



“GREEN UP”!

2011 Michigan Green Chemistry and Engineering Conference

**Advancing Innovation for a Sustainable Future
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Agenda

- ***Introduction***
- ***Sustainability – What is it?***
- ***Principles of Green Chemistry***
- ***Environmental Business Models***
- ***Chemicals Management (CM)***
- ***Resource Management (RM)***
- ***Challenges***
- ***Final Remarks***

Introduction

Man has viewed themselves living in a virtually unlimited planet. It wasn't until the last 400 plus years that man discovered that the planet is a sphere and that it could be limited.

Man has used natural resources such as air, water and minerals in an abundance as population and economic needs grew. In some cases, man thought these resources were free. Some scientists now project that during the next 50 years population will increase by 50% and economic activity by 500%

In last 50-100years, we have seen the impact of man's progress during the industrial revolution.

- **Fish kills- Great Lakes**
- **Cuyahoga river fire**
- **Landfills – Love Canal**
- **Smoke stacks – Gary, Indiana**
- **Health & Safety Issues**



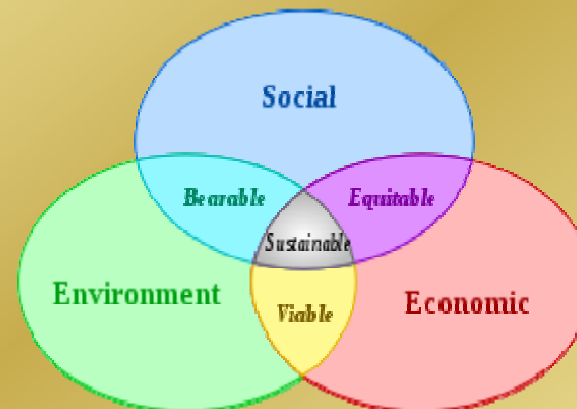
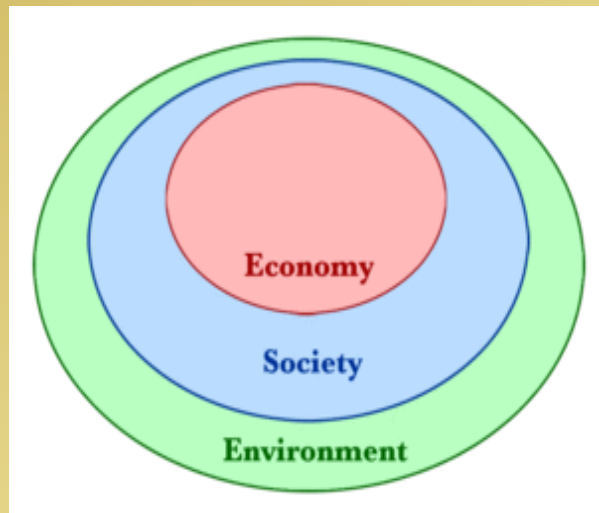
Bottom line is that these situations were the result of mismanaged waste which lead to environmental regulation to protect the environment. However, for the most part these were end of pipe requirements. The regulations didn't address both ends of the pipe solutions.

So, as we move forward globally into the next revolution (sustainable) we will need to develop systems and subsystems that will allow for more sustainable decision-making.

Sustainability – What Is It?

Definition: There are many... based on values of individuals, organizations, countries, and specific situations.

But, there are three basic systems common to all of the various definitions. And it's our challenge to create the proper integration of these systems at all levels going forward that will enable a sustainable future for quality of life and the enhancement of our biosphere.

