GSA Office of Governmentwide Policy

Sustainable Development and Society

October 2004

Sustainable Development and Society

U.S. General Services Administration
GSA Office of Governmentwide Policy
Office of Real Property

October 2004

Foreword and Acknowledgements

Albert Potter, "The Bridge," GSA Fine Arts Program.

Foreword and Acknowledgements

The Office of Governmentwide Policy is pleased to issue *Sustainable Development and Society*. From its inception, the Office of Governmentwide Policy has shared information throughout the Federal community on best practices concerning real property's entire lifecycle – from development, design and construction, through operations, maintenance and eventual renewal, reuse, or disposal. The purpose of this publication is to promote a fuller understanding of sustainable development and how it helps us to make better real property investment decisions.

This publication is part of GSA's continuing commitment to help make the U.S. Government more sustainable. However, the opinions expressed in the articles are those of the authors alone and do not necessarily reflect the official position of GSA. We recognize that many of the ideas presented here are very complex and likely may involve further investigation. We hope, through this and other efforts, to further understanding and application of these important sustainability principles.

This publication was produced and edited by Jonathan Herz, under the leadership of Stan Kaczmarczyk, Deputy Associate Administrator for Real Property. In addition, we would like to recognize the contributors from the private sector, the Federal Government and the academic community, without whose participation this publication would not have been possible. We appreciate everyone's contribution in helping to create a more sustainable government for the American People and, to that end, thank the following individuals and organizations:

William McDonough, FAIA	William McDonough + Partners
Gregory A. Norris, Ph.D.	Sylvatica
Tom Lent	The Healthy Buildings Network
Stephanie Luce	University of Massachusetts at Amherst
Gail D. A. Vittori	Center for Maximum Potential Building Systems
Karla R. Armenti	COES, LLC
Alison Kinn-Bennett	U.S. Environmental Protection Agency
Arthur B. Weissman	Green Seal
Jonathan Herz, AIA	U.S. General Services Administration
Steve Ashkin	The Ashkin Group, LLC
Kathy Gerwig	Kaiser Permanente
Blaine Robinson	NISH

We also would like to thank Ethics in Action™ for their permission to reprint "Ethics in Action," and the GSA Public Buildings Service Fine Arts Program for the use of images of work from their outstanding collection.

G. Martin Wagner
Associate Administrator
Office of Governmentwide Policy
U.S. General Services Administration

Contents

Hugh Pearce Botts, "Construction Workers," GSA Fine Arts Program.

Contents

Foreword and Acknowledgments i
By G. Martin Wagner

Preface 1
By William McDonough, FAIA

Executive Summary 5

True Life Cycle Costing
The Government and Life Cycle Cost Analysis 11
Socio-Economic Impacts in Product and Building Life Cycles 15
By Gregory A. Norris
Toxic Data Bias and the Challenges of Using LCA In The Design Community 25
By Tom Lent

Toxics
The Government and Toxics 33
What Are Toxic Substances? 37
By Gail Vittori
Pollution Prevention and Worker Protection 41
By Karla Armenti

Making Informed Choices
The McDonough Braungart Design Protocol™ 49
By William McDonough, FAIA
Environmentally Preferable Purchasing: The Progress and Remaining Challenges of Multi-Attribute Decision Making 57
By Alison Kinn-Bennett
Creating a More Healthful, Less Toxic Built Environment 65
By Arthur B. Weissman

Observations and Recommendations 71

Case Studies and Strategies

Real Cleaning 77
By Stephen P. Ashkin

Environmental Stewardship at Kaiser Permanente 85
By Kathy Gerwig

A Collaboration to Go "Green" NISH/JWOD 91
By Blaine Robinson

Well-Being and the Service Worker 95

Greening of the Pentagon 97

Measuring and Reporting Sustainability Principles 99

Ethics in Action 100

LeRoy Flint, "Street Car Rush," GSA Fine Arts Program.

Preface

Lillian Richter, "Children's Theatre," GSA Fine Arts Program.

Preface

When Thomas Jefferson wrote of the human desire for life, liberty and the pursuit of happiness, the revolutionary in him was essentially railing at the idea of remote tyranny. Political tyranny was the stated object of Jefferson's scorn, but tyranny of any kind—economic, physical, emotional, mental or spiritual—is anathema to the full expression of human life. No one wants to be tyrannized. If our goal is to bring forth a truly life sustaining world, then it is imperative that we understand the tyrannies of our time and the ways in which they undermine our hopes for a just, prosperous and healthy future.

Doing so places human-centered concerns at the heart of the contemporary conversation on "sustainability." Indeed, equity and fairness permeate all aspects of sustainability. Questions of social equity beget economic and ecological questions and the lenses of each can be used to examine each other. Economic activity, for example, has a huge social impact, which can be seen in the shifting fortunes of the public realm during times of prosperity or poverty. Social well-being is also dramatically affected by the health, or ill health, of ecosystems: Farmers with no water, buildings that make their inhabitants sick, coal-fired power plants releasing neurotoxins into the food chain—these are all forms of remote tyranny that oppress the life and liberty of workers, families and communities.

So how do we consider social factors when designing a building, a master plan for a site, or a housing complex? What about the materials used in building construction and the infrastructure that services the built environment? To begin, we can consider social factors right from the start, at the beginning of the design process. An architect designing a new facility might ask: Are the materials and products I am going to specify safe for all the people producing, installing and using them? Are all the people associated with the building earning a living wage? How will the facility affect the surrounding community?

But these questions alone will not ensure good, life-sustaining designs. They can ensure that social factors will be considered a fundamental element of the design process, but we need to remember to always consider the social realm in relation to economic and environmental concerns. To make any single area of concern a primary focus can distort the design process to the detriment of the whole, as we see in designs for energy-efficient buildings that pay scant attention to the impact of materials on human health. When we consider the rich connectivity of economy, ecology, and equity, however, we begin to notice the many ways in which their interplay generates unforeseen possibilities. We discover that we can create buildings that have a positive impact on the world--buildings that are not simply less polluting or less harmful to their inhabitants, but which generate a wide spectrum of beneficial, even regenerative effects.

This is not only possible, it's an effective, proven design strategy. Its practitioners, while maintaining the need to be practical and profitable in the conventional sense, are following Einstein's insight that no problem can be solved by the same consciousness that created it. So rather than trying to be "less bad" or more efficient within the framework of conventional design, they are innovating, enhancing the positive impacts of human activity and leaving the world a better place for having been here.

The impact of this shift is growing. In the realm of product design, we see safe, healthful materials that can be perpetually recovered and re-manufactured, effectively closing the loop on material flows. We see buildings designed to generate more energy than they consume and green-roofed manufacturing plants that create habitat, restore landscapes, and cost-effectively filter storm water while also providing safe, comfortable places to work. We see public facilities with operations that approach the effectiveness of natural systems which also offer delightful, refreshing places to meet, confer and learn. From this perspective, one can ask, not "How can I meet the minimum standards for building design?" but "How can I enhance the economic, ecological and social health of those who construct, work in, and live near my facility?"

Peter Drucker, the well-known management guru, has said that a manager's job is to do something right (to be efficient), but an executive's job is to do the right thing (to be effective). Once the executive defines the right thing to do—create a safe, healthful product people want; generate quality work by investing in people; develop policy that generates more benefits rather than fewer detriments—it becomes the manager's job to perform based on the strategy. Executives, therefore, have a strategic leadership role.

This book is designed with that role in mind. Its purpose is to encourage the development of meaningful strategies of change, to empower leaders to do the right thing. Through detailed analysis, case studies, and informed commentary it refines and expands the conventional understanding of sustainable development, giving policy-makers the tools they need to make intelligent choices today and chart an ethical, effective path into the 21st century.

William McDonough

William McDonough, FAIA
William McDonough + Partners

William McDonough was recognized by Time *magazine, in 1999, as a 'Hero for the Planet.' Mr. McDonough is the founding principal of William McDonough + Partners, Architecture and Community Design, an internationally recognized design firm practicing ecologically, socially, and economically intelligent architecture and planning in the U.S. and abroad.*

Oscar Weissbuch, "Snow and Sun," GSA Fine Arts Program.

Executive Summary

Theodore Wahl, "Midtown Tunnel Construction," GSA Fine Arts Program.

Executive Summary

The concept of sustainability has broader applicability than the environmental arena. In fact, like good governance, sustainability is fast becoming a cornerstone of public sector management.[1]

J. W. Cameron, Auditor-General, State of Victoria, Australia[1]

There are economic, environmental, and social issues associated with every business decision we make. Getting the best value for the American people means doing more than just the lowest first cost. It means understanding, acknowledging, and even celebrating the choices that the Government makes across the broad spectrum of its programs and responsibilities.

Achieving the Government's business goals, like those of GSA, includes the commitment to "carry out social, environmental, and other responsibilities as a federal agency."[2] Meeting this goal depends on making appropriate decisions. But, how can we be certain that we are making the right investments and getting credit for the right choices we make? We need to understand evolving models and business approaches and recognize the complexity of the task at hand. This publication discusses some of the challenges and explains some basic concepts that can help us make the right business choices and create a more healthful built environment.

The basic framework for decision-making exists in the form of life cycle cost analysis. Through its Circular No. A-94, the US Office of Management and Budget (OMB) applies benefit-cost and cost-effectiveness analyses to evaluate Federal programs and determine whether agencies have considered and properly dealt with all the elements. OMB's goal is to promote efficient resource allocation through well-informed decision-making by the Federal Government. The cost-effectiveness analysis helps us to make the right decisions by identifying the lowest costs, in ***present value terms***, based on life cycle cost analyses (LCC) of competing alternatives.

What we build provides visual testimony of our aspirations to future generations...

But, how we build them tells them who we are.

But, is the current application of LCC getting us to the right investment decisions? Traditionally, LCC has used the benefits and costs over the life of the material, asset, or program (including decommissioning or disposal) to evaluate investment decisions. However, we are learning that ignoring the "upstream" costs, leading up to our acquisition and "downstream" impacts after disposal of a product or service can omit major costs and impacts. We need to look at new ways of applying the traditional life cycle cost model if we are to make the right investment decisions.

Expanding the Definition

The simplest model for comprehensive consideration of life cycles is that of sustainable development. Its very definition, meeting "the needs of the present without compromising the ability of future generations to meet their own needs,"[3] guarantees the longest view of direct and possible side effects of our actions. To do this, we need to consider that the true life cycle cost looks beyond the life of the product or program.

Sustainable Development is widely recognized as an important business tool. As GSA Public Buildings Service Commissioner F. Joseph Moravec stated, in an OGP-produced video entitled *The Journey to Sustainability: A Conversation with Ray Anderson sustainability* "is fundamental and indivisible from our core mission, which is to provide a superior workplace for the federal worker and, at the same time, superior value for the American taxpayer."

In the 2000 *GSA Real Property Sustainable Development Guide*, we explained how today's successful businesses demonstrate an understanding of the environmental implications of their business functions by considering environmental issues as essential components of business processes, rather than consequences of those processes.[4] We wrote, "Sustainable development means integrating the decision-making process across your organization so that every decision is made with an eye to the greatest long-term benefit."[5] In 2000, our discussion of sustainable development focused primarily on business decisions and the environment. This publication, *Sustainable Development and Society*, aims to expand that definition.

Investment Decisions and Sustainable Development: Incorporating the True Life Cycle Costs of Societal Factors

By definition, the most economical choices are those that have the lowest life cycle cost. In order to make those choices, we should consider what really constitutes the "true" life cycle costs.

The complete sustainable development model, which considers "the simultaneous pursuit of economic prosperity, environmental quality and social equity,"[6] is a useful framework for informing the business decisions we all must make. The first two factors of the sustainable development triad, economic concerns and environmental stewardship, are well understood and are being applied effectively today--particularly in the area of facilities design and construction.

But more understanding of the third factor, societal needs – or social equity - is needed if this framework is to be applied effectively. Without such consideration, it is unlikely that we are making the most sustainable – or economical - decisions.

What is Social Equity?

Social equity is a broad topic that includes both individual and corporate responsibility. Common, in the longstanding discussion of social equity, are the ideas of people's "well-being," and "quality of life," "respect," - remembering the people and communities behind the products and services we use. Frederick Douglass, writing in 1881 for *North American Review*, said: "Neither we, nor any other people, will ever be respected till we respect ourselves and we will never respect ourselves till we have the means to live respectfully." The connection to sustainable development is clear. As Stephanie Luce, at the University of Massachusetts-Amherst, writes:

> *When policymakers talk about sustainable development, the emphasis is often on factors such as the impact of new building on the environment, the use of recyclable and renewable resources, and designing communities in order to minimize excessive transportation requirements and other sources of pollution. Often, the piece that gets ignored in the conversation is labor: the labor that is required in the actual building or production, as well as the working conditions of people who inhabit the community in question.*[7]

The World Business Council for Sustainable Development repeats similar themes:

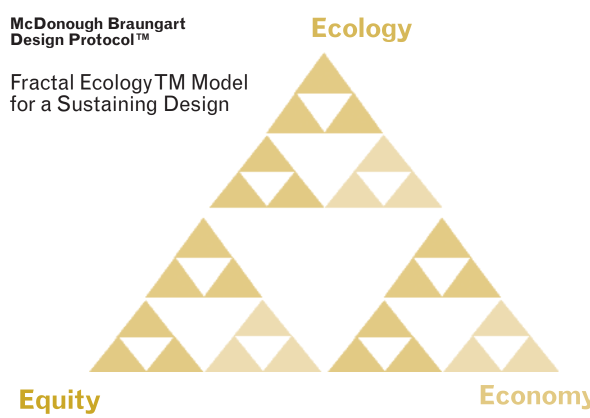
> *As an engine for social progress, Corporate Social Responsibility (CSR) helps companies live up to their responsibilities as global citizens and local neighbors in a fast-changing world. We define CSR as "business' commitment to contribute to sustainable economic development, working with employees, their families, the local community, and society at large to improve their quality of life. We are convinced that a coherent CSR strategy, based on integrity, sound values, and a long-term approach offers clear business benefits to companies and contributes to the well-being of society.*[8]

Factoring of societal issues such as respect, quality of life, and well-being into the sustainable development equation generally has not been addressed. Considering the complexity of the subject, this is not unexpected. But as our understanding of sustainability develops, opportunities exist for building more effective tools and strategies

Tools and Strategies

There are a growing number of useful tools and strategies to help us make more sustainable business choices. Some product-rating tools, such as the GREENGUARD Certification™, address single attributes such as indoor air quality. Others, like Green Seal, also focus primarily on environmental impacts, but are more comprehensive, covering each life-cycle stage.

A comprehensive tool for evaluating the sustainability of products and services in everyday business decisions is the



McDonough Braungart Design Protocol™ Fractal (discussed in William McDonough's article, "The Ecology Of Sustainable Design," below), which enables us to model the basic elements of sustainable design – Economy, Ecology, and Equity -- as well as the more complex interactions.

In this model, the basic questions posed at the corners of the fractal are:

- **Ecology:** Does the product return to a reusable or biodegradable state?
- **Economy:** Can we make it and sell it at a profit?
- **Equity:** Are employees treating one another with respect?

The secondary questions posed by this fractal model are the most useful for identifying societal needs:

- **Economy - Equity:** Are our employees earning a living wage?
- **Equity - Economy:** Are men and women paid the same for the same work?
- **Equity - Ecology:** Are employees and customers safe making and using our products?
- **Ecology - Equity:** Is our production safe for the local and global communities?
- **Ecology - Economy:** Are we making effective use of our resources?
- **Economy - Ecology:** Are we being efficient with our use of resources?

A Starting Point

To begin the conversation on sustainable development and society, this publication will try to address the issue of "safety," and how it affects real property owners and operators making investment decisions regarding the design, construction, operation, maintenance and final disposal of their real and personal property. The two relevant questions are:

- Are employees and customers safe making and using the products we specify? And, are our tenants safe?
- Are the production and use of those products safe for the local and global communities?

In the 1980's, in response to high energy prices, we sealed our poorly ventilated buildings without consideration of off-gassing materials. This resulted in costly

The Business Case for Sustainable Design in Federal Facilities
US Department of Energy Federal Energy Management Program (FEMP)[9]

The Benefits of Sustainable Design and Construction	
Economic Benefits	**Social Benefits**
• Lower (or equal) first costs	• Health, comfort, and wellbeing of building occupants
• Decreased annual energy costs	• Building safety and security
• Reduced annual water costs	• Community and societal benefits
• Lower maintenance and repair costs	**Environmental Benefits**
• Better productivity and less absenteeism	• Lower air pollutant emissions
• Indirect economic benefits to the building owner, e.g., lower risk, ease of siting, and improved image	• Reduced solid-waste generation
• Economic benefits to society, e.g., decreased environmental damage costs, lower infrastructure costs, and local economic growth	• Decreased use of natural resources
	• Lower ecosystem impacts

health problems that are finally being addressed by sustainable design, which integrates the issues of energy and indoor air quality. Our publication, *Innovative Workplace Strategies*, discussed the importance of creating healthy work environments using sustainable principles, finding that providing healthy indoor environment can support worker well-being.

As we are creating healthy and productive work environments for our tenants, we should also be concerned with the living standards, environmental health, and occupational safety of those who produce and install the products that go into our facilities, those who maintain operate and maintain them, their communities, and society as a whole.

The publication that follows will help you to answer these questions by explaining two of the basic underlying concepts: present-value lifecycle cost analysis and assessment, and toxics. Tools to assist in making informed choices are presented, along with strategies and case studies for their application. However, the opinions expressed in the articles are those of the authors alone and do not necessarily reflect the official position of GSA.

The Government is eliminating toxic materials where they threaten existing communities and minimizing the use of materials that generate toxics that threaten the environment.

Even as we are specifying the most up-to-date and seemingly economical products for construction, operation and maintenance, we should be aware of their composition and methods of manufacture. Old formulations can be reengineered to eliminate known, hazardous components. New components can be selected in a way that avoids creating new hazards.

Every building product or process has an equity component associated with it. Understanding of true life cycle costs, including economics, environmental impacts, and equity, will enable Federal agencies to make more enlightened decisions so that they "do not underinvest in new projects or maintenance of existing assets that support high priority agency missions and services to the public,"[9] as required by the OMB.

Who We Are:

The Innovative Workplaces Division in the Office of Real Property, Office of Governmentwide Policy, seeks to encourage development of Federal workplaces that embrace innovative design, operation and management by developing innovative strategies to mainstream integrated design, sustainability, telework and performance measurement.

Notes:

1. "Beyond The Triple Bottom Line: Measuring and Reporting on Sustainability," Occasional Paper, Victoria Auditor-General's Office, Melbourne, Australia, June 2004. www.audit.vic.gov.au, ISBN 0 9752308 2 4.
2. GSA's "Mission, Values, and Goals" are listed at www.gsa.gov.
3. United Nations' World Commission on Environment and Development, the "Brundtland Commission."
4. "GSA Real Property Sustainable Development Guide," 2000, p. 5.
5. Ibid, p. 6.
6. World Business Council for Sustainable Development website, Definitions, www.wbcsd.ch, 2000.
7. Stephanie Luce, "Why Living Wages Are Part of Sustainable Development," Unpublished paper, 2004.
8. World Business Council for Sustainable Development website, www.wbcsd.ch. 2004.
9. U.S. Department of Energy Federal Energy Management Program (FEMP) in collaboration with the Interagency Sustainability Working Group, 2003 (August): The Business Case for Sustainable Design in Federal Facilities, page vi
10. OMB Memorandum M-97-18, Capital Programming Guide, Supplement to A-11, Part 3, July 22, 1997.

True Life Cycle Costing

The Government and Life Cycle Cost Analysis

Seymour Fogel, "Security of the People," GSA Fine Arts Program.

The Government and Life Cycle Cost Analysis

How do we most effectively plan and carry out agency missions, fully considering the external factors that could affect the achievement of long-term goals? How does the Federal budgeting process support those goals? The Office of Management and Budget's (OMB) "Principles of Budgeting for Capital Asset Acquisitions," stresses that assets should be justified primarily by benefit-cost analysis, including life cycle costs, and that all costs are to be understood in advance. This approach works, but only if we broaden our understanding of the key terms and are aware of limitations in current interpretations.

Life Cycle Cost (LCC)

The traditional Life Cycle Cost (LCC) model, allows us to make business decisions based on expenses over the life of the material, asset, or program. OMB's Benefit-Cost Analysis allows us to select the best alternative by quantifying benefits and costs in monetary terms, wherever possible, with benefits linked to program goals and needs. Benefits and costs are estimated over the full life cycle of each alternative considered. Life cycle costs, as defined by OMB, include all initial costs, plus the periodic or continuing costs of operation and maintenance (including staffing costs), and any costs of decommissioning or disposal. Life cycle cost analysis is more than simple payback.

Investment alternatives are evaluated using a net present value criterion. Qualitative evaluation considerations — such as regulatory requirements, business strategy, or unquantifiable social benefits or costs — may override quantitative criteria in OMB's final ranking of projects. Even when the monetary value of benefits or costs cannot be measured, physical quantification may be feasible and should be pursued. When the benefits of alternative investments are the same, cost-effectiveness analysis may be used to rank alternatives. An investment is most cost effective when it has the lowest discounted present value of life-cycle costs for a given stream of annual benefits. When benefits are different, the most cost effective investment is the one that has the highest discounted net (of cost) benefit.[1]

In recent years, a major concern has arisen regarding the usual application of life cycle cost analysis. By focusing only on, in the case of goods and services, the life of a product, technology or system, major costs and impacts are overlooked. Currently, decisions on whether or not to invest in a green building are typically based only on first costs plus, in some cases, a discounted value of lowered energy and water bills.[2]

OMB Definitions

Benefit-Cost Analysis *-- A systematic quantitative method of assessing the desirability of government projects or policies when it is important to take a long view of future effects and a broad view of possible side-effects.*

External Economy or Diseconomy *-- A direct effect, either positive or negative, on someone's profit or welfare arising as a byproduct of some other person's or firm's activity. Also referred to as neighborhood or spillover effects, or externalities for short.*

Life Cycle Cost *-- The overall estimated cost for a particular program alternative over the time period corresponding to the life of the program, including direct and indirect initial costs plus any periodic or continuing costs of operation and maintenance.*

Net Present Value *-- The difference between the discounted present value of benefits and costs. Discounting factor translates expected benefits or costs in any given future year into present value terms. . . . The discount factor is equal to 1/(1 + i)t where i is the interest rate and t is the number of years from the date of initiation for the program or policy until the given future year.*

Source: Circular No. A-94, Revised, (Transmittal Memo No. 64), October 29, 1992, Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs.

Life Cycle Assessment (LCA)

Life Cycle Assessment (LCA) expands the traditional, limited focus of Life Cycle Cost (LCC) analysis, and allows us to make business decisions based, not only on expenses over the life of the material, asset, or program, but also on the environmental impacts of our choices. LCA looks at environmental upstream (extraction, production, transportation and construction) use, and downstream (deconstruction and disposal) flows of a product or service. Global and regional impacts of a particular activity are calculated; based on energy consumption, waste generation and a series of other impact categories (e.g., global warming, ozone depletion, and acidification), and integrated through a consistent application of financial discounting.[3]

There are a number of green building assessment tools for evaluating building performance across a large range of green performance criteria.[4] Two are gaining acceptance by U.S. designers: Athena™, a Canadian core and shell assessment tool,[5] and BEES™, the U.S. National Institute of Standards and Technology's (NIST) building materials selection tool.[6] European tools include LEGOE from Germany, an LCA program that runs in the background with CAD software,[7] and EcoQuantum from Holland.[8]

NIST's BEES® (Building for Environmental and Economic Sustainability) tool, is aimed at designers, builders, and product manufacturers, includes environmental and economic performance data for 65 building products across a range of functional applications. Its multiple-attributes approach avoids some of the pitfalls of selections based on a single attribute (such as recycling). Its assessments are based on a functional unit basis, so that compared products are true substitutes for one another. It discounts small amounts of negative materials in otherwise benign products; and helps to avoid short-lived, low first-cost products that are often not the cost-effective choice.

