Green Manufacturing Initiative
Annual Report

December 31, 2012

www.wmich.edu/mfe/mrc/greenmanufacturing

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Introduction

The Manufacturing Research Center at Western Michigan University (WMU) received nearly $1 million from the U.S. Department of Energy in 2009 to establish and develop a Green Manufacturing Initiative (GMI). The initiative provides a conduit between the university and industry to facilitate cooperative research programs of mutual interest to support green (sustainable) goals and efforts. Greening manufacturing operations have never been more necessary. In addition to the operational savings that greener practices can bring, emerging market demands and governmental regulations are making the move to sustainable manufacturing a necessity for success.

The funding supported collaborative activities among universities such as the University of Michigan, Michigan State University and Purdue University and among 40 companies to enhance economic and workforce development and provide the potential of technology transfer. WMU participants in the GMI activities included 20 faculty, over 25 students and many staff from across the College of Engineering and Applied Sciences; the College of Arts and Sciences' departments of Chemistry, Physics, Biology and Geology; the College of Business; the Environmental Research Institute; and the Environmental Studies Program. Many outside organizations also contributed to GMI's success, including Southwest Michigan First; The Right Place of Grand Rapids, MI; Michigan Department of Environmental Quality; the Michigan Department of Energy, Labor and Economic Growth; and the Michigan Manufacturers Technical Center.

Two key areas of focus have been advancing the use of environmentally friendly materials to include designs, products and manufacturing processes (i.e. green engineering) and energy. An emphasis has been placed on smaller companies that lack technical expertise to deal with new 'green" materials and processes to achieve environmental and energy benefits. A "green scoreboard" that tracks the investments and savings from our various projects can be found on our website (see link below).

In parallel with the Department of Energy funding, a Green Manufacturing Industrial Consortium was established in 2009 to integrate industries into GMI providing collaboration with industry to develop strategies, procedures, and systems to achieve economically feasible, environmentally benign, and energy efficient materials, designs and manufacturing processes. The Green Manufacturing Industrial Consortium, or GMIC, provides a non-competitive/pre-competitive environment specifically for this purpose. GMIC meetings provide a forum for open discussion between GMIC members to discuss joint project ideas. The founding members are Fabri-Kal, Landscape Forms, Post Foods LLC, Polywood Inc. and Steelcase.

In this final report are listed the many activities that were conducted under the GMI and GMIC. If you have questions or would like more information regarding a project please visit www.wmich.edu/mfe/mrc/greenmanufacturing or contact Carey Schoolmaster, Green Manufacturing Initiative, Program Coordinator, at carey.schoolmaster@wmich.edu.

Projects

Energy

Oven Seal

A large contribution to the energy intensity required to make a product comes from process heating, and specifically from driers. In continuous ovens, there are no opportunities to close oven doors to contain the escaping heat. Few solutions have been explored, and most of those that have been explored have not included an analytical approach to quantify improvements in energy consumption. Oven door seals, such as blowers that push hot air back into the oven, have been implemented with results that show improved temperature profiles and reduced oven energy usage. For this project a computational fluid dynamics (CFD) model was designed to simulate the air velocity and temperature profiles in continuous ovens. The oven seals were modeled, and a performance comparison made to determine the effectiveness of the seals. Extensive work has gone into the experimental testing for this project. Particle image velocimetry was utilized for accurate determination of CFD boundary conditions. Additionally, results of computational simulations were validated with various experimental techniques.

Link to: Oven Seal

Harmonics and Transformers

In-depth measurements were conducted, and data compiled on four laser machines. The team successfully completed all of its objectives and made recommendations for improvements in each subject area.

The team's objectives were to identify harmonics generated by the lasers and the effects of the harmonics on the electrical distribution system at the Rapid-Line facility and find power losses due to harmonics and voltage regulation. We also identified current in the neutral and reviewed all the laser panels and the number of transformers in order to identify power losses from the transformers and the feasibility of replacing the transformers with one transformer since all the lasers and their attached chillers operate at the same voltage. We then examined the power factor and performed an analysis of the voltage and current waveforms on the laser and chiller machines

Solar Powered Trash Compactor

In December 2010, SP-Industries approached GMI in hopes of utilizing our expertise in creating a solar powered waste compactor. The project began with a meeting in which the specifications, initial assumptions and load requirements were discussed. Further research into the project allowed students Gary Nola and Nathan Christensen to create an easy-to-use data sheet in which the energy requirements for the compactor could be calculated, based on peak sun hours per day, solar panel

capacity and the number of desired compactor cycles per day. The project ended with a report delivered to SP-Industries that included the previously described data sheet program, several small-scale renewable energy devices (solar and wind) suitable for the job and a brief analysis of the feasibility of implementing the project in areas throughout the country.

