The Case for Proactive Chemicals Management in REI Operations

Mary Fritz, Rich Grousset, Raphael Meyer, Rachel Smeak, and David Yang

SCHOOL OF NATURAL RESOURCES AND ENVIRONMENT
UNIVERSITY OF MICHIGAN

Table of Contents

Abstract

REI's CSR framework involves seven environmental lenses: climate change, energy use, waste, water, chemicals, land use, and social impacts. REI currently measures, tracks, and systematically reduces its operations level impacts related to: (1) energy use, (2) waste-to-landfill, and (3) tons of CO_2E emissions. The SNRE master's project team worked with REI's CSR team to define a strategy to address chemicals impacts within operations, and implement a robust management and reduction plan. Project objectives included:

1. Identify key chemicals impacts associated with REI's operations;
2. Develop a business case for adoption of a company wide chemicals management strategy, to be presented to REI executives;
3. Identify aspirational long term reduction goals, and foundational interim milestones;
4. Define a metric for chemicals impact reduction, if applicable;
5. Prioritize organizational activities aimed at reducing chemicals management impacts;
6. Identify potential organizational barriers to adoption of the chemicals lens and strategies to mitigate or overcome those barriers.

The team used a combination of primary and secondary company and academic research to develop a business case and feasible, effective chemicals management strategy.

Acknowledgements

We would like to express our gratitude to those who provided support and guidance throughout this project.

First, a warm thank you to our counterparts from Recreational Equipment, Inc. (REI), Kirk Myers and Alex Michalko, who gave us the opportunity to work with an amazing, well known outdoor retailer on a cutting edge sustainability topic. We appreciate your leadership, openness, and willingness to collaborate on such a challenging (yet very rewarding) project.

Second, thank you to our advisors, Andrew Hoffman (School of Natural Resources and Environment/Ross School of Business, University of Michigan) and Stuart Batterman (School of Public Health, University of Michigan) for their insights, knowledge, and ability to highlight areas of improvement throughout the research and report development process.

Lastly, we would like to extend our appreciation to the experts and organizations who shared expertise and resources with us: Michelle Harvey (Environmental Defense Fund), Anthony Ravitz (Google), Anne Less (Google), Lindsay Dahl (Safer Chemicals, Healthy Families), Dov Brachfeld (H&M), Sonia Haider (ChemSec), Nadia Haiama (ChemSec), Shari Franjevic, Jan Hutchins (Toxics Use Reduction Institute), and Adam Cooper (Accenture).

Executive Summary

Beginning with Rachel Carson's *Silent Spring* (1962), which popularized environmentalism by raising awareness about the dangers of DDT, **concerns around chemical impacts to human and environmental health have increasingly crept into the limelight**. Governments, organizations, and individuals have all started paying more attention to chemicals by looking at realistic steps to mitigate associated risks, identifying opportunities to do so through concerted management efforts, and acknowledging the implications chemicals can have in even the most ordinary items.

It is in this context that the Corporate Social Responsibility (CSR) team at REI decided to evaluate and better understand the impacts of chemicals in daily operations. The goals of the project were to build the case for an enterprise wide chemicals management strategy focused on operations, to create awareness around how chemicals impact REI's core business, and to begin to better control those impacts. Operations are defined as the physical properties of and activities related to REI's owned or leased buildings and the products it uses in daily operations.

The Problem

According to the U.S. Centers for Disease Control and Prevention, **133 million Americans are living with chronic conditions, a portion of which can be attributed to exposure to toxic chemicals**. In particular, the scientific literature links six chronic medical conditions to chemicals exposures: certain types of cancer, learning and developmental disabilities, Alzheimer's and Parkinson's disease, reproductive and fertility problems, and asthma. **If reducing toxic exposures translated into just a 0.1% reduction in health care costs, that would save the U.S. health care system an estimated $5 billion every year.** And hazardous chemicals do not only harm people – they also create a significant environmental burden.

Toxic chemicals surround us in our home and work environments. To gain a complete picture of their impacts, we use scopes that are analogous to the GHG Protocol:

Scope 1: All direct chemicals impacts at company owned or leased facilities

Scope 2: Indirect impacts from consumption of purchased electricity, heat, water, etc.

Scope 3: Other indirect impacts that occur upstream and downstream, such as the production of chemicals, manufacturing of products, transportation, waste disposal, etc.

Because chemicals are everywhere, are harmful, and are poorly regulated, they pose significant risks to businesses. As a response to this, chemicals management is evolving beyond traditional compliance functions, and businesses are beginning to incorporate chemicals management into **progressive sustainability frameworks.** But the case for action is not merely risk mitigation – there are also benefits that can be reaped as a result of proactive action.

Business Risks

Physical risk

Physical risks directly impact the physical health and wellbeing of stakeholders and the environment. Commercial products, noncommercial products, and building materials can expose humans to numerous hazards. Impacts are difficult and/or costly to measure, but can be largely mitigated through safe purchasing decisions.

One of the most difficult aspects of chemicals management is the lack of scientific consensus around toxicity and its links to human and environmental health. Very few chemicals have been thoroughly studied, and impacts are largely undetermined. Despite this uncertainty, many commonly used chemicals are known to be hazardous to human health. Most common toxic chemicals are similarly hazardous to the environment, particularly from a lifecycle perspective.

The manufacture, use, and disposal of many common materials can release various toxicants into ecosystems, where they may dissipate, break down, or persist. Many chemicals of concern are classified as **persistent, bioaccumulative, and toxic** substances (PBTs), which remain in the environment for decades and can travel long distances through air and water.

Regulatory risk

Chemicals are not adequately regulated. **Approximately 80,000 industrial chemicals are currently registered with the U.S. Environmental Protection Agency and 2,000 are added each year. Of these, only 250 have gone through hazard testing and only five have been restricted through the Toxic Substances Control Act.** Most chemicals are not adequately tested for safety because current U.S. regulations require proof of harm, rather than proof of safety, before regulatory agencies can take action to protect public health. As a result, retailers may inadvertently expose employees, customers, and the environment to dangerous chemicals despite legal compliance with current regulations.

New and pending legislation at the state, federal, and international levels indicate there will be continuous changes in what is regulated and how it will be regulated. Uncertainty about regulation and discrepancies between state level regulations create an additional risk for companies because of the additional effort and cost associated with monitoring changes, developing corporate policies, and removing newly regulated substances from operations.

Reputational risk

Public awareness of the prevalence of toxics in products and materials is increasing. Non-governmental organizations are building awareness and releasing reports about toxics, the media is disseminating information, and consumers are acting according to their beliefs. **Unaddressed toxic chemicals within products and operations pose risks to an organization's brand**. Over the past several years, there have been numerous cases of corporate reputations being damaged by concern over toxics use, as well as consumer and NGO success in altering corporate behavior.

Perhaps most important, companies and researchers are drawing concrete connections between corporate social responsibility and brand value. Irresponsible corporate actions can easily damage brand image amongst a connected and educated consumer base. Physical and regulatory risks directly affect reputation, and brand value is paramount in an age of unparalleled consumer choice. REI has multiple strong competitors in the outdoor retailer space, and therefore activities to enhance the company brand can create strategic advantages.

Business Benefits

Increased employee productivity

Toxic chemical free work environments are proven to be healthier. Employees are likely to have fewer sick days and increased productivity. Low indoor environmental quality (IEQ) is proven to lead to decreased productivity, increased absences, higher stress levels, and numerous other symptoms. Studies have shown that good IEQ can have demonstrably positive effects on employees and visitors. Employers can calculate an incremental percentage improvement in employee productivity and decreased absenteeism to measure the potential benefit to their organization.

Elevated brand value

Chemicals management is increasingly being viewed as a component within corporate sustainability or CSR, rather than a compliance function. "CSR plays a role in consumers' brand and product evaluations, over and above economic or 'rational' considerations such as product attributes," and "CSR has a spillover or 'halo effect' on otherwise unrelated consumer judgments, such as the evaluation of new products." CSR efforts such as proactive chemicals management, then, can improve a consumer's overall view of a company. **A reputation for social and environmental responsibility creates goodwill amongst consumers**, and though difficult to quantify, goodwill is a valuable asset that feeds into purchasing decisions.

Reduced chemicals compliance and handling costs

Compliance with regulatory requirements for the safe handling, storage, and disposal of hazardous products adds cost to a business. Costs associated with potentially hazardous products relate to planning, acquisition, receiving, storage and inventory, and disposition. **The easiest way to reduce costs is to simply eliminate these items, which also eliminates the associated risk**.

Reduced insurance costs

As chemicals risks continue to be disclosed, property and health insurance companies may begin to incorporate mechanisms to better assess and quantify potential consequences. This could result in increased premiums for higher risk and reduced premiums for safe or preferable practices. Several examples have already appeared in industry. Some property insurers offer reduced premiums for LEED certified buildings, and the USGBC identifies potentially lowered insurance premiums due to healthier employees as a benefit of green buildings.

REI

Given REI's vision to "enhance the natural world and our communities through responsible business practices," a public CSR strategy, progress towards CSR goals, and its annual stewardship report, it is clear that REI places a strong emphasis on sustainability. **Indeed, sustainability is part of REI's DNA.** The demographics and priorities of REI's customers make reputational risks particularly relevant for REI, as REI and its customers recognize that a healthy natural environment is vital to outdoor recreation.

Toxic chemicals clearly present risks to businesses in any industry. Much of this risk is not yet quantified or well documented, but awareness within the business community is mounting. To mitigate this risk and recognize potential business benefits, companies should put greater focus on chemicals management within their operations. Adding an operational toxics lens will help REI continue to lead and mirror industry progress. REI members will respect the organization's bold determination to position itself as a sustainability leader.

The Solution

The case for chemicals management in operations is clear. What's not clear is how to address the complexity and uncertainty inherent in the issue. Many companies have begun addressing chemicals management in their commercial products supply chains, but few have done so specifically for operations. There is, therefore, no established industry best practice for chemicals management in operations. Below is a framework tailored specifically to proactive chemicals management for human and environmental sustainability in a retail operations setting. The framework highlights the level of investment and resources required to accomplish a continuum of performance goals, and how those goals mitigate risks associated with toxic chemicals.

The framework is built upon four guiding principles and tools:

1. The **precautionary principle**, which calls for avoiding potentially harmful chemicals even in the absence of scientific consensus that the chemical is indeed harmful.
2. The **principles of green chemistry**, which guide product design to encourage manufacturers to reduce or eliminate the use of hazardous substances
3. **Restricted Substances Lists**, which inform purchasers and suppliers about which chemicals to avoid.
4. **Simplicity** and ease of use.

North star goal

The framework is guided by an ambitious north star goal, which provides a long term, ideal state vision for chemicals management: ***to have no known chemicals of concern within buildings or purchased noncommercial goods***. This goal assumes no constraints on human, financial, and informational resources.

Continuum of performance

The north star goal will require significant time and resources to achieve. The continuum of performance outlines the three milestones, or visions, necessary to achieve the desired end state. The continuum, which takes into account constraints on time, resources, availability of information, and the external environment, contains three visions:

1. Foundational (least difficult, nearer term)
2. Improvement (medium difficulty, medium term)
3. Aspirational (most difficult, longer term)

Implementation steps

Each vision involves a four step path required for successful implementation:

1. **Identify –** Understand what products, materials, and chemicals of concern exist
2. **Prioritize –** Determine chemicals of focus
3. **Act –** Mitigate, reduce, or eliminate prioritized chemicals of concern
4. **Engage –** Support the efforts made in steps 1 through 3 by engaging with internal and external stakeholders

Framework for Chemicals Management in Operations

	← Continuum of Performance →		
	Foundational	**Improvement**	**Aspirational**
Primary Objectives	1. Explore the Scope 1 chemical implications of the highest priority products found in operations. 2. Eliminate chemicals of concern in a small subset of *new* noncommercial product purchases. 3. Focus chemicals management efforts on a small subset of products first to understand the resources required, relationships required, and challenges likely when addressing chemicals in operations.	1. Understand the chemical ingredients and impacts of the highest priority Scope 1 products in operations. 2. Eliminate chemicals of concern in all *new* noncommercial products purchased through improved purchasing behavior. 3. Focus on Scope 1 and new purchases; do not address Scopes 2 or 3 impacts, and do not attempt to retrofit existing assets.	1. Understand the full lifecycle implications of each chemical found in operations. 2. Eliminate chemicals of concern in all *new* and *existing* noncommercial products purchased, and all existing physical assets, through improved purchasing behavior. 3. Address Scopes 1, 2, and 3. 4. Proactively seek out better chemical alternatives by engaging with suppliers and partners.
Assumptions	1. *Significant* resource limitations. 2. *Significant* information gaps. 3. *Unfavorable* external conditions. 4. *Minimal* supply chain collaboration. 5. Lack of a company wide strategic emphasis on chemicals management.	1. *Some* resource limitations. 2. *Significant* information gaps. 3. *Less favorable* external conditions. 4. *Moderate* supply chain collaboration. 5. Company wide agreement on importance of chemicals management.	1. *No* resource limitations. 2. *No* information gaps. 3. *Favorable* external conditions. 4. *Effective* supply chain collaboration. 5. Chemicals management is embedded in strategic vision.

	← **Continuum of Performance** →		
Step	**Foundational**	**Improvement**	**Aspirational**
1. Identify	1. Collect high level operations data for noncommercial goods and building materials, with goal of understanding primary types of items purchased. 2. Organize data into categories of noncommercial goods and building materials within operations.	1. Collect SKU level data for noncommercial goods and building materials. 2. Organize data into categories of noncommercial goods and building materials within operations.	1. Collect SKU level data for noncommercial goods and building materials. 2. Identify and catalog the chemicals contained in each product through the use of a bill of materials. 3. Conduct routine indoor environmental quality tests to achieve visibility of chemicals present in operations.
2. Prioritize	1. Map the categories from step 1 into Scope 1, 2 or 3 designations. 2. Develop a basic prioritization framework based upon easy to access information. 3. Identify suppliers with whom to engage based on the categories selected, and develop relationships.	1. Map the SKU level items from step 1 into Scope 1, 2, or 3 designations. 2. Add additional prioritization factors, such as hazard information, into the prioritization framework. 3. Address all items within Scope 1, using the prioritization to guide sequencing. 4. Develop additional supplier relationships for Scope 1 items.	1. Map the line item level items from step 1 into Scope 1, 2, or 3 designations. 2. Include all available information into the prioritization framework. 3. Use the prioritization framework to prioritize and address all Scope 1, 2, and 3 items. 4. Develop full relationships across supply chain.
3. Act	1. Develop a process to systematically monitor federal and state regulations. 2. Design a RSL system that is based upon regulated chemicals and chemicals of high concern in operating geographies. 3. Work with suppliers to understand what individual line item noncommercial goods or building materials from the selected priority categories meet or do not meet the RSL; identify alternatives. 4. Develop a company procurement policy that incorporates the operational RSL and associated questions into supplier procurement questionnaires.	1. Refine the RSL to include additional chemicals of concern, as identified by third party lists. 2. Engage with identified suppliers for all Scope 1 items to communicate the RSL and desire for chemical ingredient disclosure. 3. Work with suppliers to understand product chemistry, and what items meet or do not meet the RSL. 4. For goods that do not meet the RSL, identify and procure alternative goods that meet the RSL. 5. Track the number of goods where there is no alternative available.	1. Refine the RSL to be robust, flexible, and proactive, and incorporate regulated chemicals and other chemicals of concern identified by third party groups. 2. Use bill of materials information to compare and determine if products contain chemicals from the RSL. 3. Work within supply chain to identify safe alternative product and process chemistries. 4. Purchase only items that are RSL compliant.
4. Engage	1. Develop relationships with peer companies to push for action on an industry wide level through working groups. 2. Lobby state and federal government for increased regulation and clarity around chemical risks. 3. Expand the RSL engagement beyond the first two product categories.	1. Engage with product manufacturers to engage green chemistry principles for goods where alternatives are not available. 2. Develop relationships with peer companies to collaborate on broader industry approaches to chemicals management. 3. Disclose internal policies to employees, customers, and suppliers.	1. Lead industry in pushing for supply chain and regulatory progress. 2. Disclose internal progress to employees, customers, suppliers, and the general public. 3. Use principles of green chemistry to guide communication.

Conclusions

Proactive chemicals management is extremely complex. It requires a thorough understanding of the fundamental concepts of chemistry, risk assessment, and the links to human health and environmental impacts of the life cycles of products that, in today's world, are manufactured with countless chemicals that a majority of the population is not even aware of. The dangers are widespread and real, and the regulatory environment is uncertain and unreliable. Businesses must do something. The chemicals management in operations framework provides a comprehensive and iterative long term process for eliminating hazardous chemicals from retail operations.

Retailers should not address this issue alone, nor should they focus only on building chemicals expertise internally. Rather, industry must work collaboratively throughout the supply chain to drive change. The benefits of action may not be easily quantified or immediately apparent, but they are real.

Project Background

Introduction and Project Significance

In recent years, concerns around chemical impacts to human and environmental health have moved chemicals into the spotlight and made them a more prevalent topic of conversation. Governments, organizations, and individuals have all started paying more attention to chemicals, what can realistically be done to mitigate the risks they present, opportunities available through concerted management efforts, and the implications chemicals can have in even the most ordinary day to day items with which humans interact.

It is in this context that the Corporate Social Responsibility team at Recreational Equipment, Inc. (REI) engaged a group of graduate students from the University of Michigan School of Natural Resources and Environment ("the team", or "we") in 2011 to help REI evaluate and better understand the impacts of chemicals in their core business and daily operations. The goal of the project was to build the case for an enterprise wide chemicals management strategy, focused on operations, to help REI be more aware and engaged about how chemicals impact their core business.

This project is significant for two reasons. First, the concept of holistic chemicals management is a relatively new area of endeavor for sustainability research and discussion. Academia, corporations, governments, nonprofit organizations, action groups, and motivated individuals are increasingly placing more emphasis on toxic chemicals. People seek to understand where and how chemicals exist in products used in daily life, the buildings and spaces we use and inhabit, and how they affect human and environmental health. The sheer number and complexity of toxic chemicals, their myriad applications, and infinite interactions, makes this a difficult proposition. A lack of meaningful government regulations further obfuscates and hinders progress. The Toxic Substances Control Act grandfathered vast numbers of chemicals for use in modern products and allows virtually anything to be called confidential business information.[1] Thus, despite growing interest, best practices for companies wishing to adopt a progressive chemicals management strategy are not well formalized or documented. Extensive literature is available only for a handful of chemicals, and even then there is not broad consensus regarding which sources provide the most accurate and comprehensive information or conclusions.

Second, within the existing realm of chemicals management strategies, efforts predominantly focus on commercial products rather than operations. While this report acknowledges the importance of the former, it focuses on the latter. REI and the team realize that addressing chemicals at the commercial products level could ultimately be the most effective way to mitigate exposure to hazardous chemicals; however, addressing chemicals management and policy at the operational level demonstrates REI's commitment to a full spectrum sustainability approach. By successfully implementing an operations focused chemicals management strategy, REI has the potential to be a leader in a relatively new field, as well as to serve as a role model for other companies. Further, an operations focused chemicals management strategy serves to complement REI's ongoing chemicals management work related to commercial products.

Recreational Equipment, Inc. (REI)

With $1.8 billion in sales in 2011 and more than 4.7 million active members,[2] REI is the largest consumer cooperative in the United States. REI sells outdoor sporting equipment and apparel through a network of 122 stores, a website, and a mail order catalog. REI offers educational clinics in subjects such as bicycle repair, rock climbing, navigation, and photography, and runs an adventure travel company, REI Adventures. Headquarters is located in Kent, Washington.

In the 1930s, high quality, low cost mountaineering equipment was manufactured exclusively in Europe and largely unavailable in the U.S. When Lloyd Anderson discovered the perfect ice axe in an Austrian mail order catalog, he and his wife Mary founded REI in 1938 out of their Seattle garage. Initial growth was slow, as REI's purpose was to provide highest quality equipment to serious mountaineers. Anderson opened the first retail store in 1944, which consisted of three shelves in the back of a gas station. Anderson relinquished his presidency in 1971, and Jim Whittaker took the reins. Under Whittaker's leadership, REI became a strong regional player, opening several new stores and expanding inventory.

Throughout the 1980s, REI expanded to 17 stores and a catalog business. Consumer interest in the outdoors was on the uptick, and sales topped $200 million by the end of the decade. In 1996, REI opened a 100,000 square foot destination store in Seattle, complete with native landscaping, a mountain bike trail, and multiple on-location sites for customers to test products. REI also began experimenting with ecommerce in 1996, and started offering travel packages through its REI Adventures arm. By the end of the 1990s, annual sales neared $1 billion nonetheless. Sally Jewell became REI's president in 2005, and continues the strategy of growth by expansion in clusters.

Though its consumer base has expanded dramatically since it first began serving elite mountain climbers in the Pacific Northwest, the company has maintained the co-op structure. Anyone may shop at REI, but co-op members pay $20 for a lifetime membership and receive a portion of the company's profits each year based on a percentage of their eligible purchases. Other member benefits include special offers, discounts on gear rentals and shop services, and board voting privileges. According to the company website:

> "Being a consumer co-op, rather than a publicly traded company, enables us to focus on the long term interests of the co-op and our members. We answer to you—our members—and run our business accordingly. And it means that we're able to operate a business that plays a vital national role in growing outdoor participation and protecting the environment for future generations."[3]

This attention to environmental stewardship has been a core value at REI since the company's beginnings.

REI and Sustainability

REI's interest in environmental impacts stems from the company's long standing commitment to sustainability. Sustainability is embedded in the retailer's mission statement, which states that its "core purpose is to inspire, educate and outfit people for a lifetime of outdoor adventure and stewardship." Because of the types of products REI sells and its customer base, the company is inherently reliant on healthy ecosystems. The company has taken a holistic approach to environmental responsibility. In 2005, REI developed key performance indicators (KPIs) focused on green building, waste reduction, paper products, and climate change and energy. Among other goals, REI aspires to achieve carbon neutral operations and net zero waste-to-landfill by 2020. REI's current desire to focus on chemicals management also underscores the growing attention on toxic chemicals in current sustainability research and industry discussions.

To achieve sustainability targets, REI has identified several environmental metrics and associated personnel performance requirements. These integrated metrics are key to identifying risk and mitigating the company's environmental impacts, and are thus aligned with REI's long term success. REI currently measures, tracks, and aims to reduce its operational level impacts related to energy use, tons of greenhouse gas (GHG) emissions measured in carbon dioxide equivalent (CO_2e), and waste-to-landfill. As part of its sustainability goals, REI plans to add four additional sets of environmental metrics related to water use, toxic chemicals, land use/biodiversity, and social impacts. Together, these seven lenses will allow REI to achieve a comprehensive understanding of the environmental impacts of its operations.

The co-op's CSR team publicly reports on metrics associated with the initial three lenses within its Stewardship Report, released annually since 2006. Separate from the annual financial report, the Stewardship Report measures and tracks REI's sustainability goals and progress in order to maintain transparency and public accountability. REI intends to transition these environmental metrics from optional to full accountability with the same requirements, rigor, and transparency as financial metrics.

To address the supply chain impacts of the products it manufactures and/or sells, REI became a founding member of the Outdoor Industry Association's (OIA) Eco Working Group. The Eco Working Group is in the process of designing product level sustainability measurement tools to be applied to all products manufactured by member organizations. The OIA has adopted the seven lens approach, and REI designed its operational lenses for full integration with the product sustainability metrics in development.[4]

Many of REI's competitors in the outdoor industry are also actively engaged in sustainability work, and collaborate through the efforts of the OIA. Companies routinely donate to conservation charities and participate in community action days. REI, however, is among the few leaders that have emerged to push the envelope toward greater transparency and social and environmental responsibility. Perhaps best known for its sustainability initiatives, Patagonia engages in numerous conservation programs and is working toward complete supply chain transparency with The Footprint Chronicles. The North Face publishes an annual sustainability report and benchmarks GHG emissions and waste against annual reduction goals.

Major Guiding Concepts for this Report

Because chemicals management and toxicology are dense subjects, it is important to establish some guiding concepts that are frequently used or referenced throughout this report. What follows are brief primers on operations, commercial and noncommercial goods, chemicals scopes, and the principles of green chemistry intended to orient the reader and provide clarity around our project focus.

Operations

This project and report is focused on chemicals management in REI's operations, defined as the physical properties of and activities related to REI's owned or leased buildings and the products it uses in daily operations.

