is always advantageous to look at the demand side. One easy way to capitalize on distribution improvements is for Company E to lower the air pressure for its compressors. It is estimated that this recommendation will save $3,489/year and have a payback of 7.2 months.

AR 3: Power Factor Correction on Critical Motors
During the assessment, it was discovered that several of the critical motors had extremely low power factors in one or two legs of the three-phase power. This may be due to a need for power correction at the motor, but more likely is due to a mixture of 'DELTA' and 'WYE' wiring

configurations in the distribution system. Correcting this would require some time and the cost would be hard to estimate, so an estimate based on past experience is made. It is estimated that this recommendation will save $30,408/year and have a payback of 9.9 months or 1.3 years based on which option is required.

AR 4: Implement a Closed Loop Water Cooling System

Company E uses an average of 1,223 -1,000 cu. ft. of water a month in its cooling system. The water comes from the city of Columbus at a net rate of $10.98 per 1,000 cu. ft. If the company were to install a closed loop system, the water consumption would be limited to the make up water to replace evaporation and blow-off. Sewerage costs will be based only on the blow-off. With annual operating costs, it is estimated that this recommendation will save $63,936/year and have a payback of 3.2 years.

AR 5: Install Higher Efficiency Lighting

Company E consumes 984,401 kWh a year in lighting for a total cost of $32,485. The lighting is a mix of different types and lights, particularly in the production areas. EWI recommended a lighting replacement program that replaces approximately 460 T12 fluorescent lamps with energy efficient T8 lighting and electronic ballasts, plus replaces the mix of metal halide, mercury vapor, incandescent and high-pressure sodium lighting with energy efficient fluorescent lights and electronic ballasts. This will save $8,868 with a payback of 3.4 years.

AR 6: Implement Energy Management System

Company E can benefit from the current energy environment, which has given energy monitoring a vital management role. The most basic reason for monitoring energy use is to gather information about system operation, which can be used to:

- Understand and control energy costs
- Improve facility operations and processes

It is estimated that this recommendation will save $53,292/year and have a payback of 4.5 months.

Table E -1 gives the summary of the recommendations.

Table E-1 Details on Recommendations

AR		Annual Savings			Project Cost	Simple Payback
		Resource	CO_2 (lbs.)*	Dollars		
1	Electric Consumption Electric Demand Total	191,798 kWh 29.2 kW/mo.	441,135 lbs 441,135 lbs	$ 6,329 $ 4,078 $10,393	$7,500	8.7 months
2	Electric Consumption Electric Demand Total	64,386 kWh 9.8 kW/mo.	148,088 lbs. 148,088 lbs	$2,833 $ 1,364 $4,197	$2,080	7.2 months

3	Electric Consumption Electric Demand Total	621,960 kWh 71 kW/mo.	1,430,508 lbs. 1,430,508 lbs	$20,525 $ 9,883 $30,408	$25,000	9.9 months
3A	Electric Consumption Electric Demand Total	621,960 kWh 71 kW/mo.	1,430,508 lbs. 1,430,508 lbs	$20,525 $ 9,883 $30,408	$40,625	1.3 years
4	Cost Reduction	5,868 kcf water/year	.	$63,133/year	$200,000	3.2 years
5	Electric Consumption Electric Demand Total	163,944 kWh 24.84 kW/	37,707 lbs. 37,707 lbs	$3,458 $5,410 $8,868	$30,360	3.4 years
6	Electric Consumption Electric Demand Total	1,159,332 kWh 108 kW/mo.	2,666,463 lbs. 2,666,463 lbs.	$38,258 $15,034 $53,292	$20,000	4.5 months
Total			4,733,677 lbs	$134,834		

*Assumes 2.3 lb. CO_2/kWh

APPENDIX-F
Assessment 6: Energy Assessment for a Company F that Manufactures Flexible Permanent Magnet Products

Objective
Energy assessment for company F, one of the nation's leading manufacturers of flexible magnets

Findings
Detailed analysis of the different systems consuming electrical energy was conducted. Readings were taken off the main process equipments that included Voltage, Amperage, Wattage, Volts-Ampere, Volts-Ampere Reactive, and Power Factor. Readings indicate a fair amount of low power factors among the critical equipment. This is a cause potential cause of excessive power draw that can cause the motors to run hotter that recommended and to fail early.

Utility analysis involved the analysis of the utility bills with the help of graphs and tables to identify trends, anomalies and billing errors. The following were identified from this analysis.

- Average price of electricity for this industry is 4.3 cents/kWh. The national average for industry is about 7.26 cents/kWh.

- Energy costs comprise about 1.45 % of sales. The average for industry is about 2 - 3%.

Average Avoided Cost

Demand = $1.19/kW

Energy = $0.0207/kWh

Avoided cost represents the cost savings you would see from modifying your usage by a given amount. It is based on the historical data provided by the City of Columbus outlining your recent usage. Avoided cost is used to calculate savings in all the recommendations.

Recommendation
AR 1: Reduce Compressed Air Energy Requirement: Distribution System
Company F is presently using a 50 HP Quincy and a 60HP Atlas Copco air compressors (screw). During the assessment the air compressors were observed to be running. They were both hot to the touch, indicating full (or near full) load. Leaks and other compressed air distribution problems may be causing creation of more compressed air than is needed. This recommendation will save an estimated $3,868/year and have a payback of 7.8 months.

AR 2: Reduce Compressed Air Energy Requirement: Air Pressure
Once the air distribution system is buttoned up, it is always advantageous to look at the demand side. One easy way to capitalize on distribution improvements is for Company F to lower the air pressure for its compressors. It is estimated that this recommendation will save $488/year and have a payback of 1.02 years.

AR 3: Power Factor Correction on Critical Motors
During the assessment, it was discovered that several of the critical motors had low power factors in one or two legs of the three-phase power. This may be due to a need for power correction at the motor or is due to a mixture of 'DELTA' and 'WYE' wiring configurations in

the distribution system. Correcting this would require some time and the cost would be hard to estimate, so an estimate based on past experience is made. It is estimated that this recommendation will save $30,408/year and have a payback of 9.9 months or 1.3 years based on which option is required.