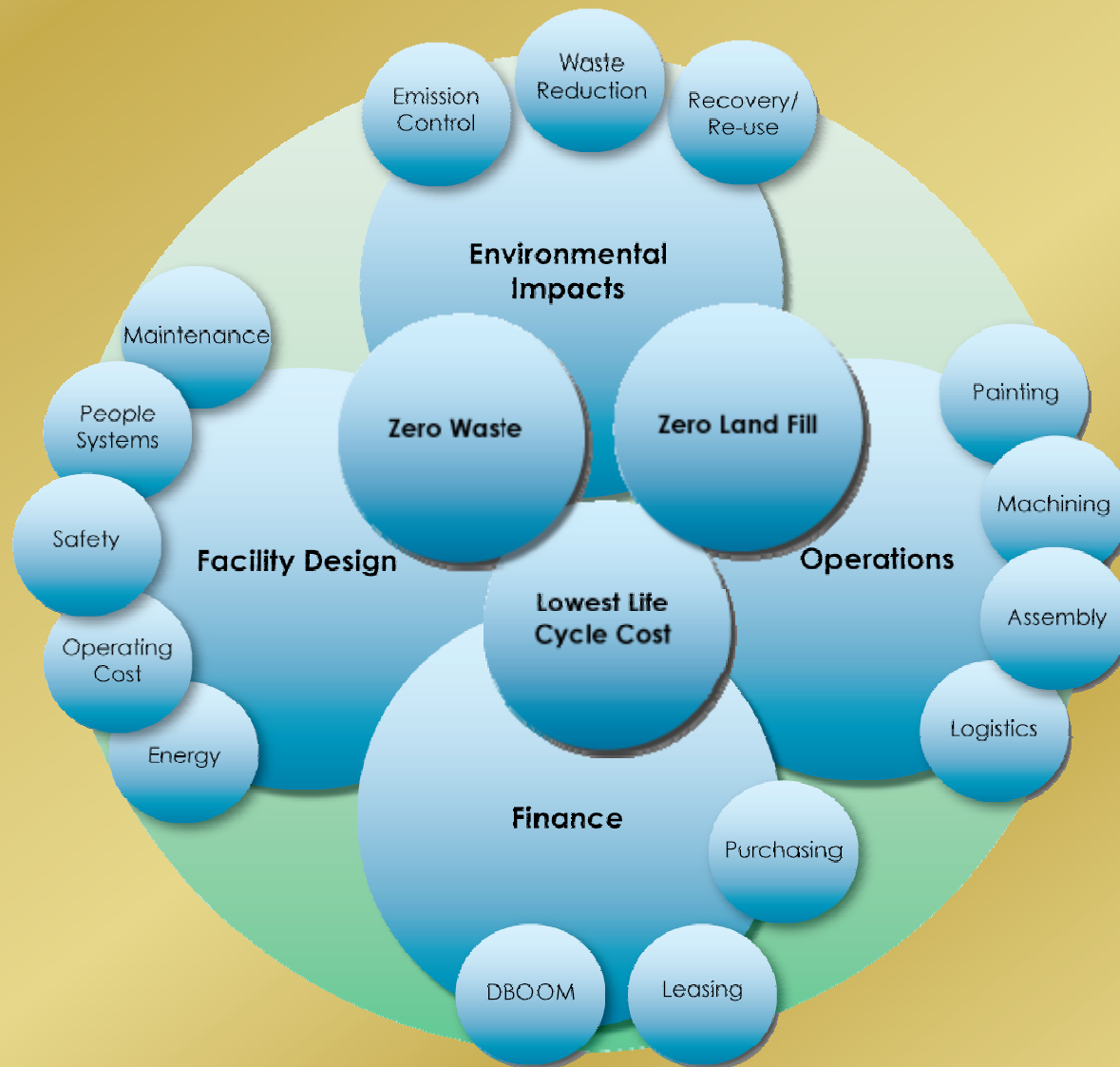


Manufacturing System

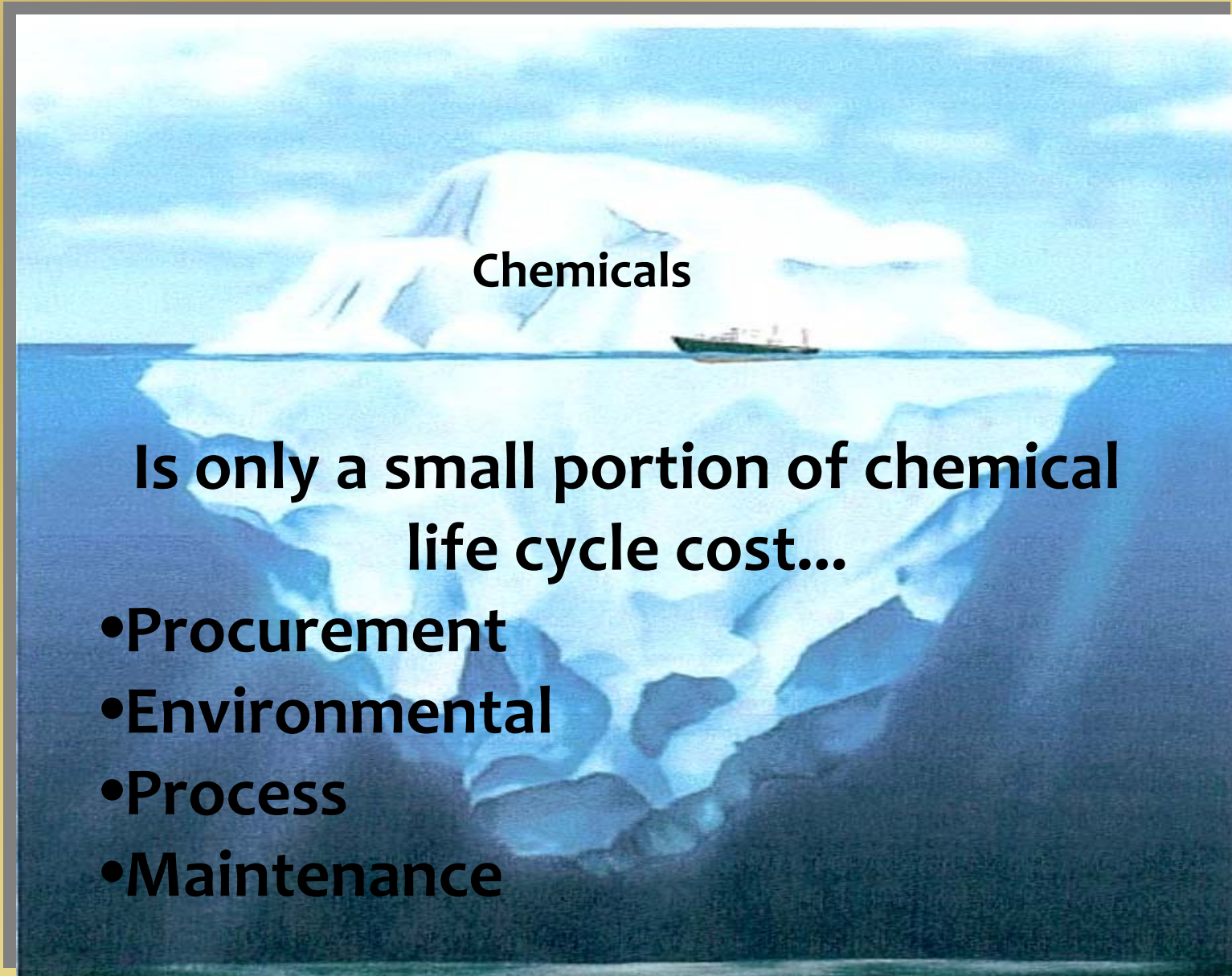
This presentation is discussed in the context that the system and associated sub-systems refers to:

The manufacturing plant!

Total Systems Approach



Chemicals Cost



Chemicals

**Is only a small portion of chemical
life cycle cost...**

- **Procurement**
- **Environmental**
- **Process**
- **Maintenance**

Waste Disposal Cost



Wasted Resources

Is only a small portion of waste management life cycle cost...