Commercial and Noncommercial Goods

The products that REI uses to conduct business and engage in daily operations are referred to throughout this report as "noncommercial goods." These goods are distinct from "commercial goods," which are products that REI sells to consumers. This distinction is drawn to further emphasize our focus on chemicals management in operations only, and not REI's entire enterprise.

REI is addressing chemicals management with respect to commercial goods in a separate but parallel effort through the OIA Chemicals Management Working Group. All commercial goods are considered part of REI's supply chain, not operations, and any toxic chemicals embedded in them are not directly in scope for the purposes of this project. However, certain commercial products may affect indoor environmental quality within REI facilities and are therefore considered relevant, such as rubber shoes that offgas in a store.

Chemical Scopes

Toxic chemicals exist virtually everywhere within an organization, and those toxic chemicals have both upstream and downstream impacts. It is necessary to place parameters around the different impact levels and define broad chemical impact categories.

These broad categories can be thought of in the same manner as direct/indirect and Scope 1, 2, and 3 greenhouse gas emissions as defined by the Greenhouse Gas Protocol (GHG Protocol).[5] REI has already utilized these frameworks for its GHG reporting, and adopting a similar framework for chemicals management will make the addition of a new environmental lens easier to understand and adopt.

GHG Protocol Scopes

Within the GHG Protocol, direct emissions originate from sources that are owned or controlled by a reporting entity. Indirect emissions, on the other hand, occur as a consequence of activities of the reporting entity but originate at sources owned or controlled by another entity. Given these definitions, the GHG Protocol defines three Scopes for GHG emissions:[6]

Scope 1: All direct GHG emissions.

Scope 2: Indirect GHG emissions from consumption of purchased electricity, heat or steam.

Scope 3: Other indirect emissions, such as the extraction and production of purchased materials and fuels, transport related activities, outsourced activities, waste disposal, etc.

Chemicals Impact Scopes

The GHG Protocol framework can then be applied to a chemicals management lens for retail operations. The definitions of direct/indirect impacts and Scopes 1, 2, and 3 remain nearly identical, instead reflecting a shift from emissions to chemical impacts. Direct impacts are translated to chemical impacts that result from sources owned or controlled within REI's operations. Indirect impacts are chemical impacts that occur not as a result of REI activities, but instead at sources owned or controlled by another entity.

Scope 1: All direct chemicals impacts (occur at owned or leased facilities).

Scope 2: Indirect impacts from the consumption of purchased electricity, heat, steam or water.

Scope 3: Other indirect impacts that occur upstream and downstream, such as the production of chemicals, manufacturing of products, transportation related activities, waste disposal, etc.

Principles of Green Chemistry

Green chemistry is "the utilization of a set of principles that reduces or eliminates the use or generation of hazardous substances in the design, manufacture and application of chemical products."[7] An understanding of green chemistry principles is essential to this report.

The concept was first coined by chemist Paul Anastas in 1991. Soon after, Anastas and fellow chemicist John Warner defined the 12 Principles of Green Chemistry, which aim to improve the design of chemicals used in manufacturing processes and products that reduce or eliminate the use and/or generation of hazardous substances throughout their life cycles.[8] Taken together, the principles provide professionals with a set of guidelines to which to aspire in all aspects of their work, from prevention of chemicals to proper waste management of hazardous substances. The 12 principles are:

1. **Prevention**: It is better to prevent waste than to treat or clean up waste after it has been created.
2. **Atom Economy**: Synthetic methods should be designed to maximize the incorporation of all materials used in the process into the final product.
3. **Less Hazardous Chemical Syntheses**: Wherever practicable, synthetic methods should be designed to use and generate substances that possess little or no toxicity to human health and the environment.
4. **Designing Safer Chemicals**: Chemical products should be designed to effect their desired function while minimizing their toxicity.
5. **Safer Solvents and Auxiliaries**: The use of auxiliary substances (e.g., solvents, separation agents, etc.) should be made unnecessary wherever possible and innocuous when used.
6. **Design for Energy Efficiency**: Energy requirements of chemical processes should be recognized for their environmental and economic impacts and should be minimized. If possible, synthetic methods should be conducted at ambient temperature and pressure.
7. **Use of Renewable Feedstocks**: A raw material or feedstock should be renewable rather than depleting whenever technically and economically practicable.
8. **Reduce Derivatives**: Unnecessary derivatization (use of blocking groups, protection/ deprotection, temporary modification of physical/chemical processes) should be minimized or avoided if possible, because such steps require additional reagents and can generate waste.
9. **Catalysis**: Catalytic reagents (as selective as possible) are superior to stoichiometric reagents.
10. **Design for Degradation**: Chemical products should be designed so that at the end of their function they break down into innocuous degradation products and do not persist in the environment.
11. **Real-time analysis for Pollution Prevention**: Analytical methodologies need to be further developed to allow for real-time, in-process monitoring and control prior to the formation of hazardous substances.
12. **Inherently Safer Chemistry for Accident Prevention**: Substances and the form of a substance used in a chemical process should be chosen to minimize the potential for chemical accidents, including releases, explosions, and fires.[9]

Precautionary Principle

A final principle that permeates any discussion of chemicals management is the precautionary principle, an approach which suggests 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.”[10] In other words, although the extent to which every chemical substance monitored may be harmful to human health or the environment is not completely clear, companies should innovate and act to improve their use of chemicals. These principles serve to frame this report and are referred to frequently.

Project Approach and Methodology

Over the course of 18 months, we used a multifaceted approach to help REI develop an enterprise wide chemicals management strategy. The breadth of this effort and diversity of relevant sources and data gathering strategies mirrors the current complexity of chemicals management as a whole.

REI

To better understand what efforts were likely to succeed at REI, we worked closely with REI staff and conducted numerous site visits to various REI facilities, including headquarters in Kent, Washington, distribution facilities in Sumner, Washington, and retail stores in Seattle, Washington; Denver, Colorado; New York, New York; and Ann Arbor, Michigan. During these visits, we conducted primary research through extensive interviews with REI employees, managers, and leadership to understand data availability, perceived impacts and results of current chemicals management strategies, and opportunities for improvements. In addition, these interviews provided an understanding of the appetite and buy-in for environmental impact reporting at various levels of the REI organizational hierarchy. Throughout the course of this project, we also interacted frequently with REI’s Corporate Social Responsibility (CSR) team to solicit feedback and input regarding ongoing work. A complete list of REI individuals with whom we interacted is available in Appendix A.

REI also provided operations data to help us understand purchasing patterns of noncommercial goods, as well as to support the business case for REI to take action. We analyzed and synthesized this data to contribute to the overall development of the chemicals management strategy.

Expert Sources and Other Companies

Expert sources, including those well versed in toxicology, provided their expertise in clarifying some of the more challenging concepts around chemicals and human impacts. In addition to these expert sources, we developed practical case studies of existing approaches at other companies to better understand how other organizations are currently managing chemicals in their operations, and to build on existing efforts. We engaged with stakeholders at companies like Google to conduct this research. A full list of expert sources and organizations is available in Appendix A.

In addition to the primary research we conducted with stakeholders at other companies, we also conducted secondary research to support the development of case studies. In particular, we conducted research on current approaches to chemicals management at Kaiser Permanente to inform another best practices case study. We also researched companies like Walmart, SC Johnson, Ford, and Seventh Generation to attempt to identify reputational impacts, as well as to understand best practices in current approaches.

GreenScreen Training
We participated in a GreenScreen Training session and Safer Chemicals in Products workshop held by Clean Production Action, a working group that promotes green chemicals and sustainable materials. This provided a solid introduction into the complexities of chemicals management, as well as scientific grounding into the principles that support the principles of green chemistry.

Academic
We wanted to emphasize the importance of chemicals management through the development of a toxicology primer, intended to be a high level primer to orient readers of this report through the basics of toxicological concepts. To create the toxicology primer **(**Appendix B**)**, we reviewed and synthesized extensive secondary sources such as peer reviewed journal articles, agency materials, and chemistry textbooks.

Other
We conducted extensive secondary research to supplement primary research efforts. For example, the toxicology primer also benefited from resources and reports produced by several government agencies and organizations, including the Environmental Protection Agency (EPA) and Centers for Disease Control and Prevention (CDC), and input from NGOs like the Environmental Defense Fund (EDF). The EPA, in particular, was a valuable resource in navigating the complex environment in which chemicals are regulated. Other industry organizations, like the Healthy Building Network and the Green Chemistry and Commerce Council, also provided insight into current approaches and the regulatory environment.

Given REI's involvement with the Outdoor Industry Association, a trade group representing suppliers, manufacturers, and retailers, and the development of the EcoIndex (OIA's environmental assessment tool designed to standardize the measurement of environmental impacts throughout a product's life), we have also closely monitored OIA's progress and used its findings from the product level to better understand and inform recommendations at the operations level. This collaboration was undertaken in the spirit of understanding how the EcoIndex might apply to an operations focused chemicals management strategy, as well as to see if our research could benefit the EcoIndex.

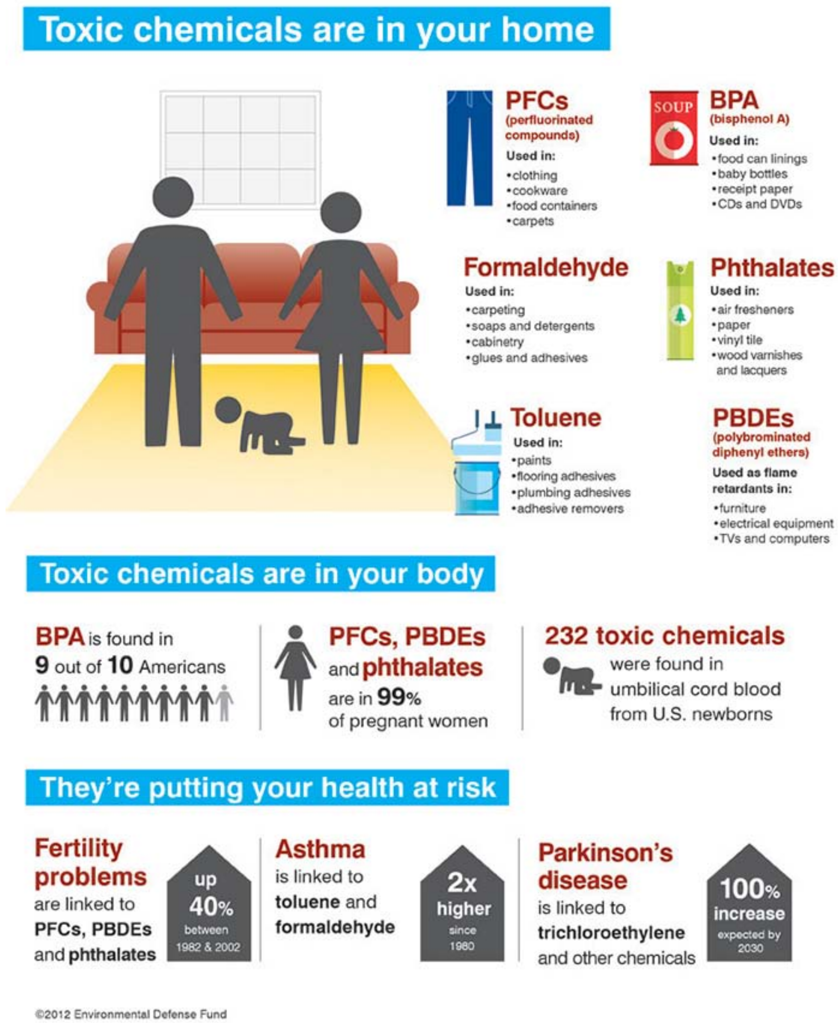
Similarly, development of the business case involved a thorough review of aforementioned government, NGO, academic (scientific and peer reviewed journals), and business sources. We also researched and followed current developments related to how toxic chemicals contribute to a variety of business risks, including competition, reputation, physical, insurance, and regulation.

The Case for Action: Chemicals Management in Retail Operations

Introduction

Chemicals are everywhere. Toxic chemicals surround us in our home and work environments. For example, formaldehyde is a known human carcinogen found in composite wood products like shelving, and in cabinetry and furniture.[11] Figure 1 depicts common chemicals in homes.

Figure 1: Toxic chemicals are in your home (EDF)



There are two primary types of items found in business operations that contain toxic chemicals:

1. *Articles*: Objects with a special shape, surface or design that determines their function to a greater degree than their chemical composition.[12] Articles include consumer products, building materials, electronic equipment, and many other items.

2. *Chemical Mixtures*: Items whose primary function is determined by the properties of a chemical substance or mixture itself, such as inks, adhesive or cleaning materials.[13]

Toxic chemicals in both articles and chemical mixtures are a growing concern because they pose threats to human health and the environment during manufacture, use, and disposal. Historically, activities related to addressing chemical risks focused primarily on toxic releases to air and water during manufacturing activities. Although releases during manufacturing are still a significant concern, there is now increased understanding and concern about the broad exposures to humans and the environment occurring during the product use and disposal stages.[14]

Chemicals cause harm. According to the U.S. Centers for Disease Control and Prevention, almost 133 million Americans are living with chronic conditions and diseases related to toxic chemicals exposure. These exposures are estimated to account for 70% of deaths and 75% of healthcare costs.[15] In particular, the scientific literature links six chronic medical conditions to chemicals exposures: certain types of cancer, learning and developmental disabilities, Alzheimer's and Parkinson's disease, reproductive and fertility problems, and asthma. If reducing toxic exposures translated into just a 0.1% reduction in health care costs, it would save the U.S. health care system an estimated $5 billion every year.[16]

Not only do chemicals harm people, they create a significant environmental burden. What we label commonly as "pollution" – water pollution, air pollution, and soil pollution – is a form of ecotoxicity. Ecotoxicity refers to the effects chemicals seeping into the environment have on fish, wildlife, plants, and other organisms. These types of impacts should be of particular concern to REI as an outdoor retailer, as the sales of their outdoor gear depend, at least to some extent, on the health of the environment. For example, water quality and health issues are linked to sales of paddling equipment.

Chemicals are not adequately regulated. Approximately 80,000 industrial chemicals are currently registered with the U.S. Environmental Protection Agency and 2,000 are added each year. Of these, only 250 have gone through hazard testing, and only five have been restricted through the Toxic Substances Control Act.[17] Most chemicals are not adequately tested for safety because current U.S. regulations require proof of harm, rather than proof of safety, before regulatory agencies can take action to protect public health.[18] As a result of this lack of testing, there is little insight into the potential human health and environmental impacts stemming from chemicals. The lack of testing is a limitation of U.S. regulations, business' citing confidential business information, as well as lack of authority given to government agencies.

Chemicals pose business risks and benefits. Because chemicals are everywhere, cause harm, and are not well regulated, they pose significant risks for business. The case for action is not merely risk mitigation – benefits can be reaped as a result of action. Chemicals risks are emerging as an area of concern for businesses. In response, chemicals management is evolving beyond traditional compliance functions and is trending toward incorporation into progressive, sustainability frameworks.

Business Risks

Given that toxic chemicals are present in products, building materials and through the retail supply chain, all businesses face at least some level of risk. While some of these risks are less pressing, they clearly exist and will continue to grow. Similar to other dimensions of corporate sustainability, the primary business risks with respect to chemicals management can be categorized as follows:

Physical: Direct human health and environmental risks resulting from toxic chemicals

Regulatory: Risks from existing or new legislation

Reputational: Risks resulting from shifting stakeholder priorities or concerns, and brand or reputational impacts

1. Physical Risk

Physical risks result from REI's operational activities and directly impact the physical wellbeing of its stakeholders and the environment. Commercial products, noncommercial products, and building materials can expose humans to numerous hazards. Impacts are difficult and/or costly to measure, but can be largely mitigated through safe purchasing decisions.

Affected populations

Because they are most likely to be in direct contact with any chemicals used within REI operations, populations included in Scope 1 run the highest risk of exposure to chemicals within REI's direct control. These populations include REI employees, customers, and populations living near REI stores and facilities.

REI employees are at risk due to their proximity to products and materials that may contain chemicals and due to the frequency of interaction. Bike and ski shop employees routinely use chemical mixtures, such as cleaner and lubricants, which typically include material safety data sheets (MSDSs) calling for safe handling procedures and indicating potential hazards. Print shop employees may be exposed to a number of chemicals released during the printing process. Retail employees likely use cleaners, handle fixtures, and may be exposed to product offgassing. Employees may also be affected by indoor environmental quality (IEQ) concerns throughout properties owned or leased by REI.

REI customers have a lower risk of exposure to operational chemicals and IEQ due to the relatively shorter amount of time they spend in REI properties compared to employees. Customers run a higher risk of commercial product impacts, highlighting the imperative to jointly address supply chain chemicals.

Other direct human stakeholders include populations living near REI stores and facilities, workers contracted by REI (including cleaning service workers, landscapers, etc.), and those reliant on healthy downstream ecosystems. Additionally, politicians, action groups, and lobbyists all may pursue agenda items related to chemicals management and impacts.
Populations impacted by Scope 2 (purchased energy) and Scope 3 (upstream and downstream activities) are more difficult to define. Energy production impacts, such as air quality and released mercury, may occur very far from the source. According to EPA, only about 25% of mercury emissions from U.S. coal burning power plants remains within the U.S. – the remainder enters the global atmosphere.[19]

Due to the global nature of supply chains and waste management, Scope 3 impacts are even farther reaching and more difficult to identify. Chemicals and ingredients are produced and assembled all over the world, impacting employees and communities in countless locations. While certain waste is likely to end up in facilities and landfills in local disposal sites, some is not. For example, much of 'recycled' U.S. electronic waste is shipped to developing countries that lack the capacity to process it safely.

Because REI can most directly control and will most directly bear the physical risks affecting populations, this report focuses primarily on chemicals in Scope 1. Risks borne by populations in Scopes 2 and 3, however, may be substantial and should not be ignored.

Exposure
Scope 1 populations are most likely to be exposed to chemicals within the built environment. This includes the use of noncommercial goods, as well as exposure to building materials and commercial products containing chemicals of concern.

The City of Seattle Department of Planning & Development estimates that the average concentration of pollutants inside buildings is two to five times higher than the average concentration outdoors. Current estimates indicate that people spend 80% to 90% of their lives indoors.[20] Since much of this time is generally spent in the workplace, it is important to foster healthy work environments to promote wellbeing and productivity amongst employees. In a retail setting, customers also are affected by pollutants inside buildings, although their exposure is again limited in comparison to employees.

The National Institute of Building Sciences defines indoor environmental quality (IEQ) as "encompass[ing] indoor air quality, which focuses on airborne contaminants, as well as other health, safety, and comfort issues such as aesthetics, potable water surveillance, ergonomics, acoustics, lighting, and electromagnetic frequency levels."[21] IEQ is affected by outdoor air quality as well as indoor emissions. Low IEQ is proven to lead to decreased productivity, increased absences, higher stress levels, and numerous other symptoms.[22] Some factors that affect IEQ include the types and ages of building materials used and the nature of ventilation systems. Ventilation is of notable concern in tightly sealed modern buildings, which are good for energy efficiency, but have the unintended consequence of trapping pollutants in the indoor environment.

As with any chemical exposure, exposure to poor IEQ can be acute or chronic. Health implications and negative reactions are so widespread that they have earned names. According to the U.S. EPA:

> "The term "sick building syndrome" (SBS) is used to describe situations in which building occupants experience acute health and comfort effects that appear to be linked to time spent in a building, but no specific illness or cause can be identified. The complaints may be localized in a particular room or zone, or may be widespread throughout the building. In contrast, the term "building related illness" (BRI) is used when symptoms of diagnosable illness are identified and can be attributed directly to airborne building contaminants."[23]

Chronic conditions, such as cancer caused by asbestos exposure, are not included under these definitions due to longevity, but such exposures are certainly important factors in IEQ. Studies have shown that good IEQ can have demonstrably positive effects on employees and visitors (some examples include Singh et al., 2010; Wargocki et al., 2000; Wyon, 2004; Fisk, 2000). Most toxic chemicals common in building materials are similarly hazardous to the environment, particularly from a lifecycle perspective. The manufacture, use, and disposal of many common building materials can release various toxicants into ecosystems, where they may dissipate, break down, or persist. Heavy metals and toxins, like persistent, bioaccumulative, and toxic substances (PBTs), remain in the environment for decades and can travel long distances through air and water.

Toxicity

Toxic chemicals can have varied affects on human health. Healthy human bodies are generally able to process and eliminate reasonable levels of toxicants through the immune system, which transports unwanted substances through the blood and lymph systems to be excreted. There are natural limits, however, to the amount and variety of substances the immune system can handle at once, and what the body cannot eliminate it simply stores.[24] Additionally, as blood carries toxicants throughout the body and transfers material into cells, toxicants come into contact with various organs.

Ecological toxicity is often a secondary concern to human health toxicity, but the two problems are inextricably linked. Healthy ecosystems provide vital support services for humans on earth, including fresh water, clean air, pollination, temperature regulation, food, and many others. Toxicants can impair the natural environment's ability to provide these functions, directly affecting the humans who depend on them. Additionally, at the top of the food chain, humans are extremely susceptible to bioaccumulation. We are capable of accruing and maintaining high levels of chemicals in our fat, and passing those chemicals on to our offspring.[25] Limiting ecological toxicity, therefore, is clearly in our best interest.

One of the most distressing aspects of chemicals management is the lack of data and scientific consensus regarding toxicity and links to human and environmental health. Very few chemicals have been thoroughly studied, and the bulk of impacts are likely unknown at this time. As David Ewing Duncan noted in his article *The Pollution Within* (National Geographic, 2006):

> Even though many health statistics have been improving over the past few decades, a few illnesses are rising mysteriously. From the early 1980s through the late 1990s, autism increased tenfold; from the early 1970s through the mid 1990s, one type of leukemia was up 62 percent, male birth defects doubled, and childhood brain cancer was up 40 percent. Some experts suspect a link to the manmade chemicals that pervade our food, water, and air. There's little firm evidence. But over the years, one chemical after another that was thought to be harmless turned out otherwise once the facts were in.
>
> The classic example is lead. In 1971 the U.S. Surgeon General declared that lead levels of 40 micrograms per deciliter of blood were safe. It's now known that any detectable lead can cause neurological damage in children, shaving off IQ points. From DDT to PCBs, the chemical industry has released compounds first and discovered damaging health effects later.[26]

Please refer to *Appendix B: Toxicology Primer*, for specific details on human health and environmental toxicity.

Chemicals of concern
Numerous commonly used chemicals are known to be hazardous to human and environmental health. Although certainly not exhaustive, Figure 2 outlines some noteworthy chemicals of concern and their likely uses within REI operations. Please refer to *Appendix B: Toxicology Primer* for complete descriptions of each chemical and its effects.

Figure 2: Select Chemicals of Concern

Chemical Name	Where it's likely to be found within REI operations (Scope 1)	Where it's likely to be found within REI operations (Scope 2)	Where it's likely to be found within REI operations (Scope 3)	Effects
Bisphenol A (BPA)	Hard plastics Epoxy resins		Manufacturing	Endocrine disruption Reproductive disorders Suspected: obesity, neurological damage, thyroid function, cancer
Benzene	Printers	Burning fossil fuels	Manufacturing	Cancer, especially leukemia Dizziness, vomiting, tremors Skin, throat and eye irritation
Toluene	Paints Detergents Printing processes		Gasoline Manufacturing	Nervous system effects Kidney damage Brain damage Skin irritation
Formaldehyde	Pressed wood products Fungicide Disinfectants		Manufacturing	Cancer
Phthalates	PVC/vinyl* Soft plastics Detergents + soaps Consumer products Wood finishes Adhesives, solvents, lubricants Insecticides		Manufacturing	Reproductive disorders Suspected: cancer
Perfluorochemicals (PFCs)	Gore-Tex, Teflon, Stainmaster Furniture Insulation Clothing		Manufacturing	Reproductive disorders Developmental disorders Cancer Suspected: infertility Persistent, bioaccumulative

Polybrominated diphenyl ethers (PBDEs) and other halogenated flame retardants	Plastics Textiles Clothing Furniture Electronics Building materials		Vehicles Manufacturing	Neurobehavioral disorders Developmental disorders Liver + thyroid disorders Highly ecotoxic Persistent, bioaccumulative
Lead	PVC/vinyl* Solder Wire insulation		Manufacturing	Highly toxic; multiple impacts
Mercury	Fluorescent lightbulbs Electrical fixtures Thermostats + thermometers Switches	Coal burning power plants Diesel + other fuel combustion	Manufacturing Oil refineries Diesel + other fuel combustion	Brain damage Blindness Deafness Kidney damage
Arsenic	Wood (pre-2004) Certain pesticides		Manufacturing	Cancer Respiratory damage Nervous system damage
Pesticides	Landscaping		Landscaping	Nervous system damage Decreased motor function Cancer Ecological damage

*** Polyvinyl chloride** (PVC), often referred to as vinyl, is very common in building materials. **According to the Healthy Building Network, PVC is often found in** pipes and conduit, waterproofing, siding, roof membranes, door and window frames, resilient flooring, carpet backing, wall covering, signage, window treatments, furniture, wire, and cable sheathing.[27]

2. Regulatory Risk

Retailers are responsible for managing physical spaces such as stores, warehouses, and offices, transporting and storing commercial products, hiring and managing employees, and purchasing, handling, maintenance, storage, and disposal of noncommercial goods needed to support all business activities. Each of these activities is governed by regulations intended to protect employees, customers, and the environment, and these regulations typically include provisions related to chemicals. When a retailer keeps or uses regulated chemicals anywhere in its operations, it must comply with the appropriate regulations or risk being fined and/or sued. Compliance can require substantial resources, and the complexity of the regulatory landscape can make compliance difficult, even with sufficient resources and the best of intentions.