Professional rigor is required for correct application of LCC analyses. But, the evolving discipline of LCA is even more complex. Tom Lent's article, below, discusses some of the challenges that still remain in their use.

Equity and Life Cycle Assessment

Life Cycle Assessment is developing as a superior tool for incorporating both economic and environmental impacts of our in our business decisions. But where does the third leg of the sustainable triad – Equity – enter the analysis? In order to be sustainable, we need to address; not just cost reduction and economic opportunity, and environmental protection and resource conservation, but also improving the quality of life for individuals, communities, and society as a whole.

And the private sector is moving in this direction, too. According to the CoreNet Global industry research and leadership initiative known as Corporate Real Estate 2010, ninety percent of the Fortune 500 companies will adopt "triple bottom line reporting," which means that companies will be measured by social responsibility, environmental sustainability and profit.[9]

Once we have made the most economical and environmentally healthy choices, we need to know the impact of those “green” products on the communities in which they were made, on those who fabricate and install them, and on those who operate and maintain them.

Greg Norris's article, below, describes an approach for estimating the health consequences of the development impacts of sustainable consumption policies and the design of goods and services and how the topic fits into sustainable development.

Notes:

1. Circular No. A-94, Revised, (Transmittal Memo No. 64), October 29, 1992, Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs.
2. The Costs and Financial Benefits of Green Buildings, A Report to California's Sustainable Building Task Force, 2003 (October), Life Cycle Assessment (LCA), p.8.
3. Evaluation of LEED™ Using Life Cycle Assessment Methods, NIST GCR 02-836.
4. For an extensive international listing of green building evaluation tools, see http://buildlca.rmit.edu.au/links.html.
5. Athena Version 2.0 Environmental Impact Estimator. 2003. Available at: http://www.athenasmi.ca/.
6. BEES Version 3.0 is available at http://www.bfrl.nist.gov/oae/software/bees.htm.
7. In German at: http://www.legoe.de.
8. In Dutch, from the Environmental Institute at the University of Amsterdam (IVAM). An older version is available in English at: http://www.ivambv.uva.nl/uk/index.htm.
9. “Dramatic Changes Predicted for the Corporate Real Estate Function in 2010,” March 5, 2004, Global Press Releases, Press Release 38, CoreNet Global.

True Life Cycle Costing

Socio-Economic Impacts in Product and Building Life Cycles: Broadening from Environmental Life Cycle Assessment (LCA) to Sustainable LCA

Charles Ernest Pont," Coal Breaker," GSA Fine Arts Program.

Socio-Economic Impacts in Product and Building Life Cycles:

Broadening from Environmental Life Cycle Assessment (LCA) to Sustainable LCA

By Gregory A. Norris

Gregory A. Norris, Ph.D., is President of Sylvatica, a company specializing in Life Cycle Assessment, Industrial Ecology, Sustainable Consumption, and Scenario Analysis, in North Berwick, Maine. Since 2000, he has also been a Visiting Scientist at the Harvard School of Public Health. He is also the Manager of the UNEP|SETAC Life Cycle Initiative Life Cycle Inventory Program, LCA Science Advisor to the Athena Sustainable Materials Institute, Ottawa, Canada, and Editor of the International Journal of Life Cycle Assessment. www.sylvatica.com|www.newearth.info

Abstract

Health is a primary human need; it is also a primary indicator of levels of satisfaction of other basic human needs; and, it is an enabler of development. Consumption behavior by one person or nation has impacts on the economic activity and development of other persons in the same nation and around the world. These economic development impacts have been shown to have a major influence on health through two primary pathways: reduction of income poverty, and increased public investments in human development and basic infrastructure. This paper describes a modified approach for estimating the health consequences of the development impacts of sustainable consumption and the design of goods and services.

We call this modified approach to Life Cycle Analysis (LCA), "Life Cycle Development (LCD)." LCD has many applications: it can associate development impacts with eco-labeling, including relating trade barriers to sustainable consumption and production; and integrate with today's methods and databases for life cycle assessment. The paper summarizes the ideas behind LCD, the basic method, initial results, and future applications. We stress the importance of creating interdisciplinary teams and projects to enrich and improve the method through practical case study applications.

Background

The environmental movement of the late 20th century was concerned about energy depletion, water and air pollution, and mounting flows of post-consumer packaging wastes. As part of the response, teams of engineers and physicists in the US and Europe, began to analyze the environmental and resource implications of increasingly popular disposable, plastic packaging. This process resulted in a methodology that in the 1990s came to be called environmental life cycle analysis (LCA).

With the rise of "product policy" and "extended product (or producer) responsibility" during the 1990s, LCA shifted from a little-known "cottage industry" to become an internationally standardized analytical tool in support of environmental management. LCA is now used by thousands of companies, many governments, consumer and environmental groups, and others to explain the "cradle-to-grave" environmental consequences of product-related decisions.

In 2002 the government leaders and representatives from industry and civil society met at the World Summit on Sustainable Development in Johannesburg. One outcome was the "Plan of Implementation for Changing Unsustainable Patterns of Consumption and Production," whose key elements included a call to "Improve the products and services provided, while reducing environmental and health impacts, using where appropriate, science-based approaches, such as life-cycle analysis." Thus LCA, originally developed to inform environmental policies at the dawn of modern environmentalism, was called upon to assist the current search for sustainable patterns of consumption and production.

Recently it has become common to refer to the "three pillars" of sustainable development: economic growth, ecological balance, and social progress.[1] Traditional LCA has addressed only the environmental pillar. However, integrating economic modeling and a "what-if" perspective opens up the potential to address more of the sustainability agenda, helping to avoid "burden shifting" among the social, environmental, and economic objectives, and potentially helping to build a broader base of support for policy proposals by addressing the concerns of a broader group of stakeholders.

There are several ways in which this expansion can take place. By integrating economic models and databases, LCA can address impacts and performance measures which are routinely tracked at the economic sectors level rather than through engineering unit processes. An example of such an impact group is occupational health and safety. A recent investigation concluded that occupational health and safety issues and incidents in product supply chains may be in the same order of magnitude as the expected near-term human health consequences of supply chain pollution releases.[2] That paper also pointed to the clear need to develop better reporting systems and databases on occupational impacts in industrialized and non-industrialized economies.

Secondly, integrating this modeling approach allows us to acknowledge that product supply chain activities bring benefits as well as burdens for the agenda of sustainable development. Sustained increases in economic output among developing countries are linked to major gains in human health through the mechanisms of income-poverty reduction, increased investment in and access to education, and increased public investments in the public health infrastructure.[3] Traditional LCA, focused strictly on pollution impacts and blind to development benefits, is seen by some sustainability analysts from developing countries as biased against their primary concerns. By addressing the benefits of economic development alongside the costs of pollution and resource degradation, extensions of LCA have the potential to meet these concerns and to point to truly sustainable solutions to the challenges of consumption and production in the 21st century.

Impacts of Development on Health

Life Cycle Assessment (LCA) is a quantitative and comparative method for supporting the identification of environmentally preferable product choices and design options. At the core of LCA is the concept of the "functional unit": a quantitative measure of the amount of function delivered by a product system or service. LCA as currently practiced takes the delivery of a specified unit of function as a given, then informs inquiries about the total system-wide environmental consequences of delivering this function via alternative product systems; thereby allowing consumers to select "greener" (that is, less environmentally damaging) products, and producers to manufacture greener products.

LCA's primary advantage lies in its ability to help decision makers avoid "burden-shifting" from one environmental problem to another or from one life cycle stage to another. The current impact scope of LCA is restricted to three "endpoints" of concern: human health, ecosystems, and natural resources, focusing on those human health impacts that arise through *environmental pathways* from stressors in the product life cycle.

In addition to environmental pathways, there are also important *socio-economic pathways* from product life cycles to human health consequences. The 2002 European Health report underlines the relation between socioeconomic factors and health. Poverty, in particular, is recognized as "the most important single determinant of ill health." The report notes the influence of gross domestic product (GDP) on health at the national level, and explained: "While GDP [has] a significantly positive correlation with life expectancy, this relationship works mainly through the impact of GDP on (a) the incomes of the poor and (b) public expenditure. . . "[F]aster economic growth with a strong employment component [leads to] the enhanced economic prosperity being used to expand relevant social services such as education, social security and health care... Unemployment as a cause of poverty and ill health is a major issue in all European countries."[4]

The importance of poverty in the global burden of disease is even clearer in the World Health Organization's (WHO) 2002 report, that found, "In both Africa and Asia, unsafe water, sanitation and hygiene, iron deficiency, and indoor smoke from solid fuels are among the ten leading risks for disease... As with underweight, these risks continue to be some of the most formidable enemies of health and allies of poverty."[5]

Health and socioeconomic status influence each other in a vicious/virtuous cycle, as increases in health promote economic development over time. Research shows that countries with weakest conditions of health and education find it much more difficult to achieve sustained growth than do those with better conditions of health and education.[6]

Extending the definition of LCA will enable it to capture the influence of product life cycles on health through the pathways summarized by the WHO reports mentioned above. When a consumer buys a product; or when a producer manufactures the product, these decisions have consequences throughout whole supply chains and life cycles—impacts that change ***the levels of activity*** in processes throughout their supply chains and life cycles. Activity levels are measured in both physical units (e.g., increased production) and economic units (increased sales).

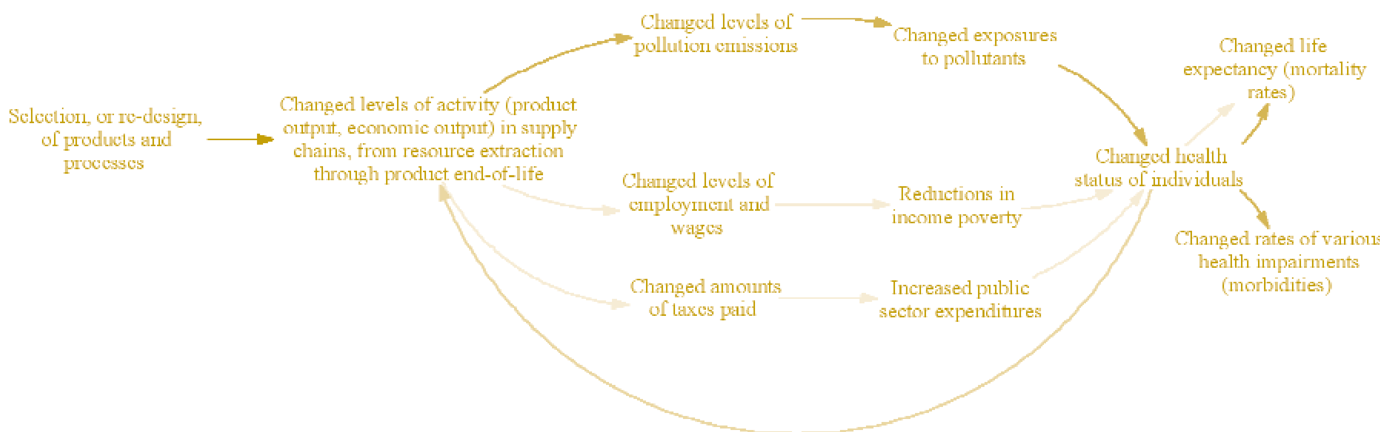


Figure 1: Pathways from product decisions to human health outcomes

Pathways from product decisions to human health outcomes are charted in Figure 1. The blue arrows indicate the pathways traditionally modeled in LCA, from process activity levels to human health. These pathways start with increased pollution emissions, leading to changed levels of human exposure to hazardous substances. The final health impacts may be measured strictly in terms of mortality impacts (e.g., life-years lost) or may also include non-lethal impacts on health (impaired functioning, chronic pain, and myriad other morbidities).

Green arrows indicate the new pathways, addressed in this paper. It shows how changed levels of economic activity throughout the supply chain lead to the two impacts on socioeconomic pathways to health. For example, increased output will increase employment and/or wages, as well as tax receipts by the government. These in turn will reduce income poverty, and thereby increase individuals' health status *if the wage and employment benefits reach people who are otherwise in poor socioeconomic status*. Likewise, increased tax receipts by the government can improve health *if the increased receipts cause an increase in health-promoting public investments*.

Figure 1 also includes a "feedback loop" from health status to levels of economic and productive activity. Impacts of health on economic growth over time are not typically modeled in LCA, and they are ignored in this paper as well. We also ignore the important influence that socioeconomic status has on morbidity, focusing instead on the long-term influence of the green pathways on the well-known relationship between life expectancy and per capita gross national product (GDP).

Long-term benefits of an incremental increase in GDP vary significantly by country. In general, in countries below $5,000 per capita GNP, there is a very steep influence of economic growth on life expectancy; while above $5,000 per capita, the influence becomes much slighter.

Application

Step 1: Including Economic Activity Levels in LCA

The first step is to include an accounting of economic activity stimulated in different countries, or sets of countries, grouped by current GNP per capita, using multi-national input/output LCA models. Process LCA databases can be augmented with economic data as well. The only need is to obtain and record, for each process, the economic value of the process output. This can be done when gathering and using new and existing LCI database data on prices.

Step 2: Including Socio-economic Pathways in LCIA

Step 1 shows how life cycle inventory analysis can be augmented to include economic output data in the supply chain of a product. The next step is to develop a model capturing the relationship between life expectancy and per capita GDP.[7] We arrive at an estimate for the number of life years saved due to an increase in per capita GDP through an equation that expresses a change in life years as a function of a change in total economic output, or GDP, for a given country. "Characterization factors" can be used together with the economic inventory data to compute life-years of impact through the "green arrow" socio-economic pathways of Figure 1. These life-years of health benefit can be compared with the pollution-related life years of damage to compute a more complete estimate of the health consequences of product life cycles.

Illustrative Application

Applying this method, we can estimate the health consequences of pollution in the total (global) supply chain and compare them with the health consequences of increased economic activity. LCA, as previously noted, provides information about impacts on at least three separate areas of concern: human health, ecosystem health, and resources. Our present focus on the human health endpoint reflects the fact that we are adding a new impact pathway to this endpoint, and is not meant to imply that human health is the only important endpoint in LCA.

The model can show the regional distribution of the economic activity in the supply chain of a product, and most importantly, the impacts upon health, as we show in our study of health consequences of pollution in the global supply chain of Dutch electricity. Comparing these impacts with the health consequences of increased economic activity, we found that approximately two-thirds of the total economic activity stimulated by the entire supply chain occurs within the Netherlands; 20% occurs in other OECD countries, and less than 10% reaches non-OECD countries. Although the fraction of supply chain *economic* activity reaching developing countries is small in this example, we found that the fraction of supply chain *development impacts upon health* was expected to be very large.

The expected distribution of health impacts of pollution is not too dissimilar from the expected distribution of economic activity. Our modeling approach captures the different mix of processes and emission factors for the different regions as contained in the life cycle inventory database of processes.

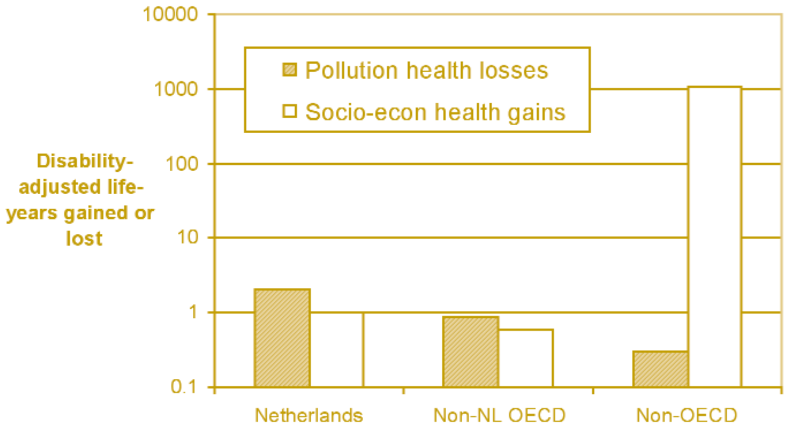


Figure 2: Geographic distribution of pollution health losses and development-base health gains in the supply chain of $1M of Dutch electricity

Figure 2 reports both the health damages due to pollution releases and the health benefits from the increased economic activity in the supply chain of Dutch electricity. The colored bars represent damages, while the white bars represent benefits. Both are plotted as positive impacts numerically because we are using a logarithmic scale; this in turn is due to the fact that the health benefits in the non-OECD region of the world *dwarf* the health benefit and cost impacts in the remaining regions.

Discussion about Applying the Method[8]

The preceding section demonstrated that it is both practical and important for LCA to begin to include socio-economic pathways to health. Here we discuss how the method might be applied in actual practice, by stakeholders and decision-makers.

First, we make the following observations about the methodology and its initial results:

- The method is applicable with today's LCAs, as long as the user can estimate total economic output induced per country in the supply chain of each product alternative. Economic output can be used to compute national-level estimates, summed over the supply chain, to estimate total development-based health benefits in a product's life cycle.
- Supply chain economic estimates require that life cycle inventory (LCI) databases or models report (or estimate) the location of processes; they also require that LCI databases contain estimates of the total economic value of process outputs.
- The modeling is extremely provisional, preliminary, and incomplete (see next section), and must be further developed by an interdisciplinary effort.

We now sketch some of the ways that improved and refined versions of this method might be used.

Conventional LCA

Once an improved, peer-reviewed, set of factors has been developed by an interdisciplinary effort, the factors could be employed directly within existing methods for Life Cycle Impact Assessment within conventional LCA software. Anyone performing an LCA using such tools will be able to estimate the development-based health impacts of product life cycles, along with the pollution-based impacts. Since the method, as now designed, takes into account differences in expected impact based on the national location of the economic activity, the same table of factors could be integrated into LCIA methods from all regions of the world.

The new modeling capability called for by this method would be the ability of users to easily "tag" processes within supply chain models as being located in a given region or country. LCA modelers often combine new primary LCI data with links to existing databases. A user might gather information about the location of 3rd tier suppliers, without gathering detailed process inventory data for these suppliers. They would then use existing process data for these suppliers, but would want to modify the specified locations of these processes and their economic output.

Ecolabels

Once the impact assessment method has been advanced and peer reviewed, and there is sufficient accumulation of experience and data to support its use within LCA, the development-based impacts of product life cycles on health can be included in the LCA results that are used to support ecolabels. This could be true for both the so-called "type 2" as well as "type 3" (Environmental Product Declaration) labels.

Including development-based impacts into LCA may significantly improve the acceptance of ecolabeling and of life cycle-based approaches to sustainable consumption and production among the industrializing and developing countries. If ecolabels and life cycle methods begin to address more fully the impacts of development, both positive and negative, then this suspicion and resistance may lessen.

More to the point, consumers and policy makers presumably want ecolabels to provide guidance on how purchasing decisions can make the world a better place. Including major health consequences from product supply chains in ecolabels and LCA results will provide consumers and decision makers with a more complete basis for action and choice. This will make them more effective at using their consumption power to help bring about the desired sustainable development outcomes.

Next Steps in Advancing the Method

While the factors reported our study might be used in some initial case studies, a more proper use of them is as a stimulant to deeper, multi-disciplinary research directed at improving the modeling and the resulting factors. This follow-on research will not only change the values in the table. It may even call into question the qualitative conclusions that appear to be indicated by this first round of investigation:

- Long-term socio-economic pathways from product life cycles through economic development to health benefits may dwarf the health damages from environmentally mediated pollution in developing countries for some product life cycles and supply chains; and
- Long-term socio-economically-induced health gains from product life cycles in developing countries may dominate the overall global health consequences of product life cycles, at least for some product life cycles and supply chains.

There are several classes of limitation to our first-round research, which must all be addressed before we are able to develop confidence in these tentative conclusions.

Specific Social Impacts

Economic development does not occur in a vacuum. The construction and operation of a major factory in most locations on earth -

in industrialized countries and especially in developing countries - will have significant impacts on lifestyles, social dynamics, and even the culture of the affected region.

The preliminary results presented earlier indicate that the *average, long-term* influences of socio-economic development on health can be at least as powerful as the pollution consequences of the related processes. Combine this finding with the reality that there are profound differences in the social influences of new economic output per year from one factor and location to another, and this study argues for extreme caution, and for the use of as much case-specific information as possible when actually performing socio-economic impact evaluations within LCA.

In summary, the preliminary investigations reported in this chapter indicate that LCA's current blind spot regarding socio-economic pathways to health is neither necessary nor advisable. It is not necessary because a practical prototype solution has been successfully demonstrated and applied. It is not advisable, because preliminary results from this prototype method indicate that the influence of these pathways can be highly significant. At the same time, the powerful influence these pathways means that they should be modeled with responsible care within LCA, that methods for doing so should be developed and widely peer reviewed by interdisciplinary teams, and that rigorous case studies should be performed as part of this development and evaluation process.

Notes:

1. World Business Council for Sustainable Development, 2003. http://www.wbcsd.ch/aboutus/index.htm.

2. P. Hofstetter and G. Norris, 2003: Why and How Should We Assess Occupational Health Impacts in Integrated Product Policy?" Environmental Science and Technology 37(10):2025–35

3. World Bank, 2002: World Development 2000-2001. Washington, DC: World Bank.

4. WHO Europe, 2002. European Health Report 2002 (Copenhagen).

5. WHO 2002: World Health 2002 (Geneva: World Health Organization), pp. xiv–xv.

6. WHO, Commission on Macroeconomics and Health, 2001. Macroeconomics and Health: Investing in Health for Economic Development (Geneva: World Health Organization).

7. Details of this derivation are provided in Gregory Norris, Addressing the Health Impacts of Economic Development in Product Life Cycle Assessment, Journal of Industrial Ecology, 2004 (forthcoming).

8. The method of accounting for the development impacts of product supply chains on health is straightforward and practical in the present, and the magnitude of these impacts appears likely to be important enough to warrant serious attention within LCA. 2. Any near-term applications of the present method and the factors should be done in the spirit of exploratory research, with the intent to generate further discussion, examination, and refinement of the method, rather than generating results that are then treated as "truth."

Frank Vanacore, "Scrap Iron," GSA Fine Arts Program.

True Life Cycle Costing

Toxic Data Bias and the Challenges of Using LCA in the Design Community

Howard Norton Cook, "Steel Industry (detail)," GSA Fine Arts Program.

Toxic Data Bias and the Challenges of Using LCA in the Design Community

By Tom Lent

Tom Lent is healthcare project coordinator for the Healthy Building Network, a national network of building and design professionals and environmental health specialists and activists working together to advance the use of ecologically superior building materials.

Overview

Awareness is growing in the design community of the need to account for impacts, throughout the life cycle, when assessing the environmental characteristics of materials. Until recently, Life Cycle Assessment (LCA) tools were inaccessible to most, due to their complexity and use of expensive, proprietary databases. Now, with the development of software tools such as BEES 3.0®, relatively simple, affordable tools are becoming available to the design community. This is a good first step. However, challenges still remain in their use.