Link to: Solar Powered Trash Compactor

Electric Vehicle Battery - Wind Energy Storage System

The proposed concept utilizes the electric vehicle (EV) battery waste stream as a means to store wind energy to increase wind energy capacity factor, improve utilization and make more efficient use of EV batteries prior to recycling. Michigan is an ideal location for such a facility because many of the battery and automotive manufacturers are located here. By 2015, a 200-MW wind farm will be able to charge a battery farm that consists of all reject and post-consumer batteries and all EVs located in Michigan. The state is on track to meet its goal of having 10 percent of Michigan's energy needs come from renewable energy by 2015, with more than 1,100 MW of planned new wind projects to be installed by then. Therefore, the state will have soon sufficient wind capacity to charge an EV battery-wind storage facility as well as all of Michigan's consumer EVs.

As the electrical demand throughout the developed and developing world increases, alternative sources of additional energy are currently undergoing research, experimentation, and development. Among the current technologies available today, harnessing energy from the wind is proving to yield some of the most significant results. Harnessing wind energy does pose a few challenges to overcome. One such challenge with utilizing wind energy on a utility grade scale is the inability to adequately control wind availability. Wind energy production could easily occur during off peak hours when the additional energy is less valuable due to lower grid demand. Nearly all of the electricity currently produced by wind turbines cannot be stored and must be used immediately if demand is present.

The proposed concept is a means to store wind energy in electric vehicle (EV) batteries after they have degraded past their usable life in consumer vehicles, extending the life cycle of the batteries. With the recent excitement surrounding EVs, a surplus of post-consumer batteries and reject batteries is expected a few years down the road. The batteries would be utilized to store electricity during off-peak demand periods and redistribute to the grid during on-peak demand periods for grid stabilization. Based on the Michigan Renewable Portfolio Standard of 10% electricity generation from renewable sources by 2015, Michigan will have an adequate amount of wind capacity to charge the EV battery wind storage facility and meet all of Michigan’s 2015 consumer EV requirements.

Link to: Wind Energy Storage System

Waste to Energy

Tons of plastic is sent to landfills each year because it is considered contaminated and therefore can’t be easily or readily recycled. This is a waste of material and money since much of that plastic can be

converted back into fuel, or other useful products. Plastic-to-fuel conversion is important not only because it reduces the amount of plastic that goes to landfills but also because it can be an energy source, making manufacturing plants more energy efficient. Much of the plastic that can't be recycled due to contamination can be converted into fuel/energy through depolymerization and pyrolysis. One of the main restraints of pyrolysis becoming more commercial is that pyrolysis isn't considered recycling. Consequently, pyrolysis is ineligible for recycling grants, although it might still be eligible for other tax credits and grants for facilities using this method of converting plastics to fuel that are built in rural areas. Pyrolysis plants at commercial scale have promising economic results that may solve future problems, such as scarce landfill space and lack of energy sources. In addition to the general study conducted during this project, the current state of the technologies and processes involved were studied and combustion energy tests were conducted on specific materials at our industrial partners' requests.

Link to: Waste to Energy

Rapid Line Air Compressor Leaks

At the Rapid Line facility, Gary Nola and Trevor Williams used the Ultra Probe to test air leaks around the facility. They entered the data they collected into a computer program to calculate a dollar amount for how much the 12 leaks they found were costing Rapid Line. The program took into account the company's hours of operation and the price it pays per kilowatt-hour to heat its facility.

The study resulted in two major findings. First, under low production, the leaks cost the operation $4,022.33 per year, due to the loss of 43,248 cubic feet of air at a rate of 42.4 cubic feet per minute and secondly, during high production times the leaks cost the operation $5,885.46 per year, due to the loss of 50, 880 cubic feet of air at a rate of 42.4 cubic feet per minute.