Retailers purchase noncommercial goods and equipment from other companies for use in operations. Many people assume that because these goods are sold in the U.S. market, they are safe for use: free from toxic chemicals that cause human and environmental impacts. This is not the case, however. The major chemicals related regulations in the U.S. do not adequately assess, monitor, or limit toxic chemicals in the marketplace. A very small percentage of the staggering number of chemicals in existence are regulated, well understood, or even tested. As a result, retailers may be inadvertently exposing their customers, employees and the environment to dangerous chemicals despite compliance with current regulations. By understanding the regulatory landscape, retailers can better design a chemicals management strategy that aligns with existing regulations, minimizes risk, and is resilient in the face of policy changes.

The primary source of chemical regulation in the U.S. is the Toxic Substances Control Act (TSCA). Other regulations govern the use of chemicals in areas such as worker safety, proper disposal, and consumer product safety. Figure 3 highlights these regulations and descriptions; implications of the other regulations can be found in Appendix C. These regulations create standards and restrictions on chemicals use in order to protect people and the environment from harmful exposures. Because TSCA is the root of chemicals policy, it is important for retailers to understand what TSCA does and does not do.

TSCA regulates chemicals used in everyday products and manufacturing. TSCA was enacted to track, test, regulate, and screen all chemicals produced in or imported to the U.S.[28] The law requires reporting of chemicals to the Chemical Substances list, which includes more than 80,000 chemicals; however, fewer than 300 of those chemicals have been tested for safety.[29]

Retailers are not directly engaged with TSCA. Even a retailer that is a product manufacturer is not directly regulated by the legislation. Chemical manufacturers are the only group that is directly regulated by TSCA. Yet product manufacturers have chemicals in their products and these chemicals may or may not be safe. Both product manufacturers and retailers would benefit from chemicals policy reform to ensure the safety of products sold – stricter policy would decrease liability without requiring vast internal resources.

In a more general sense, retailers should be concerned that so few chemicals on the Chemical Substances Inventory have been assessed and that there is so little information available about the health and environmental risks of most chemicals. In other words, TSCA does not ensure that retail operations are free of chemicals dangerous to employees, customers, and the environment.

The European Union adopted new chemicals regulation called REACH (Registration, Evaluation and Authorization of Chemicals) in 2006. REACH is a modern attempt to implement and regulate chemical policy in Europe. REACH puts the burden on companies to develop information on chemicals' effects on human health and the environment. It also requires companies to obtain authorization to use chemicals that are considered to be of very high concern.[30]

In the U.S., new legislation has been proposed in Congress that would adopt many of the same principles of REACH.[31,32] Although this legislation did not move forward in the current 112th Congress, given the attention it received, it is likely to continue to be brought forward in subsequent sessions. Additionally, many states have started to adopt more stringent chemicals legislation, particularly related to children's products. State specific regulations are of particular relevance to retailers because they must adhere to the regulations specific to the states in which they operate.

New and pending legislation at the state, federal, and international levels indicate there will be continuous changes in what is regulated and how it will be regulated. Uncertainty about regulation and discrepancies between state level regulations create an additional risk for companies because of the additional effort and cost associated with monitoring changes and developing new or revised corporate policies. There are also costs associated with regulations of new chemicals. Regulation of a chemical typically results in removal of that product, research and development costs to identify an alternative, testing, and switchover of manufacturing. While a retailer does not directly incur these costs within its operations, there are indirect costs and risks from these regulations, such as delays in receiving product from a supplier during a product switch, high product switching costs, or undesirable residual inventory.

In conclusion, regulatory risk stems from (1) the lack of regulation protecting users of chemicals; (2) increasing and changing state and federal regulation landscape; and (3) associated costs of meeting existing or new regulations and requirements. Given that U.S. federal legislation is so weak regarding chemicals, chemical users face risk because they do not have safety guarantees. States are increasingly adopting their own legislation, which creates an uncertain environment, difficult for national and international retailers to manage. Retailers can incur significant costs to remain knowledgeable about and to comply with all regulation. Therefore, in some cases it may make sense for a retailer to take the most stringent approach in order to best mitigate risks and costs. Retailers must stay informed about chemicals regulation in order to adequately understand where they are protected, and where they may want to look to outside standards or practices to mitigate risk.

See Appendix C for a more detailed description of TSCA and the other environmental regulations pertaining to chemicals.

Figure 3: Environmental Regulations related to Chemicals

		Primary Group Impacted by Legislation				
	Jurisdiction	**Commerce**	**Employees**	**Consumers**	**Environment**	**Transportation**
TSCA *Toxic Substances Control Act*	U.S. Federal	X				
OSHA *Occupational Safety and Health Act*	U.S. Federal		X			
CPSA *Consumer Product Safety Act*	U.S. Federal			X		
FHSA *Federal Hazardous Substances Act*	U.S. Federal			X		
FIFRA *Federal Insecticide Fungicide and Rodenticide Act*	U.S. Federal	X				
RCRA *Resource Conservation and Recovery Act*	U.S. Federal	X				
CERCLA or Superfund *Comprehensive Environmental Response, Compensation, and Liability Act*	U.S. Federal				X	
REACH *Registration, Evaluation and Authorization of Chemicals*	Europe	X				
RoHS *Restriction of Hazardous Substances in Electrical and Electronic Equipment*	Europe	X				
State Law *Individual state laws such as:* • *Children's Safe Products Act (Washington)* • *Act to Protect Children's Health (Maine)*	U.S. State	*Varies by each piece of legislation*				

3. Reputational Risk

As Daniel Esty and Andrew Winston claim in their 2009 CSR guidebook *Green to Gold*,

> Environmental issues have unequivocally climbed up the public agenda. For business, this means that many stakeholders, in particular customers and employees, are hearing the green message everywhere and growing more concerned. But for those companies that have legitimate and verifiable green stories to tell, the interested audience has never been larger.[33]

Public awareness of the prevalence of toxics in products and materials is increasing. NGOs are building awareness and releasing reports about toxics, the media is disseminating information, and consumers are acting according to their beliefs. Unaddressed toxic chemicals within products and operations pose risks to the reputation and brand of an organization.

A growing number of NGOs and environmental groups are paying attention to chemicals. The U.S. Environmental Protection Agency, Environmental Defense Fund, Greenpeace, and the World Wildlife Fund are a few of the better known organizations fighting for safer chemicals. Threatening brand value is a common tactic to incite change. In 2011, Greenpeace released a report entitled *Dirty Laundry*, which called out the practices of numerous apparel brands and their toxic chemicals use, and created far reaching impact across the apparel industry. Following the report, the industry experienced significant negative media coverage, and apparel brands swiftly responded with public commitments to change production practices to remove toxic chemicals.[34] Greenpeace has since lauded H&M, Marks & Spencer, Puma, Nike, Adidas, and several other apparel companies for their work on toxic chemicals reduction.[35]

In 2007, Nalgene, a popular water bottle manufacturer, came under consumer fire for using bisphenol A (BPA) as an ingredient in its polycarbonate bottles. BPA is an endocrine disruptor and teratogen that has been linked to reproductive and developmental toxicity. Major retailers such as Walmart, Mountain Equipment Co-op, Lululemon, and REI removed bottles containing BPA from their shelves.[i] Nalgene responded rapidly: by spring of 2008, the company announced plans to immediately phase out BPA. In a public statement, Steven Silverman, Nalgene's general manager, denied the potential safety hazard. He then added, "however, our customers indicated they preferred BPA free alternatives, and we acted in response to those concerns."[ii] Despite the company's reluctance to recognize chemical risks, Nalgene was forced to respond to consumer pressure.

SIGG, one of Nalgene's main competitors, enjoyed a boom in sales estimated at 250% as concern over BPA grew and Nalgene fumbled (SIGG's aluminum bottles were presumed a safe alternative).[iii] SIGG was later scrutinized for failing to tell the public that many of its aluminum bottles were in fact lined with BPA as well.[iv] As a result, Patagonia completely severed its relationship with SIGG – SIGG's brand value was too damaged. Nalgene now manufactures the largest line of BPA free bottles available.

[i] Rossmeier, Vincent. "A Very SIGG Deal." Salon. 8 September 2009. 8 June 2012. <http://www.salon.com/2009/09/08/sigg/>.
[ii] Austen, Ian. "Bottle Maker to Stop Using Plastic Linked to Health Concerns." The New York Times. 18 April 2008. 8 June 2012. <http://www.nytimes.com/2008/04/18/business/18plastic.html>.
[iii] "Sigg backpedals on BPA." CBC News. 4 September 2009. 8 June 2012. <http://www.cbc.ca/news/story/2009/09/03/siggbpa-admission.html>.
[iv] Rochman, Bonnie. "How Green Is Your SIGG Water Bottle?" Time. 27 October 2009. 8 June 2012. <http://www.time.com/time/health/article/0,8599,1932826,00.html>

Organizations within REI's home state of Washington are particularly active on this topic as well. The Washington Toxics Coalition is a reliable source of activism and information, and the Columbia River Toxics Reduction Working Group was founded to "develop strategies to identify and reduce toxics in the Columbia River basin."[36] Such groups are often responsible for campaigning against toxic chemicals use, commissioning studies, and disseminating information, and have been particularly effective in inciting both public and political action against toxic chemicals use in Washington State.

The past several years have seen various examples of corporate reputations being damaged by concern over toxics use, as well as consumer success in altering corporate behavior (see sidebar). The increasing trend in consumer demand for transparency has the potential to impact how companies address chemicals management. As stakeholders demand more information, companies that are not able or willing to disclose chemical data may face the risk of failing to meet consumer expectations, and lose business as a result.

Perhaps most important, companies and academics are drawing concrete connections between corporate social responsibility and brand value. As William B. Werther Jr. and David Chandler, authors of *Strategic Corporate Responsibility: Stakeholders in a Global Environment*, note, “Corporate actions that violate societal expectations damage, even destroy, brand image among networked stakeholders.”[37] Physical and regulatory risks directly affect reputation, and brand value is paramount in an age of unparalleled consumer choice. REI has multiple strong competitors in the outdoor retailer space, and therefore activities to maintain and enhance the company brand can create strategic advantages.

Business Benefits

The risks associated with chemicals management are better understood compared to the benefits, which can be difficult to quantify. However, there are a few potential benefits that a retailer can recognize as a result of proactive chemicals management, including:

- Increased employee productivity
- Elevated brand value
- Reduced chemicals compliance and handling costs
- Reduced insurance costs

1. Increased Employee Productivity

Toxic chemical free work environments are proven to be healthier. As a result, employees are likely to have fewer sick days and increased worker productivity. Low IEQ is proven to lead to decreased productivity, increased absences, higher stress levels, and numerous other symptoms.[38] Studies have shown that good IEQ can have demonstrably positive effects on employees and visitors (some examples include Singh et al., 2010; Wargocki et al., 2000; Wyon, 2004; Fisk, 2000).

D.P. Wyon asserted in his 2004 study, “It has now been shown beyond reasonable doubt that poor indoor air quality in buildings can decrease productivity in addition to causing visitors to express satisfaction. The size of the effect on most aspects of office work performance appears to be as high as 6-9%.”[39] Surveying employees that had moved from conventional to LEED rated office buildings, Singh et al. found that “improved IEQ contributed to reductions in perceived absenteeism and work hours affected by asthma, respiratory allergies, depression, and stress, and to self reported improvements in productivity.”[40] Therefore, taking actions to remove toxic chemicals, and thus improve IEQ, can create a significant benefit to a retailer.

Employers can calculate an incremental percentage improvement in employee productivity and decreased absenteeism to determine the potential benefit to their organization.

2. Elevated Brand Value

Chemicals management is increasingly being viewed as a component within corporate sustainability or corporate social responsibility (CSR), rather than a compliance function. There is currently no research that indicates an elevated brand value purely as a result of a strong approach to chemicals management. However, given that chemicals management can be viewed as a component with CSR, one can infer that chemicals management elevates a company's overall sustainability/CSR efforts.

While empirical links between CSR activities and purchasing decisions continue to elude researchers, it is generally acknowledged that consumers "should … be seen as complex decision makers who in their brand evaluations take into account multiple brand facets and information sources."[41] Klein and Dawar assert that "CSR plays a role in consumers' brand and product evaluations, over and above economic or 'rational' considerations such as product attributes," and "CSR has a spillover or 'halo effect' on otherwise unrelated consumer judgments, such as the evaluation of new products." CSR efforts such as proactive chemicals management, then, can positively impact a consumer's overall view of a company. A reputation for social and environmental responsibility creates goodwill amongst consumers, and though difficult to quantify, goodwill is a valuable asset that feeds into purchasing decisions.

3. Reduced Chemicals Compliance and Handling Costs

Compliance with regulatory requirements for the safe handling, storage, and disposal of hazardous products adds cost to a business. For a retailer, these types of products are likely to be rather limited. Common products such as WD-40 and gasoline canisters, however, require special management practices.

Costs associated with potentially hazardous products relate to planning, acquisition, receiving, storage and inventory, and disposition.[42] Planning costs include acquiring an MSDS, permits, and planning for how to receive, store, and dispose of the product. Storage costs for hazardous products or chemicals can be significant, and include space requirements or separate space for flammable, corrosive or temperature controlled items. Disposition, the other major cost driver, is influenced by recycling, special disposition requirements, packaging, and transportation.[43] Encompassed within these activities is protecting worker health and training employees.[44]

Given all of these costs, it is clear that these types of products have significant hidden costs beyond the purchase price. The easiest way to reduce costs is to simply eliminate these items, which also eliminates the associated risk.

4. Reduced Insurance Costs

Companies are increasingly experiencing the impact of chemicals on insurance costs, in the form of property insurance and employee healthcare insurance. As chemicals risks continue to be better disclosed, insurance companies may begin to incorporate mechanisms to better assess and quantify potential consequences. This could result in increased premiums for higher risk and reduced premiums for safe or preferable practices.

Several examples have appeared in industry. For example, property insurers have started offering reduced premiums for LEED certified buildings.[45] The Fireman's Fund Insurance Company was among the first insurers to offer discounted coverage specifically for LEED certified, green commercial buildings due to lower risk factors; Fireman's Fund specifically points to nontoxic, low odor paints and carpeting as criteria.[46] While the U.S. Green Building Council (USGBC) does not have a formal credits program regarding toxics management for buildings, it is trending in that direction with a pilot credit program towards certification for chemical avoidance in building materials.[47] This demonstrates that insurance companies are recognizing reduced risk from green and sustainable building practices, which includes reduced toxic chemicals.

From the employee healthcare insurance perspective, the USGBC identifies potentially lowered insurance premiums due to healthier employees as a benefit of green buildings. The logic is that, due to better indoor air quality and less hazardous building materials and products, employees in a healthy workspace are less likely to get sick.[48] Long term health insurance costs could decrease because employees are healthier overall. Traceability of costs arising from illnesses related to toxic substances remains approximate at best, but researchers are developing more precise methods and tools for estimating cost impacts.[49] With a better picture of costs involved, insurers and policyholders can start to develop more concrete models and understanding of savings to be realized.

While it is nearly impossible to quantify the exact insurance savings to REI as a result of toxic chemicals management to REI, these secondary or "soft" benefits are worth noting when making the case for toxics management, and will become more compelling drivers in the future as evidence grows.[50] It is unlikely that any organization will adopt a chemicals management program solely to reap insurance savings; however, these savings may serve as an additional incentive to take action on broader sustainable development and chemicals management initiatives.

The Case for Action at REI

Given REI's vision to "enhance the natural world and our communities through responsible business practices," public corporate social responsibility strategy, progress towards goals, and annual stewardship report it is clear that REI places a strong emphasis on sustainability.[51] Sustainability has become part of the DNA of the company and thus increases potential reputational risk.

Given the demographics and priorities of REI's customers, reputational risks are particularly relevant for REI, which recognizes that much of its customer base lists environmental stewardship as a top consideration in purchasing decisions.[52] REI and its customers recognize that a healthy natural environment is vital to outdoor recreation. Given the priorities of REI's customers, there is a higher potential reputational risk.

Toxic chemicals clearly present several risks to businesses in any industry. Much of this risk is not yet well documented or quantified, but awareness is mounting. To mitigate this risk and recognize potential business benefits, companies should put greater focus on chemicals management within their operations. Adding an operational toxics lens will help REI continue to lead and mirror industry progress. REI members likely will respect the organization's bold determination to position itself as a sustainability leader. Figure 4 summarizes the business risks and benefits of chemicals management as they relate to REI.

Figure 4: Business Case for Chemicals Management and REI

	Description	REI Relevance
Business Risks		
Physical	• Direct human health (such as chronic conditions and diseases) and environmental risks from toxic chemicals that are present in building materials and products.	• ~11,000 employees which have the potential to be exposed to toxic chemicals while working in retail, warehouse or headquarters facilities. • Potential for employees to suffer from health impacts from poor indoor air quality stemming from toxic chemicals.
Regulatory	• Risks from existing or new regulation. • Existing legislation is lacking – does not test to ensure chemicals are safe. • New federal chemicals legislation has been proposed in Congress. • States have adopted or are exploring adopting chemicals related regulations.	• Operates in 32 states, of which many, including Washington State, have adopted chemicals legislation. • Costly to monitor changing state and federal regulations.
Reputational	• Risks from negative publicity of impacts to the brand or reputation of the company, often a result of NGO or stakeholder publicity or a negative event.	• NGOs in Washington State are actively fighting for safer chemicals and toxics reduction. • Greenpeace's *Dirty Laundry* report highlighted toxic chemicals problems in the apparel industry.
Business Benefits		
Increased Employee Productivity	• Increased employee productivity from fewer sick days and higher productivity in healthy workplace environments.	• Improving 11,000 employees' productivity results in substantial benefits.
Elevated Brand Value	• CSR is increasingly playing a role and positively impacting brand value.	• REI's brand is fundamentally tied to environmental stewardship and long term thinking.
Reduced Operational Costs	• Reduced business operational costs from compliance and handling costs of hazardous products.	• Approximately 500 noncommercial goods. • Segregated space at distribution facility to store products.
Reduced Insurance Costs	• Reduced insurance costs for adoption of toxic free products in buildings or lower employee healthcare insurance costs.	• Benefits are not yet quantifiable, but as attention to toxic chemicals grows, likely will be a benefit.

Current Approaches to Chemicals Management

Introduction

Companies have historically viewed chemicals management as a non-strategic issue, instead treating it as a burdensome activity whose sole purpose is to comply with regulatory requirements. Recently, however, more and more companies have begun to realize the potential business benefits and implications of devising chemicals management strategies—effectively moving from regulatory compliance and a lack of understanding about the human and environmental health impacts of the chemicals present in their products to a more proactive integration of toxic chemical avoidance into corporate strategy.

Most of the work done to date has been on commercial goods: companies have focused their efforts on working with companies in their commercial goods supply chains to eliminate or replace harmful toxic chemicals present in the materials they purchase. Many of REI's direct competitors, for example, are innovating beyond addressing toxic chemicals in the product supply chain specifically by participating in the Outdoor Industry Association's (OIA) Sustainability Working Group, which includes the Chemicals Management Working Group (CMWG).

The CMWG, which is chaired by employees from Patagonia and Nike but contains members from outdoor, apparel, and footwear companies, including REI, is dedicated to creating "a world in which all consumer products are produced using Green Chemistry practices, ultimately using inherently safer chemicals and reducing or eliminating hazardous chemicals."[53] It does so by developing education, guidance, and decision-making tools, enabling its members to promote green chemistry throughout their supply chains. Select participants in the OIA Sustainability Working Group include Adidas, Nike, Burton, Columbia, Levi Strauss, Nike, Patagonia, Timberland, Brooks, and Target.

Virtually none of REI's competitors, however, are working to reduce the presence and impacts of toxic chemicals in their noncommercial goods beyond complying with existing state and federal regulations. In fact, very few companies in any industry have addressed this question publicly.

Companies seeking to address toxic chemicals run into numerous roadblocks, usually related to the complicated and technical nature of the problem and the lack of available information on the thousands of chemicals now ubiquitous in the products commonly found in the marketplace. While these roadblocks are challenging, they have led to a learning process, which has resulted in the development of tools for assessing and managing the impacts of chemicals in the commercial goods supply chain. Although these tools are primarily used for commercial goods manufacturing, they can be adapted to the arena of noncommercial goods and the built environment.

This section contains a brief overview of the types of tools available to companies for identifying, managing, and replacing toxic chemicals in the commercial and noncommercial goods they manufacture or purchase.

Tools and Approaches to Chemicals Management

Retailers differ in their approaches to identifying, managing, and replacing potentially toxic chemicals in the products they purchase or manufacture. Some develop their own internal chemical management tools; some purchase third party evaluation systems; others select methodologies or tools that allow them to collaborate with other companies facing similar issues; and many simply abide by existing regulations.[54] As a result, there is no obvious option for a retailer seeking to comprehensively manage chemicals in its operations.

There are four primary chemicals management approaches in use today, ranging from regulatory compliance to proactive chemicals management:[55]

> *Material Safety Data Sheets*: product chemical safety and hazard information sheets prepared by a hazardous chemical or product manufacturer or importer
>
> *Restricted Substances Lists*: lists of chemicals (regulated and/or non-regulated) that a company prohibits its suppliers from incorporating into products
>
> *Standards, Certifications, and Labels*: standards that evaluate products against existing criteria and specifications, providing a stamp of approval that the products meet a high standard of environmental responsibility
>
> *Third Party Evaluation Tools*: systems that evaluate products against a large set of regulatory lists and scientific studies using customized software and extensive databases

See Appendix D for a thorough analysis and examples of each type of tool.

Material Safety Data Sheet

Description
A Material Safety Data Sheet (MSDS) is an information sheet prepared by a hazardous chemical substance or product manufacturer or importer and is required by national health and safety guidelines in individual countries (such as OSHA in the U.S.). An MSDS describes the physical and chemical properties of a product, allowing a company to communicate information about that chemical that can then be used to protect workers during storage, handling, and use of the chemical. The laws governing MSDSs differ between countries.

In the U.S., chemical manufacturers and importers are required to obtain or develop an MSDS for each hazardous chemical they produce or import. This is defined as any chemical that comprises 1% or more of a product's makeup, or greater than 0.1% if the chemical is a known carcinogen. Employers – including retailers whose employees regularly come in contact with potentially hazardous chemicals – must have MSDSs available in the workplace for any hazardous chemicals present.[56] These sheets are used primarily in occupational settings for chemical substances or mixtures and the products that contain them. Throughout the supply chain, MSDSs are typically the only documents available for communicating hazard and toxicity information for a chemical ingredient.

Evaluation

MSDSs are the first step in a corporate health and safety program. Many companies do not pursue additional levels of chemicals management beyond this compliance step. However, there are several challenges with MSDSs that limit their effectiveness as a risk management tool. Some of these challenges include:[57,58]

- OSHA only requires hazardous ingredients to be listed in an MSDS if the ingredient makes up 1% or more of the product (unless it is a known carcinogen, in which case the threshold is 0.1%)
- OSHA allows companies to apply for trade secret or proprietary information exemption for certain products, sometimes resulting in only partial product transparency
- MSDSs typically lack sufficient chemical ingredient information and toxicological data for companies to effectively assess alternatives
- MSDSs were primarily designed to provide information on acute occupational health hazards, as opposed to those throughout an entire product life cycle

Restricted Substances List

Description

A Restricted Substance List (RSL) is a list of chemicals that a company can specify not to be in products or materials. The specific criteria to determine the chemicals on an RSL vary by organization. The most commonly listed chemicals are those that fall into one of the following categories: "acute human toxicity, carcinogenicity, mutagenicity, reproductive toxicity, endocrine disruption, ecotoxicity, and persistence and bioaccumulation."[59] RSLs list chemicals that are regulated in various geographic jurisdictions, in addition to others that have appeared on chemicals of concern lists. RSLs are developed by individual companies, government agencies, NGOs, trade groups, or working groups, and then adopted by companies to restrict the use of chemical substances in their supply chains.[60]

Once an RSL has been developed, a company then uses it to increase awareness among purchasers and their suppliers around which chemicals to avoid in purchased products. In the most basic scenario, chemicals appearing on an RSL and in a product are monitored internally, and the company works with its suppliers to seek better alternatives. In the best case scenario, the company is able to work with a supplier to eliminate the use of an RSL-listed chemical entirely, or the company is able to find an alternative on the market that does not contain the particular chemical.