This paper outlines some important inherent structural constraints on the ability of LCA to address a range of toxic chemicals and their related human health issues. It particularly focuses on toxicity hazards that are known by science to be serious environmental health problems but remain poorly quantified or otherwise not readily managed in an LCA framework. It explores how these LCA constraints can guide the user away from a good understanding of the full environmental health impacts and can lead to materials decisions that do not actually reflect the user's environmental goals. It also suggests approaches to overcome these problems before LCA tools are used broadly by the design community or incorporated into green building tools such as LEED®. The goal is to ensure that these tools serve the design community reliably and assure that their use does not undermine the environmental and health goals they seek to promote.

LCA: Power of the Double-Edged Sword

Quantitative LCA tools have progressed tremendously and have become an effective means for systematic internal industrial design analysis. When carried out by an individual manufacturer using datasets they understand and manage, these analyses can provide excellent insight into the impacts of alternative design pathways and can be powerful tools for identifying environmental impacts and selecting optimal design directions.

The application of these tools to material selection by the design community, however, presents significant challenges. The power of the LCA tool lies in the wide-ranging scope of its analysis, encompassing a large number of factors through which a building material can impact the environment throughout its life cycle. At this stage of development, however, this scope can be a double-edged sword. Descriptions of LCA typically imply that the analysis is complete, describing LCA as the analysis of the *total* environmental impact of a product through every step of its life.[1] While LCA designers are striving mightily to improve the accuracy of their estimates and approximations, LCAs can never live up to the expectation set by such descriptions, of total analysis. By definition, LCAs must always have boundaries limiting the impacts they attempt to model and are highly dependent upon industry and science to provide useful data to drive the models. If users don't understand these limitations, they may assume that LCA tools are providing a comprehensive, unbiased and final analysis of all of the environmental impacts resulting from production, use and disposal of a material--thereby creating a false sense of security and ending the need to ask further critical questions. In reality, serious data and analysis limitations inherent in current tools can lead them to strong but hidden biases for materials with major environmental health impacts that are as yet inadequately quantified or where acceptable health and safety threshold limits are in flux and dispute. Persistent, bioaccumulative toxic (PBT) chemical releases are one key area that is highly problematic to accurately represent in a quantitative assessment.

Reversals through uncertainty: Two Case Studies

A case study will demonstrate how the effects of data uncertainty can dramatically affect LCA results. In fact, results can be totally reversed.

Eutrophication (excess nutrient runoff) vs. Ecological toxicity

One established LCA tool is the BEES® (Building for Environmental and Economic Sustainability) model, developed by the Building and Fire Research Laboratory of the National Institute of Standards and Technology. It considers over 400 material and energy flows, from raw material extraction through product disposal, to evaluate the environmental and economic performance of building products. BEES evaluates 12 environmental impacts: global warming, acidification, eutrophication[2], fossil fuel depletion, indoor air quality, habitat alteration, criteria air pollutants, water intake, ozone depletion, smog, human health, and ecological toxicity. The tool is based on consensus standards and designed to be practical, flexible, and transparent.

BEES allows for the fact that all environmental impacts are not of equal import, and provides the option of using one of two different weighting schemes developed by a US EPA Scientific Advisory Board or Harvard University, or a user defined scheme. As interpreted in BEES, the US EPA weighting scheme suggests that global warming impacts are more than three times as important as ozone depletion impacts.[3]

Using this approach, the BEES model appears to rate vinyl composition tile (VCT) as much more environmentally sound than linoleum. The Vinyl Institute concludes that:

> *The results show VCT ranks 20 to 30 percent higher in environmental performance and 90 to 170 percent higher in economic performance. Criteria for the rating include indoor air quality, solid waste, acid rain, global warming and natural resource depletion. The BEES model for evaluating building products has been adopted as an official tool of the U.S. Green Building Council, and is used by architects, builders, contractors and other specifiers who want to select environmentally friendly products.*[4]

Applying the US EPA weighting criteria to the analysis reduces the spread between the two flooring types - but not enough to change the story. Linoleum still appears to have more than twice the environmental impact of VCT (0.333 for linoleum vs. 0.153 for VCT). For the designer with thousands of materials to specify, this could be the end of the story.

A deeper look at the numbers within the BEES model, however, reveals a different story. Comparing each BEES impact category for the two floorings reveals that VCT ranks lower than linoleum in every category except eutrophication (with impact factors from 1.4 to 8 times higher). In this analysis, the eutrophication impact for linoleum is calculated to outweigh all other categories combined. Eutrophication is indeed a significant environmental problem, affecting aquatic life. The BEES results, however, raise two important questions: Does linoleum's contribution to eutrophication really outweigh the human health issues raised by the polyvinyl chloride life cycle and are LCA tools even capable of actually making this comparison yet?

A look at one of the health impact concerns at issue in the life cycle of polyvinyl chloride will help make clear the challenges faced by LCAs in properly evaluating the health impacts of materials. Dioxins are an unavoidable byproduct of the manufacture of polyvinyl chloride (PVC) feedstock (the raw materials) used to manufacture VCT, and of the combustion of PVC products.[5] The U. S. Environmental Protection Agency has concluded that, based on all available information, dioxins are potent animal toxicants with potential to produce a broad spectrum of adverse effects in humans. These include, for example, adverse effects upon reproduction and development; suppression of the immune system; chloracne (a severe acne-like condition); and cancer.[6]

For an LCA to accurately capture and evaluate the health impacts of dioxin releases from the life cycle of VCT, LCA planners must know how much dioxin is emitted by an average pound of PVC though its life cycle. Science is still very early in its efforts to quantify dioxin flows in the environment. A tremendous volume of projected dioxin flows from various sources is known to exist, but has not yet been quantified reliably enough to be included in the official EPA assessment. There are many known sources, like incinerators, smelters, chlorine-based chemicals manufacture, and others; but additional sources, like landfill fires, may also contribute significant quantities of dioxin per year.[7]

The human health factor rating in BEES for dioxin is more than 10,000 times higher than the next highest chemical (diethanolamine) and a million or more times greater than the remainder.[8] A small difference in estimates of dioxin flows can have a massive impact on the outcomes. Increasing the dioxin flow factor in BEES for VCT only by a factor of three would be sufficient to totally eliminate the environmental advantage that BEES indicates for VCT over linoleum in the initial comparison.

There are similar data concerns (except in the opposite direction) on the linoleum side about whether the massive eutrophication impact that BEES displays is correct. Resolution of these possible discrepancies could also reverse the results of the BEES analysis in linoleum's favor.[9]

This is not meant to dismiss LCAs as a useful tool for the designer. This case study, however, also demonstrates that any use of LCAs as a tool to compare materials must be informed by knowledge of where flows are poorly characterized or totally missing and the potential impact on the LCA of those flows. Failing to do this ensures that, at least in some cases, the LCA comparison will serve to mask the worst environmental impacts, rather than clarify the tradeoffs and relative merits of the materials. In so doing, uninformed LCA use can be expected to lead to environmentally detrimental material choices.

More Missing Data: Maintenance Challenges

Dioxins are not the only significant flows unmeasured by LCAs. Another example is the emissions from flooring materials over the lifetime of the installation. Most LCAs base their flow assumptions about flooring emissions on the total of volatile organic compounds (VOCs) emitted during the first 72 hours after installation. The theory of using this as a proxy for all emissions from the floor is that VOC emissions from flooring products rapidly decline after installation and become insignificant so only the initial emissions are meaningful. This approach misses several other significant flows from installation that may far exceed the impact of the 72-hour post-installation VOC emissions, including both maintenance flows, such as VOCs and sewage loads from wax and strip cycles and semi-volatile organic compound (SVOC) emissions such as phthalates from PVC[10], that occur over a much longer time frame than the VOCs.

The emissions from cleaning, stripping and waxing maintenance activities are likely to be orders of magnitude higher than the 72-hour post-installation VOC emissions. A recent LCA study found that the amount of VOCs emitted from a single waxing of a floor is comparable to the amount of VOCs emitted from the flooring itself over its entire life.[11] Two materials with different maintenance requirements are likely to have vastly different lifetime VOC emissions that are likely to dramatically alter the relative health impact balance between the materials.

Accurately including the maintenance flows and properly weighting the impact of the exposures in an LCA intended for universal use is very difficult, as maintenance procedures and exposures vary widely from building to building. Rates of maintenance will vary widely depending upon traffic, preferences, and budgets. Staff and patients in a healthcare facility that is fully operational 24/7 are going to have far higher exposure to cleaning chemicals than occupants of a 9 to 5 office building where maintenance can be scheduled for evenings and weekends when occupancy is low. To account for this, LCA programs will need to gather input from the user on building occupancies and maintenance procedures and build that in to the model. Lacking that, users must be made aware that not only are the maintenance-related flows excluded, but that the impact of those flows could radically impact the indoor air quality results for floorings and other maintained surfaces. Otherwise, once again, the results of a comparative analysis between two materials with substantially different maintenance regimes will sometimes falsify the true comparative environmental impact.

Other Considerations

Currently, most LCAs are completely based upon relative weightings. Every impact is assumed to have a value that can be exchanged against another impact. For example, using the EPA weighting, two materials will be scored about equally in an LCA if one has three times the indoor air quality impact but only half the global warming impact of the competing material.

Real-world materials selection, however, doesn't work that way. Specifiers work with a variety of weightings, limits and absolutes. Minimum standard criteria are established by building codes for concerns such as flame spread. The building code is absolute on this issue, not allowing more flame spread in exchange for more of another value like structural strength. Owner values may also determine absolute criteria ranging from color and pattern to life expectancy and maintenance requirements. Owners may also place a combination of criteria on other factors, such as cost. These might include both absolute criteria limit (must cost no more than $X/yd) and a weighting (below that maximum price a cheaper product may outweigh another value like ease of maintenance). Environmental impact analyses can and should be similarly subject to more than just comparative weighting. Just as fire safety provided a strong rationale for setting absolute standards for flame spread and screening out inappropriate materials, other environmental and human health and safety concerns establish a strong rationale for setting standards and screens on the chemical flows resulting from materials selection.

In some cases the rationale may be for a not-to-exceed chemical standard, as in the case of the California 1350 materials emissions standards. Previous emissions standards took more of a fungible, weightings approach in which any VOC emissions were allowable as long as the total of all VOCs did not exceed a specified limit. The 1350 test, on the other hand, recognizes that an increasing number of VOCs have a known limit beyond which chronic illness effects on humans have been identified, and sets an absolute limit on the permissible emissions of each individual compound.[12] An LCA tool that alerted the user if established VOC limits would ever be exceeded would be much more useful than one that simply measures total VOCs and weighs that against all other impacts and hence buries the issue behind a composite rating number. Even 1350 should not be the endpoint for inclusion of lifetime emission issues. The 1350 test addresses VOCs released in the first few months of a product's life but not the SVOCs referred to earlier. Until and unless adequate testing and modeling protocols can be established to inform safe levels, a precautionary approach will need to be taken to address phthalates, brominated flame-retardants, and other SVOCs.

In other cases, chemicals have been clearly determined to be sufficiently harmful to warrant outright elimination. CFCs and PCBs have been banned for use in the United States[13] and hence any material that results in their use or production should be identified and disallowed in an LCA. Similarly the United States has committed in an international treaty "to reduce and/or eliminate the production, use, and/or release of persistent organic pollutants" (POPs), including through material substitution, to eliminate use of those materials that contribute to the formation of POPs in any stage of their lifecycle.[14] Useful LCAs would support implementation of these agreements with warning flags, if not outright screens, on materials that contribute to POPs formation.

Accommodating Data realities: Suggestions for LCA enhancements

To avoid the pitfalls identified here, LCA tools should consider incorporating a number of enhancements:

Data uncertainties: Identify the significant uncertainties and quantification controversies in the data and flag these uncertainties numerically and graphically to show the end-user the effect they may have on the end results through error bars and similar tools.

Use phase flows: Obtain user inputs on use patterns, preferences and maintenance procedures and build that in to the models to allow modeling of use-and-maintenance-related flows.

Chemical restrictions and screens: Build absolute chemical and maximum concentration level screening into the model to allow application of legal limits, health research based standards, international treaty obligations and precautionary specifications to the environmental flows. Prime chemicals for absolute limits are persistent bioaccumulative toxics and others whose manufacture, use or disposal results in generation or release of carcinogens (cancer causing chemicals), teratogens (chemicals inducing birth defects in the developing fetus), reproductive toxicants (chemicals that damage the functions of the reproductive system), developmental toxicants (chemicals that stop or misdirect human development), or endocrine disruptors (chemicals that disturb the operation of the endocrine system, affecting development and other key bodily functions). This process will need to be one that continues to be updated for a long time with ample use of precautionary principles for protective insurance as we await testing on thousands of uncharacterized chemicals.[15]

Conclusion

LCAs are truly a double-edged sword. On the one hand, they have the potential to provide the design community with highly important information in the search for the most environmentally friendly and healthy materials. On the other hand, the current reality is that they provide just one portion of the picture in any comparative analysis of materials. LCAs, such as BEES, do not generally incorporate information into their analyses about environmental health issues that are not yet well quantified, are affected by user patterns, are precautionary or are subject to maximum limits or absolute restrictions. When portrayed as total analyses of environmental flows, LCAs run the danger of lulling the design professional user into thinking that the provided material comparison is complete and does not require any additional analysis.

Even with these enhancements, it remains critically important for the user to understand the limitations of quantitative analysis in the face of scientific uncertainty. Put simply, this means that science understands the existence and importance of many significant environmental health hazards--like dioxin emissions--for which it can not yet provide reliable numbers to plug into LCA type analyses. The lack of those numbers means that these issues do not show up in a quantity-based LCA as currently designed. The health impacts, however, do not go away and we can ill afford to ignore them. For many of these issues, preemptive precautionary action to limit or exclude use of materials involving certain targeted chemicals is the wiser, more responsible and - considering potential liability issues - sometimes more economically conservative course than waiting for certain scientific quantification.

This paper is adapted from a presentation by Tom Lent at GreenBuild 2004, in Pittsburgh PA.

Isadore Possoff, "Pennsylvania Miner with Hardhat & Pick," GSA Fine Arts Program.

Notes:

1. Typical description states: "LCA analyzes the total environmental impact of all materials and energy flows, either as input or output, over the life of a product from raw material to end-of-life disposal or rebirth as a new product." Montgomery M, 2003 (Aug 20): Life Cycle Assessment Tools, Architecture Week E2.1)

2. Eutrophication is the addition of mineral nutrients to the soil or water—in this case primarily from agricultural practices used to raise the flax seed—which can increase algae growth, which in turn can lead to lack of oxygen, impacting aquatic life.

3. Lippiatt B, 2002 (October): BEES 3.0 Technical Manual and User Guide (NISTIR 6916) (Gaithersburg, MD: NIST), p. 27.

4. Vinyl Institute, 1998 (December): Environmental Attributes of Vinyl: Vinyl Flooring Comes First in Life-cycle Assessment. EnVIronmental Briefs. http://www.vinylinfo.org/environment/briefs_12_98.html.

5. Thornton J PhD, 2002: Environmental Impacts of Polyvinyl Chloride Building Materials (Washington DC: Healthy Building Network), p. 28.

6. US EPA, Office of Research and Development, 2001 (May 25): Information Sheet 1, Dioxin: Summary of the Dioxin Reassessment Science.

7. US EPA 2001 (March): 2001 Database of Sources of Environmental Releases of Dioxin like Compounds in the US (EPA/600/C-01/012), pp. 1-37, 1-38, 6-9.

8. Lippiatt, BEES 3.0.

9. Analysts from linoleum manufacturer Forbo have done their own internal LCA's and assert that the factor for eutrophication from linoleum used in BEES is two orders of magnitude (100X) too high and suspect a misunderstanding of functional units may have contributed to the error. If the current BEES eutrophication category value (.0454) is reduced by 99%, the total environmental impact of linoleum drops from .0521 to .0071, flipping the results. Linoleum ends up beating VCT with only 55% of the measured environmental impact—even before having accounted for all of VCT's dioxin-related flows.

10. Lundgren B et al., 2002: Small Particles Containing Phthalic Esters in the Indoor Environment—A Pilot Study, Proceedings: Indoor Air 2002, p. 153.

11. Norris G et al., 2003: Indoor Exposure in Life Cycle Assessment: A Flooring Case Study (life cycle assessment. Unpublished paper, Harvard School of Public Health, quoted in Floorcoverings: Including Maintenance in the Equation, Environmental Building News 12, no. 5: 12.

12. Lent T, 2003: Review of the California 1350 Specification and Indoor Air Quality (Washington DC: Health Building Network).

13. US EPA, 2000: Ozone Depletion Rules & Regulations: The Accelerated Phaseout of Class I Ozone-Depleting Substances (Washington DC: US EPA); US EPA, 1979 (Apr 19): EPA Bans PCB Manufacture, Phases Out Uses (press release).

14. US EPA, 2001: Persistent Organic Pollutants (POPs); UNEP, 2000: Persistent Organic Pollutants (United Nations Environment Programme).

15. The task of identifying chemical hazards and screening out materials choices for environmental and human health and safety will be an ongoing one. Complete basic publicly available toxicity information (the Screening Information Data Set, or SIDS) is available for less than 10% of the roughly 2,800 high-production-volume chemicals (those produced in volumes over one million pounds per year). No toxicity information at all is available for more than 40%. Even less is known about the tens of thousands more chemicals that are produced in smaller volumes or for any of these chemicals in combination with each other. US EPA, Pollution Prevention and Toxics Division, 1999 (March): Chemical Right to Know—Frequently Asked Questions (EPA 745-F-98-002f); Lowell Center for Sustainable Production, 2003: Integrated Chemical Policy (Lowell, Mass.: University of Massachusetts–Lowell), 2.

Toxics

The Government and Toxics

Cover, Adeline Goessling, The Housekeepers Reference Book (Springfield, MA, Phelps Publishing Company, 1910).

The Government and Toxics

To Mend Kettles

"Holes in iron kettles may be stopped by driving in plugs of lead and heading them down well on both sides of the iron. So long as water is in the kettle, the lead will not melt."

Adeline Goessling, The Housekeepers Reference Book (Springfield, Mass.: Phelps Publishing Company, 1910).

Introduction[1]

The idea of handling hazardous materials carefully and disposing of them properly sounds like common sense today, but it is markedly at odds with our history. Until recently, most industrial wastes were simply dumped where they were generated, often into a stream, pond, or lake or simply onto the ground. New England's waters are still recovering from hazardous wastes dumped over two centuries of industrial development. And, individuals have done much the same; pouring motor oil, paint thinner, pesticides, and other wastes onto the ground and into storm drains.

Hazardous wastes must now be disposed of separately from non-hazardous wastes. Unfortunately, these materials, mixed with other wastes contaminate most, older landfills across the country. Even today, household products that qualify as hazardous wastes are still being disposed of with more innocuous trash.

Early environmental laws may have contributed to the problem. In avoiding release of hazardous wastes into the air or water (to comply with the Clean Water and Clean Air Acts), processes used to clean air and water produced unexpected, new hazardous wastes: air pollution abatement devices such as scrubbers capture large amounts of undesirable particulates; wastewater treatment plants produce hazardous sludge; and municipal waste-to-energy incinerators produce significant volumes of ash containing heavy metals. For years, these products of environmental protection went straight to the landfill, where they continue to leak hazardous wastes into groundwater and generate toxic airborne emissions.

Preventing exposure to persistent, dangerous substances is at the core of the equity/toxics issue. The Government's strategy today, is waste minimization, pollution prevention, technology innovation, toxicity reduction, waste reuse, and others; all aimed at the goal of not generating it in the first place. Three major federal laws constitute the core of federal hazardous waste regulation:

Resource Conservation and Recovery Act of 1976 (RCRA)

RCRA applies to current operations of private and other hazardous waste generators, and regulates solid and hazardous wastes. RCRA established a "cradle-to-grave" system for tracking and permitting hazardous wastes from their point of origin to their disposal time and location—and thirty years beyond.

The Hazardous and Solid Waste amendments (1984) increased the number of under-regulated hazardous waste generators, introduced a schedule to ban land disposal of hazardous chemicals, encouraged source reduction, developed a waste classification process, and regulated underground storage tanks.

RCRA applies to more than manufacturing. It labeled more than 360 million tons of wastes hazardous and regulates any producer of more than 100 pounds of such wastes a month, such as dry cleaners, photo shops, and auto repair garages under regulation.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)

Also known as “Superfund,” RCRA regulates the ways in which existing businesses dispose of hazardous waste. The Superfund is aimed at cleaning up abandoned, inoperative, contaminated sites. The Superfund Amendments and Reauthorization Act of 1986 (SARA) includes provisions for requiring disclosure of hazardous waste sites under community and worker “right-to-know” regulations.

Toxic Substances Control Act of 1976 (TOSCA)

TOSCA was designed to give regulators and the general public advance warning that manufacturers are considering commercial production of a substance that may be toxic. Manufacturers submit a notification to the government along with detailed data and must win approval before proceeding.

Various Executive Orders (EO) address toxics reduction. EO 13148, "Greening the Government through Leadership in Environmental Management"[2] (April 2000), directed the Environmental Protection Agency (EPA) “to develop a list of not less than 15 priority chemicals used by the Federal Government that may result in significant harm to human health or the environment and that have known, readily available, less harmful substitutes.” In developing the list, EPA is considering: toxicity, persistence, and bio-accumulation, availability of less environmentally harmful substitutes and processes, relative costs of alternatives, and the potential risk from chemicals used by Federal agencies. The EO directed Federal agencies to reduce the usage of these chemicals by 50% by December 31, 2006.

The first five chemicals to be identified are cadmium, lead, polychlorinated biphenyls (PCBs), mercury, and naphthalene. The Federal Environmental Executive (OFEE) notes that there are known alternatives to the five priority chemicals or products containing them. For example, electronic thermostats can be used in place of mercury-bearing switches. Solders containing copper or silver can substitute for solder containing lead, and, integrated pest management can be used in place of naphthalene.

But we still need to address this problem. As Gail Vittori and Karla Armenti write, below, toxic chemicals are still widely used in manufacturing, suggesting that we must avoid strategies that simply shift hazardous materials from one place to another, rather than eliminating them. The choices we make in specifying products and services that generate toxics at any point in their lifecycle have equity consequences. We need to ask, as William McDonough does, "Are workers safe making and using the products? Are your tenants safe?" And, "Are the production and use of those products safe for the local and global communities?"

Fay Chong, "The Mansion," GSA Fine Arts Program.

"Even in the face of scientific uncertainty, society should take reasonable actions to avert risks where the potential harm to human health or the environment is thought to be serious or irreparable." [3]

-The President's Council on Sustainable Development

Notes:

1. Introduction adapted from "The Complete Guide to ENVIRONMENTAL CAREERS In the 21st Century, Copyright © 2004 The Environmental Careers Organization, Chapter 9, http://www.eco.org/Guide/Chap09/history.html."

2. http://www.ofee.gov/wpr/chemical.htm

3. "Sustainable America, A New Consensus for the Prosperity, Opportunity and a Healthy Environment for the Future," May 1999, The President's Council on Sustainable Development, p.12, http://clinton2.nara.gov/PCSD/Publications/index.html.

Toxics

What are Toxic Substances?

Joseph Gross, "Golden Cycle Mill," GSA Fine Arts Program.

What are Toxic Substances?

By Gail Vittori

Gail Vittori is Co-Director of the Center for Maximum Potential Building Systems, a non-profit sustainable planning and design firm established in 1975 and based in Austin, Texas.