Energy Center

A West Michigan company has an energy center located directly next to its main manufacturing facility. The energy center burns waste wood to produce process steam and also supplies compressed air to the facility. Originally, the energy center had a 500 kW steam turbine that generated electricity and sent it to the grid. The low pressure steam (15 psig) was then used as process and humidification steam in the manufacturing facility. Several years ago, the turbine broke down and was not repaired or replaced. However, the generator remains in place and is in good shape. A pressure reducing valve is used to deliver low pressure steam for the process and humidification. The purpose of this project was to evaluate whether the purchase of a new steam turbine would be a worthwhile purchase. Parameters considered were the outlet condition of the steam from the turbine (temperature, pressure, and enthalpy), the mass of the steam through the turbine, and the electricity demand of the air compressors used within the main facility.

Wind Charged Plug-in Hybrid Electric Vehicle

With the emergence of electric vehicles (EVs), hybrid electric vehicles (HEVs) and plug-in hybrid electric vehicles (PHEVs) from a variety of automotive manufacturers, the electrical grid will need to meet new challenges in supplying the electricity required to charge these vehicles. To help supply the electricity needed by these vehicles, we compared the electricity consumption of a modified Toyota Prius (PHEV) and the output of a small residential wind turbine (1.8 kW) over the course of one year. Our research determined that a small residential wind turbine can supply the necessary electricity demanded by the PHEV annually.

Variable Frequency Drive Air Compressor Incentives:

Variable frequency drives (VFDs) are useful devices that can be utilized in almost all industrial and commercial settings. Where a motor normally runs on a fixed speed, VFDs allow the user to adjust the speed that the motor runs, producing less work and using less input energy. Consumers Energy provides incentives for customers with specific applications.

Consumers Energy also provides incentives for customers who want or need to maximize the efficiency of their compressed air systems. This includes applying a VFD to the air compressor, drying or draining moisture out of the system, filters to prevent dirt and debris, installing efficient nozzles, adding storage tanks, and waste heat recovery.

Condenser and Green Machine Study

Herman Miller is interested in the justification for the purchase of a new vent condenser for the excess 15 psig low pressure steam produced which is vented to the atmosphere. Currently the over production of low pressure 15 psig steam at Herman Miller is 118%; the low pressure steam production is 65,846,330 pounds which means that 10,044,400 pounds of steam produced is vented. Venting this steam has the chemical cost used to treat the boiler water, and the cost to produce the steam associated with it. In total the energy center at Herman Miller is dumping $30,050 per year with the steam it is allowing to escape into the atmosphere because no vent condenser is in place. The cost of implementing a new vent condenser would range $80,000 to $100,000 and would have a simple payback of 2.66 years to 3.33 years.

The team also investigated the use of a Green Machine to recover the low pressure steam without adding condensers. The cost of implementing a green machine to utilize the energy of the low pressure steam ranges from $200,000 to $800,000, and would allow a simple payback ranging from 11 months to 3.67 years depending on the green machine implemented. Several possible technologies were reviewed and the presented to Herman Miller.

Materials

Autophoretics

Autophoretics (A-coat) is a coating process used to adhere a polymer protective coating to steel components. Environmentally speaking, A-coat is exceptionally clean compared to alternatives. It does not emit volatile organic compounds (VOCs) or contain hazardous chemicals, yet can be easily reconditioned and recycled. However, due to consumer demands, manufacturing companies are now taking stock of the total life and environmental impact of product materials. Currently, A-coat uses a Polyvinylchloride (PVC) coating that gives off chlorine gas during its manufacturing process. Due to this a manufacturing company is investigating replacing its autophoretic paint line with a greener epoxy based A-coat or converting to a powder paint line to fully replace autophoretics. This company sponsored an in depth investigation of its current A-coating process to determine causes of corrosion, failure and longevity. The purpose of this study is to ascertain if converting to powder paint or epoxy A-coat would improve product quality compared to conventional A-coat while decreasing environmental impact.

Link to: Autophoretic Coating Performance

Waste Powdercoat User Group

Starting in 2011, the Waste Powdercoat User Group (WPUG) was formed to address the growing problem with the lack of outlets for waste powder paint. WMU has been encouraged to help Michigan manufacturers, primarily those in West Michigan, come together to share ideas on this issue and to explore the possibility of working together on an ultimate solution to the problem. The overall success of this initiative is greatly enhanced by the willingness of participants (sometimes competitors) to work together on this problem. It is widely felt that this is a non-competitive issue and that if we all can get to a better level of performance with regard to diverting this material from the landfill, we all win.

