Using Sustainable Development Principles to Achieve Greener Manufacturing on the Shop Floor

Bill Stough, CEO
Sustainable Research Group
Green Manufacturing

1. Introduction
2. Relevance of Environmental Sustainability
3. Sustainability Drivers
4. Strategies
5. Opportunities
SRG’s vision is to help its customers create a system of commerce that is economically value-added, ecologically life affirming and socially ethical.
SRG Background

Provide counsel to businesses, municipalities, and institutions on designing and implementing sustainable strategies. Specializing on:

- Lean and Clean Assessments
- Energy/Materials Efficiency
- Green Chemistry
- Sustainable Standards Conformance
Green Manufacturing

In meeting our mission, we have;

• Conducted over 50 Lean & Green Assessments for SMS manufacturers;
• Assessed the energy and material efficiency of dozens of SMS manufacturers;
• Served as Project Manager for the development of the BIFMA e3 Sustainable Product Standard; and as members of the joint committees for the Textile Standard, and the Greener Products and Process Chemical Standard; and
• Were selected to develop and manage the State of Michigan’s Green Chemistry Clearinghouse.
By being involved in this set of green manufacturing activities, we have become aware of a number of great opportunities to help Western Michigan companies successfully transition to the “new economy.”
Green Manufacturing

The Environment is now a Strategic issue for Manufacturers

Biosphere + Raw Materials + Energy + Laws/Regulations + Green Customers

Most business leaders don’t see it coming!
Green Manufacturing

The Status Quo Approach

The Economy

The Environment
Green Manufacturing

The New Approach

The Environment

The Economy
Green Manufacturing

Ecological Sustainability
(and why it's important to Manufacturers)
How Much of the Earth's Water is Usable by Humans?
Graph adapted from the U.S. Geologic Survey’s Water Science for Schools Web site
Green Manufacturing

If the Earth were the size of a Basketball?
“Meeting the needs of the present without compromising the ability of future generations to meet their own needs.”

I don’t understand how you can translate the such vague concepts of sustainability into applicable business strategies. I don’t see how it is relevant!
The Triple Bottom Line

Ecological Integrity
Socially Beneficial
Economically Productive

Corporate Sustainability

John Elkington
“At its broadest, the term is used to capture the whole set of values, issues and processes that companies must address in order to minimize any harm resulting from their activities and to create economic, social and environmental value”

John Elkington
A sustainable business is one that adopts strategies and activities that allow the enterprise and its stakeholders to realize their profit goals in ways that protect, sustain, and restore earth’s life support systems for future generations.
The Concept of the Sustainability Funnel

Decline of Living Systems

Margin for Action

Population x Affluence x Technology
Green Manufacturing

The Biosphere
Atmospheric Carbon Dioxide

Source: Worldwatch Institute
World Mean Temperature

Source: Worldwatch Institute
Almost 30% of the Earth’s terrestrial area, comprising 2 billion hectares of forest and 1.5 billion hectares of grassland, has been converted to urban areas or cropland (Figure 6). According to estimates, almost a third of the Earth’s plants and animals have been lost since 1970. Current extinction rates are approximately one hundred times higher than the fossil record. The MA predicts that extinctions could increase further by a factor of ten.

Figure 6: Conversion of natural ecosystems to urban areas or cropland by region, 2005.
Almost half of Asia’s land area has already been converted.
Population through the centuries: How we got to six billion

Through most of history, the number of deaths has been nearly the same as the number of births.
The result? Slow population growth.
Then, in the last thousand years, the curve starts to move upward.

The population explosion:
The fastest population growth in history has occurred in the last 200 years.
From under one billion people in 1800, world population grew to two billion in 1930, and three billion in 1960.
That number had reached four billion in 1975, five billion in 1987, and six billion in 1999.
If current growth rates continue, there will be more than eight billion people on the planet in 2025.
Green Manufacturing

The expanding world middle class
People with income between US$ 6,000 and US$ 30,000 in millions of people

- World
- World excl. China and India
- China
- India

Figure 2: Middle classes in developing countries projected to grow by 300% by 2030.
Source: Goldman Sachs, 2008.
There are over 6 billion humans on earth, and projections indicate a doubling within the next 40 years. 80% of the increase will be in non-industrialized countries.
Green Manufacturing