Webster's Dictionary defines toxic as "of or pertaining to poison; poisonous". Naturally occurring and intentionally or unintentionally released into the global commons of air, water, and land, exposure to toxic chemicals is an unavoidable consequence of life on Earth in the 21st century. Indeed, in some ways, toxic chemicals can be thought of as the antithesis of a public good – once produced everyone can be affected by them, and, in many instances, it is impossible to prevent exposure from them (though exposure levels can be controlled). While public awareness about toxins and their consequences to human and ecological health is perhaps better understood today than ever before, widespread use of toxic chemicals in the manufacturing sector continues within a context of chronically deficient testing protocols and uncertainties associated with their dose response.

But does it have to be? In response to growing recognition of global toxicity, many people in government, industry, and non-governmental organization sectors are advocating and implementing public policies and 'green' manufacturing practices that eliminate further reliance on toxic chemicals, while transitioning to increasingly benign chemicals and raw materials required for industrial processes, known as feedstocks.

While there is continued uncertainty about what constitutes safe exposure levels, there is general agreement about what chemicals are defined as toxic. According to the U.S. EPA, the governmental agency responsible for overseeing the collection of Toxic Release Inventory (TRI) data, there are currently 582 individually listed chemicals and 30 chemical categories.

A significant sub-set of TRI chemicals are those classified as Persistent Bioaccumulative Toxins (PBTs), currently constituting 16 chemicals and 4 compound categories. (The compound categories are dioxin and dioxin-like compounds; lead compounds; mercury compounds; and polycyclic aromatic compounds). The US EPA cites the pronounced concern about PBT chemicals, reflecting not only their toxicity but the fact that they, "remain in the environment for long periods of time, are not readily destroyed, and build up or accumulate in body tissue."[1] Consequently, there are significantly lower reporting thresholds for PBTs than for other chemicals.

The EPA's concern is echoed in the National Research Council's "Building A Foundation for Sound Environmental Decisions" (1997), that identified six significant components contributing to global environmental change including persistent organic compounds. More recently, the Stockholm Convention on Persistent Organic Pollutants (POPs), a global treaty signed by 151 nations including the United States, was developed to protect human health and the environment from persistent organic pollutants. Indeed, PBTs are broadly recognized as a class of chemicals that warrant swift response, with an objective to transition away from their continued use. As stated on the Stockholm Convention's website (www.pips.int/), "In implementing the convention, Governments will take measures to eliminate or reduce the release of POPs into the environment."

Toxins in Building Materials

Today, we find that Persistent Organic Pollutants (POPs) and the closely associated Persistent Bioaccumulative Toxins (PBTs) are used in and result from the manufacture of an array of commonly used building materials, yet are seldom acknowledged in point-of-sale information or manufacturers' cut sheets.

Broadly recognized as hazardous materials, over the last 30 years both lead and asbestos have been phased out for use in building materials in the U.S., though some lingering uses of lead continue for solder, flashing, terne, and copper, and as a PVC stabilizer. For both lead and asbestos, their track records as widely available and inexpensive products with notable performance attributes are tarnished by the public health, economic and environmental burdens associated with their use. Other hazardous materials in common use include:

- Cadmium-used as stabilizer in rigid PVC and paints
- Dioxins and furans-emitted from cement kilns, secondary copper manufacture and by-products of vinyl chloride monomer
- Mercury-used in fluorescent light bulbs, high intensity discharge (HID) lamps, paint, and electrical switches.

Arsenic is a naturally occurring element present in the earth's crust. In its inorganic form, the World Health Organization, the U.S. Department of Health & Human Services, and the U.S. EPA categorize arsenic as a human carcinogen. Until December 2003, inorganic arsenic was commonly used as a wood preservative in the CCA (chromated copper arsenic) formulation. A negotiated agreement between the U.S. EPA, wood preservative manufacturers and environmental organizations, effective December 2003, curtailed continued use of arsenic as a wood preservative in the U.S. Again, the societal burden stemming from decades of use of this toxic chemical will be borne by generations to come, as the health consequences of direct exposure and the challenge of safe disposal play out.

Volatile Organic Compounds (VOCs) are carbon-based chemicals that have a high vapor pressure and vaporize at normal temperature and pressure. While some VOCs are naturally occurring and/ or benign, specific volatilized chemicals are of particular concern, especially at high emission levels, because of their toxicity. Paints, adhesives, sealants, carpets, composite wood, flooring products, and agri-based materials often are manufactured with chemicals that have high VOC emissions. Some VOCs, such as formaldehyde, are recognized as carcinogenic to humans. As a result, scores of manufacturers are reformulating their products to eliminate and/or drastically reduce their VOC emissions, while the U.S. Green Building Council's LEED® Green

Building Rating Tool encourages the use of low-emitting materials.

Building materials manufactured with chlorine represent another class of chemical use with direct links to the persistent bioaccumulative toxins (PBTs) cited above. Noting that "virtually all chlorinated organic compounds that have been studied exhibit at least one of a wide range of serious toxic effects such as endocrine dysfunction, developmental impairment, birth defects, reproductive dysfunction and infertility, immunosuppression, and cancer, even at extremely low doses," the American Public Health Association passed a resolution in 1996, "to become involved in this global effort to eliminate or reduce to the greatest extent possible the discharge of POPs (persistent organic pollutants) into the environment."

Polyvinyl chloride (PVC) is responsible for 42% of chlorine use in the United States, according to the American Chemical Society's Chemical and Engineering News. Roughly 75% of all PVC manufactured is used in building materials. One of the processes used to manufacture chlorine – the chloralkali process – results in the annual release of many tons of mercury into the environment. Mercury, like the dioxin by-products of chlorinated compounds, is classified as a persistent organic pollutant.

Summary

The life-cycle consequences of continued dispersion of, and exposure to, persistent chemicals and other toxins are both immediate and long term. For example, occupational exposure to POPs, such as for electricians who routinely put lead stabilized PVC-jacketed wire cable in their mouths in the course of their daily work, can result in immediate health repercussions. For others, cumulative exposure may result in health decline over a longer time frame, such as impaired male reproductive health, that may not be immediately evident.

Eliminating the worst-in-class POPs, PBTs, carcinogens, and reproductive toxicants in the manufacturing sector is a primary driver behind green building. As the hazards associated with these chemicals become more widely recognized, so does an evaluative framework for defining "green" materials and processes – not as options, but as prerequisites in protecting the public health.

Notes:

1. EPA Fact Sheet on EPCRA Section 313 Rulemaking, Persistent Bioaccumulative Toxic Chemicals, http://www.epa.gov/tri/lawsandregs/pbt/pbtrule-fs.pdf.

Toxics

Pollution Prevention and Worker Protection: The Importance of Integrating Occupational and Environmental Health.

Richard Correll, "Log Bucker," GSA Fine Arts Program.

Pollution Prevention and Worker Protection:

The Importance of Integrating Occupational and Environmental Health.

By Karla Armenti

Karla Armenti, ScD, MS, is an Associate Professor in the Master of Public Health program at the University of New Hampshire's Manchester campus. She also heads Consulting in Occupational and Environmental Sciences, COES, LLC, in Bedford, New Hampshire.

Occupational and environmental health risks are not always considered simultaneously when attempting to reduce or eliminate hazardous materials from our environment. Methods used to decrease exposure to hazardous chemicals in the workplace often lead to increased exposure in the environment and to the community outside the workplace. Conversely, efforts to control emissions of hazardous chemicals into the environment often lead to increased exposure to the workers inside the plant. There are government regulations in place that ensure a safe work environment or a safe outside environment; however, there is little integration of both approaches when considering the public's health as a whole.

Despite the formal separation of occupational and environmental health, there is a strong link between pollution in the environment and hazards in the workplace caused by the use and processing of hazardous materials. For the past 30 years, the United States has made an intensive and very costly effort to *reduce* the burden of environmental pollution and occupational injuries and illnesses. These efforts have traditionally been remedial in nature - addressing the problem after it has occurred by using controls to lessen the hazard. This strategy tolerates the *probability* of risk associated with the production process. If changes are made to the production process, however, by replacing or eliminating a hazardous chemical, by reducing the use of resources, or by promoting energy recovery, then industrial production can be designed in a way that would eliminate or substantially decrease pollution from toxic manufacturing processes and workplace hazards.

Pollution Prevention (P2): A Model for Sustainable Economic Growth and Development

In October of 1990, the federal Pollution Prevention Act was passed, prompting the EPA to rethink its environmental management strategies. The Act established a new pollution prevention policy advocating source reduction as a more desirable method of reducing pollution than waste management and pollution control.

The aim of the pollution prevention policy was to reduce the volume and toxicity of wastes at the source. In an attempt to define the concept of pollution prevention, the EPA published its Pollution Prevention Statement in the Federal Register, demonstrating "a preventive program to reduce or eliminate the generation of potentially harmful pollutants."[1] While the definition was broad in scope, for the EPA, pollution prevention represented:

1. the reduction or elimination of pollutant discharges to the air, water or land;
2. reducing the quantity and/or toxicity of pollutants generated by production processes through source reduction, waste minimization, and process modifications;
3. eliminating pollutants by substituting non-polluting chemicals or products (e.g., material substitution, changes in product specifications); and,
4. recycling of waste materials (e.g., reuse, reclamation).

The pollution prevention model is presented here as a method that recognizes source reduction as the most important tier in the hierarchy of environmental management. This model shifts the focus from hazard control at the end of discharge pipes to reducing or eliminating exposures at the front end of the process by changing the raw material inputs through source reduction. Pollution prevention, a valuable strategy for protecting community environmental health, can be effective in the work environment as well, but only when occupational and environmental risks are considered simultaneously.

The pollution prevention or "P2" approach encompasses several forms of prevention, including source reduction, waste reduction, waste minimization; toxics use reduction, and clean or cleaner production. These approaches emphasize the prevention of environmental damage ***before it occurs***, focusing attention on the processes that create the waste prior to being emitted into the environment. Preventive strategies focus on identifying ***potential*** harm or hazard, and on reducing or eliminating the use of materials or processes that could cause harm, injury or damage to the environment and thus to the general population. Some environmentalists refer to a "hierarchy of prevention"[2] with the ultimate goal being to change our activities. In reverse order:

- **Change in Activities:** reducing material consumption, and changing to less polluting activities.
- **Products:** creating products that work better and last longer.
- **Material usage:** reducing material inputs and changing to less toxic materials.
- **Production processes:** improving efficiency and achieving cleaner technology, better control, improved materials handling, etc.[3]

All four levels of the above hierarchy of prevention can represent primary prevention by promoting ways to reduce or eliminate the hazardous condition that is causing the pollution. Changing our activities in these ways requires a change in both social and economic policies and would lead us toward the ultimate goal of sustainable economic growth and development. By promoting changes in the technology and materials of production, in industrial processes and operations, and in attitudes, the "prevention paradigm" provides us with the means to achieve the desired compatibility between environmental and human needs.[4] Pollution prevention is a way to facilitate a transition toward sustainable production.

The potential for risk shifting when addressing occupational and environmental health problems separately

Although pollution prevention is limited to preventing environmental degradation, it has the potential to prevent adverse impacts on worker safety and health as well, if applied comprehensively to both the general and work environments. When making efforts to prevent worker injuries and illnesses, and prevent pollution, there is the potential for "risk shifting" from the general environment to the work environment and vice versa. Without simultaneous attention to occupational and environmental issues, traditional workplace-based exposure control activities have the potential to shift risk of the hazard among different media. For example, a preferred engineering control such as installing ventilation exhaust systems that remove hazardous dusts from the work area transfers the risk to the general environment, which now must deal with collecting and disposing of the dust being put into the ambient air outside the facility.[5]

While pollution prevention addresses the problem of risk shifting between environmental media, it also has the potential to shift risk between the general and work environments. For example, while acetone may be a less toxic substance to use in parts cleaning than a chlorinated solvent, it does present a new hazard of fire and explosion not present with the chlorinated solvent. Although pollution prevention does not formally consider the work environment as another "medium" that is equally affected by production or material changes to prevent pollution, there is no reason why it cannot be broadened to encompass workplace hazards. The potential use of substitute materials or proposed changes should consider the impact of the changes on worker health within the work environment. If applied systematically, pollution prevention methods used to reduce or eliminate hazards at the source can identify potential workplace hazards (during the process of considering alternative technologies, chemicals or processes). By applying the methods of pollution prevention across occupational and environmental media, the work environment is given equal standing with the general environment when pollution prevention strategies are planned.

Worker risks should be carefully explored in choosing "substitute chemicals."

Example:
Risk Shifting in Auto Repair

In response to the California Air Board's 1997 decision to phase out chlorinated solvents used in the auto repair industry (hazardous to the environment), employers substituted these solvents with hexane and acetone. Unfortunately, it was not considered at the time that hexane posed a risk to workers. It was soon discovered that with overexposure, hexane caused peripheral neuropathy – a debilitating disorder that causes numbness and tingling in the fingers and toes followed by weakness and muscle wasting.[6]

Pollution prevention planning requires careful consideration of the impact of proposed changes on both environmental and worker safety and health programs. Poorly designed pollution prevention projects that fail to consider the impact of changes in processes, practices, or procedures can increase worker health and safety risks.

"Green Building": Is it really better for construction workers?

Construction and demolition can produce significant waste and toxic releases in the form of storm water runoff, solid wastes, dusts, and vapors. Wastes can include wood, concrete, brick and block, asphalt, glass, paint roofing materials, tile, insulation, plastic, lead pipes, and ferrous and nonferrous metals. Paints, thinners, adhesives, solvents, aerosols, lead, welding fumes, and asbestos can be released during construction work. These not only have a detrimental effect on the environment, they can also adversely affect the health of the construction workers on the project.

A green building, or sustainable building, is a structure that is designed, built, renovated, operated, or reused in an ecological and resource-efficient manner. Green buildings are designed to meet certain objectives such as protecting occupant health; improving employee productivity; using energy, water, and other resources more efficiently; and reducing the overall impact to the environment. While these are certainly worthwhile outcomes, this approach may have deleterious effects on construction worker safety and health.

Certain "environmentally friendly" building practices and products such as adhesives and cement fiber siding (to replace polyvinyl chloride) may actually lead to increased worker exposure and/or injury. Some adhesives used for air sealing (which is a good thing for energy efficiency) may also contain VOCs (volatile organic compounds) harmful to workers and occupants. Additionally, cement fiber siding contains silica and when it is cut, the workers will be exposed to silica dust. Crystalline silica is a highly hazardous inhalation hazard. Cement fiber siding also weighs more than wood siding, so there may be potential for increased back injuries and ergonomic risks.

These are just a couple of examples of risk shifting in green construction. There is little attention directed to the hazards construction workers may face when working with some of these new materials. However, if equal attention is paid to both environmental and occupational risks associated with green building, we can be assured of a sustainable building with low ecological impact that protects the community, the workplace environment, and the workers creating them.

Using Pollution Prevention to Reduce or Eliminate Workplace Hazards[7]

Utilizing P2 strategies can lead to finding safer substitute chemicals, reducing toxics use, and making other changes in processes, procedures or practices that reduce worker *and* environmental exposures. Just as P2 strategies offer many advantages over pollution control approaches, P2 also offers advantages over traditional worker health and safety approaches. Few companies, however, have integrated P2 with employee health and safety. There are a few reasons for this.

First, as already discussed, occupational and environmental health measures are governed by separate laws and regulations issued by separate agencies (OSHA and EPA). Unfortunately, there is no formal consideration of the overlap between environmental and occupational exposures (outside versus inside the plant) and the potential of P2 strategies for addressing both.[8]

Second, even when the same person in a company is assigned to both environmental and workplace safety and health, opportunities to connect these two areas of responsibility may go unrecognized. While the best facilities have embraced ambitious "continuous improvement" goals for environmental management, most facilities still view their OSHA responsibilities in terms of regulatory compliance.

Third, personnel trained in environmental engineering are not necessarily trained to focus on worker safety and health. They tend to assume that P2 initiatives automatically benefit employees, which may not be the case. Similarly, P2 activities may not be on the radar screen of personnel responsible for worker safety and health.[9]

Who should be Involved in P2?

Using P2 to address both occupational and environmental safety and health goals requires input from a wide range of employees including:

- Production: Production employees contribute a "hands-on" understanding of the production process.
- Maintenance: Maintenance personnel understand the equipment, and the operations and procedures used to maintain the equipment.
- Process engineering: Process engineers bring an understanding of the technical possibilities in the production process.
- Design engineering: It is important to include those involved in the design phase of any new process or equipment, so that safety and health hazards can be "designed out."
- Facility engineering: Facility engineers know the procedures for new construction and equipment installation and modification.
- Warehouse/shipping: These employees understand storage, inventory, shipping and receiving and transportation issues.
- Product design: Chemists and design engineers take the lead in incorporating environmental and occupational health concerns into product design.
- Quality assurance: Individuals charged with "quality" functions can provide insight into how to integrate occupational and environmental safety and health aspects into quality control systems and documentation procedures.
- Environmental health and safety: EHS personnel can help identify key environmental issues and concerns.
- Occupational health and safety: OHS personnel can help identify key worker exposures and analyze health and safety impacts of proposed alternatives.
- Purchasing: Purchasing personnel bring knowledge of the procurement process and can play a lead in integrating EHS/OHS concerns into the purchasing process.
- Sales and marketing: Sales/marketing personnel can identify EHS/OHS concerns important to customers and communicate the facility's EHS/OHS initiatives.

- Accounting and finance: Accounting and finance track the costs of existing practices and analyze the costs and benefits.

Worker Involvement in P2[10]

There are several important reasons why employee involvement in P2 results in a more successful P2 program. Employees have an important stake in the success of pollution prevention efforts because they are at the front lines of exposure to toxic chemicals, both in the workplace and in the outside environment. And, since workers are directly involved with all aspects of production, they have a unique ability to contribute to the pollution prevention planning and implementation process.

In 1997, a worker at an aircraft engine manufacturing plant in Eastern Massachusetts was concerned about severe dermatitis from coolants. He researched and found a P2 solution that reduced coolant usage by 90% and prevented the mold contamination responsible for the dermatitis. It saved the company $150,000 the first year and helped them fulfill their commitment under an EPA SEP (Supplemental Environmental Project) settlement.

Successful P2 Programs Require Employee Involvement:

One program that specifically addresses the need for worker involvement in P2 is based out of the Occupational Training & Education Consortium (OTEC) at The Labor Education Center at Rutgers University in New Jersey. OTEC has developed a Pollution Prevention Training Program based on participatory and small group activity methods using a P2 Workbook that employees use to learn about P2, how it can be applied to their facilities and work processes, how to analyze for toxicity and efficiency, and how to apply Environmental/Health and Safety Systems. The workbook recommends that in order to be a full participant in pollution prevention, you need the following:

Training in P2 methods and approaches, like process mapping and root cause analysis.
Opportunities to review processes and operations to determine where and how toxic substances are used and hazardous wastes are generated.
Forums to discuss recommendations on ways to eliminate or reduce waste production at the source.
Input into the implementation process (e.g., as part of a cross-functional team).
Leadership that makes it clear that your contributions to P2 are valued.

How to Avoid Risk Shifting[11]

The best way to avoid risk shifting is to ensure that relevant health and safety personnel, along with frontline employees in the production area affected by the change, are involved in thinking through P2 options. Integrating environmental and occupational health with safety problem solving will lead to cost-effective solutions that avoid risk shifting.

Before making changes in chemicals, processes, practices or procedures, consider the following:

1. Does the change pose an exposure to hazardous substances (a different or new exposure)?
2. Does the change pose a new ergonomic hazard?
3. Does the change pose a new physical hazard?
4. Will the change increase psychological stress?

Summary

The Pollution Prevention Act clearly states that prevention of pollution ***at the source*** is to be the primary policy goal of environmental management in this country. Continued focus on technology-based control standards that react to hazardous waste and emissions prevents us from looking more broadly to define different "environmental media," including the work environment. This can shift risks from one medium to another.

In order to reach our goal of sustainable development, we should promote a more holistic approach to protecting human health, from government regulation that encourages innovation in technology, design, processes and products to industrial policy setting. The critical task is to include a broader group of stakeholders, that is, those who are affected by the results of this innovation, including workers. Integrating environmental objectives with occupational concerns and vice versa could effectively result in a process where standard-setting is accomplished with the joint cooperation of managers and workers in industry, of authorities in government, and of the public.

From the "Journey to Sustainability: A Converstion With Ray Anderson "[12]

"[We need] to be sure that whatever we do emit from our factories, from our offices, from our automobiles, from our homes... is harmless, totally benign and harmless to the biosphere.

"That is incredibly difficult to do in this society because so much of what comes into our factories, into our homes, into our offices, is replete with materials that never, ever should have been taken from the earth's crust. It took nature 3.8 billion years to put some of it there .In its presence, we never would have evolved into homo sapien sapiens, but now we're bringing that very stuff right into our living rooms, so to speak. It's very much suicidal.

"And we must learn to think upstream, and put the filters not only into the pipe, but put the filters into our brains and go upstream and stop that stuff. Find the substitutes that enable us to operate without the really dangerous stuff that we are bringing into our factories, our homes, and our offices. "

Notes:

1. US EPA, 1989 (January 26): Pollution Prevention Policy Statement, Federal Register, vol. 54, no. 16.

2. T. Jackson, ed., 1993. "Clean Production Strategies, Developing Preventive Environmental Management in the Industrial Economy" (Boca Raton, Lewis Publishers).

3. The problem of pollution is directly related to the materials cycle. Changes in the materials cycle are transitional in that toxics reduction is perceived as being easier to achieve than elimination. While focus on "toxics use reduction" allows for the realization that harmful substances may be used in manufacturing and may be present in the products themselves, it leads to the goal of true prevention by focusing on what materials are used to produce goods and services. Hirschhorn et al., 1993: "Towards Prevention: The Emerging Environmental Management Paradigm," chapter 7 in "Clean Production Strategies: Developing. Preventive Environmental Management in the Industrial Economy" (Boca Raton: Lewis Publishers.

4. Hirschhorn, et al.

5. Moure-Eraso R. 2000, "Avoiding the Transfer of Risk: Pollution Prevention and Occupational Health," in: Levy, B. Wegman, D. Editors, "Occupational Health, Recognizing and Preventing Work-Related Disease and Injury,"4th Ed., Lippincott Williams & Wilkins, Philadelphia, PA. Pgs. 124 - 125.

6. Michael P. Wilson, PhD, 2001 (November 16): n-Hexane–Related Peripheral Neuropathy Among Automotive Technicians—California, 1999–2000, CDC MMWR Weekly 50 (45): 1011–13. http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5045a3.htm.

7. Occupational Training and Education Consortium (OTEC), 2002 (September): Pollution Prevention E/HS Workbook, 1st ed. (Camden / New Brunswick NJ: Rutgers University). Contact: oshep@rci.rutgers.edu

8. For a more detailed evaluation of the differences between OSHA and EPA, and the barriers to integrating the protection of occupational and environmental health, see Armenti, Moure-Eraso, Slatin, and Geiser, 2003: Joint Occupational and Environmental Pollution Prevention Strategies: A Model for Primary Prevention, New Solutions, vol. 13, no. 3..

9. Matt Gillen, MS, CIH, 2000 (November): "What Occupational Health and Environmental Specialists Need to Know to Protect Workers and the Environment." Presented at the American Public Health Annual Meeting, Boston MA.

10. For a more detailed discussion on worker involvement in P2, see M. Ochsner, 2001 (Summer): Can Workers Participate in—and Benefit from— Pollution Prevention? Pollution Prevention Review;; and Cora Roelofs, 1999: Trade Unions and Cleaner Production: Perspectives and Proposals for Action, New Solutions, vol. 9, no. 3..

11. Matt Gillen, MS, CIH, 2000 (November): "What Occupational Health and Environmental Specialists Need to Know to Protect Workers and the Environment." Presented at the American Public Health Annual Meeting, Boston MA.