This effort was launched on April 19, 2011 with an initial meeting of the Waste Powdercoat Users Group. It was obvious from the level of interaction and sharing of information at the initial meeting that this is a high-level issue within the six companies that attended, several of which were direct competitors. The group confirmed a need and desire to work on both ends of the problem, i.e. process inefficiency leading to excessive waste material and a lack of an adequate outlet (other than landfill) for disposal. Landfill disposal costs were identified as minimal and therefore the economics of disposal is not a driving force. Rather, representatives of several of the companies stated that the driving force behind their interest is to have zero landfill disposal. Process inefficiency costs, however, were identified as being in excess of $5 million dollars (purchase cost of material) within this small group of companies.

The roll of the GMI with regard to this research area is three fold:

1. Serve as a neutral party among competitors to coordinate group activities and create and maintain a collaborative environment.
2. Conduct research leading to the identification or development of outlets of sufficient capacity for waste powder paint generated within the group. In 2012 a research project began with the help of

the Civil Engineering department assisting our industrial partners with an analysis of their ongoing product development research, as well as an independent research project developing a new product that will utilize waste powder paint.

3. Conduct research into application methods, techniques and equipment leading to a significant reduction in the level of waste generated (increased transfer efficiency). In 2012 a research project was completed in conjunction with the Chemistry department in an effort to create a more efficient powder transfer process. The results are expected to be published in 2013.

Before the initial meeting of WPUG, a survey was sent to several companies to assess the magnitude of the problem. The results from the six companies involved in the initial meeting were overwhelming. Between the six companies, nearly 1.5 million pounds per year of waste paint is being generated. At an average cost in the region of $3.50 per pound, this equates to a waste stream with a yearly value of about $5 million (purchase price). Disposal costs and concerns further complicate the issue. The survey results identify clearly that this is a huge problem for manufacturers using this process. Any improvement will not only help to divert materials from landfill, but significantly improve the bottom line as well.

WPUG formed a formal work group coordinated through the Michigan Manufactures Technical Center with Bill Stough from Sustainable Research Group managing the meetings. The, WPUG had four members: Haworth, Herman Miller, General Motors and Light Corp.

After one year of work, the group has been able to divert all of the member's waste powder paint from the landfill. The group has decided to expand their focus and in large a zero waste to landfill mission, and is currently recruiting more members.

Zero Landfill

In an effort to help manufacturers reduce their landfill footprint, GMI students have spent time attending conferences and workshops aimed at landfill waste reduction and recycling. Their road to zero landfill outlines GMIs philosophies and procedure for conducting a landfill waste audit. Zero landfill procedures include teaching how to conduct a landfill audit, establish your baseline, look for materials of opportunity, and finally, applying solutions to specific problems**.** These procedures were applied at three GMIC member companies each with a different focus and level of intensity. In addition to the company specific landfill audits, the former Waste Powdercoat User Group is expanding into a Zero Waste to Landfill User Group beginning in 2013.

Link to: Road to Zero Landfills

Tubes

The Green Manufacturing Initiative has conducted research to discover alternative uses for cardboard cores. Hundreds of thousands of these cores are currently being sent to the landfill every year in Michigan alone. Our project aims to divert these cores from the waste stream. Cardboard cores are

used throughout industry for a variety of reasons, including: shrink wrap, paper spools, and fabric rolls. Due to the nature of their use, they are designed to be very durable and maintain their compression strength. With their construction's integrity lasting for such a long time, throwing them into the landfill is a waste of both energy and materials. After researching various solutions including recycling options and reuse in the furniture, construction, and structural materials sectors, we found that the best solution in west Michigan is a recycler willing to purchase the cores directly from manufacturers.

Other

GMI Blog

The GMI blog has been organized as an information and communication outlet for members and non-members of the GMIC. The blog updates readers on current projects and completed projects by the GMI staff. For example, a discussion board was formed for the Waste Powder Coat User Group. This is a discussion group for companies that have problems reusing, recycling and removing waste paint from their facilities. The blog is constantly expanding to include up to date topics.

ScholarWorks Publications

ScholarWorks at WMU is an online open-access repository of WMU's research, scholarly and creative output. The GMI uses this repository to publish different research projects that are completed throughout the year. Faculty and students from the College of Engineering and Applied Sciences; College of Arts and Sciences departments of Chemistry, Physics, Biology and Geology; College of Business; Environmental Research Institute; and Environmental Studies program conduct the research and write the articles for this repository.