- **Cost reduction**
- **Environmental Compliance**
- **Process – waste reduction**
- **System Costing**

Chemicals and Resource Management Success At A Domestic Automaker

Successful Integration of Chemicals and Resource Management Business Models Into Manufacturing Operations is a Result of:

- Paradigm Shift in the Approach to Supplying Chemical and Resource (Waste) Management Services**
- Cultural Change in the Way Suppliers are Received Into the Manufacturing System and Team**

Total Systems Approach



Green Chemistry Principles Chart

1. **Prevention**
2. **Atom Economy**
3. **Less Hazardous Chemical Synthesis**
4. **Designing Safer Chemicals**
5. **Safer Solvents and Auxilliaries**
6. **Design for Energy Efficiency**
7. **Use Renewable Feedstocks**
8. **Reduce Derivatives**
9. **Catalysis**
10. **Design for Degradation**
11. **Real-time analysis for Pollution Prevention**
12. **Inherently Safer Chemistry for Accident Prevention**

C h e m i c a l s M a n a g e m e n t

Chemicals Management

Definition:

Under Chemicals Management, a single first-tier supplier provides all indirect chemicals and services and provides an on-site laboratory staff, to manage all chemical processes within the plant, at a fixed price with options for CPU, pass through volume, and indexing.

Under the CMS Model, Formerly Conflicting Incentives Are Now Aligned

Traditional Relationship: Conflicting Incentives

Supplier



Material
(cost, volume)

Buyer



wants to
decrease

wants to
increase

CMS Model: Aligned Incentives

Service
provider




Lifecycle costs
(material, labor,
waste
management)