Evaluation

RSLs provide companies with a public method for ensuring product safety and responsibility above and beyond what is legally required. It does so at a lower level of detail than the approaches mentioned later in this section, but also at a lower cost to the purchaser (which shares the burden with suppliers). Since they are more restrictive than MSDSs and apply to a much wider range of products as defined by the purchasing company, RSLs can in turn be expensive to comply with. Therefore, it is best if suppliers take on the responsibility to do product testing given that they have a much deeper understanding of the material inputs to a product. Complying with an RSL also adds time to the procurement cycle given the additional due diligence it requires.

Examples

<u>American Apparel & Footwear Association (AAFA)</u>

The AAFA, a national trade association, developed and updates an RSL through its Environmental Task Force. The RSL was developed to help apparel and footwear companies, including retailers, develop responsible chemical management practices specifically in the home textile, apparel, and footwear industries. It contains only legally regulated chemicals, but tracks regulations from around the world, including chemicals of concern that are currently only tracked by a small number of governments. Retailers that use the AAFA's RSL for their product supply chain include The Gap, H&M, and Timberland.[61]

<u>H&M</u>
H&M is in the process of developing an RSL for noncommercial goods.[62] This is in addition to H&M's existing RSL for commercial goods.[63] A select number of noncommercial goods suppliers have signed onto the RSL as part of their contract with H&M, and the company intends to increase the number of suppliers in the near future.[64] By doing so, H&M has shown that retailers are capable of looking outside of the product supply chain and into operations when seeking to improve chemicals management processes.

Standards, Certifications, and Labels

Description
This category describes standards that evaluate products against a set of criteria and specifications, providing a stamp of approval that products meet a high standard of environmental responsibility. Suppliers take on the responsibility of achieving certification. These standards are developed by third party organizations, both for and nonprofit, and are typically valid for a designed period of time before requiring renewal. Most standards are updated regularly, based on the latest research on toxic chemicals by toxicologists and industry experts.

Evaluation
Certifications and labels provide relatively easy to understand confirmation that a product meets a certain standard. However, given that they must be applicable across product categories or industries, they are typically not customizable to a particular company's needs. Furthermore, certifications are often focused on one category of products, such as cleaning products or building materials, thereby requiring companies to manage multiple certifications in order to cover their wide array of products.

Examples

<u>Design for Environment</u>
The U.S. EPA's Design for Environment (DfE) program works with industry, environmental groups, and academia to provide critical information to consumers and companies regarding the chemical safety of products. It evaluates both the human health and environmental concerns associated with chemicals and processes. DfE certifies cleaning products that meet its standards by giving them a DfE label through its Safer Product Labeling Program; to date, more than 2,700 products have been given DfE approval.[65] It is regarded as one of the easiest methods to use and understand with regards to chemicals management, because companies can simply purchase products that have been DfE-certified without having to invest more resources in understanding the details behind the certification.[66]

<u>BlueSign</u>
BlueSign is a certification system designed specifically for the textile manufacturing supply chain. It assesses the human and environmental health impacts of the products and processes that a manufacturer is responsible for, with criteria based on the lifecycle toxicological and

ecological risks of the substances used as inputs to the manufacturing process. It uses national and international regulations on chemicals, such as REACH, to identify chemicals of concern. Products meeting all of the stringent BlueSign criteria are then validated with a BlueSign certificate of approval. Like most certifications, it is specific to one industry (textile), and it also requires significant investment from companies seeking compliance.[67]

Third Party Evaluation Tools

Third party evaluation tools allow companies more flexibility than certifications to evaluate chemicals within their commercial and noncommercial good supply chains or operations. These tools typically contain extensive databases made up of chemicals data generated by governments, scientific bodies, or academic studies. The tools are then capable of evaluating chemical ingredients in specific products against the data contained in their databases.

Unlike labels and certification programs, which provide a stamp of approval, these tools are more customizable and resource intensive to manage. They allow manufacturers and purchasers to evaluate the chemical makeup of thousands of products, customize criteria and weightings, and compare products based on specific criteria to make informed decisions about the makeup of products or materials.[68]

Evaluation

Third-party evaluation tools are useful for ensuring compliance with current regulations, and can often be used to compare alternative chemicals to determine if a safer choice is available. When customizing these systems, a retailer must decide what types of hazard end points the tool will evaluate and how it will evaluate these end points—what authoritative lists of chemicals of concern will be used, what are the criteria for evaluating the end points, what are the weighting and scoring of criteria, and whether the scores are combined into a single score representing multiple reviewed end points."[69] Therefore, managing these tools tends to be very resource intensive, requiring staff to have a solid understanding of toxicology principles.

Examples

<u>Green Screen for Safer Chemicals</u>

The Green Screen for Safer Chemicals is a free, science-based method for comparative Chemical Hazard Assessment developed by Clean Production Action. Companies can use the Green Screen to identify chemicals of high concern, compare and rank the chemicals along a hazard index, and identify safer alternatives. Based on international regulations, hazard lists, and scientific literature, it utilizes 18 hazard end points to create a four stage benchmarking process, leading companies to eliminate toxic chemicals from their products.

<u>GreenWERCS</u>

GreenWERCS is a software solution that enables retailers and individuals to assess the chemical makeup of chemical intensive products by analyzing "the composition of individual products from ingredient data entered by manufacturers, examining its potential impact on human health and the environment."[70] It uses an ingredient based visual ranking system that allows manufacturers to identify the human and environmental health impacts of the chemicals found within their products, based on 4,000 sources of data throughout the world.[71] The tool also enables retailers and distributors to begin to identify the chemicals in the products they are selling by increasing the transparency of those products, identifying such components as persistent, bioaccumulative and toxic substances (PBTs) or endocrine disruptors. WalMart, the global retailer, uses the tool to assess the chemical makeup of more than 40,000 of its products.[72]

Pharos Project

The Pharos Project is an open source evaluation system for a comprehensive list of building materials which provides a detailed explanation of the contents of each product listed, as well as information regarding the chemicals in those products based on "40 authoritative hazard and warning lists."[73] It also contains a certification library, listing the details of more than 100 common product related certifications and explaining how each impacts a product or chemical's score in the Pharos database. The tool covers items such as thermal insulation, standard paints, and ceilings, with planned additions including wood flooring, roofing membranes, and countertops.[74]

Company Approaches

Companies seeking to address the chemicals impacts of their commercial goods, noncommercial goods, or built environment have a plethora of options. Each brings differing levels of transparency, flexibility, and business benefits, but all require an investment of time and resources to manage and monitor.

Although progress on the operations side has been slower than on the commercial goods side, two companies in particular have shown what leadership in chemicals management in operations looks like: Google, which has done so from a building materials angle, and Kaiser Permanente, which has worked specifically on its noncommercial goods purchasing practices. A third company, SC Johnson, has shown what can happen when effective chemicals management becomes a priority internally. Below are highlights of case studies on each; more details for Google and Kaiser Permanente can be found in Appendices E and F.

Case Study: Google

Google, Inc. is one of the most recognizable companies in the world and a leader in the high tech and Internet search sectors. But while most people are "Googling" they are probably not considering what's in the air being breathed by the company's more than 32,000 employees. Google's management spends a lot of time thinking about indoor environmental quality (IEQ), though, and has charged its Real Estate & Workplace Services Green Team with creating "the healthiest, most productive work environment possible for Googlers around the world." As part of this wide-reaching goal, Google is attempting to eliminate known toxicants from its buildings.

Case Study: Kaiser Permanente

Kaiser Permanente, a managed healthcare organization and a leader in the pursuit of safer chemicals in operations, is "committed to researching and sourcing safer alternatives to products such as cleaners, solvents, disinfectants, plastics used in medical devices and building materials, flame retardants, and formaldehyde."[75] This directly aligns with Kaiser Permanente's public desire to promote health in all communities.[76] Kaiser Permanente has used its considerable purchasing leverage to demand supplier transparency and influence design within its supply chain, sending ripple effects, such as lower cost barriers, across industries.

Case Example: SC Johnson & Son

SC Johnson & Son, a consumer products company, developed the Greenlist™ in 2008, an internal chemicals management tool designed to provide the company's scientists the ability to assess and select the best available chemical ingredients when designing products. Using this tool in the redesign of Windex, one of SC Johnson's flagship products, the company asserted that not only did the product perform better – it actually cleaned 30% better than with the old formula – but also helped SC Johnson achieve increased sales after its release.[77,78] Aside from the increased business from which SC Johnson benefited, any company using Windex, a noncommercial good specifically used by cleaning teams within companies' internal operations, by extension received the benefit of more efficient and safer cleaning supplies.

Figure 5: SC Johnson Ingredient Disclosure Example

Current State of Chemicals Management at REI

Like any other retailer, REI has toxic chemicals everywhere within its operations: in the building materials used to construct retail, office, and warehouse facilities; in the lubricants used for repairs in its bike shops; in the cleaning supplies used to maintain facilities; or in the print shop where marketing materials are printed. REI has an opportunity to enhance its existing chemicals management work by proactively addressing both regulated and non-regulated chemicals in its operations.

REI currently manages chemicals in a decentralized manner, which is consistent with retail industry norms. Various individuals and groups within the company are responsible for different aspects of regulatory and legal compliance with respect to chemicals. Also similar to other companies, REI does not currently have a strategic, unified chemicals management strategy, policy, or process across the entire enterprise. However, given its efforts to date on the commercial goods supply chain, REI is well positioned to start this process. In our interviews with REI stakeholders, we found a general understanding of chemicals issues and a consensus around the need for a stronger chemicals management strategy to help move the company away from reactive efforts to a more proactive, structured approach. As REI's Purchasing Manager puts it, "The one thing we have going for us is that everybody really wants to do the right thing."

Regulatory and Legal Compliance

With respect to toxic chemicals, REI currently has procedures in place to comply with all local and federal regulatory and legal guidelines.[79,80] This includes the safe handling and storage of commercial and noncommercial goods at stores and distribution centers, relevant disclosures or disclaimers on products sold, and the availability of MSDS for hazardous substances to both employees and customers. REI also has programs in place to safely dispose of hazardous waste from stores and other facilities. While compliance is important, it is distinct from the chemicals management strategy that we are proposing; compliance would ultimately be one aspect of this larger strategy.

BPA-free Receipt Tape

For nearly four years, REI has been using cash register tape free of Bisphenol A (BPA).[81] BPA is often used as a color developer for thermal receipt paper. Due to the nature of paper recycling, BPA eventually ends up in products such as toilet paper and food packaging. A study conducted in 2010 and 2011 found BPA in 100% of receipts collected in the U.S.[82] According to *The New York Times*, "Previous studies have shown that 27 percent of the BPA that finds its way to skin surfaces penetrates and reaches the bloodstream within two hours."[83] This raises serious concerns for cashiers, who have high exposures to receipt paper. As of late 2012, the U.S. EPA's DfE office was in the process of completing an alternatives assessment for BPA.

There was no regulatory mandate for REI to shift to BPA-free receipt tape; however, a concerned employee took action and the issue worked its way up the chain of command. In making the switch to BPA-free register tape, not only was REI reducing employee and customer exposure to a toxic chemical, it was also able to realize cost savings – a secondary but direct business benefit of this shift. The CSR team communicated this success story across REI, noting that the company was ahead of the curve on this issue relative to regulation and the actions of other retailers. This example demonstrates how REI employees are encouraged to take ownership of issues they deem important, which ultimately lead to company wide changes that have real impact. To move towards an overall chemicals management strategy, REI needs to build a systematic process to enable employees to pursue these types of outcomes.[84]

Hazardous Waste Disposal

Like many standalone bike repair shops, REI's in-store shops generate small amounts of hazardous waste from various lubricants, cleaners, and other chemicals used to service equipment (not only bikes but also often skis, snowboards, etc. Until recently, REI did not have a simple and scalable company wide process in place to address the waste. Pushed by regulations coming out of California (which tends to be leading edge in toxic chemical law), REI looked to adopt a more standardized procedure to manage the problem of chemicals in the repair shops. In this reactive approach, the REI CSR team saw a gap and worked closely with the Safety Coordination group to address the problem.[85] The two teams researched national vendors through their retail industry contacts, and eventually settled on the vendor best suited to REI's needs in terms of scale and cost. This approach to address an existing problem was successful, but would not place REI "ahead of the curve."

Current Approaches in Supply Chain

While many of the current approaches to chemicals management are operations focused, REI has also taken steps to address toxic chemicals in its commercial goods. In terms of commercial products sold, REI maintains a restricted substance list (RSL), which details toxic chemicals that are not permitted for REI-branded items, but does not have a similar list for noncommercial goods used in operations. REI is also a member of the Bluesign industry working group, an independent organization developing an end-to-end methodology and tool for the textiles industry to track, measure, and manage toxic chemicals at all stages of the manufacturing process. REI is also actively engaged in the adoption of OIA process and standards in its supply chain. While focused on products, the OIA process contains several aspects that are applicable to an operations level chemicals management strategy. REI does not have an RSL for noncommercial goods, although it does make efforts to buy only GreenSeal certified products for use in its operations. A noncommercial RSL developed in alignment with the existing commercial goods version could serve the company well as part of an overall strategy.

Chemicals Management Framework for Retail Operations

Introduction

The case for chemicals management in operations is clear. What's not clear is how to address the complexity and uncertainty inherent in the issue. Many companies have begun addressing chemicals management in their commercial products supply chains, but few have done so specifically for operations. There is, therefore, no established industry best practice for chemicals management in operations.

In order to address the needs of a retail operations setting, we developed a chemicals management in operations framework that details the steps necessary to achieve clearly defined goals. The framework highlights the level of investment and resources required to accomplish a set of goals, and how those goals mitigate risks associated with toxic chemicals. This section outlines the chemicals management in operations framework, which we developed based upon an understanding of the business case for chemicals management, existing chemicals management approaches, and REI research and interviews.

Much like the rest of this report, the framework is built upon four guiding principles and tools:

1. The **precautionary principle**, which calls for avoiding potentially harmful chemicals even in the absence of scientific consensus that the chemical is indeed harmful.

2. The **principles of green chemistry**, which guide product design to encourage manufacturers to reduce or eliminate the use of hazardous substances

3. **Restricted Substances Lists**, which inform purchasers and suppliers about which chemicals to avoid.

4. **Simplicity** and ease of use.

Development Process

The framework is guided by an ambitious north star goal, which provides a long term, ideal state vision for chemicals management in operations. This goal assumes no constraints on human or financial resources.

The north star goal is built upon three main criteria. First, it has to be *ambitious*: the north star goal should be something that looks beyond what is possible today, and pushes the retailer to either find the latest innovations or develop those innovations itself. Second, it has to be *attainable*: the north star goal should be based on assumptions about the external environment and the retailer's capabilities, but all these assumptions should be conceivably realized in the coming decades. Third, the north star goal for chemicals management in retail operations should align with the OIA's vision for chemicals management in product supply chains. The OIA's vision is "to create a world in which all consumer products are produced using Green Chemistry practices, ultimately using inherently safer chemicals and reducing or eliminating hazardous chemicals, in order to preserve human health and a clean environment."[86]

Given these criteria, the north star goal is ***to have no known chemicals of concern within buildings or purchased noncommercial goods***.

The north star goal will require significant time and resources to achieve. The continuum of performance, therefore, outlines the three milestones necessary to achieve the desired end state. The continuum, which takes into account constraints on time, resources, availability of information, and the external environment, contains three milestones (referred to as “visions”):

1. Foundational (least difficult, nearer term)
2. Improvement (medium difficulty, medium term)
3. Aspirational (most difficult, longer term)

The aspirational vision is equivalent to the north star goal, whereas the foundational vision is achievable in the shorter term and the improvement vision is a logical intermediary step. The framework provides a clear articulation of the actions needed to make progress towards the north star goal. It also reflects what is achievable now versus later, when external conditions may be more favorable.

The continuum of performance mirrors the Outdoor Industry Association’s commercial goods focused chemicals management framework with the intent of making the approach broadly applicable. This provides REI internal consistency for chemicals management across the entire organization (from commercial goods to noncommercial goods and the built environment).[87] The OIA’s chemicals management framework has supply chain indicators along the “continuum of performance.” These indicators are discrete, measurable actions that, once implemented, achieve a desired outcome. The purpose is to lead companies to a desired end state by enabling them to assess and track status for any given objective.[88]

The operations continuum of performance is based upon a step by step guide or “how to” rather than discrete indicators. This “how to” incorporates many of the supply chain indicators for retailers within the OIA Chemicals Management Framework.

Framework Components

In our recommendations, we define the three steps in the spectrum explained above– foundational, improvement, and aspirational – as “visions”. For each vision, we first define the end goal that, if achieved, would be considered a successful attainment of the vision. We then explain the assumptions necessary for the vision to be enacted. These assumptions are primarily focus on the human and financial resources required for implementation, the external environment that would enable or prohibit implementation, and the type of collaboration required. Without these conditions being met, each vision becomes impossible to predict or enact.

Next, we define the path required for successful implementation of the vision. This takes the form of a four step process:

1. ***Identify***: understanding what products and materials are present, and what chemicals of concern exist

2. ***Prioritize***: determining which of those chemicals of concern to focus on

3. ***Act***: taking action to mitigate, reduce, or eliminate prioritized chemicals of concern in noncommercial goods or building materials through activities like the development of an RSL system and the improvement of supplier relationships

4. ***Engage***: enhancing the efforts made in steps 1 through 3 by engaging with external stakeholders communicating progress internally and/or externally

Finally, each vision identifies the associated risks of action or inaction. These risks are important given REI's stated desire to "avoid being blindsided."[89] The risks also enable REI to understand how to prioritize its efforts and dedicate resources.

Scopes and Prioritization

A key component of our recommendation involves sifting through the immense amounts of products and items present in retail operations. In order to frame our process for determining which chemicals, products, and processes to address, we will first explain two key components of the recommendations: chemicals impact scopes and the product prioritization framework.

Scope Definition

Toxic chemicals exist virtually everywhere within an organization, and those toxic chemicals have both upstream and downstream impacts. Therefore, it is necessary to place parameters around the different impact levels and define broad chemical impact categories.

These broad categories can be thought of in the same manner as direct/indirect and Scope 1, 2, and 3 greenhouse gas emissions as defined by the Greenhouse Gas Protocol (GHG Protocol).[90] REI has already utilized these frameworks for its GHG reporting; therefore, adopting a similar framework for chemicals management will make the addition of a new environmental lens easier to understand and adopt.

GHG Protocol Scopes

Within the GHG Protocol, direct emissions originate from sources that are owned or controlled by a reporting entity. Indirect emissions, on the other hand, occur as a consequence of activities of the reporting entity but originate at sources owned or controlled by another entity. Given these definitions, the GHG Protocol defines three Scopes for GHG emissions: [91]

Scope 1: All direct GHG emissions

Scope 2: Indirect GHG emissions from consumption of purchased electricity, heat or steam

Scope 3: Other indirect emissions, such as the extraction and production of purchased materials and fuels, transport related activities, outsourced activities, waste disposal, etc.

Chemicals Impact Scopes

The GHG Protocol framework can then be applied to a chemicals management lens for retail operations. The definitions of direct/indirect impacts and Scopes 1, 2, and 3 remain nearly identical, instead reflecting a shift from emissions to chemical impacts. Direct impacts are translated to chemical impacts that result from sources owned or controlled within REI's operations. Indirect impacts are chemical impacts that occur not as a result of REI activities, but instead at sources owned or controlled by another entity. We use these Scope definitions to define and prioritize the chemicals impact categories REI should address.

Scope 1: All direct chemicals impacts (occur at owned or leased facility)

Scope 2: Indirect impacts from the consumption of purchased electricity, heat, steam or water

Scope 3: Other indirect impacts that occur upstream and downstream, such as the production of chemicals, manufacturing of products, transportation related activities, waste disposal, etc.

Most companies begin to address GHG emissions by addressing Scope 1 impacts first and moving onto Scope 2 if they have the resources to do so. How far a company goes into Scopes 1 and 2 is heavily dependent on considerations such as availability of resources, priority placed on the initiative by the management team, and comparable efforts made by competitors. Companies often face difficulties collecting accurate data on Scope 3 impacts, making it hard to address those impacts. The chemicals management improvement spectrum allows REI to take the same approach to chemicals management within its operations. It also enables REI to first understand Scope 1 and 2 chemical exposures to its employees and customers before attempting to investigate the upstream manufacturing exposures to which REI is a minor purchaser.

Prioritization Framework

Even if narrowed to only Scope 1, there still is an extremely large list of potential categories and associated items to address. The most effective way to identify the most important items to evaluate and improve upon is to develop a prioritization framework that takes into account the risks associated with a given product or product category and the associated feasibility of addressing those risks.

The prioritization framework contains two main categories, each with a plethora of factors that can be used for prioritization.

- Impact:
    - Physical human health impact
    - Physical environmental impact
    - Reputational
    - Competitive
    - Regulatory from pending legislation
    - Volume/quantity
    - Known studies of traditional ‘hot spots’
    - Known data from hazard assessment
- Feasibility:
    - Control (ownership or level of influence)
    - Cost
    - Product turnover/frequency
    - Availability of alternatives
    - New purchase or existing item in use

If each of these data points could be obtained for each product or item, there would be an extremely robust mechanism for prioritizing and addressing toxic chemical impacts. However, the majority of these data points are simply not tracked, readily available, or scientifically feasible to measure. Furthermore, there are thousands of items present in a retail operations setting; even if the data could be obtained, it would take an unimaginable amount of time to collect and analyze it all. Therefore, we recommend the development of a much simpler mechanism for prioritization.

The two basic elements of the prioritization are the same: impact and feasibility. Rather than detailed quantifiable information, though, a scale of low/medium/high can be applied to each factor. Over time, as more information is available, a more robust prioritization framework can be used.

	← Continuum of Performance →		
	Foundational	**Improvement**	**Aspirational**
Primary Objectives	1. Explore the Scope 1 chemical implications of the highest priority products found in the retailer's operations. 2. Eliminate chemicals of concern in a small subset of *new* noncommercial product purchases. 3. Focus chemicals management efforts on a small subset of products first, to understand the resources required, relationships required, and challenges likely when addressing chemicals in operations.	1. Understand the chemical ingredients and impacts of the highest priority Scope 1 products in the retailer's operations. 2. Eliminate chemicals of concern in all *new* noncommercial products purchased through improved purchasing behavior. 3. Focus on Scope 1 and new purchases; do not address Scopes 2 or 3 impacts, and do not attempt to retrofit existing assets.	1. Understand the full lifecycle implications of each chemical found in the retailer's operations. 2. Eliminate chemicals of concern in all *new* and *existing* noncommercial products purchased, and all existing physical assets, through improved purchasing behavior. 3. Address Scopes 1, 2, and 3. 4. Proactively seek out better chemical alternatives by engaging with suppliers and partners.
Assumptions	1. *Significant* resource limitations. 2. *Significant* information gaps. 3. *Unfavorable* external conditions. 4. *Minimal* supply chain collaboration. 5. Lack of a company wide strategic emphasis on chemicals management.	1. *Some* resource limitations. 2. *Significant* information gaps. 3. *Less favorable* external conditions. 4. *Moderate* supply chain collaboration. 5. Company wide agreement on importance of chemicals management.	1. *No* resource limitations. 2. *No* information gaps. 3. *Favorable* external conditions. 4. *Effective* supply chain collaboration. 5. Chemicals management is embedded in strategic vision.