AR 4: Implement Energy Management System

Company F can benefit from the current energy environment, which has given energy monitoring a vital management role. The most basic reason for monitoring energy use is to gather information about system operation, which can be used to:

- Understand and control energy costs
- Improve facility operations and processes

It is estimated that this recommendation will save $21,480/year and have a payback of 11.2 months.

Table F-1 gives the summary of the recommendations.

Table F-1 Details on Recommendations

AR		Annual Savings			Project Cost	Simple Payback
		Resource	CO_2 (lbs.)*	Dollars		
1	Electric Consumption Electric Demand Total	169,112 kWh 85.8 kW/mo.	388,958 lbs 388,958 lbs	$ 3,500 $ 368 $3,868	$2,500	7.8 months
2	Electric Consumption Electric Demand Total	46,647 kWh 7.1 kW/mo.	107,288 lbs. 107,288 lbs	$ 965 $ 101 $1,066	$500	5.6 months
3	Reactive Demand Reduction Motor Life Improvement	352 25%	N/A	$ 1,690 $ 13,815 $15,505	$20,000	1.3 years
3A	Reactive Demand Reduction Motor Life Improvement	352 25%	N/A	$ 1,690 $ 13,815 $15,505	$,000	1.6 years
4	Electric Consumption Electric Demand Total	965,201 kWh 105 kW/mo.	2,219,962 lbs. 2,219,962 lbs.	$19,980 $ 1,500 $21,480	$20,000	11.2 months
Total			2716208 lbs	$41,919		

*Assumes 2.3 lb. CO_2/kWh

APPENDIX-G
Assessment 7: Development of an ISO 14001 EMS and P2 for XYZ Chrome

Objective
The PPIS grant was used to provide technical assistance in the development of an ISO 14001 environmental management system. The implementation provided XYZ Chrome Service with a program to understand their processes and wastes, identify options for reducing wastes, and determine the options that were technically and economically feasible to justify implementation.

Procedure
The process consisted of:

1) Planning and organization goal setting:
   Top management wanted to implement the ISO 14001 environmental management system into their existing management systems, using procedures and programs whenever possible and build on what they already had in place. They created an environmental policy statement that represented their performance commitments to their employees, customers and the public.

2) Assessment of the facility's operations and waste-streams, and identification of options to minimize waste:
   The company created a cross-functional team with process knowledge to determine the facility's significant environmental aspects, which are activities that either impact or could potentially impact the environment. After identifying all aspects they determined the impacts associated with each activity and reviewing legal requirements, they developed objectives and targets.

3) Evaluation of technical and feasibility analysis of the options selected:
   From the identified aspects they chose objectives they could control and developed targets. The targets are specific, have an established time frame and are measurable. Technological options available were also considered as were financial considerations. Action plans for achieving the objectives and targets were developed.

4) Implementation of procedures to establish and maintain the environmental management system:
   Created an environmental quality manual and environmental procedures, implemented and trained all personnel on the system. Performed internal audits to verify procedures were being followed.

Recommendations
CAMP's role was not to make recommendations, but assist XYZ in developing an environmental management system. During the implementation CAMP did assist in identifying possible aspects, related to energy, air, water, contamination of land, noise, staff and public.

Results
XYZ Chrome Service has successfully completed phase I of the registration process, June 13, 2005. Company received ISO14001 certification in July, 2005.

Pollution Prevention Benefits
1. Reduced pit waste water usage to approximately 10% for Plant #1 - Chrome line - Tank #8.

2. Reduced waste water usage at Nickel line by 100% by installing new evaporator system.
3. Reduced electrical energy use for Plant #2 by shutting down unused chrome plating lines when they are not required.
4. Reduced sludge waste disposal to landfill by 10%.

The indicated benefits by Hale Chrome staff were based on visual or estimated results since the EMS program had only been fully implemented for two months. Methods for measuring and recording their performance of specified activities have been developed, and are an input to their periodic management reviews. Full benefits realization probably will not occur until the system has been in place for at least one year. An environmental management system is a continual process.

APPENDIX-H
Assessment 8: Alternative Waste Disposal for an Aerospace Parts Manufacturer

Objective
TechSolve was hired to review a Cincinnati machining company's waste to determine if there were alternative methods to disposing of the waste.

Background
The company is an aerospace parts manufacturer that employs approximately 400 workers. Parts are manufactured utilizing a variety of technologies including Multi-axis EDM drilling; 5-axis percussion drilling, fusion welding, and cutting and trepanning; and advanced brazing technologies.

Waste streams that the company wanted to find alternative disposal methods for are listed in the table below.

Table H-1 Alternative Disposal Methods for Waste Streams

Waste stream	Description	Composition	Quantity generated	Proposed disposal alternative
Activator waste	Waste dust from preparation of aluminide coatings for jet engine turbine components	Ammonium hydrogen bifluoride	25 kg/3 months	Recycler
Alumina grit	Aluminum oxide grit material used for surface preparation	99.43% Al_2O_3	Unknown	Recycler
Chromium and aluminum powder in vacuum bags	Chromium-aluminum chunklets to coat jet engine turbine parts—residual dust	Aluminum 42-46% Chromium 54-58%	Unknown	Recycler
Computer and electronic equipment	Out-of-date computers, monitors, printers, etc.	Can contain lead and mercury	Unknown-periodic upgrade of office equipment	Recycler
Copper wire	Wire ends from machining process are collected	Copper	2 gaylords per month	Recycler

TechSolve reviewed the processes that generated the above waste to determine if there were any pollution prevention methods to reduce the waste at the source. The processes did not lend to

changes to reduce these wastes, so the next step was to determine if there were recyclers able to recycle these materials. The dusts that were generated in the first three waste streams listed were from new processes so little waste had been generated at the time of this report. Metal recyclers were identified for these materials and the company is currently investigating these options.

APPENDIX-I
Assessment 9: Development of ISO 14001 Program for a Silicone Wafer Processing Equipment Re-manufacturer

Objective
TechSolve was hired to assist a local Silicone wafer processing equipment re-manufacturer develop and implement an ISO 14001 program. The company already had ISO 9000 in place and was voluntarily electing to become ISO 14001 certified.