wants to
decrease

Buyer

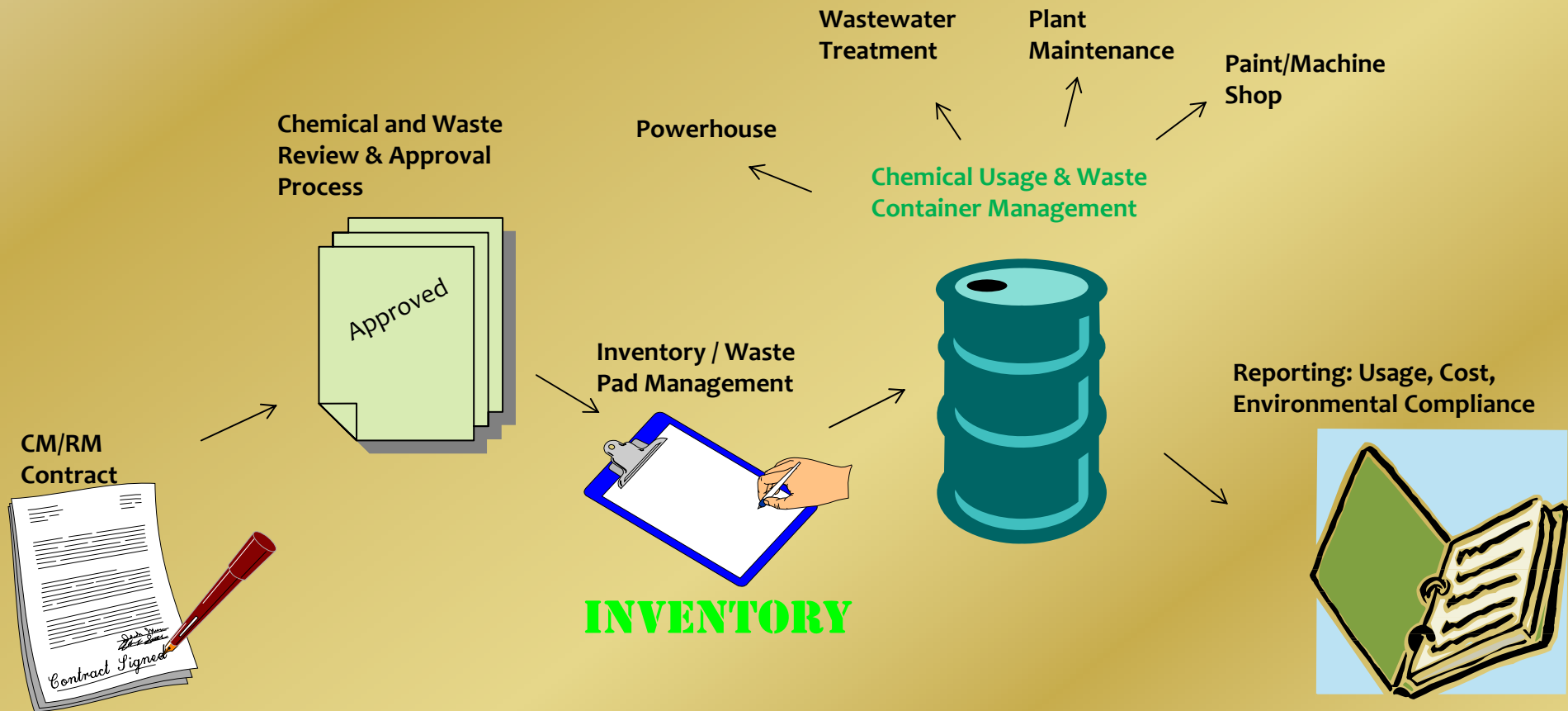


wants to
decrease



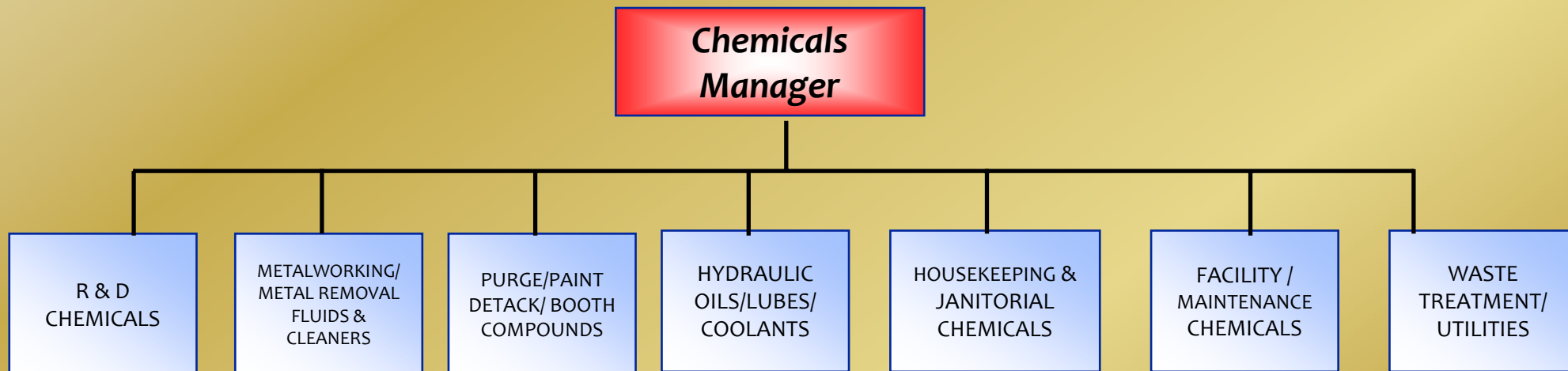
Changing the supplier compensation model
is the source of potential environmental
gains, various types, fixed fees, CPU, leasing

Chemicals/Resource Management: A Systems Approach



**3-4 Chemicals and Resource Management personnel per Assembly plant,
4-6 personnel per Power rain, 2-3 per Stamping plant**

CHEMICALS MANAGEMENT TYPICAL FOOTPRINT MANUFACTURING OPERATIONS



*** DIRECT CHEMICALS ARE NOT CURRENTLY PART OF CHEMICAL MANAGEMENT PROGRAMS, BUT IT IS POSSIBLE TO INCLUDE SOME DIRECT MATERIALS UNDER CHEMICAL MANAGEMENT.**

CHEMICAL SERVICES INCLUDED UNDER CHEMICAL MANAGEMENT:

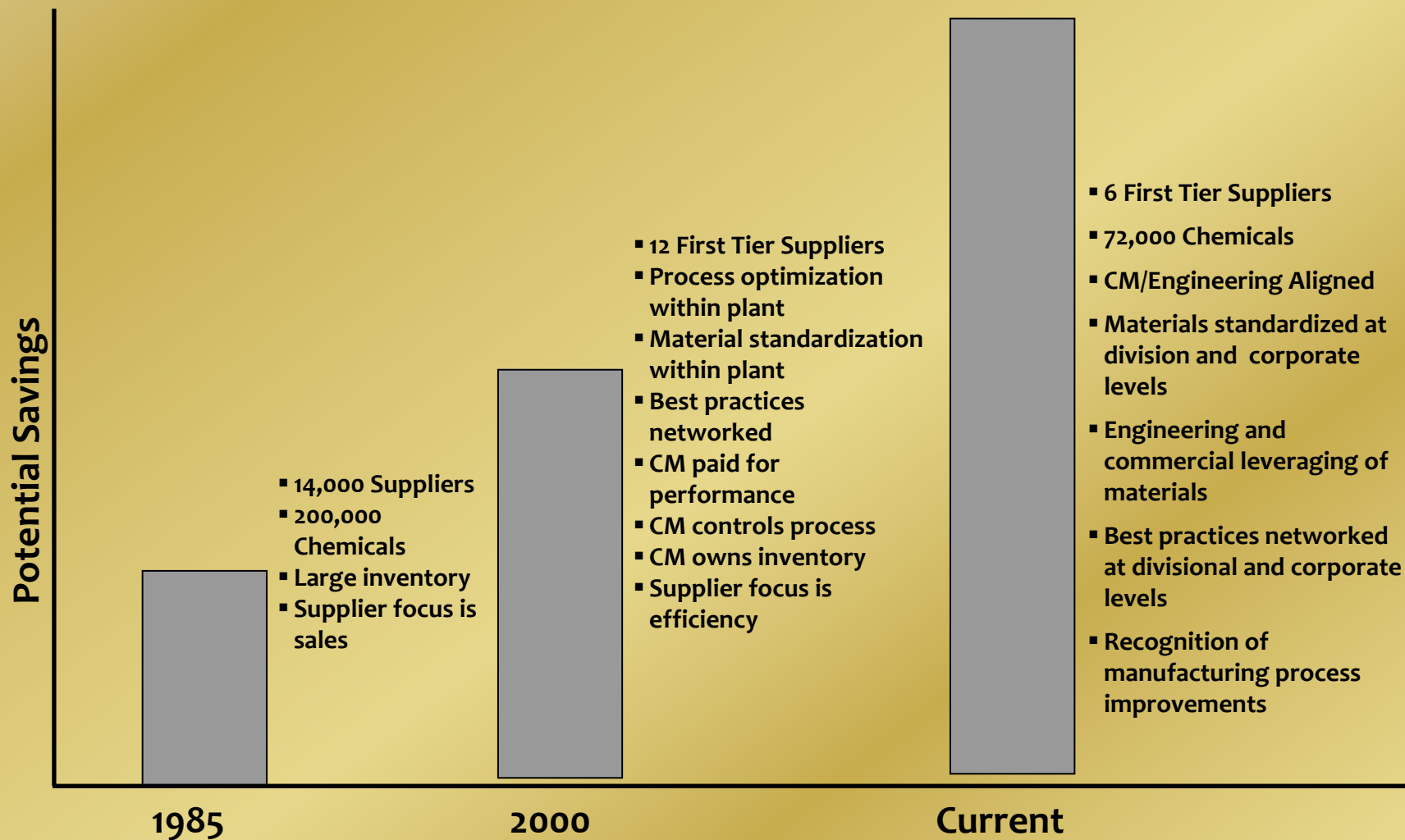
- CHEMICALS
- ON-SITE MANAGEMENT TEAM
- OFF-SITE SUPPORT
- ON-SITE CHECKS
- COMPLETE INVENTORY MANAGEMENT
- COMPLETE CHEMICAL PROCESS MANAGEMENT
- R&D PROGRAMS
- CONTAINER MANAGEMENT
- SECOND TIER DEVELOPMENT & MANAGEMENT
- PRODUCT/PROCESS ENG. DEVELOPMENT
- PREDICTIVE MAINTENANCE DEVELOPMENT
- CHEMICAL MAINTENANCE SCHEDULING
- ENVIRONMENTAL STUDIES
- SAFETY/HEALTH ISSUES / MSDS MANAGEMENT
- ASSIST ENV. REPORTING/CHEMICAL EXTRACTS
- TRAINING
- TOTAL SYSTEM ANALYSIS & TECH. MANAGEMENT
- PROBLEM SOLVING
- USAGE TRACKING
- COST REDUCTION PROGRAM
- COORDINATE OEM'S
- WASTE TREATMENT INVOLVEMENT