	← Continuum of Performance →		
Step	**Foundational**	**Improvement**	**Aspirational**
1. Identify	1. Collect high level operations data for noncommercial goods and building materials, with goal of understanding primary types of items purchased. 2. Organize data into categories of noncommercial goods and building materials within operations.	1. Collect individual line item level data for noncommercial goods and building materials. 2. Organize data into categories of noncommercial goods and building materials within operations.	1. Collect individual line item level data for noncommercial goods and building materials. 2. Identify and catalog the chemicals contained in each product through the use of a bill of materials. 3. Conduct routine indoor environmental air quality tests to achieve visibility of chemicals present in operations.
2. Prioritize	1. Map the categories from step 1 into Scope 1,2, or 3 designations. 2. Develop a basic prioritization framework based upon easy to access information. 3. Use the prioritization framework to prioritize the Scope 1 categories. 4. Select the highest priority categories (will be new procured items versus existing) to focus on, based on the results of the prioritization framework matrix. 5. Identify suppliers with whom to engage, based on the categories selected, and develop relationships.	1. Map the line item level items from step 1 into Scope 1, 2, or 3 designations. 2. Add additional prioritization factors, such as hazard information, into the prioritization framework. 3. Use the prioritization framework to prioritize the Scope 1 line item level items. 4. Address all items within Scope 1, using the prioritization to guide sequencing. 5. Develop additional supplier relationships for Scope 1 items.	1. Map the line item level items from step 1 into Scope 1, 2, or 3 designations. 2. Include all available information into the prioritization framework. 3. Use the prioritization framework to prioritize all Scope 1, 2, and 3 items. 4. Address all items within Scope 1 and 2, using the prioritization to guide sequencing. 5. Develop additional supplier relationships for remaining Scope 1 items and Scope 2 items.
3. Act	1. Develop a process to systematically monitor federal	1. Refine the RSL to include additional chemicals of concern, as identified	1. Refine the RSL to be robust, flexible, and proactive and

	and state regulations. 2. Design a RSL system that is based upon regulated chemicals and chemicals of high concern in operating geographies. 3. Communicate the newly developed RSL with the identified suppliers from Step 2. 4. Work with suppliers to understand what individual line item noncommercial goods or building materials from the selected priority categories meet or not meet the RSL. 5. For goods that do not meet the RSL, collaborate with suppliers to identify and procure alternative goods that meet the RSL. 6. Where alternatives are not available, identify alternative suppliers capable of providing RSL-compliant noncommercial goods. 7. Develop a company procurement policy that Incorporate the operational RSL and associated questions into supplier procurement questionnaires. 8. Update the RSL at least annually.	by third party lists. 2. Engage with identified suppliers for all Scope 1 items to communicate the RSL and desire for chemical ingredient disclosure. 3. Work with suppliers to understand product chemistry and what items meet or to not meet the RSL. 4. For goods that do not meet the RSL, identify and procure alternative goods that meet the RSL 5. Where alternatives are not available, identify alternative suppliers capable of providing RSL-compliant noncommercial goods and building materials. 6. Track the number of goods where there is no alternative available.	incorporates regulated chemicals, chemicals of high concern, and other chemicals of concern identified by third party groups. 2. Use bill of material information to compare determine if products contain chemicals from the RSL. 3. For goods that do not meet the RSL, identify and procure alternative goods that meet the RSL 4. Where alternatives are not available, identify alternative suppliers capable of providing RSL-compliant noncommercial goods and building materials. 5. Track the number of goods where there is no alternative available. 6. Purchase items only that are RSL compliant.
4. Engage	1. Publicize the initial steps taken to address chemicals in operations.	1. Engage with product manufacturers to engage green chemistry principles for goods where alternatives are not	1. Develop relationships with peer companies to push for action on an industry wide level

	2. Expand the RSL engagement beyond the first two product categories.	available. 3. Develop relationships with peer companies to collaborate on broader industry approaches to chemicals management. 2. Disclose progress to employees, customers, and suppliers.	through working groups (similar to the OIA's CMWG for product supply chain). 2. Lobby state and federal government for increased regulation and clarity around chemical risks. 3. Communicate to customers the importance of green chemistry innovations

Application of Recommendations in an Example REI Store

Approach

In this section, we apply the chemicals management framework to a sample, nonspecific REI retail location. We do not fully demonstrate how to implement the recommendations, but rather show how pieces of the foundational vision can be used to identify potential chemicals impacts stemming from several key aspects of retail operations. We also show how REI might move along the continuum of performance, from foundational towards aspirational, following a logical and iterative process.

The goals for the foundational vision are:

1. Explore the Scope 1 chemical implications of the highest priority products found in the retailer's operations.

2. Eliminate chemicals of concern in a small subset of new noncommercial product purchases.

3. Focus chemicals management efforts on a small subset of products first, to understand the resources required, relationships required, and challenges likely when addressing chemicals in operations.

This scenario assumes significant resource limitations and information gaps, unfavorable external conditions, minimal supply chain collaboration, and a lack of strategic emphasis on chemicals management. With this context in mind, the following represents our approach to progress in the foundational vision.

Store Overview

With the exception of flagship stores in Seattle, Denver, and New York, the typical REI retail location is a leased property located in a strip mall or shopping center. Few stores are distinct, standalone properties. There is usually a loading dock in the rear of the store and most stores share a large customer parking lot with neighboring businesses. REI is generally not responsible for maintaining the impermeable asphalt parking lots or concrete sidewalks that are adjacent to stores and drain into the municipal sewer system. In addition, REI usually does not maintain the few landscaped beds on store property. Both of those maintenance duties are typically contracted out to a property management company. Each store has an HVAC system controlled off premises by a contracted vendor in Texas. Store cleaning is also contracted to a third party cleaning company.

Most REI locations have a bike shop, many of which also offer ski and snowboard services. These workshops are typically small, enclosed spaces with doors and a ventilation system that is different from the store's ventilation system. The primary pieces of equipment within the shops are emulsifiers, ultrasonic degreasers, and air compressors. Shop employees generally keep the door closed when working to avoid disturbing customers with odors and/or noise.

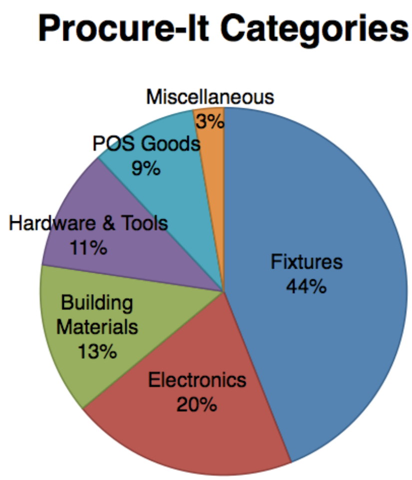
REI's Design & Architecture and Construction teams handle the build out of all retail locations and contract with construction companies to source materials and labor. Full information about specific building materials is therefore somewhat limited and not necessarily available to REI, but in general REI uses low VOC paints and other products that qualify for LEED credits.

REI's purchasing team handles the majority of supply purchases for all locations. Procure-It is the umbrella purchasing system for recurring needs across nearly all departments, including retail stores, IT, the distribution center, and REI headquarters. Procure-It contains frequently bought items in addition to links to other vendors (such as CDW, Grainger, and Staples) with larger catalogs of items available to order. These expanded catalogs contain items that stores replace only rarely, such as electronics or computers. The bike and ski shops use a separate procurement system called MasterTech, which contains approximately 200 items.[92] Bike and ski shop goods tend to be chemical mixtures. Stores may also make one-off purchases at local retailers on a procurement card; however, most stores generally purchase the bulk of their supplies through Procure-It.[93]

Implementing the Foundational Vision

Step 1: Identify

The first step is to identify product categories for noncommercial goods and building materials. Based on March 2012 data from Procure-It, REI routinely purchased approximately 500 noncommercial goods in 75 different categories (note that Procure-It is not an exhaustive list; for example, cleaning supplies are absent from Procure-It data, but should certainly be considered in this process). To simplify the analysis, we recategorized the 500 commercial products into six groups based on frequency of purchase, similarity of item descriptions, and the existing Procure-It categories into which these items were originally grouped. The category "Miscellaneous" is defined as anything that did not logically or easily fit into the other five groups. These groups, in order of most numerous to least numerous items, are:



Fixtures (33; e.g. slotwalls, mirrors, racks, shelves)

Electronics (15; e.g. printers, scanners, batteries)

Building Materials (10; e.g. MDF board, carpet, particleboard)

Hardware & Tools (8; e.g. metal covers, mounting plates, brackets)

Point of sale (POS) Goods (7; e.g. register tape, labels)

Miscellaneous (2)

From here, we used various third party resources such as the Healthy Building Network and GreenWERCS to identify common chemical substances in these six categories. Wooden display fixtures could potentially contain formaldehyde and BPA in epoxies and resins. Electronic equipment nearly always contains PBDEs and similar flame retardants. Building materials could potentially contain a litany of hazardous chemicals such as PVC, mercury, lead, and phthalates. POS goods such as plastic display stands could contain BPA, while hardware and tools could contain lead.

Step 2: Prioritize
The next step is to prioritize identified product categories in terms of factors such as turnover rate, amount of REI control, cost, availability of alternatives, and external resources that evaluate risk data. In an ideal state, the prioritization mechanism would be more robust and based upon a set of quantitative risk/hazard data specific to the ingredients in each noncommercial good category. However, given the lack of information available today and limited resources, a much simpler process will suffice for the time being. We chose to focus on items for which some information exists for two of the categories and two of the scopes: miscellaneous (bicycle chain lubricant and energy use) and building materials. Chain lubricant is on the MasterTech procurement list; we selected it because employees are constantly exposed to it and it because it is a chemical mixture. We also selected energy use in order to demonstrate the process for evaluating a Scope 2 category item. Ideally REI would prioritize which noncommercial goods to investigate based on risk rather than the availability of information.

Step 3: Act
This step requires REI to take specific actions to reduce and eliminate chemicals of concern from noncommercial goods. The first action is to engage with suppliers using a questionnaire similar to those used by Google and Kaiser Permanente (see Appendices E & F). With supply chain information in hand, REI would then be able to make informed purchasing decisions and identify safer alternatives.

Information on certain products is publicly available and does not require supplier engagement or education. We examined a product with known composition/ingredients information in the miscellaneous and building materials categories to identify potential alternatives.

Scope 1: Miscellaneous Category: Bike & Ski Shop Repair Supplies
Example Noncommercial Good: Teflon Plus Dry Style Lubricant, SKU: 634-905-0010
Bike and ski shop repair supplies are an interesting example of miscellaneous items for two main reasons. First, many of these products are chemical mixtures rather than a single article, meaning that the primary function of the product is determined by the properties of a chemical substance. Next, REI employees in the bike and ski shop have high potential exposures (via touching and inhalation) because they work with these chemical mixtures on a regular basis.

Our first step was to determine how the lubricant is typically used. We learned from a site visit to Store 124 in Ann Arbor, Michigan, that bike shop employees spray the chain lubricant at arm's length while the bike is mounted on a repair stand in the middle of the shop. The ventilation hood is located in a corner of the room and is not typically turned on during the chain lubrication process.[94] Employees are not currently required to wear masks during this process, but are offered masks for their use.[95]

Since there appeared to be at least some risk of employee exposure to the chain lubricant, we proceeded to step two, which was to learn more about the chemical composition of the chain lubricant and the risks the product might pose. We looked at the MSDS for DuPont™ Teflon™ Chain-Saver Dry Self-Cleaning Lubricant, which is a bike chain lubricant very similar to the one used by REI bike shop employees:[96]

COMPOSITION/INFORMATION ON INGREDIENTS

Components

Material	CAS Number	%
Solvent, Naptha which may also contain the following:	64742-89-8	35-70
Heptane	142-82-5	
* Cyclohexane	110-82-7	
Propane	74-98-6	5-10
Butane	106-97-8	5-10
Proprietary Additives which may include:		10-20
Paraffin Wax	64742-43-4	
Calcium Stearate	1592-23-0	
Petroleum Distillates	64742-52-5	
DuPont "Teflon" Polytetrafluoroethylene		0.05-2.5

* Disclosure as a toxic chemical is required under Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR part 372.

The material safety data sheet lists some potentially harmful chemical ingredients. For example, according to OSHA, heptane causes narcosis and symptoms of nervous system effects in humans exposed to concentrations of 1,000 ppm and above.[97] Also, according to the EPA, “breathing large amounts of cyclohexane for short periods of time adversely affects the human nervous system” and “effects range from headaches to anesthesia, tremors, and convulsions,” but the health effects associated with consuming small amounts of cyclohexane over long periods of time are not known.[98]

This lubricant also contains Teflon, a perfluorinated compound (PFC). PFCs are persistent bioaccumulative toxins (PBTs), some of which have been found to cause cancer and reproductive disorders. Though Teflon’s exact chemical makeup is proprietary to DuPont, it is likely similar to PFTE (another PFC) and composed of fluorinated telomers, which are known to break down into PFOA and other hazardous PFCs in human bodies and the environment. PFOA is also used in the manufacture of Teflon, which implies potential Scope 3 impacts.[99]

We then attempted to understand what it would take to quantify the human and environmental impacts of the chemicals in this chain lubricant and quickly realized the Herculean nature of this task. The first step would be to determine all of the exposure pathways. For humans, this likely includes employee inhalation and touch as well as customer inhalation and touch. One could use a variety of methods to reasonably estimate the amount of the lubricant inhaled by the average bike shop employee. For example, one could divide the total number of cans of lubricant purchased per year by number of bike repairs performed and then assume that a certain amount of the lubricant is inhaled during the spraying process. For a more accurate estimate, one could ask bike shop employees to wear a personal air sampling device during the chain lubrication process and send the sample to a laboratory for analysis. Estimating the amount of employee exposure through touch is even more complex, as is estimating customer exposure after bike repair is completed or the amount of lubricant escaping into the environment.

Estimating exposure is already complicated enough, but the next step would be to quantify the impacts resulting from those exposures. Several tools are available to assist in that process, some mentioned previously in this report. None of them are simple, though, and all require examining one chemical component at a time. For example, one could use the GreenScreen tool to quantify the hazard endpoints for each of the chemicals components for which information is available. After completing this exhaustive process, though, important information would still be missing. For example, risk data is not necessarily available for proprietary chemicals like Teflon™ and no information is available regarding exposure to a combination of the individual chemical components. Furthermore, this analysis would not provide insight into whether or not the risks posed by this particular lubricant are greater than those posed by a potential substitute. Therefore, other chain lubricants would also need to be analyzed to properly inform a purchasing decision.

Ensuring appropriate ventilation and employee protection will limit exposure, and REI is already working on this. According to the precautionary principle, though, the ideal solution would be to find a safe alternative lubricant that does not contain Teflon™ or any other chemicals of concern. From conversations with staff at headquarters, we learned that REI sells a greener, non-Teflon™ bike lubricant: Dumonde Tech G-10 Bio Green Bike Lubricant. According to its MSDS, this biodegradable lubricant is "a byproduct of citrus" and is made entirely from "plants entirely of natural origin."[100] Bike shop employees, however, apparently do not use this product because they believe it is inferior to the Teflon™ version and they do not want to have disappointed customers.

This situation highlights classic challenges to the adoption of green products. Safer alternatives are not always available given the unique functional properties of the chemicals we rely upon, such as Teflon™. Even when alternatives are available, though, consumers may not be aware of them or may equate "green" with "inferior performance." Therefore, employee education and engagement is absolutely necessary to drive real change. Bicycle chain lubricant provides a potentially interesting opportunity to engage with employees about chemicals management and, in turn, for those employees to engage with REI customers. For example, REI could make bike shop employees aware of product tests and reviews stating that the Dumonde product works as well as the Teflon™ alternative and challenge bike shop employees to conduct their own product tests over a specific period of time.[101] Employees will then be empowered to make more informed purchasing decisions, to engage customers on the issues, and perhaps to decide that the Teflon™ product no longer needs to appear on the shelves of REI stores.

Scope 1: Building materials

We also attempted to identify certain building materials used in a typical REI retail location, but obtaining such information for an existing structure is not always feasible. REI keeps records of carpets, paints, and concrete sealants used in most stores, which can be used to identify potential exposures. For example, in Store 124, we obtained the following information:

- *Carpeting.* REI installed 1,693 square yards of custom InterfaceFLOR carpet using TacTiles®, which eliminates the need for glue and contains no VOCs. The GlasBacRE backing ranges from 49-74% total recycled content with a minimum of 18% post-consumer content. The flooring qualified for "EQ Credit 4.3 – Low Emitting Materials Flooring Systems."

- *Paint.* REI used ICI and Benjamin Moore paint, totaling 105 gallons on the walls and 70 gallons on the ceilings. The paint qualified for "EQ Credit 4.2 Low Emitting Materials: Paint."

- *Concrete Floor Sealant.* REI used 20 gallons of Seal Hard sealant from L&M Construction Materials on 5,915 square feet of concrete floor. According to the product website, the sealant is VOC-free, contains less than 50% alkaline silicate, and the rest of the ingredients are considered proprietary to L&M but are not hazardous.[102]

As evidenced above, REI has already taken positive steps toward choosing greener and safer alternatives for the above building materials. In undertaking comprehensive chemicals management, the CSR team should pay particular attention to drywall, wood finishes, PVC piping, type of structural materials (e.g., wood framing, steel beams), insulation, roofing materials, wiring, and fixtures, which are materials for which greener alternatives may not have been considered. Existing buildings have low or nonexistent turnover; therefore, these materials are low priority to convert due to high costs, unless retrofitting is necessary for other reasons. The construction of new structures; however, should follow guidelines for toxic chemical avoidance such as those proposed by the Living Building Challenge, Healthy Building Network, or LEED.

Scopes 1 & 2: Energy
Moving along the spectrum from foundational to aspirational chemicals management requires REI to address chemical impacts from Scope 2 and Scope 3 activities. To demonstrate the nature of Scope 1 and Scope 2 chemical releases resulting from energy use, we examined natural gas and electricity consumption at Store 124. Usage amounts for 2010 and 2011 appear in the table below.

Year	Electricty (kWh)	Natural Gas (Therms)
2010	284,160	1,950
2011	281,160	2,065

Natural gas consumption represents a Scope 1 impact under REI's direct control because the fuel is burned in a furnace onsite to provide heat for the store. According to the EPA, "emissions from natural gas fired boilers and furnaces include nitrogen oxides (NOx), carbon monoxide (CO), and carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), volatile organic compounds (VOCs), trace amounts of sulfur dioxide (SO_2), and particulate matter (PM)."[103] Assuming proper ventilation, burning natural gas should not pose risks inside the store, but it does release chemicals into the atmosphere where they may contribute to human health and environmental risks. The metals and organic compounds produced by natural gas combustion appear in the tables on the next page. (There are also Scope 3 impacts resulting from extraction and transportation of natural gas, but we are not including those in this discussion.)

Metals from Natural Gas Combustion

Metal	Emission Factor (lb/10^6 scf)
Arsenic	2.0E-04
Barium	4.4E-03
Beryllium	<1.2E-05
Cadmium	1.1E-03
Chromium	1.4E-03
Cobalt	8.4E-05
Copper	8.5E-04
Manganese	3.8E-04
Mercury	2.6E-04
Molybdenum	1.1E-03
Nickel	2.1E-03
Selenium	<2.4E-05
Vanadium	2.3E-03
Zinc	2.9E-02

Speciated Organic Compounds from Natural Gas Combustion

Organic Compound	Emission Factor (lb/10^6 scf)
2-Methylnaphthalene	2.4E-05
3-Methylchloranthreneb,	<1.8E-06
7,12-Dimethylbenz(a)anthracene	<1.6E-05
Acenaphthene	<1.8E-06
Acenaphthylene	<1.8E-06
Anthracene	<2.4E-06
Benz(a)anthracene	<1.8E-06
Benzene	2.1E-03
Benzo(a)pyrene	<1.2E-06
Benzo(b)fluoranthene	<1.8E-06
Benzo(g,h,i)perylene	<1.2E-06
Benzo(k)fluoranthene	<1.8E-06
Butane	2.1E+00
Chrysene	<1.8E-06
Dibenzo(a,h)anthracene	<1.2E-06
Dichlorobenzene	1.2E-03
Ethane	3.1E+00
Fluoranthene	3.0E-06
Fluorene	2.8E-06
Formaldehyde	7.5E-02
Hexane	1.8E+00
Indeno(1,2,3-cd)pyrene	<1.8E-06
Naphthalene	6.1E-04
Pentane	2.6E+00
Phenanathrene	1.7E-05
Propane	1.6E+00
Pyrene	5.0E-06
Toluene	3.4E-03

Source: "Natural Gas Combustion." U.S. Environmental Protection Agency Technology Transfer Network Clearinghouse for Inventories & Emissions Factors. July 1998. 28 December 2012. <http://www.epa.gov/ttn/chief/ap42/ch01/final/c01s04.pdf>.

Figure 6 shows the estimated total 2011 criteria pollutant and GHG emissions resulting from natural gas combustion at the Ann Arbor store. The estimates were created by multiplying 2011 natural gas usage by EPA emissions factors.[104]

Figure 6: Estimated Emissions from Natural Gas Combustion (Ann Arbor Store, 2011)

Criteria Pollutants and Greenhouse Gases	Emission Factor (lb/10^6 scf)	2011 Emissions (lbs)
CO_2	120,000	600,000
Lead	0.0005	0.0025
N_2O (Uncontrolled)	2.2	11
N_2O (Controlled low NOX burner)	0.64	3.2
PM (Total)	7.6	38
PM (Condensable)	5.7	28.5
PM (Filterable)	1.9	9.5
SO_2	0.6	3
TOC (Total Organic Compounds)	11	55
Methane	2.3	11.5
VOC	5.5	27.5

A store's use of electricity from the grid results in Scope 2 impacts because of the emissions released at the site of electricity generation. Figure 7 shows estimated total 2011 criteria pollutant and GHG emissions resulting from electricity usage at the Ann Arbor store. These estimates were created by multiplying 2011 electricity usage by emissions factors from Argonne National Laboratory's GREET Lifecycle Model.[105]

Figure 7: Estimated Emissions from Use of Generated Electricity (Ann Arbor Store, 2011)

Criteria Pollutants and Greenhouse Gases	Emission Factor (grams per kWh)	2011 Emissions		
		Grams	Kilograms	Metric tons
CO_2	682	191,822,343	191,822	191.822
CO	0.556	156,320	156	0.156
NO_x	0.690	193,894	194	0.194
N_2O	0.009	2,436	2	0.002
PM10	0.058	16,420	16	0.016
PM 2.5	0.033	9,150	9	0.009
SO_x	1.177	331,053	331	0.331
Methane (CH_4)	0.014	3,860	4	0.004
VOC	0.010	2,872	3	0.003

As evidenced in the above tables, energy used by an REI store results in more than just CO_2 emissions. Lead, sulfur dioxide, mercury, and VOCs are also released in energy production, and create impacts beyond REI's physical locations. Including these chemical releases in a progressive chemicals management strategy would provide REI with additional incentive to invest in cleaner energy because doing so would help the company achieve not only its GHG north star goal, but also its chemical management north star goal.

Step 4: Engage
To achieve the foundational goals and to begin to push toward conditions more favorable for improvement and aspirational goals, REI should adopt mechanisms that enable it to continue making progress in chemicals management. Some actionable ideas for REI include:

1. *Engage key stakeholders across REI.* Using information from this report, the CSR team should communicate to senior leadership the importance and potential impact of a proactive chemicals management strategy, and demonstrate in what areas REI stands to benefit from undertaking this project. Additionally, the CSR team should engage specific teams that will be key to successful implementation, such as the purchasing and construction teams. With company wide input, the CSR team can begin to develop a collaboratively motivated strategy for moving forward.

2. *Develop a company wide chemicals in operations policy, and publicize it*. Incorporating stakeholder feedback and using lessons learned from applying the foundational vision, REI should further formalize its intent to work toward the aspirational vision and dedicate resources for achieving it. The CSR team will likely lead the process; keeping all stakeholders engaged will ensure that policy is developed collaboratively and cross-functionally. All departments must understand what is being asked of them, when, and what demands this effort may have on their time and workload. Ideally, a collaborative process will ensure company wide buy-in and successful implementation.

3. *Develop relationships with peer companies for data exchange, and push for action on an industry level, through working groups.* REI could create or join a working group of retailers committed to chemicals management success, and work with them to share best practices and approaches. The OIA CMWG could be a candidate, but they are currently focused on supply chain concerns. Another possibility would be a retail industry group. As the group scales in membership and expertise, members will be better positioned to make collective purchasing agreements and demands that suppliers meet more stringent standards for chemicals use and chemical content.