Currently there are four different articles published in this journal. They cover a wide variety of topics that have been researched over time at the GMI. The latest article to be published currently has nine downloads and the Journal has a total of 35 downloads since 2011.

Link to: ScholarWorks at WMU

GMI Website

To take a tour of the Green Manufacturing Initiative web site, go to:
www.wmich.edu/mfe/mrc/greenmanufacturing

Papers and Publications

NAMRI and SME Paper

A computational fluid dynamics model of a commercial industrial paint curing oven (IPCO) was created to investigate the heat containment problem when oven operation precludes the use of a conventional door. This subject is of practical relevance for reducing the energy intensity and associated costs of manufacturing processes. The model successfully reproduced hot air egress and cold air infiltration through the oven doorway. Spatial distributions of temperature and velocity generated with the model with and without the implementation of an air seal are presented and discussed. Results showed the presence of spatially inhomogeneous temperature fields in the vertical (i.e., floor-to-ceiling) and horizontal (i.e., entrance-to-exit) directions in the absence of an air seal. These features are undesirable from product quality and energy consumption standpoints. Results also demonstrated that air seals have the potential to effectively mitigate these gradients and increase the mean oven temperature, but additional improvements require air seal design optimization. Paper based on the preliminary work done for the Oven Seal project described in Projects.

IEEE VPPC and IJES Papers

Two papers were written based on the Electric Vehicle Battery – Wind Energy Storage System described in Projects. The first was published in the Institute of Electrical and Electronics Engineers' Vehicle Power and Propulsion Conference papers after the topic was presented at the IEEE conference in 2012 and can be found via the link below. A second paper was submitted and accepted by the International Journal of Energy Science and is awaiting publication.

http://www.wmich.edu/mfe/mrc/greenmanufacturing/pdf/Wind%20Charged%20EV%20Battery%20Storage%20Facility.pdf

Driving Conditions' Impact on Plug-in Hybrid Electric Vehicle (PHEV) Performance

The battery performance of a modified Prius with a 5 kWh plug-in battery was documented for a year to determine the impact of environmental conditions and user attributes on vehicle performance. Both fuel economy and pure electrical efficiency were compared to ambient temperature. The fuel economy has a positive relationship with ambient temperature until approximately 70˚F, at which the efficiency begins to drop slightly. Electrical performance has a positive linear relationship with ambient temperature. With the emergence of electric vehicles (EVs) and plug-in hybrid electric vehicles (PHEVs) from a variety of automotive manufacturers, information on EV and PHEV performance for consumers will become more important.

http://www.wmich.edu/mfe/mrc/greenmanufacturing/pdf/Impact%20of%20Driving%20Conditions%20on%20PHEV%20Battery%20Performance.pdf

Posters

Forklift Battery Pack and Charger Energy Consumption

Reducing the Environmental Impact of Hexavalent Chrome Plating Operation's

Evaluative Study if Autophoretic Coating Performance Characteristics Compared to Powder Electro-deposition Coating

Introduction to Green manufacturing Initiative/ Green Manufacturing Industrial Consortium

Department of Energy, Save Energy Now Program

Waste-to-Energy, Utilizing Manufacturing Waste as a Source of Energy

Overhead Door Heater Energy Consumption Reduction

Evaluation Study of Autophoretic Coating Performance

Electric Vehicle Battery – Wind Storage Facility

Fabri-Kal Thermo-forming Oven

Fabri-Kal Waste Heat Reclaim

Green Scoreboard

Post Waste Water Treatment

Energy Savings Improvements for Industrial Ovens

Benefits of ISO 50001 Certification

Steam Turbine Energy Generation

Landfill Audits

Wood Utilization Material and Information Control Systems Design

Green Parking Lots

Wood Utilization Optimization (Jarrah) Material & Information Control System Design

Electronic versions of posters are available upon request, please contact Carey.schoolmaster@wmich.edu.