Advantages of Integrated Total Site Chemicals/Resource Management Systems Using Single First-Tier Supplier

- **Site-wide accountability is placed with one manager**
- **Fewer chemicals/waste contracts and suppliers are used**
- **Site-wide second tier suppliers provide better service**
- **Storage facilities can be minimized and commonized**
- **Single well-equipped laboratory provides better services**
- **Common, single point environmental reporting is achieved**
- **Redundant administrative functions are avoided**
- **Financial and technical leveraging is achieved**
- **Total program cost is reduced**

Chemicals Management in North America

Reducing the Chemical Footprint



The Benefits

- **Product rationalization & consolidation**
- **Programs reduce total systems cost**
- **Promotes efficiency, consolidation & standardization of materials and procedures**
- **Chemical expertise**
- **Gatekeeper of MSDS & approvals**
- **Compatibility issues**
- **Budgets**
- **Procurement**
- **Environmental / Safety**
- **Provides the facility with control in the decision making process (Chemicals Management Committee)**
- **Eliminates profit from chemicals purchased**
- **Reducing the chemical footprint**

Assembly Operations Purge Solvent Plant Project

- **Purge Solvent Management**

- Performed process audit to verify usage
- Developed baseline for to reduce usage
- Developed reporting system to optimize and track usage
- Action was taken to add dispensing tool, regulators, restrictors and meters. Cost \$15K
- Routine service to process owners on status.
- Lead to development of best practices for Corporation

- **Results**

- 100 K gallons of usage reduction over 3 years
- Estimated 761,500 LBS of VOC emissions
- Projected 625,542 LBS of Carbon reduction
- Enough BTUs to heat 24 homes for a year

Over-all plant performance 70 ton reduction while production increased 5%

Assembly Operations Purge Solvent Corporate Project

- **Purge Solvent Management Corporate Program**
 - Development of best practices for Corporation
 - Reduce the number of purges
 - Developed metrics to reduce usage
 - Maximize recovery of purge solvent for recycling
 - Reduce emissions
 - Created a closed looped process for feedstack
- **Results**
 - Reduced the number of purge from 23 to 5
 - Reduced average usage on a per vehicle basis by 25%
 - Increased average purge solvent recovery from 65% to 85%
 - Reduced average emissions by 20% to 25%

Results for Chemicals Management

- *Chemical costs have reduced by an average of 20%*
- *Chemical usage has been reduced as much as 50%*
- *Reduced the number of chemicals by 50%*
- *Chemical processes are under better control*
- *Process improvements have resulted*
- *Chemicals /Resource Management is a cornerstone in the Environmental Strategy*
- *Plant personnel are able to better focus on core business of building automobiles*

Success of implementation has been excellent.

In addition to cost savings, reduced emissions, improved health and safety, improved quality in the production process have also been realized.

***Resource
Management***

Concept Overview

Resource Management is an effective system which: (Benefits)

- **Reduces and/or eliminates landfill waste and overall costs while increases recycling of resources.**
- **Increases supplier responsibility for total system management.**
- **Provides incentive for suppliers to dispose of less, not more.**
- **Establishes team relationship with supplier**
- **Standardizes procedures**
- **Manages changing technology**