Procedure
As part of the project, TechSolve:

- Helped develop the aspect list;
- Proposed suggestions on the criteria for determining "significant aspect";
- Clarified the ISO 14001 requirements;
- Suggested means for completing elements of ISO 14001 including objectives and targets, responsibilities, training, communication, documentation, and operational controls;
- Conducted a gap analysis to determine level of conformance prior to registrar audit; and
- Provided general pollution prevention recommendations for wastes.

The aspect identification process was a real eye-opening experience for the company. The amount of waste being generated by the company was not put into perspective until the aspect list was generated.

As a result of the company's and TechSolve's efforts, the company received ISO 14001 certification. The registrar audit went smoothly and the company only had one recommendation from the auditor.

Recommendation
The recommendations for pollution prevention included:

- Investigation of alternative solder to eliminate the use of leaded solder,
- Developing a recycling program to include paper, plastic, aluminum, and other metals,
- Procedure for eliminating the acceptance of solvents and other cleaners from customers that the company must handle and dispose, and
- Use of green tip fluorescent lights.

At the conclusion of the project, the company had already implemented all but the lead solder removal. As part of the ISO 14001 program, the company will continue to explore new means for waste reduction.

APPENDIX-J
Assessment 10: Energy Assessment for a Stamping & Welding Company

Background
A facility-wide energy audit was conducted by EISC engineers with the assistance of University of Toledo graduate research assistants for a small metal auto-parts manufacturer at Wauseon, Ohio. This was the first step to identify savings and efficiency improvement opportunities. Stamping and welding are the two major processes at this operation with annual electrical charges of about $110,000.

The audit revealed opportunities for efficiency improvement in several areas including stamping press motors, air compressors, lighting and natural gas usage for comfort heating. Findings are summarized below.

Procedure

Motors

A detailed analysis comparing premium efficiency motors to rewound average efficiency motors was performed using DOE's MotorMaster. The general recommendation was to replace, instead of rewinding, the existing A.E. motors with P.E. motors on failure. 5 to 20 hp motors would provide a less than 2 year payback, larger motors would provide a less than 3 year payback.

Table J-1 Motor Analysis

HP/RPM/V	Efficiency (AE Motor)	Efficiency (PE Motor)	Motor Premium	Energy Savings	CO_2 Savings (lbs.)*	Annual Savings	Simple Payback
5/1800/230	83.0 %	90.2 %	$171	811 kWh		$122	1.4 yr
10/1800/230	85.7 %	91.8 %	$307	1316 kWh		$197	1.6 yr
15/1800/230	86.5 %	92.7 %	$510	1959 kWh		$294	1.7 yr
20/1800/230	88.3 %	93.3 %	$527	2029 kWh		$304	1.7 yr
25/1800/230	88.9 %	93.8 %	$891	2470 kWh		$370	2.4 yr
30/1800/230	89.2 %	93.9 %	$982	2815 kWh		$422	2.3 yr
40/1800/230	89.4 %	94.6 %	$1528	4081 kWh		$612	2.5 yr
50/1800/230	90.6 %	94.9 %	$1693	4145 kWh		$622	2.7 yr
Total				**19626**	**35326.8**	**$2,943**	

- 3000 hr/yr, 75% Duty @ Full Load, $0.15/kWh
- Motor efficiencies and average motor prices from MotorMaster database, 25% discount on list prices
- 1% efficiency loss due to rewinding
- Motor Premium is the difference between discounted PE motor cost and AE motor rewinding cost

Lighting

Existing Metal Halide Lighting

Sylvania 400 Watt Clear MetalArc Bulb
50 Watt Ballast + Lithonia Fixtures
Initial Lumens: 32,000 Mean Lumens: 20,500 Rated Life: 20,000 hr
CRI: 65 CCT: 4000 K Warm-up Time: 2-4 min Hot Restrike Time: 7-12 min

Table J-2 Lighting Analysis

Location	Number of 450W Fixtures	Hours/year	$/year @ 15 ¢/kWh
Stamping Room	36	4000	$9,720
Brake Press Room 1	8	4000	$2,160
Brake Press Room 2	18	4000	$4,860
Compressor & Press Room	11	4000	$2,970
Shipping Area	15	4000	$4,050
Sub-Total	88		$23,760
Weldshop	8	2000	$1,080
Laser Building	24	2000	$3,240
Sub-Total	32		$4,320
Total	120		$28,080
Total @ 90%			$25,270

- 2 shifts, 16 hr/day, 5 day/wk, 50 wk/yr = 4000 hr
- 1 shift, 8 hr/day, 5 day/wk, 50 wk/yr = 2000 hr

Multi-lamp Fluorescent Fixtures

- 4-lamp 32W 4’ T8 with one 4-lamp Ballast: 160 W, 11,000 lumens
- 6-lamp 32W 4’ T8 with one 4-lamp and one 2-lamp Ballast: 225 W, 17,000 lumens
- 2-lamp 54W 4’ T5HO with one 2-lamp Ballast: 120 W, 10,000 lumens
- 4-lamp 54W 4’ T5HO with one 4-lamp Ballast: 235 W, 19,000 lumens
- 6-lamp 54W 4’ T5HO with one 4-lamp and one 2-lamp Ballast: 350 W, 31,000 lumens

T8 and T5 Fluorescent Lamps

- 80+ CRI, 95% Lumen Maintenance, Instant On-Off, Electronic Ballast, Compatible with occupancy sensors,

Estimate of Energy Savings

- A 6-lamp 225 watt T8 or a 4-lamp 235 watt T5HO fixture can replace a 400 watt metal halide fixture on a one-to-one basis

Table J-3 Energy Saving Estimate for Lamps

Fixture	Number	Hr/yr	Energy Savings (kWh)	CO_2 Savings (lbs.)*	Savings ($/year @ 15 ¢/kWh)	Cost @ $150/fixture	Payback
225 W 6-lamp T8	88	4000	79200		$11,880	$13,200	1.1 yr
225 W 6-lamp T8	32	2000	14400		$2,160	$4,800	2.2 yr
Total			**93600**	**168480**	**$14,040**		

- Further savings can be achieved by strategic use of 2-lamp and 4-lamp T8 fixtures along with 6-lamp T8 fixtures

Compressed Air

Coolest Available Air for Compressor Intake

Whenever feasible, the intake for an air compressor should be run to the outside of the building, preferably on the north or coolest side. Since the average outdoor temperature is usually well below that in the compressor room, it normally pays to take in cool air from outdoors. The energy savings potential in lowering the air intake temperature results from the fact that colder air is more dense, and therefore a given pressure increase may be obtained with less reduction of volume of the air. This in turn means that the compressor does not need to work as hard to obtain the desired pressure.