Research Partners

West Michigan—E3 and Michigan Industrial Energy Center (MIEC)

WMU, through the (GMIC), has partnered with the Michigan Manufacturing Technology Center (MMTC) to promote and support the roll-out of the EPA-E3 (Economy, Energy and Environment) program in West Michigan (WM-E3). This program benefits consortium members by enabling access to a pair of operational assessments supported through the E3 program. The first assessment is performed by the Michigan Industrial Energy Center (MIEC) housed at the University of Michigan. The focus of the MIEC's effort is on energy, leading to the identification of energy-saving opportunities throughout the operation. The second assessment targets the integration of lean and green opportunities. This assessment is performed by a team from the MMTC. It targets one specific "value stream" in the operation and provides an in-depth analysis of all aspects of that value stream and the corresponding improvement opportunities related to lean and green improvements. A WMU student and faculty team provides a third assessment in between the MIEC and the MMTC to aid in the identification of the specific value stream to be targeted by the lean and green assessment. The WMU assessment targets a handful of high-opportunity areas for data collection and analysis in the areas of material waste (recycled, reprocessed or landfill), and energy waste specific to process heating, compressed air, material handling and environmental conditioning. Assessment results are compiled, resulting in a categorized and quantified list of project opportunities. The GMIC team, in conjunction with the MMTC, works with the consortium member to select a project from the compiled list to fully develop. A student and faculty team from WMU develops an engineered solution for the selected problem, while the MMTC supports the project by assisting the consortium member with implementation financing through the SBA, if needed.

Department of Environmental Quality (DEQ)

WMU is partnering with the DEQ to provide funds through the E3 program to implement waste reduction and energy efficiency. Student interns will follow-up provide GMIC companies with follow-up assessments to measure the impact of completed GMIC projects under the guidance of Retired Engineers Technical Assistance Program (RETAP).

Green Manufacturing Industrial Consortium

The Green Manufacturing Industrial Consortium is a member based group that develops relationships between manufacturers based in and around southwest Michigan in a continuous effort to reduce energy and material waste in manufacturing. Commonly, this relationship begins with an assessment and then projects are continuously carried out with teams of undergraduate and graduate students, professors, and industry members.

GMIC Site Assessments

The GMI site assessment process is designed to identify potential projects for GMIC members by methodically addressing resource efficiency, waste management and value stream management. This process is supported by the University of Michigan, Industrial Assessment Center (IAC) and Michigan Manufacturing Technical Center (MMTC). The assessment produces a comprehensive resource assessment, process summary and list of potential project areas (and is discussed farther above in the Partners section). Site assessments are for the purpose of reducing energy and material waste and decreasing members' overall environmental impact. The assessment is conducted in several phases to provide a quick, low-impact study. Through cooperation with the member company, pre-audit forms allow this assessment to be accomplished within as little as three visits to the facility. This assessment focuses primarily on energy usage, via systems and material usage. Systems covered by this assessment include compressed air, process heating and HVAC. Material usage is also evaluated in order to help decrease waste and handling. Finally, material handling throughout the facility is examined for possible improvements that reduce energy and increase production speed. Projects are then chosen based upon technical feasibility, economic potential and company preference.

GMIC's founding members include: Fabri-Kal, Landscape Forms, Post Foods, Steelcase and Polywood Inc.

Founding members presented with the award of membership at the semiannual GMI/GMIC meeting May 3, 2011.
From the left: Dr. David Meade, Dr. John Patten, Nathan Christensen, Gary Nola, Michael Biro, Kal Kalkowski (founding member), Trevor Williams, Tom Bush (founding member), John Ihling, Rocky Kraiger (founding member), Ryan Kamm, Ana Perez and Andrew Gabriel.

GMIC Project Savings Summary

This summary includes completed projects only, not potential savings from assessments.

Oven Heat Analyses

$103,000/year (3.7 month ROI) – analysis of Insulation and a physical heat seal (savings for 36 ovens)

$70,000/year – damper control settings (savings for five ovens)

Optimizing Material Usage / Process Improvements

$160,800 over two years (2.5 month ROI*) – scrap reduction, inventory optimization

$43,000/year (2.5 month ROI*) – material handling reduction

$25,000/year (1 month ROI) – water use reduction through process improvements

Landfill Audits

$44,000/year (7 month ROI) – waste reduction through training/education

$12,000/year (0 month ROI) – facilitated waste exchange

Heat Recovery

$100,000/year (4 year ROI) – potential energy and water reductions

$30,000/year – elimination of chemicals for water treatment

***ROI included represents both projects marked with asterisks**

Awards

The Michigan Recycling Coalition's (MRC's) 2011 Award of Excellence was earned by the GMI. The MRC Award of Excellence recognizes only one entity that achieves the most innovative and inspiring program in the state of Michigan.