4. *Disclose progress to employees, customers, and suppliers.* Engaging stakeholders to build awareness of REI's long term vision will lay the foundation for greater transparency and disclosure in the future. REI should start to communicate its intent and efforts internally around the need for improved chemicals management processes. This could be as simple as email communications, or developing a smaller scale working group within the company to attract interested employees. Demonstrated progress would be the most effective means of communication. At this stage, external communication should be limited. As this is a sensitive topic with a high degree of complexity and uncertainty, any messages about REI's chemicals management program will need to be crafted with extreme care, to avoid frightening the public.

As REI moves along the continuum of performance, increased external efforts such as publicly supporting legislation and disclosing internal progress will be appropriate.

Observations and Conclusion

Even under the foundational vision, chemicals management is a complex process with inherent trade offs. The risks and benefits are not always clear, and REI's current internal management systems were not built to support a comprehensive approach. The best solution in the near term is for REI to identify chemicals of concern and stop the flow of those chemicals into retail operations via the steps outlined in this report. A weakness in this approach is that while it represents movement in the right direction, it does not eliminate toxic chemicals already in operations and may not prevent “blind spots.” Reducing blind spots would require REI to be extremely proactive in research regarding emerging chemical concerns, which requires expertise in toxicology. REI will still need to rely on outside experts to conduct risk assessments and aggregate data into digestible formats, which we believe to be reasonable. Eventually, as supply chain transparency and global regulatory structures improve, it may be possible for REI to track types and volumes of chemicals at both the store and company wide levels.

REI's Next Steps

The case study demonstrates the level of depth required to adopt a retail operations chemicals management strategy. Prior to and in conjunction with using the framework, REI must understand what proactive chemicals management will require at an organizational level, and how REI can make changes internally to set itself up for success in this process.

Making the Case Internally

There is a clear, compelling case for addressing chemicals management in operations. Yet adopting a new sustainability goal is difficult, not only because the topic is complex but also because organizational change is challenging. In their book *Switch*, the Heath brothers point out that humans face a constant internal battle between the rational mind, which strives for perfection and change, and the emotional mind, which wants more instant gratification and enjoys "the comfort of the existing routine."[106]

The first step in the organizational change process is to educate key internal stakeholders and demonstrate the importance of the sustainability challenge. Sustainability managers will often be the first to drive frameworks and policies for chemicals management in operations to become a reality. Other crucial internal stakeholders to bring on board are the groups directly affected by adoption of a chemicals management strategy. This includes the buildings and purchasing teams, who will need to change the way they interact with and hold accountable their suppliers; retail store and facilities managers, who will need to learn how to use new products with slightly modified characteristics; and executives, who hear from their business units every day about risks and opportunities that need to be addressed in a timely manner. Eventually, all employees should learn about the new initiative.

One potential method to help make the case for action is to educate internal stakeholders about chemicals present in daily life and the associated health and environmental impacts from those chemicals. Powerful videos, such as Environmental Defense Fund's Not a Guinea Pig campaign, are available to help tell the story.[107] Toxic chemical hazards can then be connected to potential toxic chemicals within retail operations. For example, describing the chemical risks from flame retardants in living room curtains can help raise awareness about flame retardants that also exist in desk chairs at the office. After internal stakeholders connect personally, it is important to communicate the business risks and benefits of action. The goal is ultimately to get key stakeholders at REI to ask themselves: "What can I/we do to not only address these risks but also take advantage of these opportunities?"

Communicating with the Public

REI has traditionally been very transparent in communicating sustainability goals and progress to its members and to the broader public. As REI begins to address toxic chemicals in operations, however, a different communication strategy is likely necessary. Given the uncertainty, lack of scientific knowledge, current regulatory environment, and public concern about toxic chemicals, REI should take caution in any messages communicated externally. Most consumers do not understand chemistry or the complexities of chemicals management in products. Therefore, until REI is comfortable communicating its chemicals management work internally, and able to effectively answer tough questions about what this work means to customers who visit stores before the north star goal has been attained, we recommend that REI be careful and deliberate in crafting communications that do not unnecessarily incite public alarm.

Setting Up a Plan

As with any largescale organizational shift, it is important to have a plan and next steps defined in order for stakeholders to feel sufficiently motivated to change their behavior. Otherwise, valuable momentum can be lost. We recommend engaging internal stakeholders by enabling them to give input to the process, whether that means contributing to the development of the prioritization framework, identifying what they see as potentially dangerous chemicals in their immediate surroundings, or both. Facilities managers may identify cleaning supplies or pesticides as an area of concern, while the legal department might be most concerned about proper disposal of waste from the bike shop. Bike shop employees, on the other hand, might be most concerned about the chemical mixtures they use on a daily basis. While all or none of these might end up being major areas of risk or opportunity for REI, the idea is to give each stakeholder a relatively easy first step that: 1) engages them in the process; 2) makes them feel valuable and involved; 3) gives them a sense of ownership; and 4) provides REI specific noncommercial goods with which to begins its process.

Working Towards the Foundational Vision

Ultimately, REI should aim to have a clear understanding of which chemicals to take out of operations; find out where in its operations those chemicals exist; and then actively work to eliminate those chemicals from its products (either by working with suppliers to substitute the chemicals of concern with less harmful substances, or simply by switching to new suppliers). As the continuum of performance suggests, however, getting to this point will require significant effort and time.

It would be unreasonable to expect REI to have identified and implemented a noncommercial goods RSL before beginning to prioritize, act, and engage in the foundational vision. Therefore, the steps below outline reasonable first steps: selecting a few products to focus on, and using the chemicals management framework on these products to develop a smooth and robust process while understanding and improving the chemical attributes of these products. They also provide suggestions on the other internal and external steps required for REI to be in a position to ultimately pursue holistic toxic chemicals management.

Identify

The first step is to perform a thorough review of purchasing lists and define categories for noncommercial goods. Our preliminary analysis of REI purchasing lists resulted in the six broad categories listed in the case study; we recommend using this categorization as a starting point, but improving it based on input from the purchasing, building, and facilities/store manager teams. We also recommend tracking data, even that which is difficult to obtain, in order to identify where additional effort is needed.

The other key step is for REI to determine which chemicals to include in its noncommercial goods RSL. In the short term, one option would be for REI to apply its existing RSL for commercial goods to the products selected for review; however, the list may not be applicable for retail operational goods. Therefore, REI should also assess other RSLs, or components of specific RSLs, to use as supplements. REI can do this by engaging with its key partners (such as BizNGO or the OIA's CMWG) or with industry leaders such as Google or Kaiser Permanente to learn from their experiences.

Prioritize

This step requires developing a prioritization framework specific and relevant to REI. First, REI must determine which of the framework's factors are most important to concentrate on for the first products selected. On the *impact* side, REI may want to focus on easily observed factors such as volume/quantity of product used regularly, known chemicals of concern in a product, or presence of a chemical in a known hotspot (such as the bike shop). We also recommend reviewing the latest research and the list of chemicals of high concern in Appendix B of this report, and referencing REI's existing RSL for commercial goods to assess which products might have a high concentration of toxic chemicals.

On the *feasibility* side, REI may want to focus its efforts on products for which it knows there are multiple alternatives on the market, or products that have high turnover within operations. Alternatively, REI may want to focus on products for which it has a good relationship with suppliers. These factors will assist REI in getting started, but should not be relied upon as it progresses deeper into chemicals management. As REI reaches the north star goal, all products should be considered feasible to improve upon. The CSR team has already begun conversations with Staples, which is conducting LCAs on several of its office supply products. The supplier relationship is key, and we recommend that REI be proactive about identifying and engaging suppliers that may be working to improve the chemical composition of products.

REI can use these newly defined criteria to prioritize the products, with the ultimate goal of selecting a handful of products on which to focus its chemicals management efforts. The number of products selected is up to REI; we recommend selecting at least three on which to go through the entire process to ensure that REI works on multiple chemicals, multiple product categories, and with multiple suppliers. Note also that the various Scopes are not important to consider at this point, given that REI should not begin addressing anything beyond Scope 1 until it takes on the improvement vision.

Act

With an understanding of which products it has set out to improve, REI can now begin the process of *acting* to remove chemicals of concern in those products. We first recommend presenting the findings of the prioritization exercise to management and key stakeholders, to maintain buy-in and support.

The two most important steps at this juncture are clarifying the RSL and developing a supplier questionnaire. The RSL will be the backbone of any internal audit or interaction with suppliers, and should align well with REI's existing RSL for commercial goods. The chemicals management supplier questionnaire will be key for gathering data from suppliers and communicating REI's priorities to suppliers. We recommend only delivering this questionnaire to those companies supplying products selected for review in this round of chemicals management; this will help REI stay focused while also avoiding the administrative burden of managing too many supplier relationships at once. See Appendix F for a sample scorecard used by Kaiser Permanente to obtain this type of information from its suppliers.

At this point, we recommend that REI work closely with the selected suppliers to understand which products fail to meet the RSL. REI may encounter pushback from suppliers on this question, which will demonstrate the importance of building industry wide working groups to increase purchasing leverage (see "Engage" below). Wherever possible, we recommend working closely with the supplier to identify and implement alternatives that meet the RSL's specifications while still providing the desired functionality. This will involve setting clear, achievable timelines and goals. If alternatives are not available or the supplier is incapable of or unwilling to change the chemical makeup of its products, we recommend that REI identify alternatives available on the market that satisfy similar functions.

Engage
The final step in this process involves internal and external engagement. The purpose of engagement is to build internal transparency and buy-in, while working to create an external environment more supportive of REI's chemicals management goals and strategies.

Internally, we recommend communicating regularly with the stakeholders involved in the prioritization framework development process to report on key issues faced and to highlight "big wins." Successes and lessons learned should also be presented to the executive leadership team to make the case for an increased focus on chemicals management in operations. Such buy-in will be necessary not only for expansion of the program and the eventual development of a company wide chemicals management policy, but also to ensure that REI updates the important components of the chemicals management framework – such as the RSL or the prioritization framework – on a yearly basis.

Externally, we recommend that REI encourage its existing partners (most notably OIA, but also other large retailer associations) to lobby for improved regulation of toxic chemicals. It will make it easier for REI to make the case to suppliers to share information and improve the chemical composition of their products if there is a clear regulatory incentive to do so. Improved regulation will aid REI's existing efforts on chemicals management in the commercial goods supply chain. This is not a task that REI should take on alone; instead, REI should work through its existing relationships to make the case for improved chemical management and to find the right stakeholders to approach legislators on the issue.

Finally, we recommend exploring the possibility of creating an industry wide collaboration on chemicals management in operations. This will allow REI and its competitors to pool resources and increase purchasing power, thereby easing the burden of selecting products for review and engaging suppliers to change their behavior. Establishing industry wide standards for noncommercial goods and building materials will also reduce the burden on suppliers, who will find it easier to answer one set of questions or to follow one set of requirements, rather than a different set from each individual retailer.

Moving Forward

The steps above are simply *first* steps on the road to the north star goal. They require what we consider to be the minimal amount of effort necessary to start building a successful program for addressing toxic chemicals in operations, and will result in important lessons as REI takes on the foundational vision. Even then, the foundational work should be repeated several times until the process is smooth and priorities become clear. REI will then be in a position to move along the chemicals management continuum of performance and to improve the health of its customers, employees, the environment, and other stakeholders.

Conclusions

The process of conducting research on chemicals management is full of complexity, uncertainty, and imperfect information. Everything about the topic is incredibly complex, from the fundamental concepts of chemistry to the human health and environmental impacts of the life cycles of products that, in today's world, are manufactured with numerous chemicals that a majority of the population cannot even begin to understand. This lack of understanding alone puts humans and the environment at risk, as manufacturers, retailers, and consumers are incapable of determining what is and is not acceptable to them, based on their individual risk profiles. These dangers are exacerbated by the failure of legislators to place the burden on chemicals manufacturers to prove safety prior to introducing chemicals to the marketplace. The result is that we all live in a chemical world whose full dangers have yet to be fully revealed. Why, then, should a business, specifically a retailer, respond strategically to these circumstances, and how can it systemically approach chemicals management – in operations or elsewhere? The synthesis of our research provides several key lessons that help guide the responses to these questions:

The dangers are widespread and real. There is substantial evidence linking chemicals to human health and environmental problems. In the United States alone, nearly 133 million Americans – close to a third of the population – are living with chronic conditions and diseases, of which a portion of the disease burden can be attributed to toxic chemicals exposures, according to the U.S. Centers for Disease Control and Prevention.[108] In particular, the scientific literature links six chronic medical conditions to chemicals exposures: certain types of cancer; learning and developmental disabilities; Alzheimer's and Parkinson's disease; reproductive and fertility problems; and asthma.

***The regulatory environment is changing*.** While the federal government continues to regulate through outdated and weak chemicals regulations, consumers, businesses, NGOs, and some state and local governments are becoming increasingly aware of and focused on the dangers associated with chemicals. While many consumers may not grasp all of the dangers, public opinion polling shows that a vast majority of voters support increased chemicals legislation that shifts the burden to chemical manufacturers.[109]

In response to pressure from NGOs and consumers, states like California, Maryland, and Washington have enacted stricter regulations. Europe has been more proactive through the adoption of REACH and RoHS. These regulations provide a road map that can guide other countries, such as the U.S., as they seek to enact a more comprehensive and proactive approach to chemicals regulation.

Businesses should do something. As the U.S. makes slow progress toward improved and more comprehensive chemicals regulation, businesses have an opportunity to take matters into their own hands and improve chemicals management processes on their own. Doing so is not without challenge or risk, but provides the possibility for businesses to stay ahead of regulation, to say nothing of the potential opportunities that exist to demonstrate leadership in this emerging area of concern.

***Retailers should not address this issue alone*.** Only a handful of the largest retailers, like Walmart, have enough buyer power to influence suppliers on their own. Otherwise, for relatively smaller retailers like REI, the best opportunity for progress lies in cooperation among peer organizations. The OIA CMWG serves as an example of how an industry group consisting of companies with aligned interests can successfully cooperate to make progress with an issue as complex as chemicals management in the product supply chain.

Retailers should not try to build expertise in chemicals or try to quantify lifecycle chemicals impacts. Doing so is extremely resource intensive and, due to the lack of information presently available, not likely to result in much progress. Google's approach seems much more pragmatic: relying on third party expertise and focusing on removing and keeping chemicals out of operations rather than attempting to fully quantify and compare based on hazard end points. While more comprehensive, the value of understanding full lifecycle chemicals impacts is marginal relative to the resources and time required to conduct this analysis appropriately.

***Taking action will have benefits, but they are not easily quantifiable and may not be immediately apparent*.** Increased employee benefits, elevated brand value, reduced chemical compliance and handling costs, and reduced insurance costs are the likely results of removing chemicals of concern from operations. However, it is unclear when these benefits will become apparent, how large they will be, or how they will translate to business value. These benefits must be communicated internally with care to ensure that stakeholders' expectations are realistic, and that meaningful progress is not downplayed.

REI should do something. REI's core mission and business are inextricably tied to people and the environment, and thus to sustainability. As outdoor enthusiasts, REI's customers are concerned about environmental issues, and REI has historically listened to their collective voice by building a strong reputation as a steward of the natural environment. REI's current efforts on the sustainability front have the same basic goals as what we have proposed for chemicals management, making REI uniquely positioned to take on this emerging sustainability challenge.

REI should adopt the outlined chemicals management in retail operations framework. This provides a structured framework for REI and other retailers to examine chemicals within retail operations in order to take a proactive approach to knowing, disclosing, and reducing the presence of toxic chemicals. Given that the various external factors at work – supplier collaboration, federal regulation, and scientific research – are not yet in place, the framework provides a continuum of performance to guide REI through the complex process required to reach our recommended north star goal: no known chemicals of concern within buildings or purchased noncommercial goods.

Proper communications is an important consideration in a chemicals management strategy. REI needs to understand these implications from a communications perspective. There are benefits and risks to visibility, and REI should keep these in mind as it develops an internal and/or external communications strategy to communicate progress on chemicals management. For example, REI may ultimately develop a set of unique approaches or achieve progress through the recommendations framework quickly, efforts that would justifiably be worth communicating broadly and be worthy of plaudits. However, communicating a chemicals management strategy publicly with unrealistic goals may put REI at risk of criticism, so the company needs to balance its desire to communicate with the impacts of doing so.

Whether or not REI chooses to be visible with its chemicals management efforts, we believe that action is the only viable option moving forward. The case for developing a chemicals management strategy is strong, the risks are real, and the benefits are tangible. By taking this first step forward towards the foundational stage of the recommendations framework, REI would be making important progress on an issue that will only become more relevant to retailers in the coming years.

Appendix A: REI, Academic, and Professional Sources

REI Sources

- Print Buying
- CSR Director
- Safety Coordinator
- Purchasing Manager
- CSR Analyst and Project Sponsor
- CSR Manager and Project Sponsor
- Product and Supply Chain Sustainability Director
- Fixture Shop Manager
- Retail Support Analyst
- Support Services Manager
- Facilities Administrator REI Seattle Flagship Store
- Product Sustainability Analyst
- Facilities Supervisor

Academic Sources

- Stuart Batterman, Ph.D., University of Michigan Professor, Department of Environmental Health Sciences, School of Public Health; Professor, Department of Civil & Environmental Engineering, College of Engineering; Director, Center for Occupational Health and Safety Engineering
- Andrew J. Hoffman, University of Michigan Professor of Management & Organizations, Stephen M. Ross School of Business; Professor of Natural Resources; Holcim (U.S.), Inc. Professor of Sustainable Enterprise; Director of the Erb Institute for Global Sustainable Enterprise

Professional Sources

- Dov Brachfeld, Global Environmental Sustainability Controller, H&M
- Adam Cooper, Senior Manager, Accenture Sustainability Services
- Lindsey Dahl, Deputy Director, Safer Chemicals Healthy Families
- Shari Franjevic, Green Chemistry & Sustainable Design Consultant, Shari Franjevic LLC
- Sonja Haider, Business and Investors Advisor, ChemSec
- Michelle Harvey, Senior Project Manager, Retail, EDF
- Anne Less, Real Estate + Workspace Services Green Team Consultant, Healthy Materials + Knowledge Management, Google
- Anthony Ravitz, LEED AP BD+C, Real Estate + Workspace Services Green Team Lead, Google

Appendix B: Toxicology Primer

To develop a comprehensive and proactive approach to chemicals management, REI's CSR team and other relevant employees should be familiar with several key concepts, including:

- Accepted risk assessment frameworks, and how to evaluate and apply third party results;
- Toxicant effects on human and environmental health;
- Chemicals of Concern and their common origins;
- Priority areas for chemicals risk assessment;
- Green Chemistry principles for selecting alternatives.

Toxicology Terms

The word *toxic* means "having the characteristic of producing an undesirable or adverse health effect."[110] The word *toxicity* describes that effect: "any toxic (adverse) effect that a chemical or physical agent might produce within a living organism."[111] A *toxicant* is "any substance that causes a harmful or adverse effect when in contact with a living organism at a sufficiently high concentration." A *toxin* is a naturally produced toxicant.[112]

Various factors affect whether or not a substance will be toxic, and how much harm it will cause: hazard, exposure, dose, and the genetic nature of the organism exposed. In 1983, the National Research Council codified the process for chemical risk assessments for regulatory decision-making as a four step framework reflecting these factors:[113]

1. Hazard identification
2. Dose-response assessment
3. Exposure assessment
4. Risk characterization

This appendix will define and examine those factors to provide a basis for understanding the nature of toxicity.

Hazard

Hazard is the inherent toxicity of a substance, or "the qualitative nature of the adverse or undesirable effect resulting from exposure to a particular toxicant or physical agent."[114] Hazard represents the relative degree of harm that a substance could potentially cause. Toxicologists use a rating system of 1 through 6 to identify hazard, 1 being practically nontoxic and 6 being highly toxic.[115]

Dose

Renaissance alchemist Paracelsus wrote, "All substances are poisons; there is not which is not a poison. The right dose differentiates a poison and a remedy."[116] James et al. define *dose* as "the total amount of a toxicant administered to an organism at specific time intervals," and reinterprets Paracelsus: "Even relatively safe chemicals can become toxic if the dose is high enough, and even potent, highly toxic chemicals may be used safely if exposure is kept low enough." [117,118]

Most toxicants exhibit a *dose-response relationship*, which is the causal connection between the amount and effect of a toxicant. Plotted on a graph, the relationship often follows an S-shaped curve such that lethality increases slowly at low doses, then rapidly increases with higher doses (though this is not always the case).

Factors affecting the dose-response relationship include route of exposure, chemical composition, and exposure conditions, as well as personal traits such as gender, age, health status, and genetic makeup.[119] Genetics can alter an organism's response, but do not affect the inherent toxicity of a substance.

Toxicity is often measured in terms of dose. A standard measure is the LD50, or the dose that is lethal to 50% of the exposed population. LD50 is based on an average 150-pound adult male. Damage to children, the elderly, and the environment may occur at very different dose levels. LD50 can be used to compare the toxicity of substances, but does not describe variation in effects. The slope of the dose-response curve may provide a more accurate description of the toxicity of a substance (a steeper slope means that the marginal increase in lethality exceeds the marginal increase in dose). A sentinel dose is a dose that produces a minimally adverse effect such as a headache (called sentinel because it may be a warning that increased exposure may result in more serious effects).[120] Toxicology studies look for a dose that produces toxic effects and a dose at which no adverse effects occur (*no adverse effect level* or *no observable effect level*).[121]

Exposure

Exposure, which refers to contact between an organism and a substance, is the third factor in determining toxicity. The route, frequency, and length of exposure can all significantly impact toxicity. Exposure may be acute or chronic: *acute exposure* refers to a single exposure severe enough to cause immediate and extreme harm or death. *Chronic exposure* refers to continuous exposure over a period of time.

Potential *routes of entry* for a substance are ingestion, inhalation, absorption through the skin or eyes, and injection. Several factors – including absorbability, solubility, distribution (via metabolism or via reactions with other substances in the body) – affect how exposure will occur upon entry.[122] When an exposure takes place, the *mechanism of toxicity* refers to the biologic interaction(s) necessary to produce a toxic effect. For example, carbon monoxide binds to hemoglobin in the bloodstream, preventing oxygen transport and thus causing asphyxiation.[123] An *exposure pathway* is used to determine the potential for exposure to a substance. The pathway includes the source of the substance, the media of transport of the substance through the environment, an exposure point, the route of entry, and a potentially exposed population.[124] All of these elements must be present for an exposure to occur. An exposure assessment identifies the form and duration of exposure, route of entry, and amount of substance.

Other Factors Affecting Toxicity

There are several other variations in toxicity. It can be local, which means that effects occur at the site of contact (for example, a rash developing where skin touches bleach). Toxicity can also be systemic, meaning that the effects occur throughout the organism, or in a vulnerable location (for example, mercury ingestion damages the liver and central nervous system). Idiosyncratic reactions are also possible, and usually determined by the organism's genetic makeup. Toxicity can be reversible or irreversible, immediate or latent/delayed.[125]

Risk

In toxicology, *risk* is the mathematical probability that an event will cause a toxic effect. *Safety* means just the opposite – the probability that an event will not cause a toxic effect.[126] Risk is a function of exposure and hazard. A risk assessment attempts to integrate the hazard assessment and exposure assessment results to find a potential margin of safety. The goal is to attempt to establish exposure and dose limits that minimize risk for the majority of the population. The Outdoor Industry Association's framework for risk assessment is depicted below.[127]

The Global Harmonized System (GHS) for evaluation of toxicity study results can be a powerful resource for risk assessment.

How do we incorporate these factors into a final decision?
As described above, there are a variety of factors affecting the toxicity of a substance. The decision-making process around chemicals use must carefully weigh risks against benefits, even though the risks are not always clear. James et al. warn, "Often the inherent toxicity of a substance cannot be altered. Likewise, scientific understanding of specific toxicities is limited."[128] Thus, the best option is to identify the least toxic options by pursuing products that comply with green chemistry principles. Green chemistry is "the utilization of a set of principles that reduces or eliminates the use or generation of hazardous substances in the design, manufacture and application of chemical products."[129] See Appendix D for more information on green chemistry.

How Do Toxicants Affect Human Health?

Toxicants in the body
Toxic chemicals can have varied effects on human health. Healthy human bodies are generally able to process and eliminate reasonable levels of toxicants through the immune system, which transports unwanted substances through the blood and lymph systems to be excreted. There are natural limits, however, to the amount and variety of substances the immune system can handle at once. When forced to process extra toxicants, systems become clogged. Secondary organs are the final line of defense, and attempt to expel toxicants through coughing, sneezing, vomiting, diarrhea, and urination. When all else fails, the body begins to store what it cannot eliminate.[130]

As blood carries toxicants throughout the body and transfers materials into cells, toxicants come into contact with various organs. Kidneys filter blood; any toxicants to be excreted by the kidneys must be water-soluble to be excreted as urine. The liver processes fat-soluble toxicants, producing bile and secreting those toxicants into it. Some bile gets stored in the gall bladder, but most is eliminated through the intestines. Toxicants can also exit the body through the skin via sweat, and through the lungs via waste gas.