12. Full transcript is available at www.gsa.gov/sustainabledevelopment.

Making Informed Choices

The Ecology of Sustainable Design

Lee Allen, "Soil Erosion," GSA Fine Arts Program.

The Ecology of Sustainable Design

By William McDonough

William McDonough, FAIA, is a founding partner of William McDonough + Partners, Architecture and Community Design, and Co-founder and principal, MBDC.

For all the benefits that have come from the technological advances of the last century, and there are many, it has become difficult to deny that the practices of conventional architecture and industry often prove to be at odds with economic, ecological and social health. As industry takes, makes, and wastes, using materials in a cradle-to-grave system designed more than a century ago, our air, water and soil—the very fabric of life—bear the consequences.

An architect's material choices also influence human health. Beyond the widespread environmental problems that undermine social well-being, the various ingredients that add up to a building also have invisible, long-term effects on both building occupants and those who manufacture and dispose of architectural materials. Indeed, none of the materials used to make large-scale buildings is specifically designed to be healthful for people. Even a cursory inventory begins to suggest some of the challenges architects are dealing with.

Consider, for example, the ubiquitous use of polyvinyl chloride. Polyvinyl chloride, better known as PVC or vinyl, is a common ingredient in windows, doors, flooring, wall-coverings, interior surfaces, and insulating materials. Many formulations of PVC have been known to contain toxic heavy metals and plasticizers that are carcinogenic and endocrine disrupting. Equally common is formaldehyde—a reproductive toxin found in particleboard, paints, and textiles—and other volatile organic compounds (VOCs), some of which are suspected carcinogens and immune-system disrupters that occur in adhesives and carpets. Formaldehyde and VOCs seep, or off-gas, from architectural materials, accumulating in tightly sealed buildings in concentrations that make indoor air quality on average three times worse than the most noxious urban air. The forced flow of chemicals through inadequate ventilation systems adds up to costly health problems, like those associated with Sick Building Syndrome.

Fortunately, an expanding palette of materials is allowing designers to phase out the use of polyvinyl chloride and other toxic substances, a very promising step for twenty-first century architecture.

Cradle to Cradle Design

The destructive qualities of today's cradle-to-grave system are fundamentally a deeply ingrained design problem, not an inevitable outcome of human activity. Indeed, good design can transform the making of things—from products to buildings to community plans—into a positive, regenerative force. Based on principles observed in nature, this new conception of design goes beyond retrofitting the systems of architecture and industry to simply reduce their harm. It offers instead a profoundly effective alternative, a framework in which the regenerative, cradle-to-cradle cycles of nature—nutrient cycles, water cycles, energy flows—are seen as both the model for and the context of human designs. Within this cradle-to-cradle framework, design can generate wholly positive effects whose benefits enhance all life allowing us to imagine and create architectural and industrial systems that purify air, land and water, use current solar income and generate no toxic waste, use materials that replenish the earth or can be perpetually recycled.

Over the past decade, the cradle-to-cradle framework has evolved steadily from theory to practice. In the world of industry it is creating a new conception of materials and material flows. Just as in the natural world, in which one organism's "waste" cycles through an ecosystem to provide nourishment for other living things, cradle-to-cradle materials circulate in closed-loop cycles, providing nutrients for nature or industry. The cradle-to-cradle model recognizes two metabolisms within which materials flow as healthy nutrients.

Nature's nutrient cycles comprise the biological metabolism. Materials designed to flow optimally in the biological metabolism, known in the cradle-to-cradle model as biological nutrients, can be safely returned to the environment after use to nourish living systems. The technical metabolism, designed to mirror the earth's cradle-to-cradle cycles, is a closed-loop system in which valuable, high-tech synthetics and mineral resources—what German chemist Michael Braungart calls ***technical nutrients***—circulate in a perpetual cycle of production, recovery, and remanufacture.

Biological and technical nutrients have already entered the marketplace. The upholstery fabric Climatex Lifecycle is a blend of pesticide-residue-free wool and organically grown ramie, dyed and processed entirely with non-toxic chemicals. All of its product and process inputs were defined and selected for their human and ecological safety within the biological metabolism. One result: the fabric trimmings are made into felt and used by garden clubs as mulch for growing fruits and vegetables, returning the textile's biological nutrients to the soil to feed new growth.

Shaw, the world's largest carpet manufacturer, has designed a carpet tile system made for the technical metabolism. These carpet tiles are made from a nylon 6 face fiber called EcoSolutionQ™ and a polyolefin backing material called EcoWorx™, both of which are perpetually recyclable. When the carpet is being replaced after years of use, customers can call the toll-free phone number printed on the back of each carpet tile and Shaw will retrieve the carpet for recycling. The face fiber and backing are separated, and the nylon 6 is returned to its constituent molecules and repolymerized into first quality fiber, while the polyolefin backing is mechanically reprocessed into high quality backing for a new tile. The carpet is rematerialized, not dematerialized—a true cradle-to-cradle product.

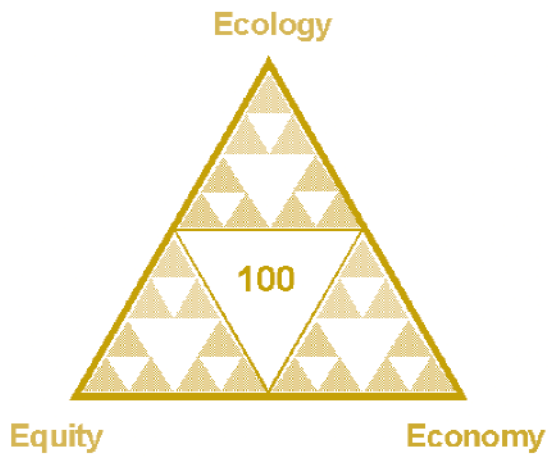
The production of nutrients cycling in healthy metabolisms starts with material chemistry. We are only beginning to understand the effects of the chemicals we live with every day in our homes and workplaces, and each year, approximately 2,000 new chemicals are introduced worldwide without any need for approval.

The toxicological data simply can't keep up. Through existing chemical assessments, however, we do know enough to begin to select materials for architecture that are safe, and even beneficial, for human and environmental health.

Michael Braungart and I, with our firm MBDC, have developed a protocol for assessing the human and environmental health characteristics of chemicals and materials, allowing designers and engineers to formulate products intelligently. The Cradle to Cradle Design Protocol begins with a full inventory of a material's chemical ingredients, followed by research into their key environmental and human health effects: carcinogenic and mutagenic potential, effects on reproductive systems, accumulation in biological systems, climate effects, and other impacts. Once these characteristics are understood, we can then work with suppliers to reformulate materials using only safe and healthful chemicals appropriate for biological and technical metabolisms.

The Fractal Triangle

The Cradle to Cradle Design Protocol addresses material chemistry issues directly, but these are part of a much broader spectrum of concerns. In our work with corporate clients such as Ford Motor Company, Nike, Herman Miller, and BASF we have found that a visual tool, a fractal triangle, helps us apply cradle-to-cradle thinking throughout the design process. Typically, the pursuit of sustainability is seen as a balancing act, a series of compromises between competing interests played out in the process of design. The key insights offered by the fractal triangle turn this notion on its head: Intelligent design, rather than ***balancing*** economy, ecology, and equity, can employ their dynamic interplay to generate value.



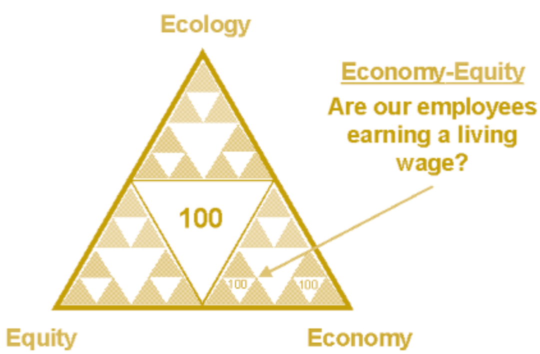
The fractal triangle, first of all, reminds us that every product, whether or not it is designed with environmental health in mind, is produced and used in an interconnected world. This is the fundamental insight of ecology and the reason why the famous triad of sustainable development is on the table in the first place.

Representing the ecology of human concerns, the fractal triangle shows how ecology, economy and equity anchor a spectrum of value, and how, at any level of scrutiny, each design decision has an impact on all three. As we design a product or building, we move around the fractal inquiring how a new design can generate value in each category. Again, the goal is not to balance competing perspectives but to optimize and maximize value in all areas of the triangle through intelligent design. Often, we discover our most fruitful insights where design decisions create a kind of friction in the zones where values overlap

When applying the fractal triangle to our own projects, we begin asking questions in the extreme, lower-right corner, which represents the Economy/Economy sector. Here we are in the realm of pure capitalism and the questions we ask would certainly include, Can I make my product or provide my service at a profit? We tell our commercial clients that if the answer is no,

don't do it. As we see it, the goal of an effective company is to stay in business as it transforms, providing shareholder value as it discovers ways to generate positive social and environmental effects.

Moving to the Economy/Equity sector, we consider questions of profitability and fairness. Are the employees producing a promising product earning a living wage?



As we continue on to Equity/Economy, our focus shifts more towards fairness—we begin to see Economy through the lens of Equity. Here we might ask, Are men and women being paid the same for the same work? Are we finding new ways to honor everyone involved, regardless of race, sex, nationality or religion? In the extreme Equity corner, the questions are purely social: Will the new building improve the quality of life of all stakeholders?

In the Ecology corner of the Equity sector, the emphasis shifts again; Equity is still in the foreground, but Ecology has entered the picture. The questions arising at this

intersection of values might explore the ways in which a product, such as the ecologically sound upholstery fabric, could enhance the health of employees and customers. Continuing to Ecology/Equity, we consider questions of safety or fairness in relation to the entire ecosystem: Will our product contribute to the health of the watershed?

In the pure Ecology sector: Are we obeying nature's laws? Creating habitat? In this realm we try to imagine how humans can be "tools for nature." Shifting to Ecology/Economy, commerce reenters the picture: Is our ecological strategy economically viable? Will it enable us to use

resources effectively? Finally, we come to Economy/Ecology, where we encounter many questions that relate to the triple bottom line. Here the inquiry tends to focus on efficiency: Will our production process use resources efficiently? Will it reduce waste?

Each of these questions presents an opportunity for creating value. Considered together, they signal the possibility of each design decision to create multiple positive outcomes throughout the entire spectrum of concerns.

Multiple Positives

Herman Miller, the furniture manufacturer, was looking to create multiple positives when it commissioned the design of a 295,000 square foot factory and office near its headquarters in western Michigan. The company's goals for the new plant were to foster a spirit of collaboration between office and factory workers, and create a workplace with a restorative impact on the local environment. Working with a design team that paid close attention to local conditions, Herman Miller built a plant that serves the needs of all its factory workers and administrative employees by celebrating an array of natural and cultural delights.

The low-lying, curved building follows the natural contours of the Michigan grassland. Stormwater spilling off the building moves off the site through an extended series of wetlands that purify the water while providing habitat for hundreds of species of birds, plants and insects. Plantings of native grasses and trees provided additional habitat for local creatures and further enhance the beauty of the site. Inside the building, offices face the manufacturing plant across a sun-lit, urbane promenade where workers meet and lunch and drink coffee among whimsical sculptures and thriving plants. The entire building—the gyms, the bathrooms, the factory floor—is so pleasantly bright and airy, it is now known as "the GreenHouse."

Does this enhance the well-being of workers? Create productivity and wealth? Well, yes. When Herman Miller moved into the building the company was producing $250 million worth of furniture each year. Within a single year it increased production by nearly $50 million, a gain of 24 percent. At the same time, both office and manufacturing staff reported a significantly higher degree of job satisfaction than they had at their previous workplace.

These substantial benefits came not from focusing strictly on the bottom line, but through a sophisticated understanding of the synergy of economic, social and ecological concerns. The customized design of the factory, which suited Herman Miller's administrative and manufacturing needs; an innovative management strategy designed to enhance relationships with customers; the environmental quality of the building; and its harmonious relationship to its surroundings together created a better outcome than could have been realized if Herman Miller had narrowly defined its goals. As a result, the company is now doing business in a productive, environmentally sound, delightful workplace.

While it's impossible to measure the influence of delight, it's easy to imagine the pleasure of working in a place where you can always see the beauty of the surrounding landscape, where copious fresh air and light actually blur the boundary between indoors and out. Workers in such a place feel as if they have spent the entire day outdoors. They see the comings and goings of birds and the passing of the seasons. They come to know the place where they live—at work!

Such pleasures have an enormous impact on the spirit. After Herman Miller moved into the new plant, sixteen young employees left for jobs with higher wages. But they soon returned. When the president of the company asked, "Why are you back?" they said, "We want our jobs back because we had never worked in another factory before. We couldn't work in the dark."

One of the icons of industry, The Ford Motor Company, is realizing multiple positives as it carries out one of the most sweeping acts of industrial restoration ever. Led by Henry Ford's great-grandson, William Clay Ford, Jr., the company has embarked on a 20-year, $2 billion dollar restoration of its gigantic Rouge River plant in Dearborn, Michigan. Built between 1917 and 1925, the manufacturing complex remains one of the world's largest. At its peak it employed 100,000 workers and churned out millions of cars (boats and airplane engines, too). It was the pride of Ford and the envy of industrialists from Tokyo to Berlin.

Yet by the beginning of the 21st century, the Rouge River plant was a brownfield, a sprawling wasteland of dark and dilapidated buildings, leaky pipes and old equipment. The land was contaminated, bare of all but the most persistent vegetation, and the river was badly polluted. Rather than walk away from a worn-out industrial landscape and a community that had supported it for nearly a century, Ford chose to transform the Rouge River site into a healthy, productive, life-supporting place. Indeed, Ford's leaders are now asking a revolutionary question: "When will we be able to let our own children play in the soils and waters of the Rouge?"

That critical question leads to a wide spectrum of inquiry. What specific innovations will make the site a place that invites the return of native species? How can the presence of the factory be beneficial to the Rouge River? On the grounds of the site what is the optimum depth of topsoil, number of worms per cubic foot and insect and bird diversity? What are the optimum aquatic populations of the river? How do we design a manufacturing facility that is a prosperous, supportive work environment?

These may sound like surprising questions for a car company to ask, but Ford is asking them—and answering them, too. In 2003, Ford unveiled a new automotive assembly plant featuring skylights for daylighting the factory floor and a roof covered with growing plants. The 450,000-square-foot "living roof" provides habitat for birds, insects and microorganisms. In concert with a series of wetlands and swales, the roof also controls and filters stormwater run-off. With these natural, built-in measures replacing the expensive technical controls called for by new regulations, Ford realized $10 million in first cost savings on stormwater remediation alone. Just as with Herman Miller's Greenhouse, these savings could not have been realized through a traditional approach to facility design.

As William Clay Ford, Jr. says, "This is not environmental philanthropy; it is sound business . . ." And he's right, of course. Businesses that fail to bring ecological and social concerns to commerce put shareholder value in danger and are not contributing to the larger prosperity.

Conclusion

These examples begin to suggest some of the ways in which considering the principles of the fractal triangle can create business opportunities. Applied throughout the design process, they introduce a new standard of quality, adding ecological intelligence, social justice, and the celebration of creativity to the typical design criteria of cost, performance, and aesthetics.

There is still a long way to go. Architecture has just begun, really, to design new ecologically intelligent materials that flow in cradle to cradle cycles and contribute to the health of those who manufacture them as well as the building occupants. Ultimately, it will be the delight buildings inspire, the way they enhance our feeling for life, that will move ecologically intelligent design from the agenda of a few to the demand of many. Imagine buildings so delightful, so expressive of the world's diverse interactions between nature and human culture, so comfortably affordable for so many, so able to inspire wonder in the living world, that the demand for them is driven by pleasure from the bottom up.

Illustrations:

Making Informed Choices

Environmentally Preferable Purchasing: The Progress and Remaining Challenges of Multi-Attribute Decisionmaking

Keith Sonnier, "Cenozoic Codex," GSA Fine Arts Program.

Environmentally Preferable Purchasing:

The Progress and Remaining Challenges of Multi-Attribute Decisionmaking

By Alison Kinn-Bennett

Alison Kinn-Bennett is the Model Green Construction Specifications Project Officer, for the US Environmental Protection Agency, Environmentally Preferable Purchasing Program in Washington, DC.

Consumers can play an integral role in improving environmental and public health through their purchasing patterns. By demanding certain attributes, consumers can send a clear signal to manufacturers about their preferences for those products and services that pose fewer burdens on the environment. By leveraging their purchasing power, consumers are voting with their pocketbooks, directly affecting manufacturers' bottom lines. Some manufacturers are attuned to this market signal and have recognized that differentiating their products on the basis of environmental attributes can serve as a competitive advantage.

As the single largest consumer of goods and services, spending over $250 billion annually on a wide variety and large quantity of products and services, the U.S. Federal government leaves a large environmental footprint. By the same token, it can wield its purchasing power to propel companies to manufacture products and services that pose fewer burdens on the environment and thereby leverage and jump-start the market for "green" products in both the public and private sectors.[1] In the environmental arena, the fact that paper with recovered materials content has become the norm is an example of how purchases of such goods by the Federal government made them more widely acceptable and available.

The Benefits of Environmentally Preferable Purchasing

- Improved ability to meet environmental goals through markets rather than mandates
- Improved worker safety and health
- Reduced liabilities
- Reduced disposal costs

However, despite this potential, the Government has not relied heavily on demand-driven policies to achieve environmental improvement, and the market for "green" products remains a niche market in many sectors. Why? In part, this is because there currently is no existing infrastructure that can easily facilitate the identification of "green" products and services for American consumers. Although there are a number of private sector environmental labeling or certification organizations in the United States that are attempting to fill this gap, their programs have not yet made deep inroads into consumer buying patterns.[2]

The Federal Drive for Green Purchasing

The commitment for the U.S. Government to be an environmentally responsible consumer is ensconced in a number of national statutes:

The Resource Conservation and Recovery Act of 1976, the solid and hazardous waste statute, includes a provision--Section 6002--which directed government agencies to promote recycling by increasing the purchases of products made with recovered materials and thereby developing markets for those products.

The Pollution Prevention Act of 1990 establishes an environmental management hierarchy and places pollution prevention[3] as the approach of first choice. This Act directed EPA to identify opportunities for Federal procurement to encourage source reduction.

The Energy Policy Act of 1992 emphasizes energy efficiency and renewable energy; it promotes, for example, the use of alternative fuels and encourages the purchase of alternative-fueled vehicles.

Although these laws have been on the books for a number of years, their potential to harness purchasing power to achieve environmental objectives has not been fully utilized.[62] These statutory mandates were given a major boost in the nineties by a series of Presidential Executive Orders, which, in sum, require the Federal Government to improve environmental performance in its daily operations and practices -- i.e., to "green" its decision-making process.

An integral component of these Executive Orders and U.S. "greening of government" efforts is the use of its purchasing power to achieve environmental improvement. The Executive Orders require Federal agencies to purchase products ranging from energy

Presidential Executive Orders Related to the Environment

Executive Order 13101 "Greening the Government through Waste Prevention, Recycling, and Federal Acquisition"

Executive Order 13123 "Greening the Government through Efficient Energy Management"

Executive Order 13134 "Developing and Promoting Biobased Products and Bioenergy"

Executive Order 13148 "Greening the Government through Leadership in Environmental Management"

Executive Order 13149 "Greening the Government through Federal Fleet and Transportation Efficiency"

Executive Order 13150 "Federal Workforce Transportation"

Executive Order 13211 "Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution or Use"

Executive Order 13221 "Energy Efficient Standby Power Devices"

Executive Order 13302 "Amending Executive Order 13212, Actions to Expedite Energy-Related Projects"

Executive Order 13327 "Federal Real Property Asset Management" efficient computers and recycled content products, to "environmentally preferable" products. The Executive Orders also require changes in the standards, specifications, and regulations guiding purchasing in the Federal government to be modified to allow for "green" purchasing.

These Executive Orders served as important catalysts, rejuvenating or creating new "green" procurement programs including:

Buy Recycled Program - Originating in Section 6002 of RCRA (see above), the Buy Recycled Program is the oldest and the most well-established environmental procurement program in the United States. RCRA requires EPA to designate products that can be made with recovered materials and to recommend practices for buying these products, based on a market survey to ensure sufficient availability, reasonable price, and competing vendors. Once a product is designated, agencies are required to buy the product with the highest recovered material content level practicable.[4]

Energy Star Program - Originally for private sector purchases, this popular, internationally known program establishes energy efficiency levels for computers and other energy-consuming products. Executive Order 12902 requires Federal government to buy only those computers, monitors, and printers that meet Energy Star requirements.

These programs helped to establish the U.S. Government's presence in demand-driven policies for environmental improvement and have been instrumental in getting the environment on the radar screens of many of the Federal purchasers. And, each program is tied to a very clear mission, based on a single product attribute - like recycled content or energy efficiency.

This single attribute focus is not surprising given that environmental management in the first 20 or so years of EPA's history centered around controlling and cleaning up industrial pollution in disparate pieces--often shifting the pollutant from one medium to another. This is not to criticize or underplay the tremendous success of this approach in cleaning up the most egregious and noticeable environmental problems.

Like the Agency's past policies in the industrial sector, the few policies and programs directed at influencing consumer behavior and products have been driven by single-issue concerns (e.g., solid waste [Buy Recycled Program], air quality [Energy Star, Green Lights Program], water quality, etc.). However, as the Agency moves away from addressing environmental problems on a single-medium basis to a multi-media systems-based approach that focuses on preventing pollution, programs targeted at the consumer sector will also have to evolve to reflect this paradigm shift. Thus, we need to build on the successes of the single-attribute green procurement programs to introduce the Federal purchasers to a more comprehensive approach to buying green.

This broader perspective is reflected in EPA's Office of Pollution Prevention and Toxics' Environmentally Preferable Purchasing (EPP) Program, which aims to minimize environmental impacts across all environmental media and over the entire life cycle of the products or services purchased by Federal agencies.

EPA's Environmentally Preferable Purchasing Program

The Environmentally Preferable Purchasing Program is an outgrowth of Executive Order 13101, which mandates the U.S. Federal

Government to identify and give preferences to those products and services that pose fewer burdens on the environment when compared to competing products or services that serve the same purpose. This definition goes on further to say that this comparison should consider environmental impacts across the various life-cycle stages of the product.

EPA's Five Guiding Principles for EPP
Guiding Principle 1: Environmental considerations should become part of normal purchasing practice, consistent with such traditional factors as product safety, price, performance, and availability.
Guiding Principle 2: Consideration of environmental preferability should begin early in the acquisition process and be rooted in the ethic of pollution prevention, which strives to eliminate or reduce, up-front, potential risks to human health and the environment.
Guiding Principle 3: A product or service's environmental preferability is a function of multiple attributes from a life cycle perspective.
Guiding Principle 4: Determining environmental preferability might involve comparing environmental impacts. In comparing environmental impacts, Federal agencies should consider: the reversibility and geographic scale of the environmental impacts, the degree of difference among competing products or services, and the overriding importance of protecting human health.
Guiding Principle 5: Comprehensive, accurate, and meaningful information about the environmental performance of products or services is necessary in order to determine environmental preferability.

In 1999, EPA published "Final Guidance on the Acquisition of Environmentally Preferable Products and Services," the first articulation of U.S. policy on "green" products and services. The Guide is a broad framework within which Federal agencies can make more environmentally preferable purchasing decisions.[5] However this broad approach fell short of Federal agencies' expectations for a set of "how to" directions from EPA on incorporating human health and environmental considerations into their purchasing decisions. This need led EPA to develop a number of tools and resources to help Federal purchasers apply these broad principles to specific acquisitions (See Figure 2).