Resource Management

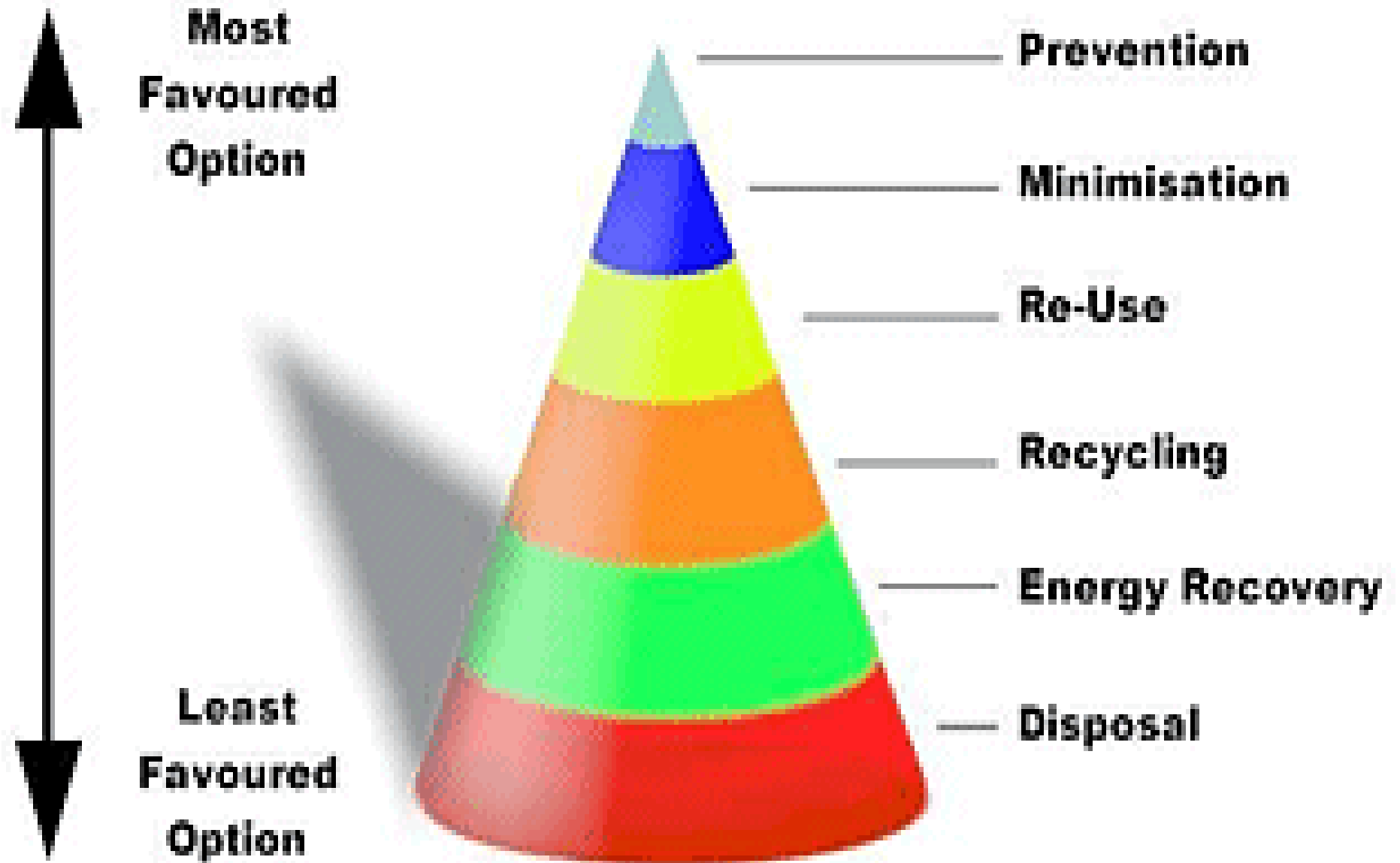
Definition:

- Rather than paying a waste contractor to dispose of materials, customer engages a supplier, or resource manager, as a partner inside the plant.
- A single resource manager in each facility uses on-site staff to handle all applicable aspects of the waste business– **focusing on waste elimination first, then reduction and recycling, and finally disposal.**
- The resource manager receives financial incentives for finding innovative ways to eliminate waste created during the manufacturing process.

“Waste is nothing more than a misplaced resource!”

John Bradburn, GM Sr. Environmental Engineer

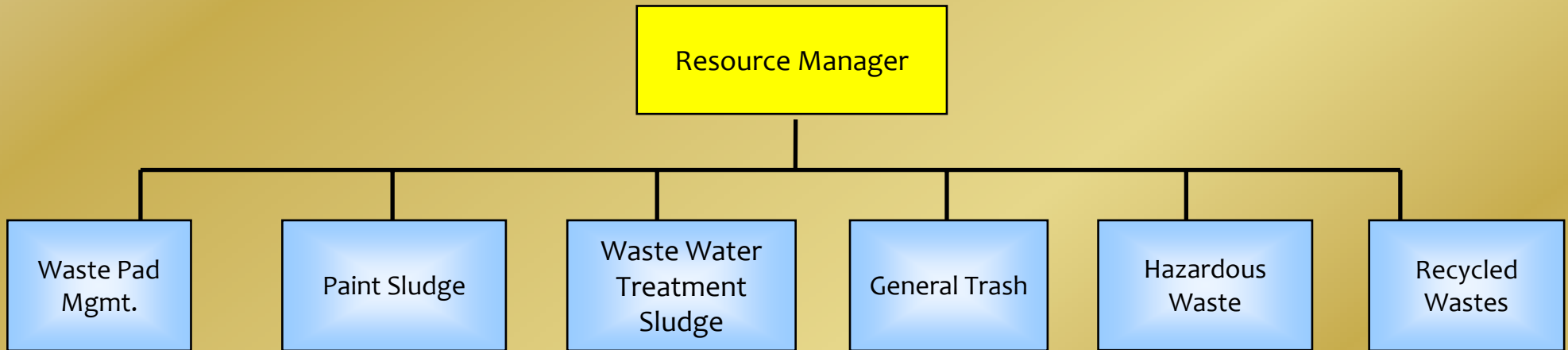
Waste Hierarchy



Resource Management Program

DEFINITION:

Under resource management, a single first-tier supplier manages all plant wastes. The supplier provides all Resource Management services through their on-site staff and the supplier is economically compensated to reduce waste volumes.



Services included under Resource Management:

- Consultation
- On-site management team
- Off-site support
- On-site inspections
- Hazardous waste pad management
- Container preparation & labeling
- Investigate recycling opportunities
- Second tier development & management
- Source separation studies
- Source reduction studies
- Waste disposal scheduling
- Environmental studies
- Safety/ Health issues
- Assist Environmental reporting\training
- Total system analysis & tech. mgmt.
- Problem solving
- Usage tracking
- Cost reduction program
- Coordinate OEM'S
- Waste treatment involvement
- Emergency response services

Resource Management Program Scope (Ladder Chart)