Human health toxicity

As human toxicity studies emerge, we are gaining a better but still very incomplete picture of how chemicals behave within human bodies. Much of the below information is based on animal testing. We still know very little about the human or environmental health effects of tens of thousands of chemicals in commerce today, and virtually no work has been done on the multiple simultaneous chemical exposures we experience daily. Additionally, certain chemicals listed below are not inherently toxic in nature, but through chemical reactions in cellular processes produce toxic compounds.

Neurotoxicants are harmful to the nervous system, and can cause a wide range of harm, including headache, fatigue, insomnia, emotional and behavioral problems, and dementia. Common neurotoxicants include aluminum, acetone, pesticides, ammonia, benzene, ethylene glycol, polybrominated diphenyl ethers (PBDEs), fluoride, formaldehyde, and lead.[131]

Genotoxicants alter the genetic information coded in DNA, and therefore can be passed on and inherited through generations. A recent study by Washington State University has linked several common chemicals to epigenetic (heritable) disease. Among the tested chemicals were a pesticide mixture containing permethrin (commonly used in insect repellent fabrics) and DEET; a plastic mixture containing Bisphenol A (which has attracted much negative attention in recent years) and phthalates; dioxin; and jet fuel.[132] Genotoxicants affecting sperm and egg cells can be passed on to offspring.[133]

There are three subcategories of genotoxicants, and many substances fall into more than one subcategory:

1. *Mutagens* cause permanent, irreversible changes by altering or inserting nucleotides in DNA sequences. Many mutagens are known to be detrimental to human health. Some common mutagens include formaldehyde, dioxane, nicotine, pesticides, and benzene.
2. *Carcinogens* cause cancer, either by "altering cellular metabolism or damaging DNA directly in cells."[134] This triggers uncontrolled cell division and replication, forming tumors. Carcinogens can be substances, radionuclides, or radiation. Thousands of chemicals are known or suspected to be carcinogenic. Some common carcinogens include tobacco smoke, formaldehyde, vinyl chloride (an ingredient in PVC), arsenic, asbestos, benzene, and heavy metals.[135] Carcinogens that do not alter DNA (but cause other forms of damage) are not considered genotoxicants.
3. *Teratogens* "cause structural or functional birth defects in the developing embryo or fetus, growth retardation, or death of the embryo or fetus when the mother or father is exposed before or during pregnancy."[136] Birth defects occur in 3 to 5% of all newborns, and this number is increasing throughout the developed world.[137] A wide range of chemicals are known or suspected to be teratogens, including: tobacco, caffeine, alcohol, certain prescription medications, BPA, PCDDs (polychlorinated dibenzodioxins), dioxin, toluene, PCDFs (polychlorinated dibenzofurans), and mercury. Radiation, some infections, and certain types of metabolic imbalance also act as teratogens.[138]

Endocrine disruptors mimic hormones, entering hormone receptors and disrupting the body's ability to make natural chemical connections. This category includes xenoestrogens, which are chemicals that imitate estrogen and have been increasingly linked to developmental and reproductive problems.[139] Endocrine disruptors are extremely common and can cause a multitude of effects, such as thyroid dysfunction, high blood pressure, obesity, hair loss, insomnia, and depression. According to the Environmental Defense Fund, no chemical currently in use has been thoroughly tested for its endocrine effects, but products such as cosmetics, pesticides, plastics, detergents, and pharmaceuticals include chemical ingredients that have been shown to impact the endocrine system.[140] Endocrine disruptors that have recently come under scrutiny include Bisphenol A, soy, PBDEs, and phthalates. The full effects of BPA exposure are still being researched, but the chemical is widespread: according to a recent study be the Centers for Disease Control, nine out of 10 Americans have BPA in their bodies.[141]

Cardiotoxicants harm the function of the heart and blood. These are especially dangerous because damage can spread to other parts of the body through the bloodstream. Cardiotoxicants elevate blood pressure and harden arteries, potentially leading to heart attack or stroke. Common cardiotoxicants include lead, arsenic, carbon monoxide, cadmium, mercury, CFCs, nitrates/nitrites, dihalomethanes, and many pesticides.[142]

Immunotoxicants suppress immune system function. Common immunotoxicants include vinyl chloride, benzene, copper, lead, mercury, naphthalene, many pesticides, and some solvents.

Nephrotoxicants (kidneys) and hepatotoxicants (liver) are particularly harmful to organs that cleanse or filter ingested materials. Because the liver and kidneys are exposed to most toxicants that enter the body, they are highly susceptible to damage. Common nephrotoxicants include carbon tetrachloride, trichloroethylene, chloroform, some solvents, and many heavy metals (such as cadmium, chromium, mercury, and lead). The most common hepatotoxicant is alcohol, but others include chloroform, carbon tetrachloride, and many solvents.

Dermatotoxicants impact the skin, hair, and sebaceous glands. Skin irritation is a normal reaction and often manifests immediately after direct exposure; skin corrosion is an extreme and irreversible effect. Dermatotoxicants can impair melanin production, cause hair loss and acne, and produce hyperpigmentation. Many common substances, such as solvents, detergents, tar, and petroleum, are dermatotoxicants.[143]

Gastrointestinal toxicants impact the digestive system, and include food additives, pesticides, chromium, solvents, and byproducts from water chlorination processes. The respiratory system is highly susceptible to gases such as ammonia, chlorine, and plastic fumes, as well as mercury and dust. The skeletal system can be harmed by prolonged exposure to aluminum, fluoride, ethyl alcohol, lead, mercury, PCBs, toluene, and many pesticides. The muscular system is vulnerable to mercury, as well as many pesticides and solvents.[144]

Much is known about the benefits provided by common chemicals, but relatively little is known about the risks associated with their use. It is therefore imperative that chemical hazard studies be conducted and data made public available so that thorough chemical risk analysis is possible, and the principles of green chemistry begin to guide decision-making.

How Do Toxics Affect Environmental Health?

Ecological toxicity is often a secondary concern to human health toxicity, but the two problems are inextricably linked. Healthy ecosystems provide vital support services for humans on earth – fresh water, clean air, pollination, temperature regulation, food, etc. Toxicants can impair the natural environment's ability to provide these functions, directly affecting the humans who depend on them. Additionally, at the top of the food chain, humans are extremely susceptible to bioaccumulation. We are capable of accruing and maintaining high levels of chemicals in our fat, and passing those chemicals on to our offspring.[145] Limiting ecological toxicity, therefore, is clearly in our best interest.

The widely accepted definition of *ecotoxicology* is “the branch of toxicology concerned with the study of toxic effects, caused by natural or synthetic pollutants, to the constituent ecosystems, animal (including human), vegetable and microbial, in an integral context.”[146] According to the U.S. EPA, “Ecotoxicity studies measure the effects of chemicals on fish, wildlife, plants, and other wild organisms.”[147]

Ecotoxicity is determined by evaluating the inherent toxicity of a substance, its persistence in the environment, and whether it bioaccumulates in the food chain. Many synthetic chemicals lack the natural breakdown processes of naturally occurring chemicals, and therefore tend to persist for extended periods. Some of the most dangerous chemicals to the environment and human health are known as persistent bioaccumulative toxicants, or PBTs. PBTs do not break down naturally, build up in the fat tissue of animals, and are highly toxic. They travel easily and can therefore end up long distances from their origins. The EPA’s list of 12 priority PBTs includes: aldrin/dieldrin, benzo(a)pyrene, chlordane, DDT/DDP/DDE, hexachlorobenzene, alkyl-lead, mercury, mirex, octachlorostyrnene, PCBs, dioxins/furans, and toxaphene.[148] Most of these chemicals are now regulated but continue to affect natural and human systems. For example, PCBs, though outlawed in the U.S. in 1976, can persist in the environment for decades and therefore continue to persist in people’s bodies.

Bioaccumulation makes measuring ecotoxicity difficult because substances can be differently toxic at different trophic levels. A trophic level is similar to a step along the food chain: a chemical may be harmless to prey but highly toxic to a predator. A substance toxic to humans may not be toxic to other organisms, and vice versa.

Human activity has spread synthetic chemicals throughout nature. What we label ‘pollution’ is generally ecotoxicity – air pollution, water pollution, and soil pollution are all common examples of ecotoxicity. Humans can limit contributions to ecotoxicity through reductions in energy use, automobile exhaust, pesticides, and household products such as shampoos and cleaners that often contain toxic ingredients.

Chemicals of High Concern

A number of chemicals are repeat offenders, falling into multiple of the above categories. Though it is certainly not exhaustive, the list below outlines some noteworthy chemicals of concern. Many of these chemicals may affect REI’s Scope 1 stakeholders. It is also likely that all of them occur somewhere within REI’s operational supply chain, and those effects should also be kept in mind.

BPA (Bisphenol A)

BPA is used to harden plastics and epoxy resins. BPA can leach from products into food, water, and the environment.[149] In humans and animals, BPA is an endocrine disruptor, interfering with both female and male hormones and reproductive capability. BPA has also been linked to obesity; neurological problems affecting development, memory, and mood; thyroid function; and several forms of cancer.[150,151,152,153] REI discovered that BPA was an ingredient in cash register receipt tape and took action to keep the chemical out of operations (see Current Approaches to Chemicals Management section of this report).

VOCs (Volatile Organic Compounds)

A number of chemicals fall into the category of volatile organic compounds (VOCs). VOCs vaporize at room temperature and can therefore easily be inhaled. Usually, a high level of VOCs offgasses from new products, and this level decreases over time. However, "VOCs from solid materials, such as flooring, fabric, furniture and furnishings emit more slowly and maintain a low level of emissions over a longer period of time."[154] VOCs of particular concern include benzene, toluene, and formaldehyde.

Benzene is a natural byproduct of fossil fuels; it is also released in tobacco smoke. Benzene is widely used in the manufacturing of plastics, resins, nylon, lubricants, rubbers, dyes, detergents, and pesticides.[155] Workplace exposure is common, particularly in industries that use or manufacture benzene, such as chemical plants, petroleum related industries, and commercial printers. For REI employees, exposure may occur in the print shop. In REI's operational supply chain, benzene exposure is likely common. Benzene is a known carcinogen and particularly affects the circulatory system, causing leukemia and other blood cell cancers. In the shorter term, high doses can affect the central nervous system, cause dizziness, vomiting, confusion, and tremors, and can irritate the skin, eyes, and throat.[156]

Toluene is a VOC used in the production of benzene. Also used as a solvent, toluene is a common ingredient in gasoline, kerosene, paints and paint thinners, detergents, adhesives, rubbers, and some printing processes.[157] Workplace exposure to toluene is common, but people may also be exposed via contaminated well water or hazardous waste sites.[158] Toluene is likely to impact populations in REI's Scope 3. Toluene affects the nervous system – "low to moderate levels can cause tiredness, confusion, weakness, drunken type actions, memory loss, nausea, loss of appetite, and hearing and color vision loss. These symptoms usually disappear when exposure is stopped."[159] Higher levels can damage kidneys, and cause dizziness, unconsciousness, and death. Repeated exposures can cause permanent brain damage, and direct contact can cause skin rashes.[160]

Formaldehyde is a known carcinogen in humans and animals. It is commonly used in plastics manufacturing, as a resin in pressed wood products (plywood, particleboard, fiberboard), or as an ingredient in adhesives, coatings, insulation, consumer products, and permanent press fabrics. Formaldehyde is a fungicide, germicide, disinfectant, and preservative. REI's fixture shop has a No Added Urea Formaldehyde policy for paneling and particleboard, but formaldehyde may still be present within adhesives, coating, and insulation. REI employees and customers may be exposed as these products release formaldehyde emissions over time. It is also present in tobacco smoke and many fertilizers.[161]

SVOCs (Semi-volatile Organic Compounds)

Many semi-volatile organic compounds (SVOCs) are also potentially dangerous. According to the Healthy Building Network, SVOCs "are released as gas much more slowly from materials" than are VOCs.[162] SVOCs of concern include phthalates, perfluorochemicals, and halogenated flame retardants.

Phthalates have been shown to cause reproductive disorders and are a suspected carcinogen.[163] Used to soften plastic and improve pliability, phthalates are commonly found in PVC, shower curtains, plastic wrap, food packaging, and other soft plastic products. Phthalates are showing up in an increasing number of consumer products; cosmetics, perfumes, detergents, soaps, shampoos, and moisturizers often contain phthalates. In buildings, phthalates are used in wood finishes, adhesives, plastic plumbing pipes, lubricants, solvents, insecticides, and vinyl flooring.[164] REI employees and customers are likely exposed to a number of items containing phthalates, as they are not heavily regulated chemicals at this time. The EPA intends to complete a DfE alternatives assessment in 2012.[165]

Perfluorochemicals (PFCs) are synthetic PBTs used to create resistance to water, stains, heat, and oil. Common products containing PFCs include Teflon, Stainmaster, Scotchgard, and Gore-Tex. PFCs are used in many products, including clothing, furniture, adhesives, and insulation. Responding to consumer concern, some corporations have voluntarily ceased using certain PFCs (PFOA, PFOS, and PFAS). The EPA has also undertaken steps toward PFC reduction, but environmental persistence means that PFCs remain ubiquitous. In a 2003-2004 study, "CDC scientists found four PFCs (PFOS, PFOA, PFHxS or perfluorohexane sulfonic acid, and PFNA or perfluorononanoic acid) in the serum of nearly all of the people tested, indicating widespread exposure to these PFCs in the U.S. population."[166] PFCs have been shown to cause reproductive and developmental impairments and cancers in animals, and are potentially linked to infertility.[167]

Halogenated flame retardants
PBDEs (polybrominated diphenyl ethers) are widely used SVOC flame retardants, found in products as diverse as plastics, textiles, electronics, clothing, furniture, building materials, paints, and vehicles. PBDEs are not chemically bound to the products they protect, and are therefore likely to leach over time. The EU has banned most PDBEs from use. The EPA has initiated action to monitor and reduce the manufacture and use of PBDEs.[168] Some statewide bans have been enacted in the U.S. (notably California, Washington, and Maine), but full regulation is absent. In 2011, Walmart initiated a full ban on PBDEs in its products.[169] REI employees and customers may be exposed to PBDEs through various furniture, textiles, and building materials.

The U.S. "EPA is concerned that certain PBDE congeners are persistent, bioaccumulative, and toxic to both humans and the environment. The critical end point of concern for human health is neurobehavioral effects. Various PBDEs have also been studied for ecotoxicity in mammals, birds, fish, and invertebrates. In some cases, current levels of exposure for wildlife may be at or near adverse effect levels." PBDEs can aggregate in blood, breast milk, and fat tissue, and have been linked to developmental, liver, thyroid, and neurotoxicity.[170] Additionally, PBDEs move easily through the environment and can end up far from original sources. A recent study by the National Oceanic and Atmospheric Association (NOAA) found PBDEs up and down the U.S. coastline, throughout the Great Lakes, and in other inland watersheds.[171] As noted in National Geographic, "scientists have found [PBDEs] planet wide, in polar bears in the Arctic, cormorants in England, and killer whales in the Pacific."[172]

Other potentially harmful flame retardants include chlorinated tris and TCEP.
According to EDF, PBDEs, PFCs, and phthalates have been found in 99% of pregnant women studied.[173]

Polycyclic aromatic hydrocarbons (PAHs)
PAHs are byproducts of burning carbon-based fuels (Scopes 2 and 3), and are therefore present all around us. Several PAH compounds are considered genotoxicants that fall under each category: mutagen, carcinogen, and teratogen. PAHs are present in tobacco smoke, car exhaust, coal fumes, and charred food; and can be ingested through contaminated water, air, and soil as well.[174]

Heavy metals (lead, mercury, arsenic, chromium, cadmium, and others)

Lead is present in a surprising number of consumer products, and has been used to highlight lax standards in certain global supply chains. PVC products also often contain lead. Soil can be contaminated with lead from older homes, smelters, or formerly used pesticides, and drinking water may contain lead leached from pipes. Lead is highly toxic and causes a range of symptoms, including behavioral problems, high blood pressure, anemia, kidney damage, memory and learning difficulty, miscarriage and decreased sperm production.[175]

A subject of much recent political controversy, *mercury* is emitted from coal burning power plants, oil refineries, various manufacturing practices, and the combustion of diesel and other fuels. Mercury is also present in fluorescent light bulbs, various electrical fixtures and components, and many thermostats. Mercury in products is usually contained (and safer alternatives are readily available), so the risk of direct exposure to REI employees and customers is relatively low. Mercury emissions, however, occur throughout Scopes 2 and 3, and mercury is highly bioaccumulative; the well known example is mercury settling in water and working up the aquatic food chain all the way to humans eating fish. High doses of mercury can cause blindness, deafness, brain damage, kidney damage, and mental retardation.[176] Acute cases of mercury poisoning have resulted in deaths, the most famous of which occurred throughout the 20th century in Minamata, Japan. Chisso Corporation's wastewater had accumulated in the fish and shellfish relied upon by the local population. As many as two million people may have been affected, with more than 900 deaths.[177]

Until 2004, *arsenic* was the most common wood preservative used in outdoor building materials. Treated wood can leach arsenic into soil, and direct contact can release arsenic into an organism.[178] Arsenic compounds are still used in the production of certain varieties of glass, semiconductors (gallium arsenide), some paints, dyes, metals, soaps, and drugs. Arsenic is also present in soil from smelters and some pesticides. Seafood and drinking water may contain traces of arsenic.[179] In some BRICS[i] countries and other areas of the developing world, arsenic in drinking water is a major concern.[180] Arsenic is a known carcinogen, and exposure can additionally cause problems in the respiratory and central nervous systems, decreased intelligence, digestive issues, and death at high levels.[181]

A 2010 Ocean Alliance study found high levels of heavy metals in whale tissue, triggering even higher concern for the safety of marine life and seafood.[182]

Pesticides

Pesticides and insecticides, widely used in agriculture and landscaping, can be highly toxic. These chemicals leach into watersheds, potentially even contaminating ground water. Though REI minimizes pesticide used in landscaping, these decisions may not be under REI's control in leased properties. According to Washington Toxics Coalition, "organophosphate and carbamate pesticides can have immediate effects on the nervous system, with symptoms including weakness, cramps, breathing trouble, nausea, and vomiting."[183] Studies have shown that greater exposure impairs motor function and attention span. Certain pesticides have been linked to cancers. Many pesticides are also highly toxic to other animals, and most insecticides are toxic to all insects, including beneficial insects such as bees.[184]

---

[i] **B**razil, **R**ussia, **I**ndia, **C**hina, and **S**outh Africa

Databases of pesticides and relevant fact sheets are kept by the Northwest Center for Alternatives to Pesticides (http://www.pesticide.org/get-the-facts/pesticide-factsheets) and the Pesticide Action Network (http://www.pesticideinfo.org/Index.html).

PCBs and DDT
Though banned in the U.S. in the 1970s, PCBs and DDT are both PBTs that still exist widely in the environment and can be consumed by humans.

Nanoparticles
A nanometer (nm), the essential unit in rapidly emerging nanotechnology, is one billionth of a meter in length. As Jennifer Kahn explains in her 2006 National Geographic article:

> Nanotechnology matters because familiar materials begin to develop odd properties when they're nanosize. Tear a piece of aluminum foil into tiny strips, and it will still behave like aluminum—even after the strips have become so small that you need a microscope to see them. But keep chopping them smaller, and at some point—20 to 30 nanometers, in this case—the pieces can explode. … Substances behave magically at the nanoscale because that's where the essential properties of matter are determined. Arrange calcium carbonate molecules in a sawtooth pattern, for instance, and you get fragile, crumbly chalk. Stack the same molecules like bricks, and they help form the layers of the tough, iridescent shell of an abalone.[185]

Essentially manufacturing at the molecular level, nanotechnology shows promise in a huge variety of applications: tech gadgets, cancer detection and treatments, electricity conduction, gene therapy, and more. But the rapid proliferation of nanotechnology is also somewhat troubling: because nanoparticles don't behave like their parent materials, their effects are difficult to predict. Rice University chemist Vicki Colvin found that a weak (20 parts per billion) solution of buckyballs, spherical structures made up of 60 carbon nanoparticles, killed fully half of lab-grown human skin and liver cells exposed.[186] Nanoparticles are intended to move easily throughout cells, and this property could potentially turn dangerous if they are shown to persist and accumulate in the environment. Initial nanotoxicology studies warn that stringent precautionary measures should be taken until nanoparticles are well understood.[187,188]

Figure 2: Select Chemicals of Concern

Chemical Name	Where it's likely to be found within REI operations (Scope 1)	Where it's likely to be found within REI operations (Scope 2)	Where it's likely to be found within REI operations (Scope 3)	Effects
Bisphenol A (BPA)	Hard plastics Epoxy resins		Manufacturing	Endocrine disruption Reproductive disorders Suspected: obesity, neurological damage, thyroid function, cancer
Benzene	Printers	Burning fossil fuels	Manufacturing	Cancer, especially leukemia Dizziness, vomiting, tremors Skin, throat, + eye irritation
Toluene	Paints Detergents Printing processes		Gasoline Manufacturing	Nervous system effects Kidney damage Brain damage Skin irritation
Formaldehyde	Pressed wood products Fungicide Disinfectants		Manufacturing	Cancer
Phthalates	PVC/vinyl* Soft plastics Detergents + soaps Consumer products Wood finishes Adhesives, solvents, lubricants Insecticides		Manufacturing	Reproductive disorders Suspected: cancer
Perfluorochemicals (PFCs)	Gore-Tex, Teflon, Stainmaster Furniture Insulation Clothing		Manufacturing	Reproductive disorders Developmental disorders Cancer Suspected: infertility Persistent, bioaccumulative
Polybrominated diphenyl ethers (PBDEs) + other halogenated flame retardants	Plastics Textiles Clothing Furniture Electronics Building materials		Vehicles Manufacturing	Neurobehavioral disorders Developmental disorders Liver + thyroid disorders Highly ecotoxic Persistent, bioaccumulative
Lead	PVC/vinyl* Solder Wire insulation		Manufacturing	Highly toxic; multiple impacts

Mercury	Fluorescent lightbulbs Electrical fixtures Thermostats + thermometers Switches	Coal burning power plants Diesel + other fuel combustion	Manufacturing Oil refineries Diesel + other fuel combustion	Brain damage Blindness Deafness Kidney damage
Arsenic	Wood (pre-2004) Certain pesticides		Manufacturing	Cancer Respiratory damage Nervous system damage
Pesticides	Landscaping		Landscaping	Nervous system damage Decreased motor function Cancer Ecological damage

*** Polyvinyl chloride** (PVC), often referred to as vinyl, is very common in building materials. **According to the Healthy Building Network, PVC is often found in:** pipes and conduit, waterproofing, siding, roof membranes, door and window frames, resilient flooring, carpet backing, wall covering, signage, window treatments, furniture, wire, and cable sheathing.[189]

Appendix C: Environmental Regulations

This appendix supplements the regulatory risks section of the report by providing a more detailed overview of key environmental regulations related to chemicals.

Toxic Substances Control Act (TSCA)

The Toxic Substances Control Act addresses chemicals used in everyday products and manufacturing and, therefore, is the primary regulation addressing chemicals safety and imminent hazards.[190] The Act was passed in 1976 under President Ford, has been amended significantly three times, and basically covers everything except for food, drugs, cosmetics, and pesticides, which are regulated separately under the *Food, Drug, and Cosmetics Act* (FDDCA, FDCA, or FD&C) and the *Federal Insecticide, Fungicide, and Rodenticide Act* (FIFRA).[191,192] The law is federally managed, not delegated to states, and gives the EPA's Office of Pollution Prevention and Toxics (OPPT) responsibility for "assuring that chemicals manufactured, imported, processed, or distributed in commerce, or used or disposed of in the United States do not pose any unreasonable risks to human health or the environment."[193] A major objective of TSCA is "to characterize and evaluate the risks posed by a chemical to humans and the environment before the chemical is introduced into commerce" and TSCA attempts to accomplish this by requiring manufacturers[i] to "perform various kinds of health and environmental testing, use quality control in their production processes, and notify EPA of information they gain on possible adverse health effects from use of their products."[194] TSCA also requires the EPA "to develop regulations that establish import/export requirements for chemicals subject to certain requirements under TSCA."[195]

When TSCA was passed in 1976, "it was not known how many chemicals were in commerce in the U.S., in what quantities or where they were produced and/or imported."[196] Therefore, requiring the EPA "compile, keep current, and publish a list of each chemical substance that is manufactured or processed in the United States" represented an important, and necessary, first step toward understanding the human and environmental risks posed by chemicals in commerce.[197] The initial Chemical Substances Inventory (CSI or "Inventory") was published in 1979 and was followed by second version in 1982 that included approximately 62,000 chemical substances.[198] By 2012 there were more than 84,000 chemical substances on the CSI.[199] In 2010, the EPA made the CSI available on Data.gov, a government wide website developed to provide public access to important government federal information.

