Business Case for Green Chemistry: Trends and Drivers

Al Innes
Minnesota Pollution Control Agency
Toxics Reduction/Pollution Prevention Program

November 16, 2015
alister.innes@state.mn.us / 651-757-2457
Factors driving green chemistry work

- Growth – a chemical component in 96% of goods
- Consumer profile
- Key consumer product types
- External stakeholder concerns
- Internal sustainability-related drivers
- Brands, buyers & groups pressing supply chains
Consumer profile

- Older consumers: 10 to 25% willing to pay more
- Rise of millennials, new parents
- Desire for control over hazards and exposure
- Information via web, search tools and apps, and from peers via social networks - brands
- More expect – and look for - lower hazard at the same price and quality
Key sectors

- Children’s – esp. with higher exposure potential
- Food and its packaging
- Personal care
- Clothing
- Home and office maintenance
- Building products and furnishings
Corporate: external stakeholder drivers*

- Increasing inquiries from investors
  - Producer responsibility for products, packaging (42%)
  - Toxic chemicals in products (39%)
  - Sustainable sourcing & procurement (34%)

* Ernst & Young/GreenBiz 2013
Corporate view of sustainability drivers*

- Changes in customer demand (87%)
- Brand risks (87%)
- Increased stakeholder expectations (86%)
- Competitive threats (81%)
- New revenue opportunities (80%)
- Regulatory compliance (~40%)

* Ernst & Young/GreenBiz 2013
Growing numbers of “doers”
Pressure on supply chains

- Company-by-company red lists
- Major buyers – require disclosure of current or specification of future chemicals used
- Alliances of major buyers/brands
- Product testing – buyers, regulators, activists
- Audits or certifications
Building the Business Case for Green Chemistry: Communicating Payback

Michelle Butler
Global EHS Growth and Sustainability Leader

GE Transportation

Any opinions, findings, and conclusions or recommendations expressed in this presentation and/or discussion do not necessarily reflect the views of the New York State Pollution Prevention Institute (NYSP2I), the New York State Department of Environmental Conservation (NYSDEC), or the US Environmental Protection Agency (EPA).
Simple payback?

Payback Period = Cost of Project / Annual Cost Savings

For Green Chemistry projects, the charge of P2 Practitioner is to:

• Account for all costs
  – **Theory**: Environmental Management Accounting guidance doc (International Federation of Accountants)
  – **Practice**: NEWMOA/Massachusetts OTA procedure

• Communicate strategic importance
  – Value to brand (Trends and Drivers, Core Values)
  – Value to customer (Internal and External – Case Studies)
Accounting for Costs

• Hidden/Indirect Costs
  – Water management
  – Regulatory fees
  – Corporate overhead (labor)

• Less tangible costs associated with external Impacts
  – Liability
  – Future regulation
  – Productivity
  – Depletion of key natural resources (business disruption)
EMA Case Study 1: PCB Transformers

US Company
• Concerned about risks associated with hundreds of PCB transformers
• US regulation allows use through end of useful life
• Evaluating early phase out

Cost analysis:
+ Cost of removal and disposal of PCB transformers
+ Cost of new transformers
+ Incremental cost of new fluids
- Impact and probability of acute events, such as spills or fires, estimated (cleanup costs, litigation insurance, business disruption)

NEWMOA/OTA Tool

- Draft process flow diagram
- Compare costs generated by “old” and “new” process
  - Consult tables to identify typical project costs (initial and operating)
- Calculate cost savings /incurred

Communicating Value

• Green Chemistry initiatives can strengthen the company’s brand, mitigate reputational risks, and deliver value to the customer

• In developing the business case:
  – Understand the core values of the company
    *(What does the company care about?)*
  – Understand the strategic direction of the company and how it differentiates itself in the marketplace
    *(How does the company want to grow?)*
  – Understand key risks to the company
    *(What keeps management up at night?)*
  – Understand the company’s external messaging
    *(What has the company committed to?)*
When Value is Clear....