Potential Savings

(Rutgers Office of Industrial Productivity and Energy Assessment)

1. Intake Air Temperature = 85 F
   Available Cool Air Temperature = 50 F
2. Fractional Reduction of Compressor Work = (85 - 50) / (85 + 460) = 6.4 %
3. Annual Electricity Usage by Hill Manufacturing's Kaeser 91 Air Compressor
   (75 hp, 4000 hr/yr, 75% duty, $0.15/kWh)
   = 168,000 kWh
   = $25,000 ($21,500 @ 85% of 168,000 kWh)
4. Potential Savings @ 6.4 % = $1600 ($1370 @ 85%)

Setback Thermostats for Laser Building

Summary

Annual Gas Cost (approximate): $7,000 (8000 ccf)
Potential Savings with Setback Thermostats: $2,250 (2400 ccf)
Capital & Installation Cost (4 to 6 Digital Thermostats): $1,000 to $1,500

Gas Usage Analysis:

2004 Jan-Dec Total Gas Cost = $7182.16
Usage = 8166 ccf

Average Gas Cost = $0.833 per ccf (2003-04 winter), $0.945 per ccf (2004-05 winter)

Climate Data:

Toledo Ohio Annual Heating Degree Days = 6579
http://www.climate-zone.com/climate/united-states/ohio/toledo/

Days/year with Average Temerature below 65 F = 220 days
(Assumed from Climate Data, October – April, 7+ months)

Calculations:

(Rutgers Office of Industrial Productivity and Energy Assessment)

1. Percent of weekly time when Laser Building not in operation assuming 50 hr/wk operation
   = (168 – 50) / 168 = 70 %
2. Average temperature difference between indoors and outdoors in winter with 70 F indoor temperature
   = Temp. Indoors – {65 – Heating Degree Days / Days below 65 F}
   = 70 F – {65 – 6579 / 220}
   = 35 F
3. Energy Savings in ccf assuming off hours setback to (70-15) = 55 F
   = Off Hours Temp. Reduction * % Off Hours * Annual ccf Usage / In-Out Temp. Difference
   = 15 F * 70 % * 8000 ccf / 35 F
   = 2400 ccf
4. Annual Savings = 2400 ccf * $0.945 / ccf = $2,270
5. Approx. Cost of Digital Seven Day Programmable Setback Thermostat = $200
   (Approx. Cost of Analog Thermostat = $100)
   Installation Cost = $50 per thermostat)
   Required Digital Thermostats = 4 to 6
   Implementation Cost = $1000 to $1500
   Simple Payback = 6 to 8 months (One winter season)

APPENDIX-K

Assessment 11: Greenhouse Energy Efficiency Improvements for a Retail and Wholesale Producer of Nursery and Landscape products at Sandusky, Ohio

Objective

A retail and wholesale producer of nursery and landscape products at Sandusky, Ohio intends to improve the energy efficiency, E2, of their overall greenhouse operations by construction of a new greenhouse to replace their most inefficient and oldest greenhouses at their Sandusky site. An existing traditional greenhouse constructed in the 1940's of steel, wood and small single glazed glass panels will be demolished and replaced with a new modern galvanized steel and polyethylene unit. The existing unit is about 19,800 square feet of floor area and the new unit will be about the same size.

Benefits of the Project

The new greenhouse will better utilize solar energy, thermal insulation, seal co

nstruction techniques to reduce air leakage, improved natural ventilation and incorporate a higher efficiency heating system. It is to be constructed with energy efficient features such as double polyethylene glazing for the roof, double wall acrylic walls facing south and east and a hot water floor heating system.

The existing steam boiler heating system is also used to heat a portion of another small glass greenhouse. The existing steam boiler heating system is to be removed and an energy efficient hot water finned tube will be installed in this small glass greenhouse.

The construction and equipment costs directly associated with the energy efficiency features of this greenhouse project are $300,000 and the grant amount requested is 25% or $75,000. The actual energy efficiency related project costs exceed this value but the lower value has been selected for this grant application. The total project budget including non energy efficiency related work is $855,059.

The goal of this project is to have a modern, attractive greenhouse facility with energy efficiency improvement components that reduce energy consumption and improve the output of product line of value added plants. The major tasks include demolition and removal of the existing greenhouse structure and related equipment, construction of a new greenhouse and installation of the equipment and electrical components that comprise the system of energy efficient features.

The summarized E2 features for this greenhouse project are as follows:

1. Double polyethylene glazing covering the roof replacing single layer glass glazing reducing heat loss due to conduction by about 50%.
2. Tight construction with double poly glazing and a tight structure reducing air infiltration related heat losses by about 50%
3. Double acrylic wall replacing glass wall (east and south)
4. Perimeter insulation at the knee wall and floor level
5. Heating system
6. Ridge opening ventilation to allow trapped warm weather solar heat to escape the greenhouse by natural ventilation. This ridge ventilation feature allows the warm weather electric vent fans to be eliminated from this new greenhouse.
7. Vented south and east wall features

8. Sliding shade curtain
9. Greenhouse peak orientation is being changed from east west to a north south orientation to allow better collection of solar energy to be utilized to heat the greenhouse space during daytime cold weather periods.
10. Improved solar light and less blockage to the growing plants due to large wooden structural members being replaced with slimmer galvanized steel. Dispersion and light scattering features
11. East and west heating zones to allow differential temperature zones. West can continue to grow and operate at 65^{o}F while the east portion controlled at 50^{o}F. Requires east west zone temperature control
12. Computer control
13. Maintenance
14. Improved plant growing productivity due to less aisles, better access, improved growing environment control, plant exposure to improved solar light, hanging plants
15. Convection heating units for non-routine cold weather heating (back-up units for extremely cold days, snow or ice build-up melt on roof, etc.)

Energy Efficiency Related Savings

An energy audit was conducted by EISC engineers on the greenhouse and related equipment that is to be replaced. The existing structures, operations, equipment and the electric and gas usage based on utility bill information were reviewed to establish the baseline energy related costs.