Reducing the Environmental Footprint

LEVEL I

- * Disposal

LEVEL II

- * Disposal
- * Hauling

LEVEL III

- * Disposal
- * Hauling
- * Consultation

LEVEL IV

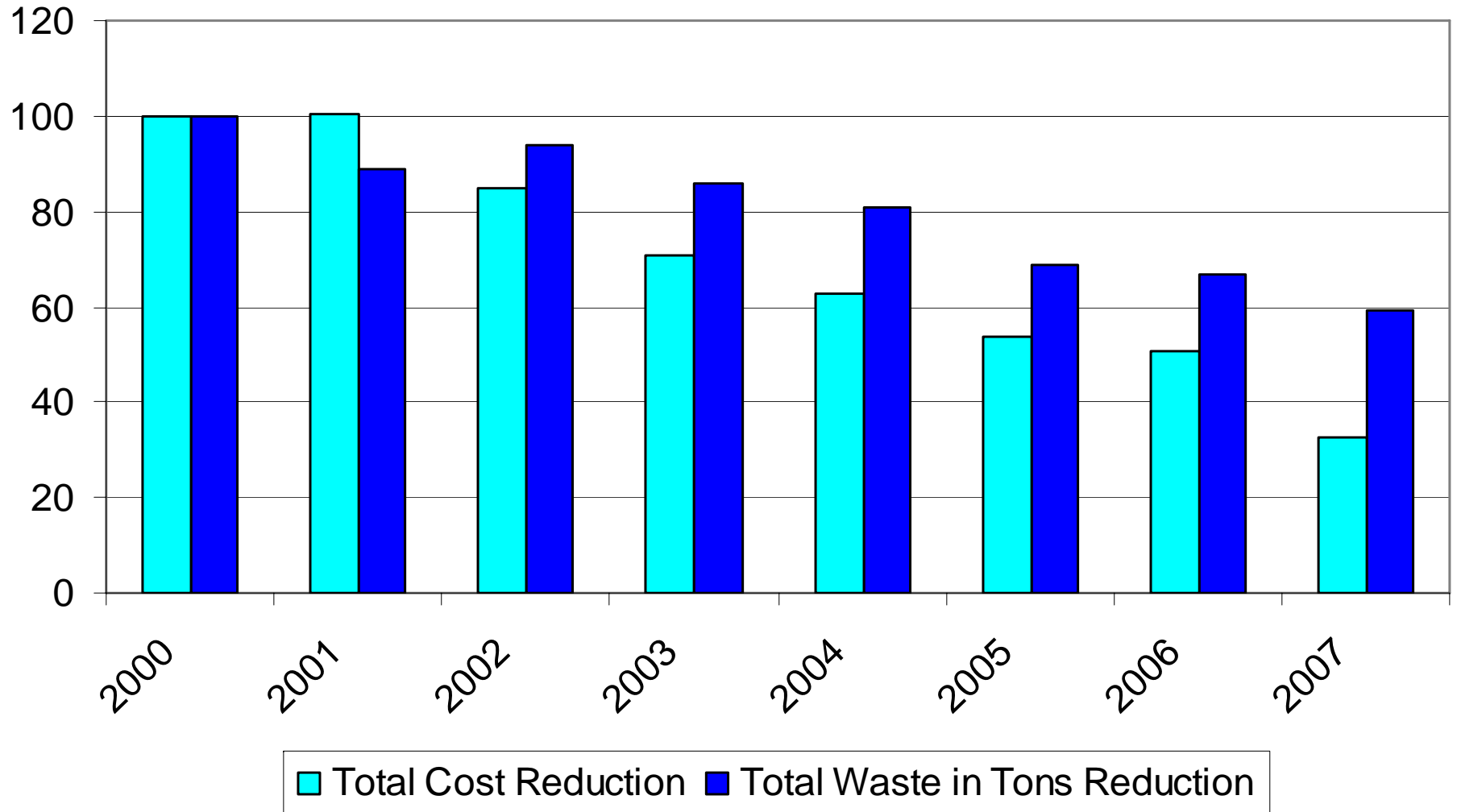
- * Disposal
- * Hauling
- * Consultation
- * Limited Cardboard recovery using MRF
- * Limited Off-site support

LEVEL V

- * Disposal
- * Hauling
- * Consultation
- * On-site Management Team
- * Off-site Support
- * On-site Checks
- * Development Programs
- * Total System Analysis & Tech. Support
- * Source Separation Program
- * Recycling Center Search
- * Environmental Reports
- * Waste Elimination, reduction, reuse programs
 - * Tracking
 - * Training
- * Hazardous Waste Pad Management
- * Second Tier Development & Mgmt
 - * Waste Treatment
- * Container Prep & Labels
- * Safety-Health Studies
- * Container Management
- * Emergency Response