<table>
<thead>
<tr>
<th>Company</th>
<th>Core Values</th>
<th>Commitment</th>
</tr>
</thead>
</table>
| IFF          | • Passion  
               • Expertise  
               • Creativity            | • **Train** chemists in the use of 12 principles  
               • Green Chemistry **Evaluation** tool in R&D  
               • Complete LCAs on key fragrances  
               • **Focus** on manufacturing excellence |
| MERCK & CO., INC. | • Improve life  
                               • Achieve scientific excellence  
                               • Operate with integrity  
                               • Expand access | • Train scientists in the use of 12 principles  
                               • Use PMI (process mass intensity) metric in R & D  
                               • Focus on innovation in key areas, e.g biocatalysis  
                               (3 Presidential Green Chemistry Awards) |
| Pfizer       | Innovate to bring therapies to patients that significantly improve lives | • Educate scientists about Green Chemistry  
                               • Develop new drugs with greatly improved E-Factors (kilos of waste/kilo of product)  
                               • Reduce the use of undesirable solvents |
Case Studies

Kate Winnebeck
Sr. Environmental Health & Safety Specialist

New York State Pollution Prevention Institute
Rochester Institute of Technology (RIT)

Copyright © 2015 Rochester Institute of Technology (RIT)

Any opinions, findings, and conclusions or recommendations expressed in this presentation and/or discussion do not necessarily reflect the views of the New York State Pollution Prevention Institute (NYSP2I), the New York State Department of Environmental Conservation (NYSDEC), or the US Environmental Protection Agency (EPA).
Wet Cleaning Conversion Program

Two perc cleaners were selected by NYSP2I to receive $17,500 from EPA Region 2 to help offset the cost of PWC equipment

All Fabric Cleaners, Suffolk Co.
- Installed PWC system in Sept 2011, disconnected perc system in Dec & removed it in spring 2012
- System cost $48,886 (PWC washer, dryer, pant tensioner, top tensioner, installation)

Rainbow Cleaners, NY
- Installed PWC system in March 2012; removed perc at the same time
- System cost $60,277 (PWC washer, dryer, pant tensioner, top tensioner, installation)
Benefits of Professional Wet Cleaning
All Fabric Cleaners

Since converting to wet cleaning, quality has increased, as shown by more than a 99.9% reduction in sendouts, redos, and claims. Electricity usage has decreased by one third and natural gas usage has also decreased. In addition to saving money, perc use and its associated health and environmental effects as well as hazardous waste are eliminated. All Fabric’s employees are happier operating in a cleaner environment, without the smell of perc and their customers are pleased with the quality of cleaned garments.

<table>
<thead>
<tr>
<th>Metrics</th>
<th>2012 Estimated Annual Savings</th>
<th>2013 Estimated Annual Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance</td>
<td>99.98% reduction in quality defects</td>
<td>99.96% reduction in quality defects</td>
</tr>
<tr>
<td>Electricity usage</td>
<td>34% reduction</td>
<td>33% reduction</td>
</tr>
<tr>
<td>Natural gas usage</td>
<td>1.6% reduction</td>
<td>30% reduction</td>
</tr>
<tr>
<td>Detergent &amp; spotter usage</td>
<td>4% increase</td>
<td>11% reduction</td>
</tr>
<tr>
<td>Perc used for cleaning</td>
<td>173 gallons, 100% eliminated</td>
<td>173 gallons, 100% eliminated</td>
</tr>
<tr>
<td>Filters &amp; maintenance</td>
<td>100% eliminated</td>
<td>100% eliminated</td>
</tr>
<tr>
<td>Hazardous waste disposal</td>
<td>766 pounds, 100% eliminated</td>
<td>766 pounds, 100% eliminated</td>
</tr>
<tr>
<td>Perc air pollution</td>
<td>852 pounds, 100% eliminated</td>
<td>852 pounds, 100% eliminated</td>
</tr>
<tr>
<td>NYSDEC permit</td>
<td>permit eliminated</td>
<td>permit eliminated</td>
</tr>
<tr>
<td>Total</td>
<td>12% reduction in operating costs, $28,700+</td>
<td>13% reduction in operating costs, $31,600+</td>
</tr>
</tbody>
</table>

Comparing Jan-Dec 2010, Jan-Dec 2012, and Jan-Dec 2013 operating data. Data are normalized to pieces cleaned in 2012.