The $26,000 energy savings identified in the table below is a calculated value and is based on a detailed spreadsheet modeling of greenhouse heat loss and gain.

The other savings listed below are estimates based on projections. These are conservative estimates of the expected savings related to the features identified.

The improved productivity per unit of energy is listed below as $20,000 per year. We expect that this value may be very conservative and the actual productivity improvements per unit of energy will be considerably higher. The new greenhouse, for example, will accommodate the growth of 1000 additional hanging baskets per year with an increase in productivity of more than $20,000 per year with no additional increase in energy compared to the projected energy consumption. For the purposes of this grant application, a conservative value of $20,000 was selected because more accurate projections are difficult to calculate.

Table K-1 Energy Efficiency Related Savings

Greenhouse E2 Features	Expected E2 Annual $ Savings
1. Double poly glazing 2. Tight construction, reduced ACH 3. Double acrylic wall, south & east 4. Perimeter insulation 5. Heating system	Current Nat Gas = $44,000 Projected Nat Gas = $18,000 Calculated Savings = $26,000
6. Ridge vent opening, reduced vent fans	Reduced electric = $1,000

7. Vented south and east wall features	
8. Sliding shade curtain	Included in $26,000 savings above
9. Greenhouse peak orientation 10. Improved solar light	Improved light capture = $1,000
11. East & west heating zones, vertical curtain	
12. Computer control	Reduced energy usage = $1,000
13. Maintenance of the boiler system related to water usage, chemical treatment and replacement parts for the system such as steam condensate traps, valves, seals, etc.	Reduced boiler maint. = $2,000
14. Improved plant growing productivity and output per unit of energy usage	Improved productivity = $2,000
15. Convection heaters	No energy impact change = 0
Total Projected Energy Cost Related Savings	**=$51,000**

APPENDIX-L
Assessment 12: Greenhouse Energy Efficiency Improvements for Greenhouse Vegetable Grower at Milan, Ohio

Objective
The goal of this project at a greenhouse vegetable grower in Milan, Ohio is to replace four old growing greenhouses plus one central utility greenhouse with more energy efficient and productive greenhouses. The existing greenhouses will be removed and new greenhouses of approximately the same size and in the same location will be constructed. The entire greenhouse facility consists of about 30 separate greenhouse units and several open farm fields used during the growing season.

Background
The existing four growing greenhouses were constructed in the 1980's. Although the construction and equipment are reasonably energy efficient, the layout of the greenhouse and arrangement of the equipment can be substantially improved. A new layout and equipment features will significantly reduce the amount of energy required per unit of production by substantially increasing the production output of the greenhouses while actually decreasing the amount of energy required for operation of these four greenhouse units. This will result in substantially lower energy usage per unit of production output compared to the production output per unit of energy from the existing greenhouses.

The greenhouse facility produces more than 600 specialty vegetables, micro greens and herbs that are shipped overnight to top chefs across the nation as well as oversees throughout the entire year. Production during the cold months is especially important for the operation and is the prime reason to upgrade the existing greenhouses. Faced with increasing energy costs, the farm would like to incorporate energy efficiency features into their greenhouse operations.

A portion of the energy efficiency gains will be accomplished by reducing the cold weather heat losses and improving the overall efficiency of the heating system. The most significant energy efficiency gains will also be accomplished by better utilization of the growing space and environment for the vegetables inside the greenhouses. All of the greenhouse equipment being installed is readily and commercially available.

Summary of Energy Audit Review

An energy audit was conducted by EISC engineers on the greenhouse and related equipment that is to be replaced. The existing structures, operations, equipment and the electric and gas usage based on utility bill information were reviewed to establish the baseline energy related costs.

The existing four greenhouses to be replaced are in good to fair condition. For the calculations the air changes per hour was estimated at 2 ACHs. The U insulation factor for the existing double poly was estimated at 0.75 BTUs/hour-square feet-^{o}F. The transmittance of the double poly was estimated at 0.7 factor. The overall energy efficiency of the heating system was estimated at 70%. Based on these values and the propane gas invoices for the past year, the corrected annual energy usage was calculated at $50,860 / year.

For the new, replacement greenhouse calculations the air changes per hour was estimated at 1 ACHs. The U insulation factor for the existing double poly was estimated at 0.5 BTUs/hour-square feet-^{o}F. The transmittance of the double poly was estimated at 0.8 factor. The overall energy efficiency of the heating system was estimated at 85%. Based on these values and the

propane gas invoices for the past year, the corrected annual energy usage was calculated at $26,287 / year.

So just considering energy usage, the value of energy used for the existing greenhouses is $50,860 compared to the projected value of energy (propane) used for the new greenhouses of $26,287 which is a savings of $24,573 per year.

A very significant energy efficiency impact to be realized by this greenhouse replacement project is the energy efficiency improvements simply due to the new layout configuration of the new greenhouses. The new layout configuration will allow better utilization of the growing space. The effective growing floor space of the existing four greenhouses is 11,123 square feet and the effective growing floor space of the new greenhouses will be 13,133. The new greenhouse will allow a better space utilization estimated at 95% of the gross floor space. Using the current turns per year ratio of 7.4, the new layout will allow an improvement of productivity from $470,344 per year to a value of $555,330 per year which is an improvement of $85,000 per year.

The new greenhouse layout configuration and equipment will also allow an increased productivity per unit energy. Improved air circulation around the plants, improved shade management by the use of a sliding horizontal shade curtain and improved worker access to the plants for improved ease of work will be realized.

It is estimated that improved air circulation will improve production output per unit of energy 7% or $32,925. Also, it is estimated that improved temperature control due to the shade curtain will improve production output per unit of energy by 2% or $9,407 per year. Also, it is estimated that improved worker access and ease of work will improve production output per unit of energy by 3% or $14,111. The combined increase in productivity per unit of energy for these changes is estimated at $56,440 per year.

The total improvement in energy efficiency related value for this project is as follows:

- Reduced propane usage – improved systems $ 24,573 per year
- Improved output / unit energy – new layout $ 85,000 per year
- Improved output / unit energy – ease of work $ 56,440 per year

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- Total value of E2 related improvements $166,013 per year

The total project related costs are estimated to be $363,344 of which $218,344 are directly related to energy efficiency improvements. A simple return on investment payback calculation of $218,344 divided by $166,013 equals 1.3 years simple payback.

