Green Manufacturing Initiative

Western Michigan University
Manufacturing Research Center
Dr. John Patten, Director
Green Team

• Faculty, Staff and Students
• Colleges of Engineering,
• Arts and Sciences
• Business, and
• Environmental
  – Research and
  – Studies
WMU Green Team

Chuck Ide
Harold Glasser
Mike Barcelona
Sime Curkovic
Carla Koretsky
Dave Middleton
Bade Shrestha
Pete Parker
Andrew Kline
Dan Flemming
Green Manufacturing History at WMU

• Concept proposed in 2003
  (idea for such an activity dates back to 1999)

• Manufacturers contacted to ascertain their interest and support for a proposed effort

• Proposals submitted to NSF for funding
  (Industry/University Cooperative Research Center)

• Green continues to stimulate interest and support
Green History Continued

• Proposals submitted internally within WMU

• Efforts culminate in support from Rep. Upton (and Sen. Stabenow and Levin)

• U.S. Dept. of Energy-funding, $972,000 (2010)

• Green Manufacturing Industrial Consortium organized and formed (2010)

• Green manufacturing projects being developed and research conducted at WMU
Green Manufacturing Initiative Today

• Preview meeting in Battle Creek, March 31

• Kick off Event in Kalamazoo, May 5-6, 2010

• Green Manufacturing Industrial Consortium
Green Manufacturing at WMU

- Designs
- Materials
- Processes
- Facilities
- Use (energy and environmental impact)
- Reuse, recycle, disposal
Green Manufacturing at WMU

Environmental (benign) + Energy (conscious) + Economical (viable)
Completed Projects

- Chrome Plating (process improvements and alternative technologies)
- Alternative energy (wind and solar) charging of electric fork lift trucks
- Door closures and heating (design and operation) for exterior building, etc.
- Waste to energy resource
• Designer and manufacturer of precision crafted gages and measuring instruments.
  – Serving the automotive, aircraft and construction equipment industry.
  – Located in Holland, MI.
• Project: Reduce the environmental impact of the companies hexavalent chromium plating operations.
  – Provided plans to decrease hazardous waste stream by 97% by reducing the amount of solid and chemical chromic acid waste coming from their process.
  – Proposed heat cycling plan of the plating tanks to reduce energy consumption by 53%.
  • Total projected savings of $5000.00/annually and 1.5 year payback.
Electric Fork Lift Battery and Charger Solution

- 10 new chargers and battery packs
- Reduced on-peak charging
- Programmed time charging
- Higher efficiency, and a lower phantom draw.
  - Total Investment (Batteries and Chargers): $71,650
  - Charger and Battery Savings (Estimated): $36,131
    - Estimated savings are annual.
    - Based on 14 forklifts using the new chargers.
  - Return on Investment: 10 months
Renewable Energy to charge forklift truck batteries

- Estimated kWh generation needed to meet 20% of forklift demand: 5,250 kWh annually.
- Wind:
  - Estimated cost: $48,000
- Solar:
  - Estimated cost: $42,000
- Wind (2.4 kW) and Solar (4 kW) Combined
  - Estimated Cost: $43,600
Fork Lift Trucks: chargers, batteries, and renewable energy

- Total Estimated Investment: $76,350
  - Batteries: $10,000
  - Chargers: $23,000
  - Renewable Energy: $43,600
- Total Estimated Savings Annually: $76,350
- Return on Investment: Approximately 2 years.
Waste-to-Resource

• Investigated profitability of converting mfg. waste as a biomass fuel pellet

• Capital Cost: $720,000
  – 200 Hp Pellet Press: $690,000 (10 yr MACRS Depreciation)
  – Testing & Verification: $30,000

• Annual Costs: $1,547,842 (inc. by 6% annually)
  – Opportunity Cost: $1,408,200
  – Labor Cost: $109,500
  – Electrical Cost: $30,142

• Annual Revenues: $3,102,500 (10 yr IRR 197%)
Overhead door heaters

• Analyze the cost associated with running the overhead door heaters on an annual basis.
• Analyze the air movement through the overhead doors (two Plants).
• Provide alternative solutions to help increase the efficiency of the overhead doors.
## Summary of Options