Waste Volume & Cost Reduction Trends

Baseline Year 2000 Equals 100



Results for Resource Management

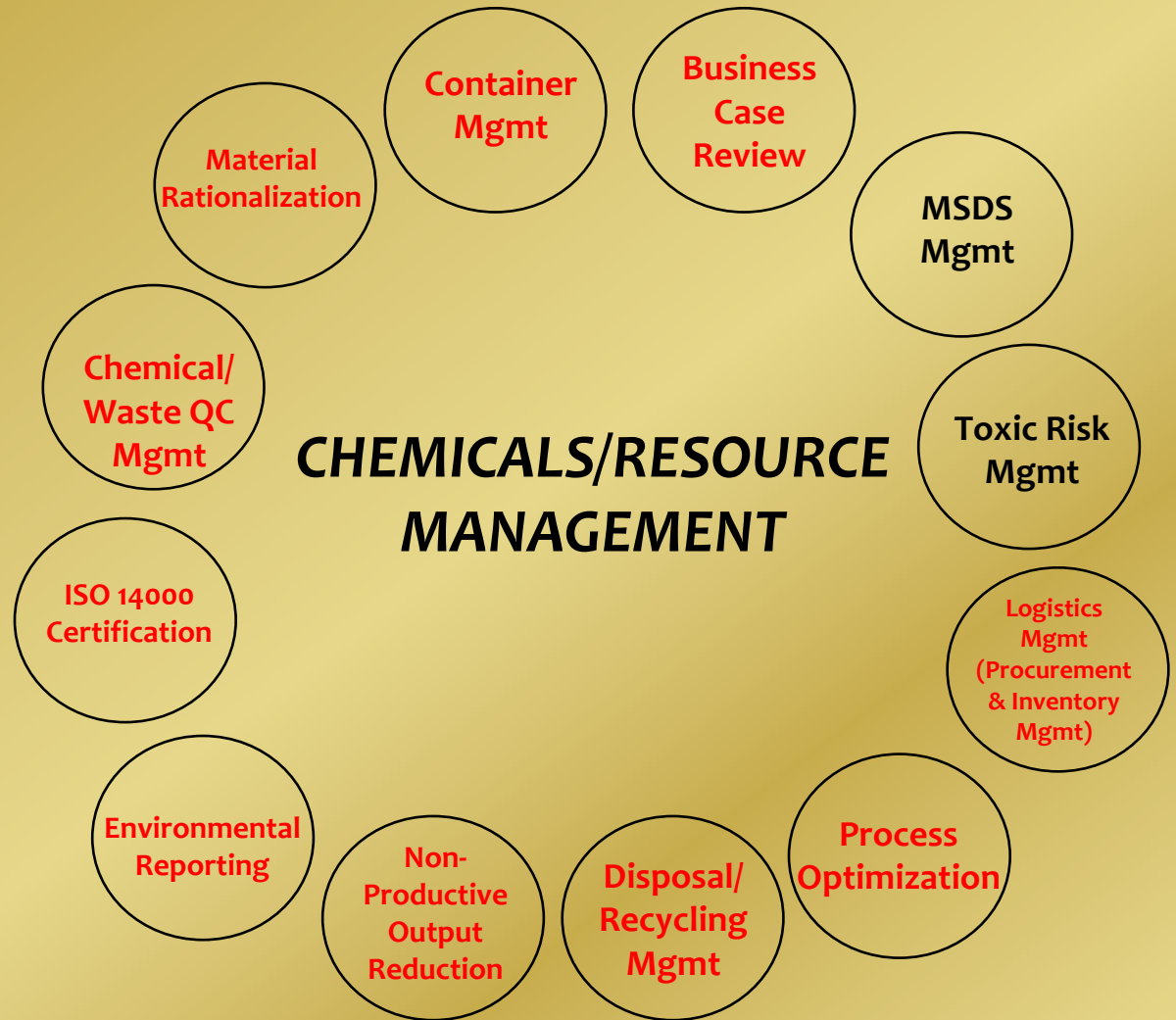
Achievements

- Reduced waste by 40% since 2000
- Reduced cost by \$30 million since 2000
- **Better process control**
- **Improved data**
- **Enhanced environmental stewardship**
- Added Scrap metal in 2007
- Better focus on core business
 - **On-site internal waste handling reduced**
 - Environmental reporting staff requirements reduced
 - Waste pad internal management eliminated
 - Plant waste tracking and coordinating disposal reduced

**CHEMICALS
/RESOURCE
MANAGEMENT**

**Common Total
System Process**

**CHEMICALS /RESOURCE
MANAGEMENT
SUBSYSTEMS ARE
OPTIMIZED AND
STANDARDIZED**



Better Chemical and Waste Decision Making

Red color denotes overlap between programs

Supplier Expectations

- **Supplier Capabilities**
 - Supply highest technology products
 - Design of chemical process & management system
- **Supplier Investment in Product & Process**
 - Budget for R & D
 - Innovation in design of greener products and processes
 - Products and systems must be continuously optimized to reduce emissions and costs within the manufacturing process
- **Supplier Investment in people**
 - Resources of trained people in SPC, problem solving, manufacturing process
 - Training programs to keep employees current in skills and knowledge of technology.
- **Supplier Focus on EH&S**
 - Must proactively invest in products which support compliance
 - Support and improve in-plant environment and employee safety.
 - Regulatory knowledge current and proposed.
 - Capable of toxic materials assessments.

Challenges

- Implementation of Chemicals and Resource Management business models are paradigm shifts from the traditional sense.
- Need to continue to change in culture for the Product Development and Manufacturing facilities to design and develop green technologies.
- Need to continue to set supplier expectations to bring innovative technologies that are green, safe, and eliminate waste. Marketplace is where that happens.
- A change from a purchasing perspective from the price of chemicals and waste disposal to the cost of chemicals and wasted resources.
- “Zero Landfill” is not “Zero Waste” its about making better choices for our natural resources... from extraction, to production, and to disposal.
- Apply the 12 Principles of Green Chemistry and use them as a guide to integrate into specifications where possible.

Successful Strategies Need Focus

Product/Manufacturing
Engineering

Environmental
Engineering

Purchasing

Plants

Strategies Must be Focused on Reducing Total Systems Emissions & Costs

Product/Mfg Engineering

Purchasing

Environmental Engineering

Plants

Reduce

Total

System

Emissions & Costs

Successful Global Environmental Programs – A Foundation



Final Remarks

These service providers are incentivized to provide products and services that are based on the performance of managing the chemical and waste systems within the manufacturing process.

These management systems have demonstrated over time that they continue to bring emission and cost reductions... these environmental business models are enablers toward **sustainability and they do and can provide a vehicle for green chemistry!**

Both of these programs have been recognized by the US EPA as “Green Servicing” programs that are sustainable.

Whether we like it or not, we environmental/health/safety folks need to recognize its about the “environmental business” of these programs and that they save money, reduce risk and the impact on people and the environment.

Widespread acceptance for Chemical Management across multiple business sectors.

Successful environmental business models that I discussed today require top down management commitment, because it takes the whole organization which includes all the bubbles to be on board to support the system.

Finally, we need to have a strong commitment to evaluating our decision-making for materials we use and the elimination of waste at the source... **Green Chemistry !** Thank You

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