EPA's Purchasing Tool Suite

The Federal Government does not endorse specific products, but the EPA has developed a number of tools and resources to begin to help Federal purchasers find the products that meet their environmental goals and mandates. EPA's purchasing tool suite was developed with Federal employees in mind, but will also be useful for others in the private and public sectors, including product designers, manufacturers, suppliers, and purchasers. EPA has different approaches for different types of procurements and product categories. A tailored approach and level of analysis have been employed to fit the complexity of the product and service categories.

Some of the tools and resources available on-line include:

General EPP Training Tool: Basic EPP principles, along with some more in-depth applications of EPP, are introduced in an entertaining and interactive multimedia format. www.epa.gov/epp/gentt/index.htm

Database of Environmental Information for Products & Services: This searchable database includes product-specific information (e.g., environmental standards and contract language). www.epa.gov/epp/database.htm

Tips on Buying "Green" with the Government Credit Card: This manual includes tips and ideas to help one make "greener" choices.
www.epa.gov/epp/tools/creditcard.htm

Promising Practices Guide for "Greening" Contracts: Case studies highlight successful strategies for incorporating environmental factors into products and service contracts.
www.epa.gov/epp/ppg/index.htm

Cleaning Product Attributes Ranking Tool: An interactive tool that helps the user choose greener cleaning product by prioritizing environmental attributes (e.g., skin irritation potential, VOCs, recycled packaging).
www.epa.gov/epp/cleaners/select/

Buying Green Online: Greening Government E-Procurement of Office Supplies: An overview of federal government office supply e-procurement initiatives and references.
www.epa.gov/epp/pubs/buying_green_online.pdf

"Greening" Your Meetings and Conferences: An interactive, multi-media tool that helps meeting planners, and the industries that supply them, create environmentally responsible meetings, with checklists, case studies, a calculator for monitoring progress, and links to resources.
www.bluegreenmeetings.org

Building for Environmental and Economic Sustainability: BEES 3.0, developed by the National Institute of Standards and Technology (NIST) Building and Fire Research Laboratory with support from the EPP Program, is a powerful tool for selecting cost-effective, environmentally preferable building products.
www.epa.gov/epp/tools/bees.htm

DRAFT Federal Guide for Green Construction Specs: EPA and our partners, including the Office of the Federal Environmental Executive, are developing this tool to assist Federal design professionals in meeting their building environmental goals and mandates. Organized according to the Construction Specifications Institute's MasterFormat™, the model language provides performance-based options, allowing for flexibility in application.
(http://fedgreenspecs.wbdg.org)

In June 2004, EPA released for public review four draft EPP guides covering the specific issues surrounding the following (www.epa.gov/epp/documents/pfs.htm):

- "Greening Your Purchase of Carpet: A Guide for Federal Purchasers."
- "Greening Your Purchase of Cleaning Products: A Guide for Federal Purchasers."
- "Greening Your Purchase of Copiers: A Guide for Federal Purchasers."
- "Greening Your Meetings and Conferences: A Guide for Federal Purchasers."

Conclusion

"Greener" public purchasing requires the expertise of both environmental and acquisition experts. This is because EPP in the Federal government context presents at least two challenges. First is the challenge of how to define what is environmentally preferable. As EPA has defined it, environmental preferability depends on numerous and specific product or service factors, including the local conditions within which the product will be used, available alternatives, life cycle impacts, etc. Environmental information on life cycle impacts is scarce, and where available, it is often difficult to translate into useful formats to allow for decision-making. We need to look to the private sector (e.g., research institutions and standard setting organizations) that can be relied upon to fill the information gaps.

The second part of the challenge is how to ensure that those products or services that do pose fewer burdens on the environment are indeed purchased. The Federal acquisition process involves complex and sometimes arcane rules and regulations (even with the recent reforms to the acquisition process) that may make it difficult for new environmental products and services to compete on an equal footing with traditional products and services. As a first step, the U.S. Federal Acquisition Regulation (FAR), which provides the basic contracting guidance and implementing regulations used by Federal agencies for buying products and services from the private sector, was formally revised in August 1997 to incorporate policies for the acquisition of environmentally preferable and energy-efficient products and services.[6] The changes require consideration of environmental factors in all aspects of Federal acquisition--acquisition planning, describing an agency's needs, conducting market surveys, and evaluating and selecting a vendor. However, translating these policies into practice will require time and resources as well as innovative acquisition approaches that ensure that environmental considerations become routine in the purchasing decision-making process.

Notes:

1. James Lee Conrad, 1993 (December): Buying Green: Implementation of Environmentally-Sound Purchasing Requirements in Department of Defense Procurements, p. 2.

2. Two notable examples are Green Seal and Scientific Certification Systems.

3. The Pollution Prevention Act defines source reduction to mean any practice that: reduces the amount of any hazardous substance, pollutant, or contaminant entering any waste stream or otherwise released into the environment (including fugitive emissions) prior to recycling, treatment, or disposal; and reduces the hazards to public health and the environment associated with the releases of such substances, pollutants, or contaminant.

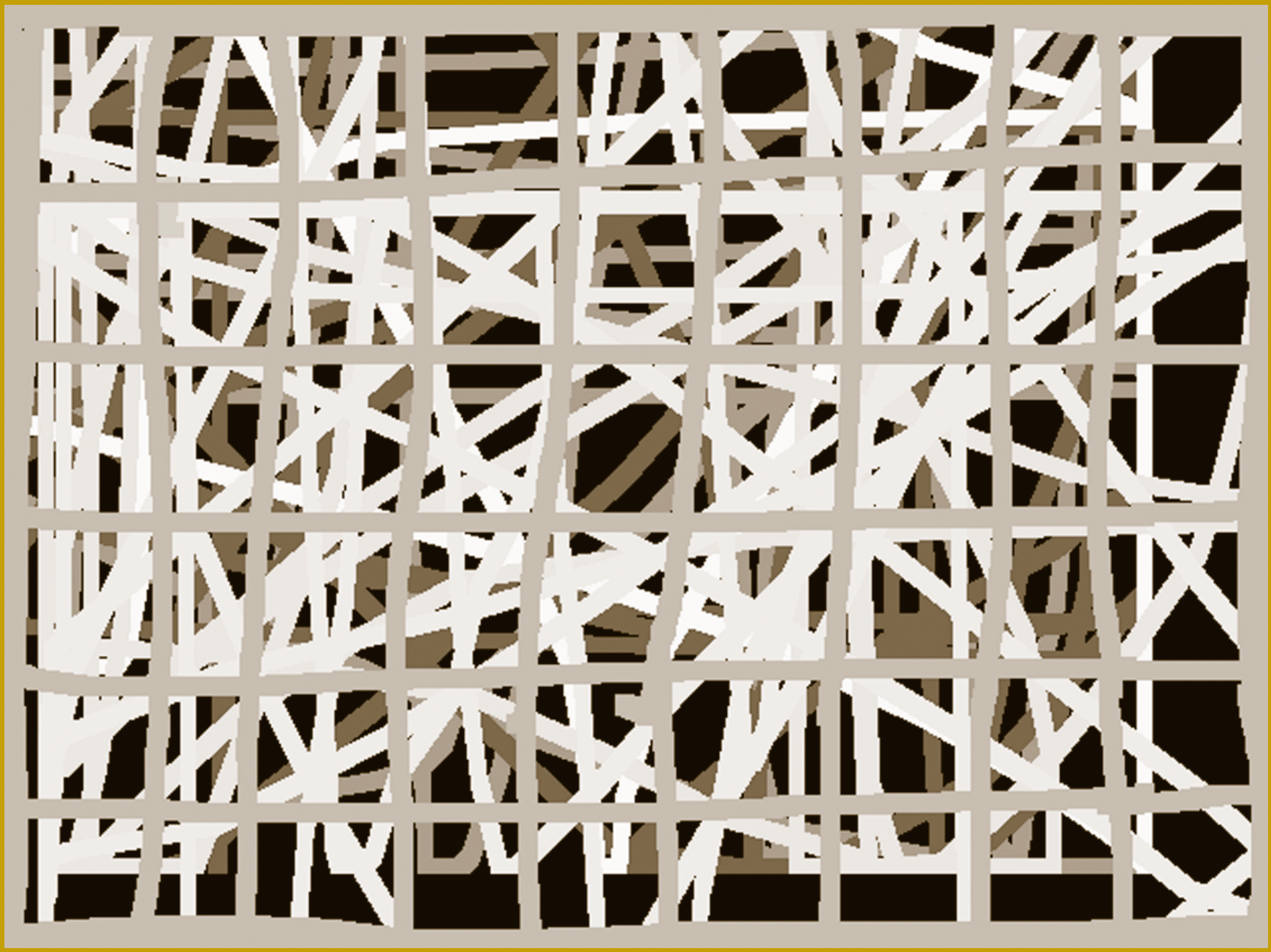
For example, between 1976 and 1992, only five products made with recovered materials—paper, cement and concrete containing fly ash, building insulation, re-refined oil and retread tires—had been designated by EPA under Section 6002 for purchase by government agencies.

4. US EPA, Office of Solid Waste and Emergency Response, 1997 (November): Environmental Fact Sheet: EPA Expands Comprehensive Procurement Guideline (CPG).

5. From the "Final Guidance," at www.epa.gov/epp/guidance/finalguidancetoc.htm.

6. For additional information, consult the 22 August 1997 Federal Register, vol. 62, no. 163, pp. 44809–44813.

. Emil Eugen Holzhauer, "Brooklyn Bridge," GSA Fine Arts Program.



Making Informed Choices

Creating a More Healthful, Less Toxic Built Environment

Jonathan Herz, Untitled, (Jonathan Herz)

Creating a More Healthful, Less Toxic Built Environment

By Arthur B. Weissman

Arthur B. Weissman, Ph.D., is President and CEO of Green Seal, Inc., an independent, non-profit organization that identifies and promotes products and services that cause less toxic pollution and waste, conserve resources and habitats, and minimize global warming and ozone depletion.

As the manager of building facilities, you have an enormous opportunity to affect positively the health and welfare of your workers, occupants, and visitors. The products and systems that have been designed into your building, as well as the products and procedures you put into place for operating and maintaining your building, can either be a source of toxins and other harmful health effects or be neutral or even nourishing to human health and the environment.

This article describes the basic connection between products in the built environment and human health and environment. We will look first at how common products in the built environment can be the source of highly undesirable toxins and how good alternatives can be found for them. Then we will look at some data linking toxins in the built environment to the health, productivity, and welfare of workers and the community. We will describe how environmental standards can be developed to promote alternatives to toxic products, and look briefly at the methodology called life-cycle assessment on which product standards are based. Finally, we will explore the benefits of life-cycle-based environmental standards for the built environment and show the linkages to improved health, productivity, and welfare of building occupants and the community at large.

Basic materials and common products that have become familiar features of our built environment may nonetheless be a source of toxins with potentially serious adverse health effects. Contamination of building ventilation systems resulting in Legionnaire's Disease is a striking and acute version of many quieter, more insidious dangers in the buildings we inhabit. Sources of contaminants and toxins include not only heating, ventilating, and air-conditioning (HVAC) systems but also carpets, window furnishings, wallboard, furniture, partitions, paints, cleaners, fax and copier machines, etc. For example, particleboard, which may be found in doors and furniture, is usually bonded together with urea formaldehyde, which emits vapors of formaldehyde, a probable human carcinogen. Paints may contain petroleum distillates, also potentially carcinogenic, as well as high levels of volatile organic compounds (VOCs) that can cause respiratory distress or disease. Even common surface or floor cleaners used frequently in buildings can be a source of reproductive toxins or endocrine disruptors as well as VOCs.

The good news is that in most cases there are good alternatives to products that have harmful toxic ingredients in them. Particleboard can be made with resins that do not contain formaldehyde. Paints can be made without carcinogenic petroleum distillates and other toxic ingredients and with low levels of VOCs, or none at all; so can cleaning chemicals. All of these so-called "green" products are made with compounds that are not carcinogens, reproductive toxins, or endocrine disruptors, and are not toxic to humans or aquatic life, harmful to the ozone layer, bad for air quality, or persistent and bioaccumulative. Yet green products can also be designed and formulated to work as well as conventional products; in fact, they must, or they cannot hope to replace the latter.

For years many in industry resisted the notion that everyday products could, as a whole, be harmful to health or environment. The typical response was that, while some of the chemicals in these products might pose a hazard, the exposure to them by building occupants or environmental endpoints was negligible or inconsequential. Risk assessment – a very uncertain "science" – was used to determine levels of exposure or risk that were considered acceptable. But experience has proved that this approach is not only inadequate but also erroneous and misleading. Sick building syndrome, chemically sensitive individuals, increases in asthma and allergies, and long-term genetic damage in the environment from endocrine disruptors have all shown that chronic exposure to toxic chemicals can be harmful even at very low levels.

In fact, a study was conducted a few years ago by the internationally recognized Lawrence Berkeley National Laboratory on the macro-scale link between indoor air quality and worker health and productivity. It determined that there is "relatively strong evidence that characteristics of buildings and indoor environments significantly influence prevalence of respiratory disease, allergy and asthma symptoms, symptoms of sick building syndrome, and worker performance." It calculated "potential annual savings and productivity gains in 1996 dollars of $6 to $14 billion from reduced respiratory disease, $2 to $4 billion from reduced allergies and asthma, $15 to $40 billion from reduced symptoms of sick building syndrome, and $20 to $200 billion from direct improvements in worker performance that are unrelated to health. In two example calculations, the potential financial benefits of improving indoor environments exceed costs by factors of 9 and 14."[1] Please note the last statistic: you will reap ten times in financial benefits what you spend to improve the indoor environment!

Is there any question, then, why building managers should strive to introduce only green materials and products into the built environment? These results make very clear why we pursue a pollution prevention or precautionary policy of getting toxic ingredients out of the workplace and economy; a more healthful building turns out to be a much more productive one. But how exactly do we determine what is a green material or product? How do we define non-toxic, and how do we ensure that something won't harm the environment in another respect?

Green Seal uses rigorous, scientifically developed environmental standards for products and services to set appropriate criteria for what is "green." Two points are critical in developing such standards: they must be developed in an open, transparent process that allows participation by all interested stakeholders; and they must be based on sound technical information on the life-cycle environmental impacts of a product category and the environmental attributes of products in the current market.

An open, transparent process is necessary to ensure that all possible information and perspectives are considered in defining leadership criteria for a product category. Moreover, for major institutions such as government bodies to adopt an environmental standard, it has to be perceived as fair and unbiased. If the criteria are explicit and transparent, everyone knows on what basis the standard defines a product as green or not green. At a minimum, all standards should be developed with proper notice; a draft standard should be proposed to stakeholders and the public at large for comment, and any comments received should be carefully and in good faith evaluated for any revisions to the proposal before the standard is finalized. We also recommend creating a public document responding to each substantive comment, showing whether it resulted in a change in the proposal or why such change was not accepted. In the best of scenarios, a consensus can be achieved among stakeholders on the final standard, but, at the least, reasonable efforts should be made to achieve such a consensus.[2]

Product environmental standards must also be life-cycle-based. A product life cycle is all the material, energy, resource, and pollutant flows, in and out, associated with the manufacture, use, and end-of-life of the product. It looks at the raw materials that are extracted from the environment and processed for the product; the manufacturing process to assemble or formulate the product; the transportation of materials associated with extraction, processing, and manufacturing and of the finished product to the market; the use of the product during its productive life; and the recycling, disassembly, reuse, or disposal of the product after its useful life. Formal life-cycle assessment analyzes the environmental impacts of a product by creating an inventory of materials, energy, and pollutants in all the life-cycle stages and then determining the corresponding environmental impacts. For an environmental standard, an evaluation of the significant environmental impacts at each important stage in the product's life cycle ensures that no significant attribute is neglected (for example, highly toxic chemicals used in manufacturing an otherwise acceptable product) and that environmental impacts are not simply shifted from one life-cycle stage or environmental impact to another (for example, from manufacturing to use; or from air pollution to water pollution).

Life-cycle-based environmental product standards take all this information and, along with an analysis of the environmental attributes of products in the current market, set criteria for significant product attributes – including its manufacturing process or end-of-life – so that the standards represent a leadership level in the current market in that category. This level may vary, but Green Seal typically strives to capture 15% to 20% of the top environmental performers in a given product category in its environmental standards. Purchasers who select products that meet these standards therefore know that they are buying environmental leadership products and are helping to reduce the environmental impact of their own purchasing and activities as well as encouraging green products in the market.

For the built environment, using life-cycle-based environmental standards has the same positive effect. If the products and procedures employed in constructing and maintaining a building meet environmental standards, the materials will have the least possible impact on the particular environments from which they were extracted; they will have minimal or no adverse impact on the health of building occupants and those who operate and maintain the building (such as the janitorial staff); and, in the best of cases, they will actually enhance the productivity and well-being of all building occupants and visitors from the community at large.

The good news is that the greening of buildings is happening, and these positive effects are beginning to ripple through our population and economy. The State of California recently built and opened up a huge office complex on the Capitol grounds (the East Wing Complex) that has very low-emission carpet and office dividers. One of the models of green hotels, the Sheraton Rittenhouse Square in Philadelphia, provides high-volume filtered fresh air to all rooms, and guests are pampered with linens and towels that are organic and natural in fiber. Data coming in about other green buildings are showing not only a reduction in absences due to sickness, but also enhanced productivity from the tenants. A major corporation experienced a 15% drop in employee absenteeism after moving into a new high performance facility.[3] An insurance company in Wisconsin recorded a 16% increase in productivity upon moving into a green building.[4] Overall, green buildings can boost occupant performance by 6 to 26%.[5]

Since your tenants spend a lot of their time inside the buildings you manage, you can be sure that anything you do to make the buildings greener will only help them, the environment, and the community of which we are all a part.

Notes:

1. William Fisk, 1999: Estimates of Potential Nationwide Productivity and Health Benefits from Better Indoor Environments: An Update, Indoor Air Quality Handbook, Report number LBNL-42123 (New York: McGraw-Hill).

2. The ISO standard for environmental labeling programs, ISO 14024, requires that reasonable efforts be made to achieve consensus on their environmental standards. Consensus is not mandated because it could give a stakeholder bloc, such as industry, too much control over the standard and possibly result in its being compromised as an independent, leadership standard.

3. U.S. Green Building Council, n.d.: Making the Business Case for High Performance Green Buildings.

4. Maryland Department of Natural Resources, Environmental Design Program, 2002. Presentations on CD. Sean McGuire, contact.

5. U.S. Green Building Council, Making the Business Case.

Isaac J. Sanger, "Coal Barges," GSA Fine Arts Program.

Observations and Recommendations

Daniel Rasmusson, "Men On Scaffold," GSA Fine Arts Program.

Observations and Recommendations

The Government and Equity: Making It Green, Economical, and Fair

Applying sustainable development principles in a way that recognizes the economic, environmental, *and* social issues associated with every business decision we make, will enable the Government to obtain the best value. By investing in and protecting communities - specifying products and services that reduce or eliminate toxic materials - we are getting closer to our goal of carrying out "social, environmental, and other responsibilities as a federal agency."

But, we need to recognize the complexity of the task. While recognizing and celebrating the right choices we are making, we need to develop the data and tools necessary to support a comprehensive planning approach in the future.

Based on the existing body of literature in this field and our experience to date, we can make some observations concerning sustainable development and the equity corner of the Ecology/Economy/Equity approach.

Observations and Recommendations:

- **Build on the Sustainable Design and Development Business Model –** consider the triad of economic prosperity, environmental quality and social equity holistically, to develop a meaningful understanding of the complex nature of sustainability.
- **Practice Integrated Design –** consider and where possible, include all participants in a building's life cycle in the decision-making and design process. Sometimes, the maintenance staff and building tenants can tell you more about impacts and effectiveness of materials choices than many complex models.
- **"Expand" Life Cycle –** always start with present-value *life cycle cost analysis*, then expand to *life cycle analysis*. To be sustainable, we need to address more than just cost reduction, economic opportunity, environmental protection and resource conservation. We must also consider improvements in the quality of life for individuals, communities, and society as a whole.
- **Eliminate Toxics and Avoid Risk Shifting –** understand the impact of our product choices, including "green" products, on the communities in which

Mary De Neale Morgan, "Trees on Coast," GSA Fine Arts Program.

they are made, on those who fabricate, install, occupy, operate and maintain, and dispose of the materials and services associated with our facilities. Be certain that the "lowest first cost" includes their health and safety, too.

- **Establish an Evaluative Framework for Green Materials –** recognize the demonstrated human health, societal and environmental burdens associated with persistent organic pollutants, persistent bioaccumulative toxics, carcinogens, and reproductive toxicants, and incorporate these costs into our business calculations.
- **Incorporate Society Factors into Green Design Templates –** as understanding of, and agreement on, equity factors increase, consider their explicit incorporation into recognized green modeling tools and guidelines, such as EPA's Model Green Specifications, BEES, Greenseal Standards, the McDonough Braungart Protocol™, and LEED®.
- **Affirmatively Recognize Agency Commitment –** to our goal of carrying out social, environmental, and other responsibilities as Federal agencies, by embracing sustainable development principles (per EO 13123), and eliminating toxics (per EO 13148). Responsibility for *compliance* is with all Federal Agencies not just the Environmental Protection Agency, Department of Labor and Department of Justice, which, in these areas, are primarily monitoring agencies.

Green and Fair Means Best Value

The Office of Governmentwide Policy is committed to educating and helping Federal decision-makers in planning and carrying out their real property programs in a way that will result in the most effective use of limited resources. This means investing in building products that have the best long-term value over their entire lifecycle. The reality is that the Government will likely continue to use products that generate toxics through their lifecycle where they currently represent the best alternative. But, we must be aware of their future costs and impacts--and take steps to mitigate them.

Sustainable development only works when societal issues are considered. As we noted in the "GSA Real Property Sustainable Development Guide," it helps us to understand the environmental implications of our business functions, such that environmental issues are considered essential components of business processes, rather than consequences of those processes. Understanding and holistically considering the three pillars of sustainable development - economic prosperity, environmental quality and social equity – will lead us towards getting the best value for the American People.

First and foremost, applying the sustainability principles means going beyond traditional financial reporting to measure and report on at least the environmental, social and economic dimensions of performance.

The reductionist approach is inconsistent with the concept of sustainability, and its principles, for two main reasons. Firstly, sustainability is not a single thing. It is multidimensional . . . Secondly, sustainability is a vision of wholeness. Breaking it down into disconnected parts and then studying the parts individually will not help us understand the relationships between the parts that make up the whole. Instead, taking the reductionist approach can lead us to oversimplify the complex nature of sustainability" . . .

Auditor-General's Office,
State of Victoria, Australia[1]

LEED Innovation in Design, Green Building Concerns:[2]

The U.S. Green Building Council's LEED® Green Building Rating System was devised to address current sustainable issues involved in commercial building design. While still focusing major energy conservation-related issues, LEED has broadened the definition of green buildings, by requiring point credits in six categories: sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, and, innovation and design process.

To attain LEED certification, project investment decisions follow a template. Different levels of green building certification are awarded based on the total points earned. Currently, the LEED certification template exemplifies an economic and environmental approach to sustainable development. By focusing on these two core values, the USGBC was able to bring together diverse segments of the building industry to create a national standard for high-performance buildings. But, the third core value, equity, is only peripherally addressed.

And, while the Government's use of economic (Life Cycle Cost) and environmental (Life Cycle Analysis) criteria is consistent with LEED, the current version does not credit the Government's (or any other owner's) investments in equity.

