Green Manufacturing Initiative

Annual Report 2011

Dr. John Patten
Dr. David Meade

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www.wmich.edu/mfe/greenmanufacturing

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Introduction

The Manufacturing Research Center at Western Michigan University received nearly $1 million from the U.S. Department of Energy in 2009 to establish and develop a Green Manufacturing Initiative. Called GMI, the initiative provides a conduit between the university and industry to facilitate cooperative research programs of mutual interest to support industry's green (sustainable) goals and efforts. Greening manufacturing operations has 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 sustainability a necessity for success.

WMU participants in GMI activities include faculty, staff and students 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 contribute to GMI's success, including Southwest Michigan First; The Right Place in Grand Rapids, Mich.; Michigan State University; the University of Michigan; the Michigan Department of Environment Quality; the Michigan Department of Energy, Labor and Economic Growth; and the Michigan Manufacturers Technical Center.

In parallel with the Department of Energy funding, a Green Manufacturing Industrial Consortium was established 2009 to integrate industries into GMI, providing a direct link between the university and industry. 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 and Post Foods LLC.

Acknowledge: This material is based upon work supported by the Department of Energy under Award number DE-SC0005363.

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Projects

Energy

Oven Seal

A large contribution to the energy intensity required to make a product comes from process heating, specifically 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, with the CFD model to be verified through temperature and air velocity instrumentation. The oven seals also have been modeled, and a comparison in performance will be made to determine the effectiveness of the seals.

Link to: Oven Seal

Harmonics/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 as follows:

1. Identify harmonics generated by the lasers and the effects of the harmonics on the electrical distribution system at the Rapid-Line facility; power losses due to harmonics and voltage regulation.
2. Identify any current in the neutral.
3. Review all the laser panels and the number of transformers in order to identify power losses from the transformers and feasibility of replacing the transformers with one transformer; all the lasers and their attached chillers operate at the same voltage.
4. Examine the power factor of the laser/chiller machines.
5. Perform analyses of the voltage and current waveforms of the laser/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.

Link to: Wind Energy Storage System

Driving Conditions Impact on Plug-in Hybrid Electric Vehicle 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.

Link to: Driving Conditions PHEV Performance

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.

Link to: Wind Charged PHEV

Waste to Energy

There are tons of plastics that get sent to landfills each year because they are 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. Plastics-to-fuel conversion is important not only because it reduces the amount of plastics 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 to problems in the future, such as scarce landfill space and lack of energy sources.

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:

1. 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.
2. 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.

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 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

Green Certificates and Green Product

Purdue University offered a Green Generalist online class in the summer of 2011. 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.

Waste Powdercoat User Group

Through our activities with industry over the last year, the Waste Powdercoat User Group (WPUG) has become aware of a 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 and GMIC 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.
3. Conduct research into application methods, techniques and equipment leading to a significant reduction in the level of waste generated (increased transfer efficiency).

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 has met three times in the last six months and is coordinated through the Michigan Manufactures Technical Center with Bill Stough from Sustainable Research Group managing the meetings. This project is soliciting members and is moving forward. Currently, WPUG has four members: Haworth, Herman Miller, General Motors and Light Corp.

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, what conditions can help you succeed**.** These procedures were applied at a GMIC member company.

Link to: Road to Zero Landfills

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. One tab is called, ”Waste Powder Paint”. This is a discussion group for companies that have problems reusing, recycling and removing waste paint from their facilities. More discussion tabs will be created as needs arise.

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.

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
Overview of the website links:
Brochure
Contact Us
Education & Certification
Events & Conferences
Green Manufacturing Industrial Consortium
Green Scoreboard
Green Team
News
Projects
Website Tour
Publications
    Papers, Posters, Presentations and Proposals
Related Research
    Energy, Environment, Green Certification, Products & Standards, Publications
Research Partners
    Industry & Manufacturing, Organizations, Interested Companies
GMI Blog
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Papers and Posters

NAMRI/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.

IEEE VPPC Conference Papers Submitted http://scholarworks.wmich.edu/greenmanufacturing/

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 soon have sufficient wind capacity to charge an EV battery-wind storage facility as well as all of Michigan's consumer EVs.

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

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.

Energy Center

The purpose of this project is to determine whether the purchase of a new steam turbine would be worthwhile for their energy center. Preliminary results have yet to confirm the outcome. Dr. Parker has been assisting with this project.

Poster Abstract: 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 poster is 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.

Battery Project

A poster was made of a small-scale facility based on MAREC in Muskegon. Nate Christensen and Dr. Patten presented the large-scale and small-scale battery project at the IEEE Institute of Electrical and Electronics Engineers conference earlier this year. The next presentation will be at the Michigan Annual Energy conference April 2012 in Grand Rapids.

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 Energy – Save Energy Now, ALLY Program

This program is used to expand industry access to resources and accelerate reductions in industrial energy intensity, the Industrial Technologies Program (ITP) works cooperatively with *Save Energy Now*® ALLY Organizations—U.S. trade associations, suppliers, utilities, state organizations, universities, nonprofit organizations, consultants and other groups. On this website you'll find information on how your organization can participate as a *Save Energy Now*.

Link to: Save Energy Now

Green Manufacturing Industrial Consortium

Site Assessment Tool

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. Projects are then chosen based upon technical feasibility, economic potential and company preference.