Funding provided by the New York State Department of Environmental Conservation
Benefits of Professional Wet Cleaning
Rainbow Cleaners

Since converting to wet cleaning, quality has increased, as shown by more than a 98% reduction in sendouts, redos, and claims. Rainbow Cleaners cleans 33% less garments as they no longer clean for a drop shop which installed its own dry cleaning system. In addition to saving over $1,500 a year in detergent, spotters, and eliminated hazardous waste fees, perc use and its associated health and environmental effects are removed. Most importantly, the residents above Rainbow Cleaners are happy with the wet cleaning system as there are no known health effects from the wet cleaning system.

I am very happy and glad that I changed to the wet cleaning system. My employees are happy too because there is no smell of dry cleaning solvent in the store. I feel better servicing with the wet cleaning system because it really cleans the garments fully.

Danny Yoo, owner

<table>
<thead>
<tr>
<th>Metrics</th>
<th>Estimated Annual Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance</td>
<td>98.1% reduction in quality defects</td>
</tr>
<tr>
<td>Detergent &amp; spotter usage</td>
<td>$1,283 reduction; increase 68 gallons detergent</td>
</tr>
<tr>
<td>Perc used for cleaning</td>
<td>65 gallons, 100% eliminated</td>
</tr>
<tr>
<td>Filters &amp; equipment maintenance</td>
<td>100% eliminated</td>
</tr>
<tr>
<td>Hazardous waste disposal</td>
<td>262 pounds, 100% eliminated</td>
</tr>
<tr>
<td>Perc air pollution</td>
<td>229 pounds, 100% eliminated</td>
</tr>
<tr>
<td>NYSDEC permit &amp; operator training</td>
<td>permit eliminated, $700+ annual cost</td>
</tr>
</tbody>
</table>

Comparing Jan-Dec 2011 and May 2012-April 2013 operating data. Data are normalized to pieces cleaned in May 2012-April 2013.

Funding provided by the New York State Department of Environmental Conservation.
Children’s Furniture Manufacturing Assessment

Children’s Furniture Manufacturer
- Manufacture maple furniture and spaces designed for children
- Produce about 4,000 cribs each year

Work Performed
- NYSP2I developed a framework to assess the functional & environmental performance characteristics of the crib mattress and bite guard materials
- Environmentally friendly alternatives were identified and ranked according to EHS attributes to assist in decision making

Results
- NYSP2I staff identified & evaluated alternative bite guard materials and mattresses that meet the stringent performance criteria and have a reduced environmental footprint. Alternatives were provided to the manufacturer to assist in their decision making process.
- Using alternative materials results in
  - Reduction of 5,400 lbs of PVC each year by replacing the bite guard
  - Reduction of 1,500 lbs of PVC annually by replacing the mattress
  - Brominated flame retardants eliminated from the crib mattress

PeroxyChem LLC manufactures hydrogen peroxide, peracetic acid, persulfates and adjacent technologies in Tonawanda, NY.

**Work Performed**
- Evaluated new metal cathodes to find the root cause of corrosion and shorter life-span using Scanning Electron Microscope (SEM) analysis and SEM Energy Dispersive X-ray (EDX).
- Identified potential coatings and conducted accelerated corrosion and delamination tests.

**Results**
- Determined original coating had poor performance and the new metal had a manufacturing defect.
- Identified an alternative coating material that can potentially withstand the process environment, prevent corrosion, and provide improved longevity for the new cathode metal.
- Should the new coating material be implemented, it would enable the replacement of the previous cathode metal thereby eliminating toxic materials and the generation of over 1,000 pounds of toxic hazardous waste.

**Assessment of Alternative Coatings for Improved Cathode Longevity and Toxic Metal Elimination**

*Laboratory setup for accelerated corrosion/delamination testing of coatings on cathode substrates*

*1500 magnification using SEM showing a defect as the point of initiation for the corrosion*

*Funding provided by the New York State Department of Environmental Conservation*
Ecolab: new hard surface cleaners

- Glass, bath (acid, alkaline, neutral), all-purpose
- Soil removal equal or better vs. Ecolab’s, others’
- 64% increase in renewably-sourced chemicals
- All formulas comply with Green Seal 37 standard
  - Safer than GS-37 for oral and aquatic toxicity
  - Meet GS-37 for ready biodegradability
- 295,000 lb. VOC reduction – all now under 1%