So where might credit for eliminating toxics and paying prevailing wages be pursued using the current version of LEED?

LEED® Innovation in Design, Green Building Concerns:

Environmental Issues: *With all sustainable design strategies and products, it is important to consider the related impacts to the environment and occupant well being, and to assure that other building aspects are not adversely impacted.*

Economic Issues: *Innovative strategies and measures have variable first costs and operating costs, depending on the degree of complexity, materials incorporated, and the novelty of the technology. Initial costs can range from free to prohibitively expensive. To understand the implications of design features, a life cycle analysis can be applied to determine if the strategy or product is cost-effective over the lifetime of the building.*

Community Issues: *Community issues are those that affect others in close proximity to the project, as well as members of regional and world communities. Local actions can have dramatic effects on the world when considered in aggregate.*

"Innovation Credits" are how LEED recognizes and awards exemplary performance, "where the outcome provides substantial benefits." Under the present LEED version, this appears to be the logical place.

In the LEED rating system: "environmental," usually relates to natural resource depletion, air pollution, global warming, air and water pollution, habitat restoration; "economic," focuses on saving money and reducing liability; and "community," usually relates to tenant comfort, better community quality, and conserving and protecting local resources. Community issues occasionally address creating "a more stable and interactive community,"[3] "or instilling "a new sense of pride."[4] However, more often than not, those community issues are most often environmental concerns, such as better water quality; and economic concerns, such as enhancing property values.

The Office of Governmentwide Policy has initiated a dialogue with the U.S. Green Building Council, with an eye towards considering these and other issues relevant to the Government.

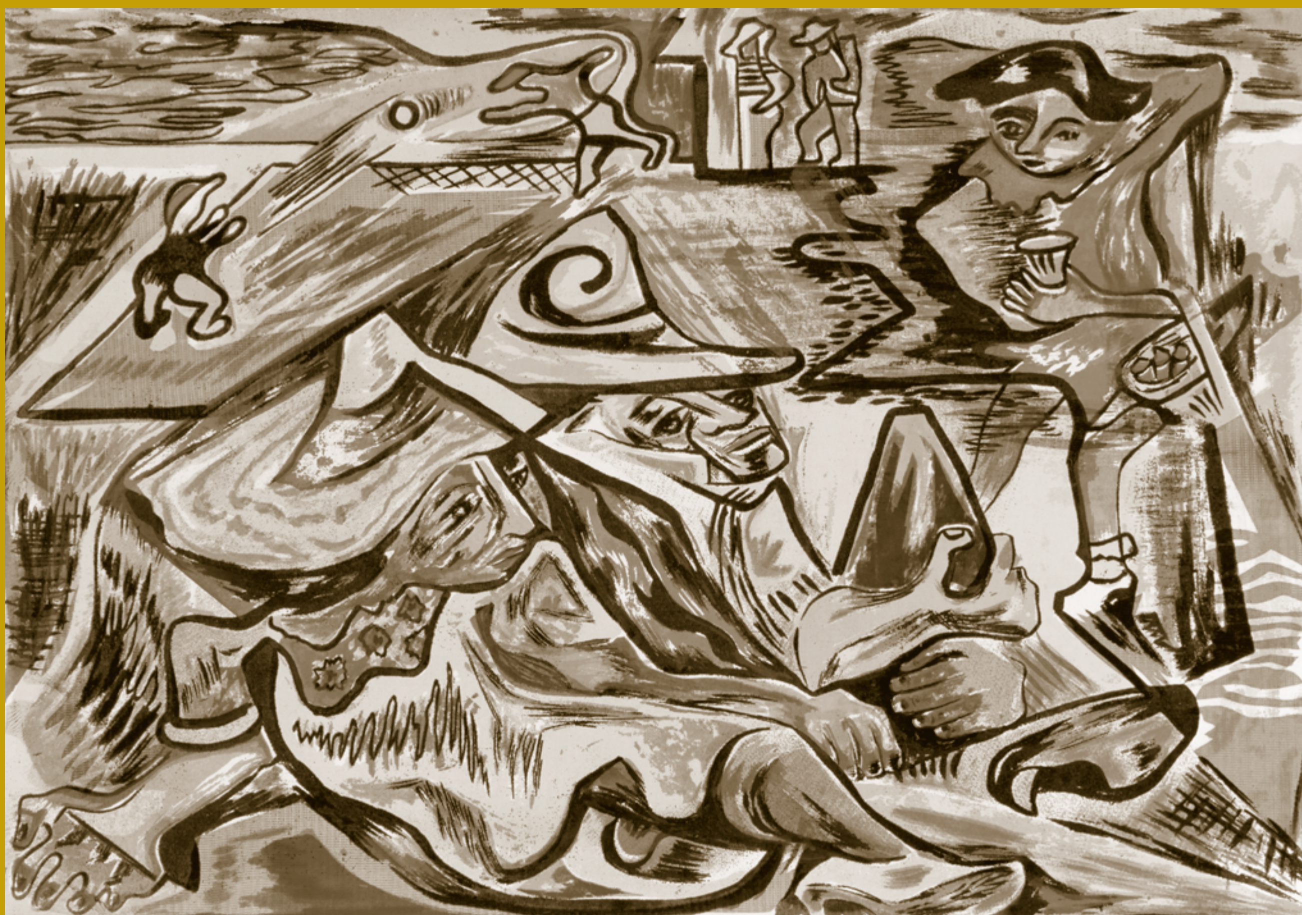
Notes:

1. "Beyond The Triple Bottom Line: Measuring and Reporting on Sustainability," Occasional Paper, Victoria Auditor-General's Office, Melbourne, Australia, June 2004. www.audit.vic.gov.au, ISBN 0 9752308 2 4.

2. LEED-NC Version 2.1 Reference Guide, May 2003 Edition, p.314.

3. Ibid, p. 20.

4. Ibid, p. 26.



Bernece Berkman, "Gobbers! Git A Bag!!!," GSA Fine Arts Program.

Case Studies and Strategies

Real Cleaning

Chaim Gross, "Construction," GSA Fine Arts Program.

Real Cleaning

By Stephen P. Ashkin

Stephen P. Ashkin is president of The Ashkin Group, a consulting firm specializing in "greening" the cleaning process. The Ashkin Group provides green consulting services for federal, state and local governments, commercial office building owners/managers, major school districts, healthcare organizations, contract service providers, labor unions and environmental groups. (http://www.ashkingroup.com/index.htm)

Abstract

Today in the United States, cleaning is a $150 billion industry employing some three million custodians, the majority of whom are at the bottom of our socioeconomic ladder. Cleaning also consumes huge quantities of natural resources.

Cleaning of commercial and institutional buildings in the United States each year is estimated to consume: 6 billion pounds of chemicals, most of which are derived from non-renewable natural resources; 4.5 billion pounds of paper, requiring the cutting of approximately 50 million trees; and, hundreds of millions of pounds of janitorial equipment, filling approximately ten thousand garbage trucks, headed for disposal in our landfills.

Cleaning affects our environment through energy consumed to run equipment and illuminate office buildings as they are cleaned in the night, as well as water consumed during both the manufacture of janitorial products and the cleaning process itself. We have also learned that building occupants are affected by cleaning, as we connect it with the quality of the indoor environment and its effect on health and productivity.[1]

The American Society of Testing and Materials (ASTM) 1998 "Standard Guide on Stewardship for the Cleaning of Commercial and Institutional Buildings," has identified the process for implementing a state-of-the-art program, as well as the most common opportunities for improvement. Cleaning programs based on it appear to have an important role in reducing overall environmental impacts on worker and occupant health, performance and productivity, as well as reducing environmental impacts.

Introduction

Building owners in the United States currently pay, on average, approximately $1.30 per square foot for janitorial services.[2] Unfortunately, the primary focus on this investment is not on protecting occupant health but, rather, on maintaining an acceptable appearance while minimizing tenant complaints and costs. The result is significant lost opportunities to address indoor air quality (IAQ) and other problems which are either caused by improper cleaning - or are correctable by appropriate cleaning. These improvements can reduce absenteeism and increase worker productivity.[3]

The perception among building owners and managers is that all cleaning activities, products and services are the same. As a result, janitorial cleaning services have become a commodity. And, if all services are seen as equal and abundant--then the only thing to negotiate is the cost. Thus, there is a heavy focus on simply reducing costs.

But not all services are the same. Over the past ten years, the cleaning industry has made enormous strides. Cleaning product manufacturers have reduced the toxicity of their products and included renewable components, both of which benefit health and the environment. Manufacturers of backpack vacuums and high-speed floor-burnishing machines have significantly increased the ability to capture and eliminate finer particulates, which can adversely affect occupant health, computers, and other building equipment. Other equipment manufacturers have developed automated floor scrubbers that significantly reduce water consumption and, by drying floors faster, reduce the potential for slips and falls. Paper-towel and toilet-tissue makers now offer products with recycled content, bleached without chlorine, again significantly reducing environmental burdens. And finally, we know that bringing all the components together - products, equipment and people (including building occupants) can create a healthy, high performance environment, while reducing overall health and environmental impacts.

Not all buildings are the same. The US Government has an enormous variety of building types to consider when developing cleaning programs that protect the asset itself, the occupants, cleaning personnel, and the environment - at the most competitive price. Buildings range from historical landmarks to new offices, to military command centers, to laboratory complexes, to healthcare facilities; from high occupancy buildings with many visitors, to those with few occupants and no visitors; from the dry desert Southwest, to the hot and humid Southeast; from buildings housing our aging veterans, to schools and daycare for the youngest and most vulnerable children. Each building type and use impacts cleaning requirements. One size (or one contract) does NOT fit all.

Another complication is the use of "performance-based" contracts when there are no generally accepted performance metrics. However, sustainable cleaning has begun with EPA's Environmentally Preferable Purchasing Program, which has developed a model green custodial contract with GSA's Public Buildings Service.

The performance-based contract can provide many opportunities for addressing sustainability, but it must be clearly articulated. Many Federal agencies are assessing the US Green Building Council's Leadership in Energy and Environmental Design (LEED®) Rating System for New Construction (LEED-NC) and Existing Buildings (LEED-EB), which offer numerous credits for sustainable cleaning products and practices.

Methods

The following ten steps, based on our programs in over two hundred buildings, appear to be the common thread in successful programs that utilize cleaning to maintain a healthy, high-performance, sustainable indoor environment. These steps deliver the best return-on-investment relative to other cleaning programs; they provide a proven and easy implementation process, and identify opportunities for improvement, with the least expenditure of resources.

STEP 1. Commitment: Gaining commitment from senior management of all stakeholders is essential for program success. This includes the building owners, managers, tenants, and cleaning staff. Implementing a healthy, high-performance, sustainable cleaning program must be a priority. Commitment is demonstrated in actions taken to clearly define goals, expectations, and performance criteria and establish implementation plans with timetables by which the program can be evaluated.

STEP 2. Team Development: Like senior management, so must the team responsible for implementation make the commitment. The team should recruit additional members, as needed, such as environmental, health and safety personnel, union representatives, engineers, human resources representative, and, other concerned individuals. When developing a healthy, high-performance, sustainable cleaning program it is necessary not only to manage the cleaning operations themselves but also to manage occupant perception of those activities. Developing an effective project team cannot be over-emphasized.

STEP 3. Baseline: A building investigation will identify existing or potential indoor environmental problems, either caused by or correctable by cleaning activities. This can include a building survey, cleaning chemical and equipment evaluation, and review of other information, such as complaint and IAQ records. The baseline is critical for identifying and prioritizing opportunities for improvement and documenting them. It is also important when participating in pollution prevention programs, such as reducing VOCs or using biobased cleaning products. Finally, thoroughly review existing cleaning products and procedures. With a clear baseline, improvements can be demonstrated and management support maintained.

STEP 4. Products: Cleaning products should be reviewed specifically for impacts on human health and the environment. See Opportunities, below.

STEP 5. Procedures: Evaluate cleaning procedures and establish processes that protect health and safety and minimize environmental impacts. Traditional cleaning approaches simply focus on appearances, which may be deceptive. Even buildings that appear to be clean can be unhealthy. A healthy, high-performance sustainable cleaning strategy focuses on maximizing the control and elimination of microorganisms, VOCs and particles. Cleaning procedures should be based on requirements of individual building areas, with specific attention on occupants with special needs. These include individuals with pre-existing health conditions, asthmatics, chemically sensitive individuals, children, the elderly and other at-risk populations. Recognize that not all areas of a building require the same cleaning, and manage workloads and scheduling to optimize resources. The cleaning program must also be sensitive to the needs of the cleaning personnel, especially for those with disabilities, such as NISH contractors, who may require modified procedures and closer supervision.

STEP 6. Training: Identify and implement training required to carry out the new procedures. Remember: no two buildings are the same, nor are cleaning crews. Training should include functional, procedural and OSHA requirements. Inform and motivate the cleaning personnel on their critical role in maintaining a healthy environment. Finally, recognize learning, language, and other potential barriers and ensure that training is provided in easily understandable language; especially if cleaning personnel use English as a second language. Color-coded, post-able materials and pictographs are valuable, especially with high turnover of cleaning personnel.

STEP 7. Controls: Institute controls to provide consistent product quality, greater health and safety protection, and reduced risk from the incorrect or accidental mixing of chemicals. Automated chemical mixing equipment can reduce consumption by 30% to 60% and protect workers from exposure. Other, simple controls include labeling storage areas and shelves for proper identification and storage of chemicals. Label product containers, mops, and other equipment and develop specific auditing tools to ensure work is being conducted as specified.

STEP 8. Communications: Communications should foster a team effort, develop a clear sense of ***shared responsibility*** (see STEP 9), and establish a framework for continual improvement. An intranet message system can explain the process and notify occupants of upcoming meetings and major cleaning activities. Other means include letters, building newsletters, safety fairs, and employee activities. Establish feedback loops between management, occupants, cleaning personnel and vendors, to optimize resources and reduce response time.

STEP 9. Shared Responsibility: The traditional cleaning approach delegates the responsibility for the building cleanliness solely to the cleaning personnel. But, to optimize resources and generate healthy, high-performance indoor environments, all who share the environment must contribute to maintaining that environment. A ***shared responsibility*** education program should be provided for occupants, vendors, and visitors. Occupants need to recognize how their activities impact the building and individuals working nearby. For example, food debris in work areas can impact the entire building's requirements for cleaning and pest management, while the use of personal care products such as strong perfumes can adversely affect chemically sensitive individuals in a nearby area. Vendors, too, need to understand that the products they use can affect indoor air quality and modify their products, augment ventilation, or adjust product use time.

STEP 10. Continual Improvement: Continued involvement of the project team is the key to long-term success and program improvement. Review occupant feedback and evaluate opportunities for improvements. And, institute periodic meetings with cleaning personnel, both to train new workers and to reinforce correct procedures.

Opportunities For Improvement

1. Work from a Written Plan. All buildings should have effective operations plans that address the mission of the facility and its unique constraints, such as individuals with health conditions or sensitivities, geographical settings, building age, seasonal changes, and security. It should also have a stewardship component to involve all building occupants. A helpful guide is ASTM's *Standard Guide for Stewardship for the Cleaning of Commercial and Institutional Buildings*.[4] For buildings cleaned under contract, review the contract periodically and include green requirements for chemicals, janitorial paper, trash bags, equipment, etc. And, incorporate a clear auditing process to ensure that sustainable cleaning methods are actually being utilized, especially when using performance-based contracts. Since cleaning standards are often very subjective, be precise. Stating, "Restrooms shall be clean and well stocked," might suggest to some that a full-time restroom matron is required in each restroom, but others will likely disagree.

2. Employ Entryway Systems. Since 80% to 90% of all dirt enters a building on people's feet, installing and maintaining entryway systems can have an enormous impact on both people's health, as well as cleaning costs. Grills, grates, mats, etc. should be used both inside and outside to prevent dirt, dust, pollen, and other particles from entering the building. Entryway systems should cover a minimum of 12 feet (when walking across the mats, each foot should hit the mat at least twice). Systems should begin outdoors and be appropriate for weather and other site conditions (i.e. based on the types of soils–sand versus clay). Outdoor systems, including concrete and stone walkways, should shed standing water and be rough enough to scrape soils off shoes prior to entering the building–but not rough enough to cause slips and falls.

3. Janitorial Closets & Chemical Storage/Mixing Areas. Chemical and janitorial equipment storage and mixing areas can have a serious impact on indoor air quality because items off-gas during storage, mixing or spills. Minimize the potential for VOC's, mold spores, particulates, etc. circulating throughout the building, by building closets with structural deck-to-deck partitions, negative air pressure, and separate, outside exhausts. Well-organized closets and storage areas minimize time to find tools or cleaning products and make it easier to identify foreign objects placed in these areas.

4. Floor Care Systems. One third of a typical maintenance budget ($0.35 to $0.70 per square foot) is devoted to the care and maintenance of floors. Maintaining (i.e., burnishing, stripping, and recoating) floors can create IAQ problems from VOCs and particles, occupational hazards to janitors, and huge environmental burdens. Excellent products are available that are highly durable and contain no metals that can accumulate and become toxic in the environment after disposal. Some jurisdictions may have local requirements to reduce discharge of metals, including those found in traditional floor finishes, into water systems. Equipment and procedures are available that extend the period between stripping for years. Although the first cost is higher, with more coats required, the payback of both labor costs and reduced exposure to cleaning personnel and occupants pays off.

5. Use Environmentally Preferable Cleaning Products. Every year billions of pounds of cleaning products are used in commercial and institutional buildings in the United States. This number increases by a factor of approximately ten, if we consider the chemicals used to produce those cleaning products. Opportunities to reduce impacts through source reduction and pollution prevention strategies are substantial. Traditional cleaning products are not "bad" per se. Over the years, they have contributed to protecting public health and the buildings themselves. However, new technologies allow us to accomplish the same tasks, while reducing overall impacts on human health and the environment. Use existing standards, rather than developing new or even "tweaking" existing ones. Even small product attribute changes require manufacturers to expend large sums to reformulate and test products for compliance. Green Seal's standard for industrial and institutional cleaners (GS-37) is recommended.[5] Products not covered by GS-37 should meet or be less volatile than the California Code of Regulations maximum allowable.[6] While no federal requirements exist for these product categories, many federal regions have voluntary goals to reduce VOC's.

6. Biobased/Renewable Resource-Based Cleaning Products. In the early 1900's, petroleum, a finite and non-renewable resource, became chemical

Morton Birkin, "Garment Workers," GSA Fine Arts Program.

industry's feedstock of choice. Disposing of those petroleum-based cleaning products down the drain after a single use is hardly a sustainable practice. New products include solvents, surfactants, and other ingredients, derived from agricultural products such as corn, soy, sugar beets, coconuts and citrus fruits. When purchasing an agriculturally based product, be sure that the renewable resources represent a substantial portion of the active ingredients, not merely cosmetics such as the fragrance. Not only is using biobased/renewable resource-based products a more sustainable practice, but generally, production of these materials is more benign than their petroleum-based counterparts.

7. Use Concentrated Products.
Concentrated cleaning products reduce packaging (e.g., bottles, closures, boxes, etc.) and the amount of water being transported, providing environmental and cost savings. However, it's important to use dilution systems to control the concentration; otherwise the environmental and costs savings can be lost.

8. Selection Of Janitorial Supplies.
Billions of pounds of paper (e.g. toilet tissue and hand towels) are used every year in the restroom, substantially impacting our forests, and, if bleached, contributing significant amounts of dioxins to our environment. We can make an important contribution to sustainable practices by utilizing paper containing a high percentage of recycled content and manufactured without chlorine or chlorine compounds. Use plastic trashcan and other liners with a high percentage of recycled content. Both paper products and plastic trashcan liners

are designated items under RCRA and EPA's Comprehensive Procurement Guidelines.[7]

9. Selection of Janitorial Equipment. Proper janitorial equipment can make a substantial difference. Carpet care equipment should capture 96% of particulates 0.3 microns in size. Backpack vacuums can save time and money. Perhaps the simplest strategy is to specify vacuum cleaners that have been tested and certified under the Carpet & Rug Institute's *Green Label Program*[8]. Equipment for hard floor maintenance such as buffers and burnishers should be equipped with active dust control systems, including skirts and vacuums, guards and other devices. Carpet and floor care equipment should be electric or battery-powered, be durable and have a maximum sound level less than 70 dBA.

10. Implement Integrated Pest Management (IPM) Program. Bugs, rodents, vermin, birds, and other unwanted creatures can seriously affect the health of building occupants. Eliminating these pests through the use of pesticides can also cause serious health affects. An effective integrated pest management program removes the food, moisture and nesting and entry opportunities that allow pests to enter and flourish in a building thereby obviating the need for pesticides.[9]

Conclusion

An appropriate, healthy, high-performance, sustainable cleaning program is an essential part of maintaining a healthy and productive indoor environment. In addition it can play an important role in reducing environmental impacts. The new cleaning paradigm is not focused on appearances alone, but rather constitutes a low-cost health intervention and productivity improvement strategy.

Notes:

1. Heerwagen, 2000: Green Buildings, Organizational Success and Occupant Productivity, Building Research and Information (London) 28 (5): 353–67.
2. OMA, 1997: Cleaning Makes Cents (Washington DC: Building Owners and Managers Association International), p. 57.
3. Krilov, 1996. Impact on an Infection Control Education Program in a Specialized Preschool, American Journal of Infection Control, 1996 (24), pp. 167–73.
4. ASTM, 1998: ASTM Standard E1971-98, Standard Guide on Stewardship for Cleaning Commercial and Institutional Buildings (West Conshohocken: American Society for Testing and Materials).
5. Green Seal, 2000. Industrial & Institutional Cleaners (GS-37) (Washington DC, Green Seal Inc) http://www.greenseal.org.
6. http://www.arb.ca.gov/consprod/regs/Cpreg.doc
7. EPA's Comprehensive Procurement Guidelines can be found at http://www.epa.gov/cpg/products.htm
8. Information on the Carpet & Rug Institute's Green Label Program can be found at http://www.carpet-rug.com/drill_down_2.cfm?page=8&sub=9
9. Information on integrated pest management can be found at http://www.beyondpesticides.org/main.html.

Case Studies and Strategies

Kaiser Permanente Medical Center, Santa Rosa (Photo: Kaiser Permanente)

Environmental Stewardship at Kaiser Permanente

By Kathy Gerwig

Kathy Gerwig is the Director of Environmental Stewardship and National Environmental Health and Safety for Kaiser Permanente, a non-profit, group practice prepayment program with headquarters in Oakland, California. It includes the Kaiser Foundation Health Plan, Inc., Kaiser Foundation Hospitals, and the Permanente Medical Groups.

Environmental activism at Kaiser Permanente began four decades ago when the organization invited Rachel Carson to deliver the keynote address to a large symposium of physicians and scientists. Her book, Silent Spring, which has been widely credited for launching today's environmental movement, had just been released. Her keynote address at the Kaiser gathering was her last public appearance before her death from breast cancer.

The Paradox

The environmental paradox for health care is that in the course of providing health care to individuals, health care institutions use chemicals and materials that are hazardous to human health.

Two examples are:

- Medical waste incinerators that are among the highest contributors of dioxin in the air we breathe. Burning polyvinyl chloride creates dioxin, and polyvinyl chloride is ubiquitous in healthcare.
- Mercury thermometers, one of which is enough to contaminate a 20-acre lake.

  Heavy metals are found in manometers, fixatives, and a variety of other healthcare products. They are persistent, and they bioaccumulate in the environment.

The only responsible course of action is to eliminate or reduce these hazards.