GMIC Facility Site Assessment

Site assessments are for the purpose of reducing waste and decreasing 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.

GMIC founding members are; Fabri-Kal, Landscape Forms and Post Foods, LLC.

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, founding member; Kal Kalkowski , Trevor Williams, founding Member; Tom Bush, John Ihling, founding member; Rocky Kraiger, Ryan Kamm, Ana Perez and Andrew Gabriel

Awards

The Michigan Recycling Coalition's (MRC's) 2011 Award of Excellence was earned by WMU's 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 for a number of compelling reasons. 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; Dr. John Patten, Gary Nola, Andrew Gabriel, Ana Perez, Nathan Christensen, Mike Biro, Dr. David Meade, John Ihling, Carey Schoolmaster.

Experience and Knowledge

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. Furthermore we have also utilized the 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 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, lessen its impact on the environment as thoroughly as possible. At the Green Manufacturing Initiative, we are committed and continue to explore ways 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.

ISO 14000 Series and ISO 50000

The ISO 14000 series, most notably known for ISO 14001, 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 14000 series standards is important for providing your member companies with solid, third party verification of your companies' environmental practices.

In addition to ISO 14000, the Green Manufacturing Initiative is eagerly awaiting the release of ISO 50000, Energy Management Standards. The standards are set to encompass procedures that will help to manage and report energy consumption.

Link to: ISO Standards

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. 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.

Presentations and Talks

Battle Creek Chamber of Commerce, Eye Opener Breakfast, Jan 11, 2011
What Might the Future Bring? How Emerging Technologies are Impacting West Michigan's Energy Future, Feb. 2, 2011
Power Wind Turbine, Feb. 3, 2011
Energy Economics: The Role of Reduced Energy Demand and Clean Energy Jobs in Preserving West Michigan Wealth, March 2, 2011
Business Review Forum, "The New Economy" Feb. 17, 2011
Green Workforce, South West Michigan Sustainability Business Forum, February 17, 2011
ITB Automotive Energy Storage and Fuel Systems Conference, March 4, 2011
Michigan Industrial Energy Center at U of M, "Advance Management of Compressed Air System", March 8 and 9
Made in Michigan/MAREC Renewable Energy Technology Show, March 21-23, 2011
Energy Fair, Ferris State University, Energy Fair, April 13, 2011
Green Virtual Career Fair, April 26-27, 2011
Advanced Energy Storage, Prepare Your Business for the Future of Lithium-ion Technology
Business Review, Building the Business Case, May 3, 2011
Process Heating System Workshop & Green Specializes Training, March 10, 2011
Energy Conference and Exhibition May 10, 2011
The Michigan Recycling Coalition's Annual Conference, May 10-12 2011
Zero Waste to Landfill Workshop, May 18, 2011
IIE Annual Conference, May 23-25, 2011
Green Generalist Online Training, Webinar, May, 2011
Sterling Green Solutions 2011 Educational Forum, May 24, 2010
Business Review, Building the Business Case, May 26, 2011
Manufacturing Council Meeting, Steelcase Learning Center, June 1, 2011
Green Screen for Safer Chemicals, June 7, 2011
Sustainable Business Forum, Green Your Supplies, June 15, 2011
Business Review, Energy Award, June 16, 2011
TAP-Purdue, Fundamentals of Compressed Air – June 16, 2011; Demand Workshop – June 30, 2011; Fundamentals of Power Factor – June 30, 2011
Ludington Pump Storage Tours as Part of the Michigan Energy Fair, June 25, 2011
IEEE PES, July 24-29, 2011
IEEE Vehicle Power and Propulsion Conference, DOE, Sept. 6-9, 2011
Get the Real Bottom Line Results with Green Training, Sept. 15, 2011
Webinar – P2 Cost Calculator andP2 GHG Calculator, Oct. 25, 2011
Green Chemistry and Engineering Conference, Oct. 27, 2011
Materials and Design seminars, Webinar, Nov. 2, 2011
Green Suppliers Network, Dec. 14, 2011

Industry Partners

Research Partners & Interested Companies

Armstrong International
Bell's Brewery
Borg Warner
Borroughs
Cascade Engineering
Consumers Energy
Cummins
DENSO
Eaton
Erdman Machine
Fabri-Kal
Flowserve
Haworth
Heinz
Herman Miller
IAC
Johnson Controls
Kalsec
Kellogg Company
Kohler
L3 Communications
Landscape Forms
Mead Westvaco
Metabolics
Noble Polymers
Ottawa Gage
Perrigo
Post (Ralcorp)
SP Industries
Steelcase
Stora Enso
Subaru
Sustainable Research Group
Unist
Whirlpool

Staff/Faculty/Students

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Green Manufacturing Initiative Direct Cost Statement as of November 12, 2011			
			PROJECTED
ITEM	**BUDGET**	**BALANCE**	**2012**
Personnel	394,696	240,313	212,782
Students	99,878	30,325	62,045
Fringe	89,706	67,018	48,357
Travel	15,000	1,262	1,262
Supplies	6,483	665	665
Consulting	10,000	7,547	880
Other	3600	615	600
Tuition	49149	37,146	23,900
Totals	668,512	384,891	350,491