Other benefits including other financial benefits are also expected to be realized but since they are not energy efficiency related benefits, they are not included in these calculations. The other benefits to be realized are product and company marketing benefits, improved development of new products and other benefits not related to energy efficiency.

APPENDIX M
Assessment 13: ISO 14001 Assistance for an Ohio Rubber Products Manufacturer

TechSolve assisted a synthetic rubber manufacturer with development and implementation of an ISO 14001 system. The medium-sized company located in east-central Ohio manufactures specialty rubber stripping for the automotive and other industries. The company was approved for registration on 1/20/06.

As a result of the ISO program, the company has initiated a paper, aluminum can, and plastic recycling program. A cardboard recycling program has also been initiated. To reduce the scrap generation from their rubber strip manufacturing operations, the company has implemented TS 16949 to improve the quality and make product right the first time. The scrap product that cannot be avoided was being landfilled. TechSolve assisted the company in identifying a recycling company from Michigan that will accept their mixed rubber waste. Other pollution prevention projects the company will be working on are the reduction of dusting from their manufacturing operations. This is both an environmental and safety issue. The company is also examining either product substitution or modified equipment to reduce the use and disposal of a curing salt.

Table M-1: Summary of Projects Identified

Type of Waste	Quantity Waste Generated Annually, lb	P2 Suggestions	Status
Lead in rubber (approximately 0.05% lead)	50,000	1) Revisit formulation to find an alternative catalyst; 2) Maintain quality program to minimize scrap generation	Working on finding an alternate catalyst. Anticipating on reducing scrap rubber by 10%.
Salt—nitrate/nitrite compounds	10,000	1) Identifying reason for waste generation; 2) Examining other technologies for curing rubber	In progress. Anticipating on reducing salt waste by 50%.
Organic peroxide	NA	Reviewing need to change waste handling procedures for containers	Complete
Silica dust	NA	Reviewing silica handling methods to minimize dusting	In progress
Silicone dust	NA	Reviewing formulation to minimize dusting	In progress

In addition to the ISO program, the company is now pursuing energy efficiency. TechSolve is to conduct the Envinta energy diagnostic to determine the best energy management practices the company should employ.

APPENDIX N
Assessment 14: ISO 14001 Assistance for an Ohio Solenoid Manufacturer

TechSolve was contracted by an Ohio solenoid manufacturer to assist in the implementation of an ISO 14001 program. The company has approximately 310 employees and was mandated by their customer, Eaton Corporation, to become certified to the ISO 14001 standard.

In addition to the ISO 14001 program, TechSolve utilized the PPIS Tool MSDS manager to help the company organize its MSDSs for easier access. The company is continuing to work with TechSolve to implement P2 and safety projects as a result of ISO. The company needed to eliminate lead from its non-military applications because of the European requirement, Restriction of Hazardous Substances (RoHS). TechSolve used its company network to contact another company that had already gone through this process so that lessons learned could be shared to expedite the client's lead removal. As a result of this effort, the client was able to minimize the amount of lead waste generated.

Table N-1: Summary of Projects Identified

Type of Waste	Quantity Waste Generated Annually, lb	P2 Suggestions	Status
Lead	500	Remove lead from products per RoHS	Complete. 95% of lead eliminated
Cleaning Solvents	8,000	Reduce usage through better monitoring of use	In progress. Anticipated 10% reduction
Paint waste	2,000	Ensure all painting employees are aware of procedures	Complete
Stormwater	NA	Monitor and manage outdoor activities to minimize impact and provide employee awareness	Complete
Methyl Ethyl Ketone	100	Eliminate use of solvent through product substitution	In progress. Anticipated 100% reduction

APPENDIX O
Assessment 15: Energy Assistance for an Ohio Aluminum Caster

TechSolve conducted an energy diagnostic under the Ohio Department of Development's Envinta program. As a result of this diagnostic, TechSolve and a contractor assisted the company to obtain a new melter and holding furnace.

Implementation of new stack melter and crucible holding furnace was recommended based on the technical audit. Potential savings of $235,000 are estimated from these two projects with a payback of 1.66 years after the State of Ohio grant of $50,000. The existing melter has a measured energy usage of 2,419 Btu/lb. The new melter is rated at 1,100 Btu/lb total with the projected resultant savings of 55% or 22,800 MMBtu per year natural gas. The company has installed the new furnace and is currently verifying the savings.

APPENDIX P
Assessment 16: Management of Hazardous Chemicals

EISC provides assistance to the staff in developing improved methods to manage hazardous chemicals used in production and stored at this facility X. The work is primarily with the Environmental Manager and the work extends to maintenance and production staff, student interns as well as the management staff. The environmental issues to be reviewed are spill prevention, proper storage and handling and response plans to manage other potential environmental conditions. Work is in progress.

APPENDIX Q

Assessment 17: Energy Assistance for an Ohio Coining Company

TechSolve was hired by a company located in Cincinnati, Ohio to conduct an energy diagnostic under the Ohio Department of Development's Envinta program. Following the diagnostic, TechSolve and a local energy consultant were contracted to develop an energy management plan and do a technical audit.

For the coining company, the two consultants identified the following energy saving measures:

1) Optimizing the compressed air system
2) Adding programmable thermostats to the HVAC system for night set back
3) Installing a high efficiency hot water boiler for heating

By implementing these projects, the company is expected to reduce their electric consumption by approximately 50,000 kwh per year resulting in 90,000 lbs/year of reduction in CO_2 emissions. In addition to these energy saving projects, TechSolve developed a management plan to sustain energy awareness and savings activities. Through these efforts, the company is expected to save between $18 and $27 K or between 17 and 25 percent of their energy expenditure. The company is preparing to implement these changes.

APPENDIX R

Assessment 18: Energy Assistance for a Heat Treater

TechSolve was hired by a company located in Cincinnati, Ohio to conduct an energy diagnostic under the Ohio Department of Development's Envinta program. Following the diagnostic, TechSolve and a local energy consultant were contracted to develop an energy management plan and do a technical audit.