Raw Materials
World Materials Production
A Sustainable Strategy

1. LME Nickel Settlement 1 Year - $/LB
   - 05 May, 2009 - 30 Apr. 2010
   - MetalPrices.com

2. COMEX Copper Spot 1 Year - $/LB
   - 04 May, 2009 - 04 May, 2010
   - Metalprices.com

3. LME Aluminum Settlement 1 Year - $/LB
   - 05 May, 2009 - 30 Apr. 2010
   - MetalPrices.com
Green Manufacturing

Energy
Green Manufacturing

30 Years of Natural Gas Prices

Wellhead price of natural gas since the mid-1970s to January 2009.
<table>
<thead>
<tr>
<th>Period</th>
<th>Residential</th>
<th>Commercial(^1)</th>
<th>Industrial(^1)</th>
<th>Transportation(^2)</th>
<th>Other</th>
<th>All Sectors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996</td>
<td>8.36</td>
<td>7.64</td>
<td>4.6</td>
<td>NA</td>
<td>6.91</td>
<td>6.86</td>
</tr>
<tr>
<td>1997</td>
<td>8.43</td>
<td>7.59</td>
<td>4.53</td>
<td>NA</td>
<td>6.91</td>
<td>6.85</td>
</tr>
<tr>
<td>1998</td>
<td>8.26</td>
<td>7.41</td>
<td>4.48</td>
<td>NA</td>
<td>6.63</td>
<td>6.74</td>
</tr>
<tr>
<td>1999</td>
<td>8.16</td>
<td>7.26</td>
<td>4.43</td>
<td>NA</td>
<td>6.35</td>
<td>6.64</td>
</tr>
<tr>
<td>2000</td>
<td>8.24</td>
<td>7.43</td>
<td>4.64</td>
<td>NA</td>
<td>6.56</td>
<td>6.81</td>
</tr>
<tr>
<td>2001</td>
<td>8.58</td>
<td>7.92</td>
<td>5.05</td>
<td>NA</td>
<td>7.2</td>
<td>7.29</td>
</tr>
<tr>
<td>2002</td>
<td>8.44</td>
<td>7.89</td>
<td>4.88</td>
<td>NA</td>
<td>6.75</td>
<td>7.2</td>
</tr>
<tr>
<td>2003</td>
<td>8.72</td>
<td>8.03</td>
<td>5.11</td>
<td>7.54</td>
<td>--</td>
<td>7.44</td>
</tr>
<tr>
<td>2004</td>
<td>8.95</td>
<td>8.17</td>
<td>5.25</td>
<td>7.18</td>
<td>--</td>
<td>7.61</td>
</tr>
<tr>
<td>2005</td>
<td>9.45</td>
<td>8.67</td>
<td>5.73</td>
<td>8.57</td>
<td>--</td>
<td>8.14</td>
</tr>
<tr>
<td>2006</td>
<td>10.4</td>
<td>9.46</td>
<td>6.16</td>
<td>9.54</td>
<td>--</td>
<td>8.9</td>
</tr>
<tr>
<td>2008</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^1\) All Sectors
\(^2\) NA: Not Available

U.S. Energy Information Administration
Green Manufacturing

Laws and Regulations
Regulatory Changes

- Greenhouse Gas Mandatory Reporting Rule
- The Stockholm Convention on Persistent Organic Pollutants (POPs)
- The European Union’s (EU) RoHS; China’s RoHS
- The EU’s REACH (Registration, Evaluation and Authorization of Chemicals)
- Formaldehyde Emissions from Pressed Wood Products
Green Manufacturing

Customers Demanding Products with Green Attributes
Customer Demand

Green Purchasing Policy?

- 38% We do not have a policy.
- 30% We have a formal policy.
- 22% We have an informal policy.
- 10% I don't know.

Source: terrachoice 2007
Customer Demand

Percentage of respondents agreeing to the statement “I would be more likely to purchase products or services from a company with a good reputation for environmental responsibility.”

The Purpose of a Sustainable Strategy

To develop and share a common framework comprised of easily understood, scientifically-based principles that can serve as a compass to guide society toward a just and sustainable future.
A Sustainable Strategy

The vast majority of Supply Chains are operating from an “Old Economy” perspective; this presents a huge competitive opportunity for those business leaders that understand and implement operating rules of the “New Economy.”
A Sustainable Strategy

If you are just starting the journey…

There are Two Essential Strategies Needed for Embracing Sustainable Development:

1. Eco-Efficiency—To Stop the bleeding of $
2. Eco-Design—To Start the Transformation $
EcoEfficiency:

The delivery of competitively-priced goods and services that satisfy human needs and bring quality of life, while progressively reducing ecological impacts and resource intensity throughout the life cycle to a level at least in line with the Earth’s estimated carrying capacity.