The Green Manufacturing Initiative was chosen to receive the award because of our innovative university-industry based research collaborative comprised of WMU faculty, students and staff as well as industry partner companies. The consortium helps companies assess what projects they should tackle to reduce the environmental and energy impact of their designs, materials, processes and facilities, with a focus on efficiency. Many of these companies are interested in moving from recycling to eliminating waste completely.

This approach is gaining momentum. As manufacturers begin to explore the entire lifecycle of their products, they often need technical assistance and expertise to eliminate waste created in manufacturing, the supply chain and at the product's end-of-useful life. GMI provides needed expertise to industry to reduce negative impacts and improve products at the beginning of their life, a key to building sustainability into our lives.

Accepting the award right to left; Dr. John Patten, Gary Nola, Andrew Gabriel, Ana Perez, Nathan Christensen, Mike Biro, Dr. David Meade, John Ihling, Carey Schoolmaster.

Experience and Knowledge

ISO 14000 and 50001

The ISO 14001 standard, Environment Management Systems, serves as a foundation for companies wanting to develop environmental policies ranging from management systems, developing product labels, and conducting life cycle assessments. Understanding and complying with the various ISO standards is important for providing your member companies with solid, third party verification of your companies' environmental practices. ISO 50001, a standard published in June, 2011, is the first ISO standard designed solely for the management of energy. It provides a framework for the implementation of an efficient Energy Management System (EnMS). ISO 50001 can help your business by reducing energy related operational costs, increasing energy efficiency, and lowering greenhouse gas emissions. Certified facilities are recognized as world class leaders in energy management. The Green Manufacturing Initiative has received a copy of ISO 50001 through the Western Michigan University Engineering Library, and is developing expertise with it in order to assist our industrial partners upon their request.

Link to: ISO Standards

DM Strategists – Real-Time Process Monitoring Software Development

The GMI teamed up with DM Strategists to integrate cutting edge sensory equipment with a proprietary Oracle-based data mining program developed by DM Strategists. Further software development will include automated data analysis, reporting, and benchmarking against other manufacturing organization and government standards. System applications are energy management, emergency notification, and lifecycle cost analysis platform development.

DOE Software Tools (PHAST)

The US department of energy has created a series of computerized assessment tools for evaluating and quantifying various industrial processes. These tools allow for assessments of compressed air systems, process heat, steam, cogeneration, electric motors, and much more. We at the GMI have since gained a base of knowledge in these tools and have begun to apply them in our facility assessments and various research projects. Presently we have conducted multiple studies using the Process Heat Assessment Survey Tool (PHAST) which studies the efficiency and losses which occur in manufacturing process which require heat. We have applied the PHAST tool in the assessment paint cure ovens, heated wash stations, and baking ovens. We have since used the results of these analyses to determine areas of improvement as well as to investigate the feasibility of waste heat recovery implementation. Additionally, we have employed the compressed air tool called AirMaster+ at one facility with additional facilities slated. We have also utilized sections of the Combined Heat and Power (CHP) tool in an ongoing research project.

Green Design Software

Whether you are developing a new product or re-designing an existing one, software packages with built-in green design capabilities provide a useful tool for assisting to create green products. Green software packages such as the EcoAudit tool by GRANTA, or the Sustainability Xpress tool within DS Solidworks are both examples of how green design and material selection are the foundation of any green product. We are developing expertise with the Solidworks Sustainability Xpress tool. This tool allows you to select product materials, location of manufacture and use, and manufacturing processes to provide you with an overall environmental product footprint encompassing areas such as the products Carbon Footprint, Water Eutrophication, Air Acidification, and Energy Consumption. The values provided by the Sustainability Xpress tool come from PE-International, a world leader in product life cycle assessment.

Green Training

In an effort to keep our team updated on current best practices in green and sustainable topics, multiple team members have obtained a Green Generalist certificate offered through Purdue University and their Technical Assistance Program (TAP). The class aims to teach students and professionals general environmental awareness principles prevalent throughout the manufacturing industry. The information learned will be useful and applied to future GMI projects.

The GMI was also invited to attend Purdue University TAP's beat testing for their recently released Front Line Green Worker training. This training program was developed in conjunction with the Society of Manufacturing Engineers and focuses on giving manufacturing workers special knowledge in green practices to better prepare them to find employment in manufacturing. GMI project manager Brian Wummel received SME certification in the program and the knowledge gained from this training was then shared with the rest of the GMI team.