The second local company, a steel heat treater, underwent the same diagnostic and energy management plan development. This company had approximately $700,000 in annual energy costs. Projected savings of $40,000 to $80,000 were identified in these areas:

1) Develop and implement an electric demand management strategy
2) Relocate compressors
3) Install variable speed drives for oil agitators

The company is projected to save approximately 98,000 kwh (176400 lbs/year reduction in CO_2 emissions) per year in electricity consumption by implementing these changes. The company is currently preparing to make these changes.

APPENDIX S
Assessment 19: ISO 14001 Assistance for an Ohio Solder Manufacturer

TechSolve was contracted by a solder manufacturer to help them with ISO 14001 implementation. Safety was incorporated into the program at company request. In addition to the traditional P2 projects that were recommended, TechSolve also conducted process hazards analysis to identify any safety-related issues for the processes identified as potential or actual generating the most significant waste. This program is currently being implemented, but the following recommendations were identified:

Table S-1: Summary of Projects Identified

Type of Waste	Quantity Generated Annually, lb	P2 Suggestions	Status
Casting system fume	Unknown	Place the dust collection units on PM schedule to ensure proper operation	In progress
Acid bath	Unknown	Better ventilation	In progress
Metal storage	Unknown	Improved storage and housekeeping	In progress

APPENDIX T
Assessment 20: Improved Material Handling Practices

EISC is working on Improved Material Handling Practices at a mid size injection molding company with a goal of preventing oil from entering the sewer system in the plant from October 2005 through current. This company had in place a mature ISO 14000 EMS but was still encountering some pollution problems in their oil water separator system. EISC participated in a meeting with the plant pollution prevention team to identify the causes of the spillage and develop practices to prevent the spills from polluting the water discharged to the sewer system and the existing oil water separator. Based on the investigation, the source of the oil appeared to be used machine lubricating oil coming from poor handling practices in the maintenance department. Procedures to eliminate these poor practices were developed and implemented.

As part of this project, the operation and effectiveness of the existing oil water separator was investigated and it was determined that is was operating effectively according to the design specifications. In order to determine if the revised work practices in the plant were effective, the installation of an oil skimmer on the oil water separator was investigated. It was determined that an oil skimmer would provide the staff with feedback necessary to properly address this situation on an ongoing basis. A skimmer is in the process of being installed and the oil skimmed will be monitored for quantity and type in order to help determine the source of the oil. The oil skimmer will be a tool utilized to assist in determining how to prevent oil spills and leaks at this plant.

The appropriate sections of the ISO 14000 EMS are being modified to incorporate these improved practices and procedures. The project is in progress.

APPENDIX U
Assessment 21: Waste Reduction at the Ketchup Factory

EISC is working with a ketchup company in Freemont area. They want us to find ways to reduce the waste of ketchup while cleaning the pipes at night time. Significant amount of ketchup goes to sewer system. EISC and UT staff met with the plant manager and reviewed the drawings. The efforts will be focused on determining the amount of ketchup that could be saved and used next day. Initial estimates are that over 30% could be diverted from the waste stream and used in producing the product.

APPENDIX V
Assessment 22: Waste Reduction at the Turkey Factory

EISC is with a turkey farm to reduce waste. UT students received data about the load, suction, discharge, oil, inlet temperature, discharge temp, suction temp and compressed air for various compressors. The data were entered into an excel sheet for analysis. The missing data points were linearly interpolate. Individual regression of load versus various parameters was done to obtain a relation between them. But since the relation for all the parameters could not be obtained a multiple regression analysis was performed. The graphs showing the variations of each parameter for a particular month were drawn. Motor data are being analyzed.

APPENDIX W
Assessment 23: ISO 14001 Assistance for a Metal Company

TechSolve was hired by a local surface finishing company to assist with improvement of their existing ISO 14001 program to the 2004 Standard and to conduct a pollution prevention assessment:

1) TechSolve was able to identify several new aspects that were missed during the original list generation. In addition, several improvements for compliance, communications, and competence and training were provided;
2) The policy statement was not posted for public view;
3) The scope of the environmental management system (EMS) was not clearly defined;
4) Legal and other requirements were not being reviewed for changes;
5) Contractors were not informed of the EMS and the competence of these contractors was not demonstrated; and
6) No method for receiving and handling external communication was provided.

TechSolve's pollution prevention assessment focused on the elimination of chemicals that were harmful to the environment and to the employees.

1) The company was encouraged to switch from using methyl ethyl ketone as a metal cleaner and to switch to a detergent or alcohol instead to eliminate the 100 pounds of this solvent used annually for hand-cleaning parts;
2) Approximately 50 pounds of lead in a product was found on the premises. The company had planned to remove the unused lead product;
3) The company had an unused mercury thermostat. TechSolve instructed the company on how to store the thermostat and provided the contact from Ohio EPA to pick up and properly recover this material; and
4) TechSolve also encouraged the company to develop a chemical review program so that material properties on the MSDSs are examined prior to their purchase to determine if a less hazardous material can be used.

Appendix-X

Assessment 24: Pollution Prevention/Energy Assessment for a Local City

TechSolve conducted a site walkthrough of a local city's City Hall, Service and Safety facilities. The city was founded in 1795, is located near Cincinnati, and has 60 full-time employees. The following discussion provides current practices and recommendations for waste reduction/best practices.

City Hall

The primary wastes generated from this facility are office-type wastes. Information on the type of wastes generated at this facility was provided. The wastes generated include:

1) Mixed office paper-recycled
2) Used toner-recycled
3) Used electronics-recycled/auction
4) Cardboard-recycled
5) Fluorescent lights--disposed

Recommendations:

One waste that could be reduced is office paper use by:

- Double-siding copies whenever possible;
- Using unneeded paper as scratch paper;
- Utilizing electronic correspondence whenever possible; and
- Electronic storage of drawings (environmental group reviewing option)

The City's facility can improve its energy efficiency through:

- Continued purchase of Energy Star appliances and other office equipment;
- Policy and posted reminders to turn off lights and computers when not in use;
- Placing copiers and printers in sleep mode when not in use;
- Occupancy sensors to reduce lighting costs; and
- Use of green tip fluorescent lights which contain less mercury.