WBCSD, 2001
Eco-Efficiency – Stop the bleeding of profits

1. Develop environmental data management systems
2. Aggressive energy conservation & efficiency programs
3. Lean and green value stream mapping to help eliminate all forms of waste
   1. Raw materials
   2. Chemicals of Concern
   3. Regulated emissions
4. Goal - zero recycling
Reasons to Measure Eco-efficiency

Opportunities

- 5% Establishing consumption baselines
- 5% Tracking and documenting performance
- 5% Conducting Lean & Green VSM reviews
- 5% have appropriate decision making infrastructure
- 15% have environmental lead person
- >1% communicate environmental program to stakeholders
A Sustainable Strategy

Eco-Design – To increase sales

Establish a Design for the Environment (DfE) Program
- New products
- Production systems
- Operation and maintenance systems
Eco Design – Basic Principles

1. Waste is Food
2. Matter Cycles
3. Energy Comes From the Sun
4. There is Strength in Diversity
Sustainable Supply Chains
Using life cycle thinking is a next step in broadening the horizons of pollution prevention; a process which has gone from a focus on production processes (cleaner production), to Products (Design for Sustainability) and then to product systems (incorporating transport logistics, end-of life collection and component reuse or materials recycling).
Seven Elements for Improvement

1. Reduced material intensity
2. Reduced energy intensity
3. Reduced dispersion of toxic substances
4. Enhanced recyclability
5. Maximized use of renewables
6. Extended product life
7. Increased service intensity
Elements addressed in the BIFMA e3 Standard

The standard is divided into four basic elements consisting of various prerequisites and credits that are potentially available to organizations seeking product conformance to the standard.

- Materials
- Energy & Atmosphere
- Human and Ecosystem Health
- Social Responsibility
Prerequisites

- Each element has one or more prerequisites that are required as the minimum performance against the standard.
- Once all the prerequisites are met; products may achieve additional credits toward multiple levels of achievement in each element by meeting the specified performance requirements.
BIFMA e3 Materials

Prerequisite: Design for the Environment

Credit Categories:
1. Life Cycle Assessment
2. Material Use Efficiency
3. Bio-based Renewable Materials
4. Recycled Content
5. Recycled/Biodegradable Materials
6. Reclamation
7. End-of-Life Management
8. Water Management
Prerequisite: Develop Energy Policy

Credit Categories:
1. Building Energy Inventory
2. Energy Star Rating
3. Embodied Energy: raw materials; components
4. Product Manufacturing
5. Finished Product Energy Consumption
6. Transportation
7. On-site Energy Generation
8. Greenhouse Gases
Prerequisites:
1. Comply with Health & Safety Laws
2. Chemical Inventory

Credits:
1. Chemical & Environmental Management
2. Chemical Management Plan - Facility
3. Effects of Process and Product Chemicals
4. Reduction/Elimination of Chemicals of Concern
5. Low Emitting Furniture
### Structure of the BIFMA e3 Standard

<table>
<thead>
<tr>
<th>Points Amassed</th>
<th>First-Party or Second-Party verified</th>
<th>Third-Party verified</th>
</tr>
</thead>
<tbody>
<tr>
<td>32-44 points</td>
<td>Silver</td>
<td>level</td>
</tr>
<tr>
<td>45-62 points</td>
<td>Gold</td>
<td>level</td>
</tr>
<tr>
<td>63-90 points</td>
<td>Platinum</td>
<td>level</td>
</tr>
</tbody>
</table>
Triple Bottom Line Examples

- Environmental Performance
  - Assessing the ecological footprint of operations
    - Energy consumption
    - Material consumption
    - Waste Generation
    - Chemicals of Concern
  - Targeting essential sustainability metrics
    - Absolute and Normalized measures
  - Measuring performance to goals
  - Selecting a sustainability reporting format
Environmental Leading Indicators

- Energy consumption
- Material consumption
- Water consumption
- Greenhouse gas emissions
- Chemicals of Concern
- Total waste
Leading Companies Understand:

- The Walls of funnel are real: Opportunity vs. Constraint
  - Witnessing early stages of economic transformation
  - From linear to cyclical

- Regulations will accompany this transformation
  - Take-back laws
  - Carbon taxes

- Innovation using Nature as the design inspiration is the key to success in the future

*Business Driven Sustainable Development, Barton, et.al.*
WHY DO COMPANIES INVEST IN SUSTAINABILITY?

• Morality
• Compliance
• Opportunity
  • Innovation
  • New Product and Market Development
  • New Technology
  • Customer Loyalty
  • Major Cost Reductions
  • Improved Employee Morale

*The Next Bottom Line, Arnold and Day*
Investing for the Future

Strategic vs. Defensive Enterprise

Defensive Enterprise

Long Term Profitability

Strategic Enterprise
“We are moving from an era when natural resources were abundant and people were scarce into a new era where natural resources will be scarce and people abundant”

Amory Lovins, RMI
“The core idea is that nature, imaginative by necessity, has already solved many of the problems we are grappling with. Animals, plants, and microbes are the consummate engineers. They have found what works, what is appropriate, and most important, what lasts here on Earth. After 3.8 billion years of research and development, failures are fossils, and what surrounds us is the secret to survival.”

Janine Benyus, Biomimicery
“Inquiry is fatal to certainty”

Will Durant, American Philosopher, Circa 1940
Thank You

William Stough, CEO
Sustainable Research Group
P.O. Box 1684
Grand Rapids, MI 49501
616.301.1059
bstough@sustainableresearchgroup.com