Green Products

As shifts occur in the manufacturing world to create more and more products that are environmentally friendly, business professionals are pushed to make sure their products are as green as possible. As we work to minimize the impact our products have on the environment, we create "green" products. A green product can generally be defined as a product that, from raw material extraction and processing to use and end-of-life disposal, lessens its impact on the environment as thoroughly as possible. At the Green Manufacturing Initiative, we are committed to help companies create green products and have appropriate products certified as being green.

Green Product Certifications

We are increasing our expertise and knowledge of a variety of Green Product Certification systems. These product certifications require a deep understanding in several areas such as material use, product design, energy, water, atmosphere, chemical use, life cycle assessment, and social responsibility. Landscape Forms has volunteered one of their products as a test case. We will guide them through the level Certification process designed by the Business and Institutional Furniture Manufacturer's Association. Other certification systems are Cradle to Cradle, Green Seal, and SMaRT Certification.

Link to: Green Product Certification

Life-Cycle Analysis

Life-Cycle Analysis (LCA) addresses the triple-bottom line impact from the acquisition of raw material to end-of-life use of a consumer product. The LCA requires detailed information from the suppliers, the manufacturers, and the waste-management service; however, there is no standard process accepted across the board. The GMI follows the DOE suggested LCA methodology with consistency throughout the supply chain. The LCA can be used to track embodied energy and carbon in a product for carbon accounting purposes, qualify the product for a green/sustainable certification, and identify potential areas for improvement in the supply chain.

Financial Incentives

Besides the environmental benefits of becoming more energy efficient, there are also numerous financial incentives and rewards. Many utility companies such as Consumer's Energy and DTE offer industrial energy efficiency programs, in which companies receive discounts as well as funds to help off-set implementation costs of energy efficient products and improvements. There are also numerous state incentives and grants for energy efficiency and alternative energy. At the federal level, numerous corporate incentives exist including the Business Energy Investment Tax Credit and the High Energy Cost Grant Program (from the USDA). These financial incentives are meant to help companies become more energy efficient while improving their bottom line. In addition to advocating relevant programs in west Michigan, we have actively assisted companies in applying for and receiving incentives.

Presentations and Talks

Showcasing Model Utility IEE Programs Feb. 7, 2012

State and Local Energy Efficiency Action Network Webinar Feb. 7

ITB's Automotive Energy Storage Systems Conference Mar. 1-2, 2012

Elevating IEE Regulatory Issues for Commissioners Mar. 6, 2012

Strengthening Sustainable Manufacturing in Indian Mar. 9 2012

Chemical Coaters Association Mar. 13, 2012

MGSSBF Sustainability 101 March 14, 2012

Plastics Manufacturing Technology 101 April 9, 2012

IR=EEE Transportation Electrification Conference and Expo

Michigan Energy Conference Apr. 12, 2012

GMIC Semi-Annual Meeting May 7, 2012

Michigan Recycling Coalition, May 9-10, 2012

Frontline Green Workers Training, Purdue

MSEC – NAMRC – ICTMP June 4-8, 2012

Zero-Waste-to-Landfill Challenge – Haworth Oct. 24, 2012

GMIC Semi-Annual Meeting Nov. 6 2012

Industry Partners

Armstrong International

Bell's Brewery

Borg Warner

Borroughs

Cascade Engineering

Consumers Energy

Cummins

DENSO

Eaton

Erdman Machine

Fabri-Kal

Flowserve

Haworth

Heinz

Herman Miller

Industrial Assessment Center (U of M)

Johnson Controls

Kalsec

Kellogg Company

Kohler

L3 Communications

Landscape Forms

Mead Westvaco

Metabolics

Noble Polymers

Ottawa Gage

Perrigo

Post (Ralcorp)

The Right Place

SP Industries

Steelcase

Stora Enso

Subaru

Sustainable Research Group

Unist

Whirlpool

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Cost Statement

Green Manufacturing Initiative Direct Cost Statement as of December 31, 2012		
ITEM	**BUDGET**	**BALANCE**
Personnel	394,696	-4682
Students	99,878	7832
Fringe	89,706	5,927
Travel	15,000	-7,663
Supplies	6,483	-2534
Consulting	10,000	-527
Other	3600	3350
Tuition	49149	19,452
Totals	668,512	5,489

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