Safety Facility

The Safety Facility houses the police and fire departments and the training room and Mayor's Court. Information on the type of wastes generated at the facility was obtained from facility personnel. The wastes generated at the facility include:

1) Office-type wastes-recycled
2) Batteries—recycled
3) Infectious waste-provided to Bethesda North Hospital
4) Used electronic equipment—recycled
5) Fluorescent lights-disposed

Recommendations:
The Safety facility could also reduce its paper consumption as described for City Hall. Because the facility operates 24 hours per day, the recommendations for turning off lights and computers do not apply. Purchase rechargeable batteries whenever possible to minimize battery waste.

Service Building

The Service Building houses the repair facilities and landscape/road treatment supplies. Information on the type of wastes generated at this facility was obtained. The facility generates the following wastes:

1) Used oil—recycled
2) Batteries—recycled
3) Antifreeze—recycled/reused
4) Freons—recycled
5) Salt storage—covered
6) Safety Kleen solvent bath—recycled
7) Used oil-recycled
8) Used oil filters-dispose
9) Fluorescent lights—disposed
10) Tires-recycle
11) Batteries-recycle
12) Metals-recycled
13) Grease pit residue—cleaned and disposed every year or so
14) Absorbent—disposed
15) Aerosol cans—emptied and disposed

Recommendations:

1) The facility has a floor drain that runs down the length of the building that flows to a grease pit, which is cleaned of sludge every year. Oil and other spills are cleaned up using a "kitty litter" type material. The facility needs to periodically reinforce the need for good housekeeping and spill prevention through use of catch pans so as to not have vehicle fluids discharged to the floor drain.
2) Investigate the replacement of overhead T-12 fluorescent lights with the more energy efficient T-8 lights. The need for the overhead lights on bright, sunny days should be considered since the facility also has natural lighting options. Apply task lighting through use of small lamps for tasks that require extra lighting and fine work.
3) Continue to ensure aerosol cans are emptied prior to disposal to avoid the generation of a hazardous waste.

City Energy Management Diagnostic

An Energy Management diagnostic was conducted to determine the current state of energy management practices for government buildings managed by the City. The diagnostic report attached provides 5 recommended action items for immediate attention:

1) Understanding opportunities through conduct of a technical audit to identify areas for energy improvement;

2) Energy supply evaluation for best cost
3) Awareness and Training—general awareness training with employees and more extensive training for operations and maintenance staff;
4) Targets and key performance indicators for energy reduction; and
5) Energy trending to determine any problems that may arise.

Additional energy management activities are planned through the Ohio Department of Development's energy program. ODOD offers grant and loan funds to conduct a technical audit and development of a management plan. The anticipated savings for the city are 63,000 kwh per year and $6,800.

APPENDIX Y

Table Y-1: Pollution Prevention Assessment Outcomes

No.	Assessment	Center	Hazardous Material	Waste Water	Solid	Annual Energy Savings kWh/year and $	Water	CO_2 Reduction (lbs)	Clients developing EMS
1	Waste water recycling at turkey plant	EISC	N/A	Potential 50-70% of waste water recycling	N/A	N/A	N/A	N/A	
2	Electrical energy efficiency assessment	EISC	N/A	N/A	N/A	--- kWh/year and $ 66,947	N/A	Not Quantified	
3	Waste reduction opportunities for a doughnut corporation	TechSolve	N/A	Not Quantified	Not Quantified	N/A	Not Quantified	N/A	Yes
4	ISO 14001 implementation for Transmission parts supplier	TechSolve	Not Quantified	N/A	Not Quantified	N/A	N/A	N/A	Yes
5	Energy Assessment	EWI	N/A	N/A	N/A		N/A	4,733,677	

	for plastic and resin manufacturer					2,823,380 kWh/ year and $ 134,834			
6	Energy assessment for a company manufacturing magnet products	EWI	N/A	N/A	N/A	1,180,960 kWh/year and $ 41,919	N/A	2,716,208	
7	Development of ISO14001 EMS and P2	CAMP	Not Quantified	Not Quantified	Not Quantified	Not Quantified	N/A	Not Quantified	Yes
8	Alternative waste disposal for Aerospace parts manufacturer	TechSolve	Not Quantified	N/A	Not Quantified	N/A	N/A	N/A	Yes
9	ISO 14001 for a silicone wafer processing equipment re-manufacturer	TechSolve	100% Elimination of leaded solder	N/A	N/A	N/A	N/A	N/A	Yes
10	Energy assessment for a stamping and welding company	EISC	N/A	N/A	N/A	281,226 kWh/year and $20,833	N/A	203, 806	
11	Green house efficiency improvement for a producer of nursery and	EISC	N/A	N/A	N/A	$51,000 (Electric and Gas savings not	N/A	Not Quantified	

	landscape products					quantified)			
12	Green house efficiency improvement for a vegetable grower	EISC	N/A	N/A	N/A	$166,013 (Electric and Gas savings not quantified)		Not Quantified	
13	ISO 14001 assistance for rubber products manufacturer	TechSolve	Not Quantified	N/A	Not Quantified	N/A	N/A	N/A	Yes
14	ISO 14001 assistance for Ohio solenoid manufacturer	TechSolve	Reduction in 475 lbs/year of lead	N/A	Not Quantified	N/A	N/A	N/A	Yes
15	Energy assistance for an Ohio aluminum caster	TechSolve	N/A	N/A	N/A	Estimated 22, 800 MMBtu per year of natural gas	N/A	Not Quantified	
16	Hazardous waste management	EISC	In Progress	N/A	N/A	N/A	N/A	N/A	
17	Energy assistance for Ohio coining company	TechSolve	N/A	N/A	N/A	50,000 kWh/year and $27,000	N/A	90,000	
18	Energy assistance for a heat treater	TechSolve	N/A	N/A	N/A	98,000 kWh/year and $ 80,000	N/A	176,400	
19	ISO 14001 assistance for Ohio solder manufacturer	TechSolve	In Progress	N/A	N/A	N/A	N/A	N/A	Yes
20	Spill prevention	EISC	N/A	In Progress	N/A	N/A	N/A	N/A	

	for an injection molding company								
21	Waste reduction at a ketchup factory	EISC	N/A	In Progress	N/A	N/A	N/A	N/A	
22	Energy reduction at a Turkey factory	EISC	N/A	N/A	N/A	In Progress	N/A	N/A	
23	ISO 14001 assistance for a metal company	EISC	In Progress	N/A	N/A	N/A	N/A	N/A	