<table>
<thead>
<tr>
<th>Overhead Door Solution</th>
<th>Cost To Implement Given Solution (Estimated Costs)</th>
<th>Savings</th>
<th>Return on Investment (Estimates)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driver Education/Door Modification</td>
<td>$1,000</td>
<td>$578 (Per 30 seconds of average open door time reduced.)</td>
<td>2 years (maximum)</td>
</tr>
<tr>
<td>Proximity Sensor</td>
<td>$1,114</td>
<td>$2,938</td>
<td>4 months</td>
</tr>
<tr>
<td>Temperature Control Valve</td>
<td>$3,000</td>
<td>$24,750</td>
<td>2 months</td>
</tr>
<tr>
<td>Temperature Control Valve / Proximity Sensor</td>
<td>$4,114</td>
<td>$28,493</td>
<td>2 months</td>
</tr>
<tr>
<td>Temperature Control Valve / Driver Education and Door Modification</td>
<td>$4,000</td>
<td>$25,328 (minimum)</td>
<td>2 months</td>
</tr>
</tbody>
</table>
Current Projects

• Recycling, Rebuild, Reuse of products
  – Paint, polymers, corrugated, polystyrene, food and ag., metals,
• Bio-digester (power producing) based upon agricultural and food waste
• Co-Tri-Quad generation: combined heat, power, cooling and waste treatment
Research & Literature Reviews

• **Autophoretic Coating**
  – Research into how Autodeposition coating works and how to improve its environmental impact

• **Wheatboard / Eco Board**
  – Alternative replacements to medium density fiber construction materials using agriculture waste

• **Wood Fiber/ Polymer tube Recycling**
  – Finding uses or recycling techniques for Polymer impregnated fiber tubes used in manufacturing

• **Styrofoam** (Reduce, Reuse, Recycle, biodegradable)
  – Investigating uses or recycling techniques for styrofoam packaging

• **Tube** (spools-packaging for fabric, plastic etc.)-Reuse and Recycle
Renewable Energy Demonstration System

• Development of multiple integrated alternative energy systems to meet energy demands of Erdman Machine manufacturing facility

• Systems Included:
  – Cash crop/oilseed cultivation (corn, soy, canola, cranberry)
  – Algae cultivation for oil
  – Anaerobic digestion for methane and fertilizer production
  – Biodiesel processing
    • To offset internal diesel demand
    • For market sales
  – Wood Chip Biomass CHP System
    • Primary electrical source for manufacturing facility
    • Primary process & space heat source
    • CO2 source for algae pond aeration
Quad-Generation for Brewing Facility

- Primary energy source: Natural Gas
- Secondary Energy source: Methane from brewhouse washwater treatment
- Electrical generation: Gas turbine
- Cold source: Absorption chiller
- Heat load strategy
  - Designed for heat load; electrical and cooling output are dependent on heat load
Ongoing Projects

• Waste Heat Recovery
  – Investigating methods for Waste Heat recovery during the brewing process
  – Assisting in cogeneration plant development
  – Research and development into current waste heat recovery systems and technologies

• Furniture Industry
  – Investigating field corrosion problems in autophoretic coated components
  – Finding environmentally friendly coating materials and/or process to replacement
Ongoing Training regarding DOE assessment tools

• Plant-wide Assessment
  – Analyzes overall facility energy usage & efficiency
• Motor-Driven
  – Analyses facility subsystems which are motor driven (ie: Pneumatics, fans, pumps, conveyers)
• Steam Assessment
  – Efficiency and
  – trouble shooting steam systems
• Process Heating
  – Analyses and trouble shoots power generation, efficiency, pollution and heating systems
• Data Centers
Proposed Projects

• Lignin use as base material (substitute) for molded components
• Pelletized bio waste-fuel source for combine heat and power (CHP) system
• Air seals and Door closures (design and operation) for ovens and booths
• Solar thermal heating (hot water) for wash operations (paint)
2010 Activities

• Recruit Consortium Members (ongoing)
• Identify projects of interest to consortium
• Match university resources to work on projects
• Conduct research
• Host a meeting (fall/winter) to review project status
• Continue to identify and apply for external funding and grants
What is the consortium?

- A mechanism to catalyze partnerships among industry, academe, and government for the purpose of greening the manufacturing supply chain.
- Based on the National Science Foundation’s Industry/University Collaborative Research Center (I/UCRC) model
  - I/UCRC program began nearly 35 years ago
  - Currently there are 55 consortiums operating around the U.S.
  - As of 2009:
    - 700 industrial partners
    - 100 member universities
    - nearly $90 million in research funding FY’09
Vision

- The Green Manufacturing Industrial Consortium (GMIC) is a university-industry based research collaborative comprised of Western Michigan University (WMU) faculty, students, and staff, and **10-30** industry partner companies.