Kaiser Permanente's Vision for Environmental Stewardship

Kaiser Permanente's (KP's) organizational mission is to improve the health of the communities it serves. That mission extends to the health of the environment because healthy people require clean air, water, and soil.

KP's vision for environmental stewardship is to aspire to provide health care services in a manner that protects and enhances the environment and the health of communities now and for future generations.

A Precautionary Approach

KP takes a precautionary approach to addressing environmental impacts of the materials and products it uses. This approach is based on the Precautionary Principle, which states that when an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause-and-effect relationships are not fully established scientifically.

A New Way to Think About Safety

KP pursues a concept called "the three safeties," reflecting KP's priorities related to worker safety, patient safety, and environmental safety.

- Worker safety means freedom from on-the-job injuries.
- Patient safety means freedom from medical errors and harm.
- Environmental safety means freedom from adverse impacts on the environment.

These priorities are integrated through a common theme of preventing the preventable. When we eliminate mercury, we're creating safer places for our workers and patients and eliminating the possibility of environmental releases. When we find safer alternatives to chemicals of concern, we're promoting the three safeties.

This way of thinking allows KP to see its environmental efforts in a larger context, and it also provides a method for prioritizing resources. For example, since using the least toxic cleaning chemicals apply to all three safeties, identifying such products is a priority.

Environmental Stewardship at Kaiser Permanente

KP's focus is in three areas:

- Green buildings--sustainable design and construction
- Environmentally responsible purchasing
- Sustainable operations (e.g., waste minimization, mercury elimination)

Green Buildings

KP is building twenty-five new, replacement or significant additions to hospitals, and a hundred new medical office buildings in the next ten years. This represents enormous responsibility as well as opportunity.

- KP standards and templates for all capital projects are aligned with achieving minimum LEED® criteria.
- KP has identified cleaner alternatives to interior materials, including resilient flooring, carpet, paint, ceiling tiles, casework, and furniture.
- KP hosted a public forum that attracted four hundred designers, contractors, architects, and engineers to share their learning and learn state-of-the-art green building techniques.

Environmentally Responsible Purchasing

KP's purchasing strategy is to incorporate environmental considerations into nationally contracted products. Where "green" products are not available, KP works with manufacturers to produce cleaner, less toxic materials.

Priorities have included carpet, casework, resilient flooring, and a variety of medical products, as well as greener cleaning products (pursuant to the three safeties concept).

- Overall, KP has focused on phasing out the use of PVC, eliminating the presence of mercury, increasing recycled content, reducing waste volumes, and demonstrating a preference for least toxic chemicals.
- KP is methodically removing DEHP from products in neonatal units.

Sustainable Operations

In 2003, approximately 8,000 tons of solid wastes were diverted from landfills. KP's overall waste volume reduction is now 30%.

- In 2003, 65,500 pieces of electronic equipment were reused within KP, re-deployed outside of KP, or ultimately recycled, through a partnership with Redemtech.
- In the last few years, 100 tons of single-use devices were reprocessed.
- KP has eliminated the purchase and disposal of 40 tons of hazardous chemicals through finding safer alternatives and recycling solvents.
- 27,000 grams of mercury have been eliminated from KP health care operations through the phase-out of mercury-containing blood pressure devices, thermometers, and GI equipment. KP's goal is to be virtually mercury free by the end of 2004.

What the Future Holds:

KP's' Environmental Stewardship Council is pursuing two bold initiatives in addition to the current work:

Chemical Policy: Rather than continuing to take an approach that is problem-focused (e.g., eliminating mercury, eliminating PVC, eliminating incineration),

Kaiser Permanente Medical Center, San Francisco (Photo: Kaiser Permanente)

KP wants to pursue their work from a solution-focus.

KP's new chemical policy (still under development at the time this paper was submitted) will call for avoiding the use of carcinogens, mutagens, and reproductive toxins (CMRs) and persistent bioaccumulative toxic chemicals (PBTs). Clearly, it will be a long time before these chemicals can be avoided entirely. But KP's policy will signal the marketplace that innovation and change are necessary, and they will demonstrate a preference for manufacturers who provide cleaner products that meet the organization's quality and cost imperatives.

Food Policy: A new policy on food will support healthy food systems in health care. Specifically, that means supporting food systems that are ecologically sound, economically viable, and socially responsible. As a start, KP has farmers' markets in operation at five medical centers in California and Hawaii, with plans to expand to additional centers in 2004. The food policy is a way to encompass the wide-reaching aspects of food, including ecosystem health, antibiotic use, pesticide use, and food security, as well as nutrition and weight management.

Improving the Environmental Performance of Health Care

Imagine how many cancers could be prevented by eliminating the use of carcinogens in health care.

Imagine how much infertility could be prevented if there were no endocrine-disrupting phthalates like DEHP in neonatal units.

Imagine how many communities could have access to nutritious locally-grown organic food if every hospital made it part of their procurement policy.

What other sources of environmental health problems can be impacted?

These are questions that KP's Environmental Stewardship program aims to address.

Isaac J. Sanger, "Flowers," GSA Fine Arts Program.

Case Studies and Strategies

Stanley Wood, "Boulder Dam--Government Hoist House," GSA Fine Arts Program.

A Collaboration to Go "Green": NISH/JWOD

By Blaine Robinson

Blaine Robinson, an Operations Manager in the NISH National Office, has worked with both the President's Committee and the federal government on developing strategies associated with the "Greening of JWOD."

When referring to a restroom with a heavy scent of disinfectant, have you ever heard someone comment, "Doesn't this restroom smell clean?" The public has been schooled to equate particular chemical scents with the idea of clean. The new and more environmentally sound approach evaluates the delivery of janitorial services based on the foundation of "green."

GSA and NISH have been strong proponents of green cleaning. NISH, formerly the National Industries for the Severely Handicapped, is a nonprofit agency designated by the Committee for Purchase from People Who Are Blind or Severely Disabled (the Committee) to provide technical assistance to Nonprofit Agencies (NPAs) interested in obtaining Federal contracts under the Javits-Wagner-O'Day Program (JWOD). In fact, Janitorial services represent the largest portion of the approximately $1.6 billion in Federal contracts currently being provided under the JWOD Program. Over 30 million square feet of space is currently being "Green Cleaned." for the Federal Government customer by NPAs under the JWOD Program. These 890 JWOD contracts support myriad Federal Government agencies including GSA and the Department of Defense.

Over two years ago, NISH and National Industries for the Blind (NIB) signed the Memorandum of Understanding in Support of Environmentally Preferable Purchasing and Selling Practices. The Federal Government signatories were Department of Interior (DOI), Environmental Protection Agency (EPA), and the Committee for Purchase from People Who Are Blind or Severely Disabled and National Industries for the Blind.

There has been strong support for NISH to take a leadership role. "It is just good business to create a cleaner, safer, healthier environment for the JWOD-associated employees who perform cleaning tasks, the Federal personnel who work in the buildings, and for citizens who visit these same facilities," said Lee Wilson, Executive Director of the Committee for Purchase

Bob Chamberlin, NISH President and CEO, commented, "The use of environmentally-preferable products and practices is important, not only for the protection of the environment, more importantly, to protect the health of workers on JWOD contracts and their customers. NISH wants to assist in the development of Green Cleaning solutions for customers today and in the near future so that when the demand for such services shoots upward, as we fully expect it to do in the near future--NPAs will be ahead of the curve." That future is now . . . a Green Cleaning partnership between a NPA, a supplier of janitorial products, NISH, and NIB received the White House "Closing the Circle Award" for Leadership in Environmentalism.

One of the most important initiatives that NISH has undertaken involves the development of a definition for the term "Green Cleaning." This definition requires mutual acceptability throughout the JWOD contracting arena. The goal seeks to provide a shared understanding of what is required when a janitorial contract indicates a Green Cleaning requirement.

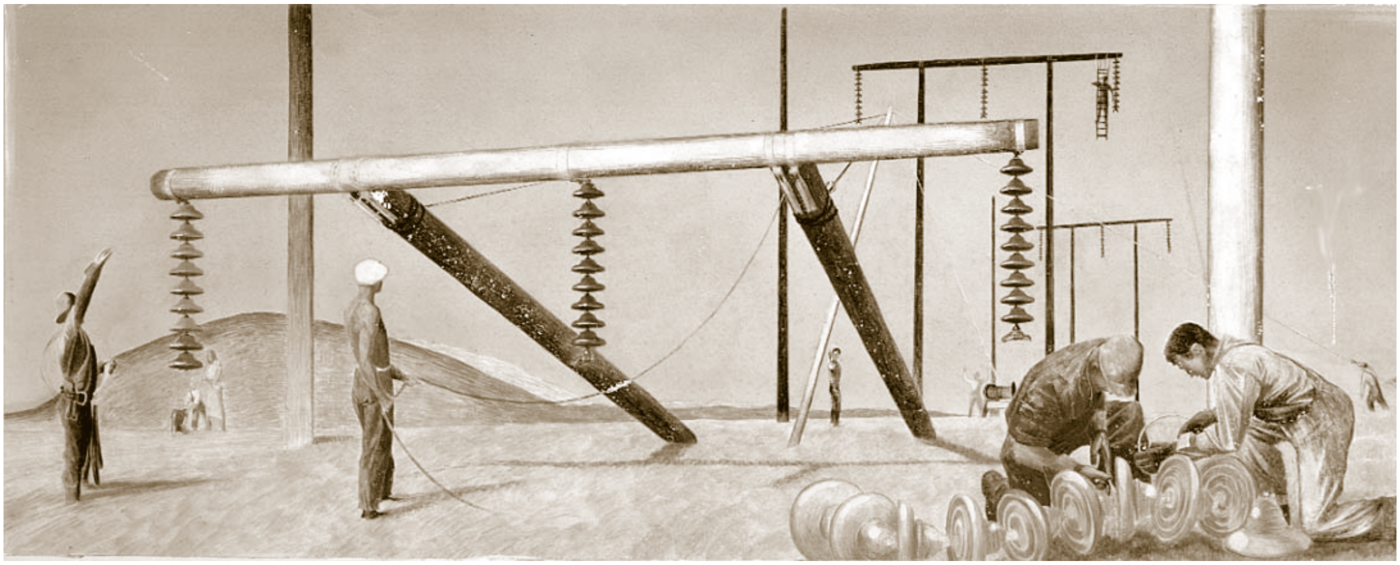
The term "Green Cleaning" is frequently misused and misunderstood by building managers, occupants, and janitorial contractors. True green cleaning involves more than just using products that are labeled environmentally acceptable (such as Certification by Green Seal). The commitment to Green Cleaning requires a comprehensive approach that includes the following:

- Selecting the right products, including cleaning and maintenance chemicals, janitorial paper items, tools, and equipment.
- Understanding how to properly use products to reduce their impact on janitorial workers, building occupants, and the environment.
- Implementing "stewardship" (responsible leadership and caring) for the occupants of the building where the products are being used.
- Providing training for the workers on the appropriate use of all products.
- Communicating with all participants in the Green Cleaning process.

Steve Ashkin, a recognized expert in the field of Green Cleaning and one of the leading advocates for a stronger environmental profile among cleaning product manufacturers, suppliers, and consumers; supports the idea of a comprehensive approach to Green Cleaning. He says, "The goal of Green Cleaning is to reduce the total impact on both health and the environment. This cannot be accomplished simply by switching to an environmentally-preferable product. It requires the willing participation of all those involved in the process."

Cleaning chemicals should not be judged to be "green' because they are bio-based or biodegradable. The EPA recommends that multiple health and environmental attributes of all chemicals need to be examined. Some examples of these attributes are skin sensitization, the potential to burn eyes or skin, and the potential to cause cancer or to be a reproductive toxin or be toxic to aquatic life. The organization, Green Seal (greenseal.org), evaluates products and is leading the industry toward a standard for evaluation.

Running an effective Green Cleaning Program involves a lot more than convincing a janitor to switch from "Product A" to "Product B". A holistic approach to cleaning must be embraced. The changes range from preventive measures that reduce the need for harsh chemicals to modifying occupant activities and traffic patterns that can increase cleaning needs. For maximum results, the Green Cleaning approach requires the cooperation of key stakeholders, including agency management, purchasing agents, environmental staff, facilities manager, janitorial staff, and the building occupants.



David Stone Martin, "Electrification," GSA Fine Arts Program.

The Green Cleaning approach designs a program to get everyone who uses a building involved in making it a healthier place in which to work. The outcomes achieved from a successful Green Cleaning contract include:

- An optimized cleaning program that is responsive to individual occupant needs,
- A cleaner, healthier work environment,
- A responsive janitorial staff,
- An increase in worker productivity;
- A decrease in absenteeism due to illness,
- An improvement in building safety,
- An enhancement of the self-respect for the individual janitorial professionals and their team,
- A more proactive understanding by building occupants of how a building is maintained and what is occurring in the facility where they spend more that one-third of their lives.

NISH has created a comprehensive Green Cleaning Seminar for Federal Government Agencies and NPAs associated with the JWOD Program. The seminar is offered several times per year on a national basis through the NISH Training Department. Additionally, onsite seminars may be requested by Federal Government agencies or NPAs. There is no charge for NISH-sponsored training and technical assistance for agencies participating in the JWOD Program. For more information, contact Blaine Robinson at brobinson@nish.org.

Case Studies and Strategies

- Well-Being and the Service Worker
- The Greening of the Pentagon
- Measuring and Reporting Sustainability Principles
- Ethics In Action

Hugh Pearce Botts, "Construction Workers," GSA Fine Arts Program.

Well-Being and the Service Worker

One of the accomplishments I think we've made here is to help reduce turnover in our industry. We've got better benefits now for people to stay around and make it a career. We're looking forward to that.[1]

— Kevin Rohan, lead negotiator for the Washington Service Contractors Association and president of contractor Cavalier Services Inc.

This agreement means we have a future we can look forward to. With health benefits, I'll have more peace of mind.[2]

— Maria Rivera, a part-time UNICCO janitor

In May 2003, the union that represents workers who clean about 85 percent of downtown Washington's office buildings reached an agreement with cleaning contractors that paid higher wages and provided new benefits. The agreement between the Service Employees International Union (SEIU) and the Washington Service Contractors Association included extending employer-paid health insurance to more janitors, boosting pay significantly, increasing hours for part-timers, and securing benefits such as sick leave. Both union officials and cleaning contractors said that the settlement made janitors' jobs more professional.

The five-year agreement:

- Extended employer-paid health coverage to 26 percent of part-time workers.
- Increased hours for part-timers from 20 hours a week to 25, in buildings over 100,000 square feet; and - in the last year of the contract - from 25 hours a week to 30, in buildings over 500,000 square feet.
- Raised weekly pay 60-90 percent; with all janitors receiving a $2.20 per hour increase over five years, to $10.20 an hour, for most. By the end of the contract, with the increase in hours from 20 to 25 per week, most janitors' total pay will increase by 60 percent.
- Provided 3 paid sick days for all janitors.

Typically, building owners who have contracted-out cleaning services do not play a part in negotiations between their cleaning contractors and their employees. But this is changing, as major real estate investors, like the California Public Employees' Retirement System (CalPERS) begin including "responsible contractor clauses" in their partnership agreements.

"The California Public Employees' Retirement System... has a deep interest in the condition of workers employed by the System and its advisors. The System, through the Responsible Contractor Program Policy . . . , supports and encourages fair wages and benefits for workers employed by its contractors and subcontractors, subject to fiduciary principles concerning duties of loyalty and


Harold Anchel, "Family Portrait," GSA Fine Arts Program.

prudence, both of which further require competitive returns on the System's real estate investments."[3]

And large developers have begun to respond, too. For example, William B. Alsup III, Senior Vice President, Hines East Regional Office, commented, "In general, we feel that providing a living wage and health care benefits is an important thing to try to do, as long as the costs are reasonable"[4]

Notes:

1. Neil Irwin, 2003 (May 2): Janitors, Employers Set Deal, Contract Offers Better Wages, Benefits, Washington Post, E03.

2. Ian Birlem and Cynthia Kain, 2003 (May 6): Janitors Ratify New Contract, http://www.seiu.org/building/janitors/press_center2/press_releases2/press.cfm?ID=1131

3. CalPERS, 2004 (April 19): California Public Employees' Retirement System Statement of Investment Policy for Responsible Contractor Program, © 2004 by CalPERS.

4. Stephen Pearlstein, 2003 (May 12): Owning Up to the Plight of Janitors, Washington Post, E03.

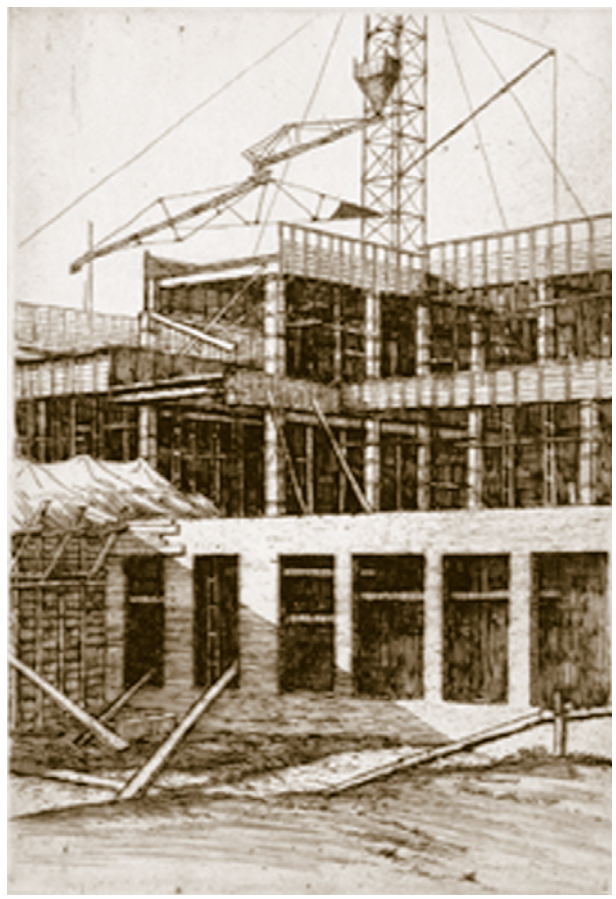
The Greening of the Pentagon[1]

Part of the Pentagon's $1.2 billion Renovation Program's design-build strategy includes Environmentally Preferable Purchasing (EPP) performance specifications built into the contract, along with incentives and awards fees for performance. The process has been hailed by the federal government as leading edge, innovative, and consonant with sound business practices.

The Integrated Sustainable Design and Constructability (ISDC) Team incorporated sustainable design into the overall acquisition and management strategy using the EPA's EPP Program guidelines. Environmentally preferable products for the Interior Renovation of Wedge 1 included the wood from sustainable managed forests, low-water-use plumbing fixtures, low VOC paints and sealants, mineral wool insulation, energy-efficient lighting, the use of recycled steel, ceiling tile, ceramic tile, concrete masonry units, including recycling construction debris, and using packaging, labeling and instructions made from recycled material. Future applications for incorporating EPP into the Pentagon renovation include the Department of Defense custodial, operations and maintenance, and recycling programs.

Health-related environmental considerations and goals included:

- Removal of 25 million pounds of asbestos



Gordon Waverly Gilkey, "Univ. of Oregon Library Construction #3," GSA Fine Arts Program.

- Removal of lead paint, mercury, PCB's
- Cleaning of contaminated soil
- Use of low VOC sealants.
- Compliance with Comprehensive Procurement Guidelines (CPG) (40 CFR 247)

- Minimizing of polyvinyl chlorides
- Maximizing use of greenhouse gas reducing materials
- Plan for erosion and sediment control from the construction site
- Implementation of a pollution control plan
- Limiting air pollution from the construction site
- Controlling debris--limit debris entry into drainage system
- Compliance with Executive Order 13123 to maximum extent possible--Sustainable Design and Development for Federal Agencies--categories similar to LEED® criteria
- Compliance with Executive Order 13101--Greening the Government
- Compliance with Affirmative Procurement Guidelines (42 USC 6962)

Contact Teresa Pohlman (PohlmanT@army.pentagon.mil) at (703) 697-4720 for more information.

Notes:

1. Adapted from "Greening the Pentagon" at http://www.epa.gov/oppt/epp/ppg/case/penren.htm.

Measuring and Reporting Sustainability Principles

From "Beyond the Triple Bottom Line: Measuring and Reporting on Sustainability," Occasional Paper, Victorian Auditor-General's Office, Melbourne, June 2004.

Adopting the sustainability principles impacts on all aspects of an organisation's business, from planning to operations to governance arrangements…

First and foremost, applying the sustainability principles means going beyond traditional financial reporting to measure and report on at least the environmental, social and economic dimensions of performance . . . However, as critics of these models have pointed out, they use a reductionist approach to measuring and reporting on sustainability. That is, they:

- Break sustainability down into three or more pillars
- Break each pillar down into a series of topics
- Break each topic down to a series of performance indicators
- Measure each indicator separately
- Use 'scientific approaches' to measure each indicator.

The reductionist approach is inconsistent with the concept of sustainability, and its principles, for two main reasons. Firstly, sustainability is not a single thing. It is multidimensional… Secondly, sustainability is a vision of wholeness. Breaking it down into disconnected parts and then studying the parts individually will not help us understand the relationships between the parts that make up the whole. Instead, taking the reductionist approach can lead us to oversimplify the complex nature of sustainability . . .

Applying sustainability principles has the potential to improve performance, in the short and long terms. For this reason, governments in many countries have adopted sustainability policies, resulting in an explosion of sustainability initiatives…

Applying these principles is not a simple task. The interrelated nature of sustainability complicates all aspects of organisational life, from planning to operations to measurement and reporting… The currently available measurement and reporting tools apply some of the principles well. However, approaches that capture the relationships between the pillars are still evolving. Approaches to measuring and reporting on intergenerational equity are even more rudimentary.

Ethics in Action[1]

Vancouver City Savings Credit Union sponsors the Ethics in Action™ Awards to advocate corporate social and environmental responsibility among the business community. Its 2000 award for Ongoing Social Responsibility (Business) was awarded to the Chesterman Property Group (www.chestermangroup.com), of Vancouver British Columbia, for the comprehensive application of sustainable principles to their work.

"These real estate developers are changing the standard industry approach to real estate development. The focus is on minimizing environmental impact and on delivering healthy houses (minimizing toxic materials used in building prevents unhealthy interior environments). This focus involves extensive research into purchasing options.

"For example, President Robert Brown purchases bamboo flooring because it is more environmentally friendly. He has conducted extensive research to find a manufacturer who used nontoxic glue and who treated the workers well (most bamboo flooring is made in Asia under poor working conditions). Ecologically sustainable and healthy housing is not yet in high demand in Vancouver, so Chesterman provides these benefits at the same cost as standard housing. This means absorbing the costs of extra research and labor (instead of bulldozing old buildings his workers take them apart by hand so the wood can be reused). Brown also has to get buy-in and support from architects and building teams. He has helped them get experience in environmental processes, which will benefit future projects they are involved in. He also shares his knowledge and expertise with others in the property development industry.

"Brown was a cofounder of CBSR, and has been a longtime contributor, supporter, and board member of Tradeworks Training Society."

Notes:

1. http://www.ethicsinaction.com/recipients/past.html

Leonard Pytlak, "Lunch," GSA Fine Arts Program.

GSA®

Smarter Solutions

October 2004

GSA Office of Governmentwide Policy
Office of Real Property

U.S. General Services Administration
1800 F Street, NW
Washington, DC 20405
www.gsa.gov

100% Recycled Fiber

PRINTED WITH SOY INK™