- WMU will work with GMIC partners to *improve (i.e. reduce) the environmental and energy impact of their designs, materials, processes, and facilities*, including end use of their products through the end of the product lifecycle.

- Projects accomplished through leveraging the industrial partners *experience and resources* and the university’s *technical expertise and research facilities*. 
Mission

• The Green Manufacturing Industrial Consortium (GMIC) has two focuses:

1. To support advancement in manufacturing practice through the creation of more energy efficient and environmentally benign processes and products while enhancing productivity and sustaining or increasing output.

2. To provide a forum for manufacturers to coordinate research and share results, while leveraging R & D funding, at the pre-competitive stage.

**Pursuing Environmental, Energy, and Economic opportunities in partnership with Industry**
What problem is the consortium trying to solve?
Existing industry efforts and/or needs
GMIC sweet spot

Opportunity Area for Consortium

University Research Capabilities

- Laboratory
- Equipment
- Tools/Software
- Personnel
- Experience

Member R&D Interests

- Materials
- Process
- Product Design
- New (Green) Technologies
Consortium Management Process

Member Company → Member Company → Member Company → Member Company → Member Company → Project Submissions → Screen for WMU fit

GMIC Advisory Committee
(1 voting member from each member company)

WMU Manufacturing Research Center
Green Manufacturing Program

Prioritized List of Projects → Build Research Teams Allocate Resources → Project Updates and Report-Outs
Year 1 – Get Rolling

Based on “target member” survey results

“Quick return” focus – low hanging fruit

• Target Areas: (Environmental Focus)
  1. Material Intensity/Efficiency (recycling is an indication of inefficient material use)
  2. Energy Efficiency (membership fee could easily be saved through low/no-cost improvements in energy use)

• Activity:
  1. Site assessments to identify a list of $ savings opportunities in focus areas
  2. Completion of one applied research project chosen from list – goal: ROI on membership fee

One cost savings project per company leveraging the collective knowledge and experience of the consortium member companies
The Maturing Consortium

Members steer the future direction of the research based on their collective needs.
What is the “value” to you

1. Marketing Material – “founding member in the GMIC”
2. Identification of “green” cost savings opportunities through a standardized process
3. Completion of an internal project – ROI
4. Access to research of emerging technologies
5. Sharing of information/knowledge/experience among peer group – the “brain trust”
6. Continuous learning going forward
Win-Win-Win

Source: Gray, D. O., and Lindbald, M.

• Industry:
  • Leveraging of research investment (potentially 20:1 in 2010-2011)
  • Recruitment of talented students
  • Achieving high levels of technology transfer resulting in technical advances or development
  • Average industry-university collaborative research center produces at least one disclosure and patent per year

• Faculty:
  • Research support $$
  • Opportunity to work on industrially relevant research
  • Higher levels of interaction with other faculty
  • High rate of publication

• Students:
  • Rate their educational experience higher
  • Receive more job offers than their peers
Membership

• 5-Year “commitment” (non-binding)
• $25,000 annual membership dues (payment schedule negotiable)
• Signed Memorandum of Understanding (MOU)
  • Operation (by-laws) of the consortium
    – Project selection procedures
    – New member induction process
  • Ownership and management of Intellectual Property
$1 for $1 match on membership fee to support research on “big challenges” identified through the opportunity identification phase.
Future 2010-2015

Collaborative Research Centers typically have a five (5) year life cycle (or longer)

• Develop a five year plan
  – Potential members
  – Budget and funding stream
  – Personnel and resources
  – Projects: large (long term), medium (mid term) and small (short term)

• Apply for additional grants and funding (NSF)
2015 and beyond

• Program review in 2015
• Ascertain any new directions or activities
• Develop five year plan and funding model
• Identify long term (major) projects and goals
• Continue to recruit industry and university participation
• Explore collaborations with external constituents, e.g., other universities.
Contact Information

• John Patten, Director, Manufacturing Research Center  
  (269) 276-3246, john.patten@wmich.edu

• Dave Meade, Assoc. Director, Green Manufacturing Initiative  
  (231) 777-0593, david.meade@wmich.edu

• Carey Schoolmaster, Program Coordinator, Green Manufacturing Initiative,  
  carey.schoolmaster@wmich.edu  
  (269) 276-3245

Web Site:  
http://www.wmich.edu/mfe/mrc/greenmanufacturing/index.php