Who is affected?

Under TSCA, EPA has authority to "regulate the manufacture (including import), processing, use, distribution in commerce, and disposal of chemical substances and mixtures that present or will present an unreasonable risk to human health and the environment."[200] In general, this means that chemical manufacturers and importers are the most affected when they are manufacturing or importing "new" chemicals. The primary industries that are directly regulated under TSCA are manufacturing (SIC Codes 20-39) such as chemical production and importation, petroleum refining, paper production, and microelectronics manufacturing. Any organizations handling National Program chemical substances must ensure compliance with

---

[i] Under TSCA, "manufacturing" is defined to include "importing", and thus all requirements applicable to manufacturers apply to importers as well (ChemAlliance.org)

TSCA rules, or risk fines or lawsuits. The law also affects nearly every company and person throughout product supply chains because manufacturers produce goods that either become inputs to other products or are directly used or consumed by others.

Enforcement
EPA may issue a civil administrative complaint to any person or company in violation of TSCA. Actions may include recovery of economic benefit, correction of the violation, and penalties up to $27,500 per violation per day.[201] Under the Chemical Data Reporting Rule of TSCA (formerly known as Inventory Update Reporting) companies are required to report chemical data to EPA. The rule has led to 43 civil enforcement actions, resulting in $2.3 million in civil penalties.[202]

Substances on the CSI are considered "existing" chemicals while those not yet on the CSI are considered "new." Under TSCA, the EPA has different programs for each, commonly referred to as the "New Chemicals Program" and "Existing Chemicals Program." The New Chemicals Program "was established to help manage the potential risk from chemicals new to the marketplace" and "impose conditions, up to and including a ban on manufacture, on the commercialization of a new chemical before entry into commerce, or on a 'significant new use' of an existing or new chemical."[203] The Existing Chemicals Program is primarily geared toward data development and gathering activities. As previously mentioned, there are more than 84,000 chemicals on the CSI, 62,000 of which were grandfathered onto the first inventory and, therefore, did not go through the New Chemicals Program procedures. Both programs have their strengths and weakness, and several major criticisms are discussed later in this section.

When a manufacturer wishes to use a chemical, it must first consult the CSI to find out whether or not the chemical is "existing" and, if it is, whether or not there are any restrictions on the manufacture or use of that chemical. If the chemical is not on the CSI the manufacturer must submit a Premanufacture Notice (PMN) unless "the substance meets a TSCA reporting exclusion (e.g., is a naturally occurring material) or is exempt from PMN reporting (e.g., is an exempted polymer)."[204] According to the EPA, the PMN review process is "designed to accommodate the large number of PMNs received (approximately 1,500 annually), while adequately assessing the risks posed by each substance within the 90-day timeframe prescribed by TSCA." [205] Unfortunately, "the information included in PMNs is limited: 67% of PMNs include no test data and 85% include no health data" and therefore the EPA must rely on several general approaches "to address data gaps to rapidly evaluate potential risks and make risk management decisions for new chemicals."[206] Based on its findings, the EPA can "prohibit or limit activities associated with the new chemical if EPA determines that insufficient information exists to evaluate the human health and environmental effects of the substance, and that: (1) it may present an unreasonable risk ('risk-based finding') or (2) be produced in substantial quantities, and substantial or significant exposure/release ('exposure-based finding')."[207] However, if the EPA takes no action with the 90-day PMN review period, the company submitting the PMN may begin manufacturing or importing the chemical. [208]

After a PMN has been reviewed by the EPA or the 90-day review period ends, "the company that submitted the PMN must provide a Notice of Commencement of Manufacture or Import (NOC) to EPA within 30 calendar days of the date the substance is first manufactured or imported for nonexempt commercial purposes." [209] Once the EPA receives a complete NOC, the chemical substance is considered to be on the TSCA Inventory and becomes an existing chemical. The Agency receives between 500 and 1,000 NOCs each year and, therefore, the CSI changes daily.[210]

When it come to existing chemicals, OPPT focuses its data development and data collection efforts on a subset of chemicals that are produced in quantities greater than 10,000 pounds per year. The OPPT has further focused its efforts on High Production Volume (HPV) chemicals that are "produced and/or imported in annual volumes of 1 million pounds or more across all U.S. companies."[211] The EPA has several voluntary reporting programs, but can also require companies to test existing substances for which additional data is needed to identify potential hazards or exposures. Reporting and testing requirements that can be triggered by "a report of a 'significant adverse reaction' to one of [a manufacturer's] chemical substances or products or products containing a substance."[212] In other words, allegations alone may be enough to trigger reporting and testing. TSCA also contains a provision allowing for citizens to petition EPA to take action to require chemical testing, to impose substantive controls on chemicals, or to gather information.[213] However, before requiring testing the EPA first must be able to "make certain statutory findings about the substance involved, including that there are insufficient data available to determine the effects of the substance on health and/or the environment; and testing is necessary to provide such data; and the chemical may present an unreasonable risk of injury to health or the environment, and/or may be produced at substantial quantities and is reasonably expected to enter the environment in substantial quantities or may result in significant or substantial human exposure."[214] Essentially, this means the burden is on the EPA to determine there is a risk from an existing chemical before requiring further testing. Given this, it is not surprising that TSCA has generated data for only a few hundred chemicals since the 1970s.

Under Section 6 of TSCA, the EPA has the authority to ban the manufacture or distribution, limit use, require labeling, or place other restrictions on existing chemicals, but again can only due so after finding that there "is a reasonable basis to conclude that a chemical substance presents or will present an unreasonable risk of injury to health or the environment."[215] The EPA has only used its Section 6 authority on eight occasions to restrict manufacture or use of six chemicals. Two of these regulations were later superseded by regulations under other environmental laws and four others are still regulated to some extent under Section 6: metalworking fluids, hexavalent chromium, PCBs, and new uses of asbestos. The EPA also devotes significant resources to "national program chemicals," which include dioxin, mercury, and those addressed specifically by Section 6 TSCA Section 6(e) and Titles II through IV, which include PCBs, asbestos, radon, and lead.[216] In 1996, Ed Brooks, of EPA's Chemical Control Division, explained that the EPA used its Section 6 authority sparingly because "With respect to the unreasonable risk issue, ... the Agency came to view Section 6 rulemaking as an inherently large and complex undertaking that offered little prospect of resulting in success."[217]

The EPA may also issue a Significant New Use Rule (SNUR) for an existing chemical after considering several factors, "including but not limited to the projected production and processing volume of the chemical substance, and the anticipated extent to which the use increases the type, form, magnitude and duration of exposure to humans or the environment."[218] A SNUR requires that all manufacturers, importers, and processors notify EPA at least 90 days before beginning any activity that EPA has designated as a "significant new use" of the chemical and "allows EPA to prevent or limit potentially adverse exposure to, or effects from, the new use of the substance."[219]

For additional information about the EPA's extensive rules, procedures, programs, and tools for evaluating the potential risks posed by new and existing chemical substances, see the document "Overview: Office of Pollution Prevention and Toxics Program" on the EPA's website.

Criticisms

Though the law represented significant progress at the time it was written, TSCA has been criticized by NGOs, businesses downstream of chemical companies, and even some representatives of the chemicals industry itself as being out of date and failing to adequately protect humans and the environment from toxic chemical exposure. Additionally, in 2009 the U.S. Government Accountability Office (GAO) added TSCA to its list of "High Risk" areas of government needing immediate reform and concluded that "without greater attention to EPA's efforts to assess toxic chemicals, the nation lacks assurance that human health and the environment are adequately protected."[220,221] The GAO cited some alarming statistics in its report, including:[222]

> *GAO recently reported that EPA's Integrated Risk Information System (IRIS)—a database that contains EPA's scientific position on the potential human health effects of exposure to more than 540 chemicals—is at serious risk of becoming obsolete because the agency has not been able to complete timely, credible assessments or decrease its backlog of 70 ongoing assessments. Overall, EPA has finalized a total of only 9 assessments in the past 3 fiscal years. As of December 2007, 69 percent of ongoing assessments had been in progress for more than five years, and 17 percent had been in progress for more than 9 years. In addition, EPA data as of 2003 indicated that more than half of the 540 existing assessments may be outdated. Five years later, the percentage is likely to be much higher.*

According to Safer Chemicals, Healthy Families, a coalition of millions of Americans and more than 450 organizations, ranging from parents, to nurses, to labor organizations, to national environmental organizations, four of the key areas in which TSCA falls short are:[223]

- Fails to require the development of hazard data on chemicals in commerce
- Does not require the EPA to identify chemicals of greatest concern to human health and the environment
- Fails to restrict uses of the most toxic chemicals
- Does not promote safer alternatives to toxic chemicals

Dr. Lynn Goldman, former EPA Deputy Director for the Office of Prevention, Pesticides and Toxic Substances, stated, "It is fair to state that the results [of TSCA] have come nowhere close to … the original Congressional intent … Under TSCA, existing chemicals are assumed safe until proven guilty, even when found in breast milk and even as toxicology evidence accumulates."[224] Dr. Goldman was referring to what Dr. Richard Denison, Senior Scientist at Environmental Defense Fund, called "a classic 'catch 22,' government must already have information sufficient to document potential risk, or at the very least, extensive exposure, in order to require the development of information sufficient to determine whether there is actual risk."[225] In other words, the legislation places the burden on the EPA to prove that a chemical substance poses an "unreasonable risk" to health or the environment before it can be regulated, as opposed to placing the burden on manufacturers to prove that chemical substances are safe for use in the marketplace. As a result, fewer than 300 of the 80,000-plus chemicals on the Chemical Substance Inventory have been tested for safety, and only five have been partially regulated.[226,227]

The National Resources Defense Council (NRDC), a national nonprofit environmental organization, points to still more weaknesses in TSCA that allow "chemical companies to exploit the act by thwarting the EPA's attempts to finalize health assessments and delaying regulation of chemicals— sometimes for decades."[228] The NRDC specifically discusses this in the context of the Integrated Risk Information System (IRIS), an EPA program in which staff scientifically assess the health effects of chemicals already in commercial use (e.g., "existing"). In the IRIS program, the EPA risk assessors evaluate all the relevant science and determine the "acceptable" level of exposure to a chemical, in the air, water, food, or soil. Currently there is "no enforceable deadline for the EPA to complete its chemical assessments, no 'harmful until proven safe' interim standards to limit chemical exposures until assessments can be completed, and no consequences for industry if the EPA fails to complete (or is prevented from completing) an assessment." [229] Since revised assessments can result in additional regulations and, therefore, companies might incur costs associated with changing formulations or finding safer substitutes, "industry has every incentive to resist data collection and data requests, and to argue with every study in order to delay the completion of those assessments." [230] The NRDC claims that the industry does just that and has developed an effective set of tactics to combat and delay the EPA's efforts.

TSCA also handcuffs the EPA by requiring it "to impose the 'least burdensome' regulatory measure that provides adequate protections."[231] This forces the EPA to go beyond answering the scientific question of a substance's safety and to also consider "the social and economic costs of imposing controls on the chemical, including the benefits of the chemical, the availability of alternatives, and the impact of regulation on the economy."[232]

The criticisms of the EPA, TSCA, and the legal system are numerous, but Dr. Denison succinctly described the situation when he said, "By failing to identify, let alone control, the long and growing list of chemicals in everyday products that we now know can harm people and the environment, TSCA has forced states, businesses, workers and consumers to try to act on their own to address what should be a national priority."[233] Additionally, due to increasing awareness of the potential dangers posed the many chemicals allowed to exist in commerce, many manufacturers, processors, and distributors of chemical substances "increasingly are the targets of litigation," and "tort claims frequently involve allegations of personal injury and property damage directly caused by products containing chemical substances."[234]

Europe's Chemical Policy

The European Union is currently leading the path forward in chemicals regulation with the passage of two important laws: Restriction of Hazardous Substances in Electrical and Electronic Equipment (RoHS) Directive in 2003; and Registration, Evaluation and Authorization of Chemicals (REACH) in 2006. The RoHS Directive bans from the EU market new electrical and electronics equipment containing higher than acceptable levels of certain chemicals. REACH is a modern attempt to implement and regulate chemical policy in Europe. While both REACH and TSCA are federal chemical policy frameworks, REACH is considered to be far superior. Some of the key improvements over TSCA include:[235]

- REACH puts the burden on companies to develop information on chemicals' effects on human health and the environment, while TSCA does not require companies to develop such information absent EPA ruling.
- REACH requires companies to obtain authorization to use chemicals of very high concern, while TSCA provides EPA with differing authorities for controlling risks depending on whether the chemical is new or existing.
- TSCA and REACH both protect confidential or sensitive business information, but REACH requires greater public disclosure of certain information and places greater restrictions on the kinds of information companies may claim as confidential.

Regulatory Changes

The U.S. may be headed in the direction of a system similar to REACH. Opinion polling data shows strong bipartisan support for tightening chemical regulations. According to a report from Safer Chemicals, Healthy Families, 80% of Americans expressed support of a new federal law to restrict toxic chemicals.[236]

In 2011, Senator Frank Lautenberg (D-N.J.) introduced the Safer Chemicals Act (S. 847) in the Senate, and the Toxic Chemicals Safety Act (H.R. 5280) was introduced in the House of Representatives.[237, 238] In July 2012, the Safe Chemicals Act was approved in the Senate's Environment and Public Works Committee for the first time, and the bill may advance to the floor of the Senate.

These acts propose the following major elements of reform:

1. Chemical industry to prove that the chemical is safe in order to stay on or enter the market
2. Immediate action to be taken on the worst chemicals – persistent, bioaccumulative, toxic, and other high priority chemicals
3. Requirement that the legislation is held to the standard of the most vulnerable (fetuses, infants, and young children)
4. Use of best available science based upon recommendations from National Academy of Sciences
5. Disclosure of essential health and safety information for all chemicals to the market, consumers, and the public through disclosure to the EPA

Occupational Safety and Health Act of 1970 (OSHAct)

The Occupational Safety and Health Act (OSHAct) is federal regulation protecting the health and safety of workplaces. Congress created the Occupational Safety and Health Administration (OSHA) to assure safe and healthy working conditions for working men and women and to reduce the costs related to lost production.[239] OSHA accomplishes these goals by setting and enforcing standards and providing training, outreach, education, and assistance. OSHA's primary goal is to provide a working environment free from recognized hazards such as exposure to toxic chemicals, excessive noise, mechanical dangers, heat or cold stress, or unsanitary conditions.[240]

Hazardous and toxic substances in the workplace are defined as chemicals present in the workplace capable of causing harm. More specifically, OSHA defines a "health hazard", as "a chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occurs in exposed employees."[241] OSHA currently regulates exposure to approximately 400 substances, including dusts, mixtures, and common materials such as paints, fuels, and solvents. The agency maintains a list, the Chemical Sampling Information file, which contains information for approximately 1,500 substances.[242]

The act established a three part structure to accomplish its goals. OSHA is "primarily responsible for inspecting workplaces, promulgating regulatory standards, determining compliance with standards, and proposing appropriate sanctions and remedial action where violations have occurred."[243] The National Institute for Occupational Safety and Health (NIOSH) is the research arm charged with providing OSHA the information it needs to develop health and safety standards. The Occupational Safety and Health Review Commission (OSHRC) oversees citations issued by OSHA and generally becomes involved when an employer challenges a citation.[244]

OSHAct requires employers to comply with standards for individual substances, such as asbestos, lead, bloodborne pathogens, or anything OSHA determines to create a risk of material impairment of employees' health at current levels of exposure.[245] OSHA also has a general duty clause to account for situations in which OSHA standards for specific chemicals are not applicable.

The Hazard Communication Standard (HCS) applies to all chemicals and "reaches beyond the workplace to the party that manufactured or imported the chemical."[246] Its goal is to "provide for the evaluation of chemicals used in the workplace and to provide a comprehensive mechanism for the communication of information regarding the hazards from manufacturers to employers and, ultimately, from employers to employees."[247] The idea behind the HCS is to "provide workers with sufficient information to make their own choices regarding the hazards that they face in the occupational setting."[248]

The HCS places the burden on manufacturers and importers to determine existence of a hazard and to develop material safety data sheets (MSDSs) containing detailed information regarding each hazardous chemical and the dangers it presents. [249] MSDSs travel with chemicals to employers' places of business, where employers are required to post them and make them available and obvious to employees while at work.[250] Employers are also required to keep a record of every non-consumer chemical product used in the workplace, develop a written hazard communication program "designed to identify hazardous chemicals present in the workplace, and to formulate a plan for informing the employees of hazards."[251,252] Furthermore, employers are expected to develop methods to determine and manage a release of a hazardous chemical and steps that employees can take to protect themselves.[253]

With the number of chemicals in the marketplace, OSHAct compliance can become quite burdensome for employers. The issue can become even more complicated when state level regulations are added to the mix. Twenty-five states have adopted their own standards and enforcement policies, which, fortunately, are for the most part quite similar to OSHAct.[254] The Washington State Department of Labor and Industries is one example. Labor and Industry's Division of Occupational Safety and Health (DOSH) administers the Washington Industrial Safety and Health Act (WISHA) law by developing and enforcing rules that protect workers from hazardous job conditions.[255]

Enforcement
OSHAct provides for civil and criminal penalties against employers. OSHA conducts workplace inspections and OSHRC assesses civil penalties against employers deemed to be in violation of applicable standards.[256] Criminal penalties are available for "willful violations of the OSHAct that result in the death of an employee."[257] This occurs when an employer consciously or recklessly disregards a known standard or provision.[258]

Why This Matters to Retailers
OSHA has estimated that 32 million workers are exposed to 650,000 hazardous chemicals in more than three million workplaces. These hazardous chemicals are not prohibited from use; rather, employers and employees are to understand the hazards of chemicals in the workplace.[259] This can be a daunting task. The burden is primarily placed onto employees to read and understand the hazards communicated on MSDSs. The hazards described on MSDSs are primarily related to immediate health risks such as poisoning from ingestion or corrosion from interaction with the skin, rather than long term effects. OSHA does not take a proactive approach to regulating chemicals that may have long term human health effects.

Consumer Product Safety Commission (CPSC), Consumer Product Safety Act (CPSA), & Federal Hazardous Substances Act (FHSA)

In 1972, Congress created the Consumer Product Safety Commission (CPSC), which is charged with "protecting the public from unreasonable risks of serious injury or death from more than 15,000 types of consumer products used in homes, schools, and recreation that pose a fire, electrical, chemical, or mechanical hazard, or otherwise cause injury."[260] CPSC carries out two broad product laws along with other product-specific laws. The two broad product laws are the Consumer Product Safety Act (CPSA) and Federal Hazardous Substances Act (FHSA). The EPA regulates the testing and manufacture of chemical substances and the FDA regulates chemical substances in food.[261]

CPSA is an umbrella regulation for all federal safety regulatory activity related to consumer products within the CPSC. FHSA requires proper labeling of hazardous household products that are toxics, corrosive, combustible, or otherwise hazardous. It also permits banning of certain products that are considered too hazardous for household use.[262] For a substance to be considered hazardous under FHSA, it must be toxic, people must be exposed to the substance, it must be able to enter the body, and there must be a significant risk of an adverse health effect.

However, the existing regulation leaves significant gaps in protecting consumers from chemical hazards in products. There are four primary challenges with CPSC:[263]

- CPSC relies heavily on voluntary industry groups to create standards and has limited capacity to ensure compliance with the standards.
- CPSC is responsible for more than 15,000 types of products, making the task extremely intensive. Further, the commission operates with less than half of its original budget.
- CPSC relies on TSCA for chemical safety information and as a result of the challenges and limits of TSCA, few chemicals are regulated in consumer products.
- Current laws do not require consumer products to be tested for most chemical hazards.

Enforcement

The CPSC can take several different types of actions to reduce or eliminate "unreasonable risk of harm;" however, the agency's authority is considered limited. The types of actions fall into the following categories:[264]

- *Testing*: Pre-market safety testing is not required, nor does CPSC have the authority to test products for the chemicals within a product (this is given to the EPA under TSCA). CPSC may selectively test certain products for restricted substances, particularly when consumer concerns are brought forward.
- *Safety Standards:* Ability to issue mandatory federal safety standards deemed to be unreasonably dangerous to the public. There are less than 20 mandatory standards for chemicals in toys and consumer products; one such example is lead in paint.
- *Labeling*: To require labeling, a product must meet the definition of a hazardous substance (toxicity, exposure, and potential for harm). If a product is not labeled properly, it is considered "misbranded" and cannot be sold. The challenge is that there is little data to prove toxicity; therefore, few products require labeling.
- *Bans*: Ability to ban products when labeling and safety standards do not adequately product consumers from hazards. Less than a dozen chemicals have been banned.
- *Voluntary Standards*: The CPSA requires the CPSC to utilize voluntary standards, rather than a mandatory regulation, when voluntary standards adequately address the hazard

and there is likely to be considerable compliance with those voluntary standards.

- *Recalls*: CPSC may recall products when they contain a defect, which makes them unsafe, or because they violate an existing consumer product safety regulation.
- *CPSC Database*: A database for consumers to self report unsafe products, which was a requirement of the Consumer Product Safety Improvement Act (H.R. 4040) passed in 2008.[265]

Why This Matters to Retailers
While CPSA specifically covers consumer products, some of the noncommercial products REI uses, such as cleaners, paper, and office supplies, are considered consumer products and thus are regulated under CPSC or FHSA. As a result of the challenges with CPSC, many states have enacted their own statues and regulations related to consumer product safety. National or regional retailers must therefore make the additional efforts required to remain abreast of, and to comply with, consumer product safety laws in each state. The next section will discuss some of the various state laws that have been enacted.

State Laws

Many states have begun to adopt more stringent chemicals legislation, particularly related to children's products. State-specific regulations are of particular relevance to REI and other retailers because they must adhere to the state regulations in the states in which they operate.

CPSA allows states to enact their own statutes regarding product safety so long as they meet the minimum federal requirements. Therefore, many states have enacted chemicals legislation particularly related to consumer products and especially related to exposures to children.[266] In the past eight years, 18 states have passed 71 chemical safety laws with an overwhelming majority vote. Of the 9,000 votes cast for these laws, 8,000 were in favor of the tighter regulation. The rate of the laws passing is also increasing, as demonstrated by the passage of 31 toxic chemicals laws in the 2010-2011 legislative sessions (compared to seven in the 2003-2004 legislative sessions). Specific laws that address children's health received the greatest level of support in 2010-2011. These regulations address various chemicals, including BPA, PBDEs/flame retardants, lead, cadmium, and cleaners. For example, California state law regulates lead in children's and adult jewelry.[267]

When these restrictions are imposed, some companies respond by not selling products that contain the restricted chemicals in that particular state, while others switch to a safer alternative for the entire U.S. market, thus achieving the same objectives as federal legislation.
More recently, several states, including California, Minnesota, Maine, and Washington, have adopted comprehensive toxic chemicals legislation rather than restriction of select chemicals. These state programs that regulate broad classes of chemicals have phased out uses of several PBT (persistent, bioaccumulative, and toxic chemicals) such as lead and flame retardants.[268]

In particular, California, Washington, Maine, and Massachusetts have been leaders in chemicals policy reform. A recent California report identified current failures of policy, which should be used to inform development of state level policy[269]:

1. *Data Gap*: Little information is known about the health effects, exposures, and uses throughout supply chains.
2. *Safety Gap:* As a result of disjointed policy and infrastructure, there is little authority and burden of proof is extremely heavy. Agencies must demonstrate each chemical's risk before preventative action may be taken as a result of TSCA, which assumes chemicals

to be safe until it is demonstrated they pose an "unreasonable risk."

3. *Technology Gap:* The current system provides few incentives for innovation and use of safer chemicals.

Toxic Torts

A "tort" refers to a civil wrong resulting in an injury or harm. Some torts are also crimes punishable by imprisonment. Tort law is created at the state level by judges (common law) and by legislatures (statutory) and provides relief for the damages incurred and to deter others from committing the same harms.[270] More explicitly, an injured party may sue for monetary damages or for an injunction to stop the harmful conduct. The damages the party may sue for include present and future loss of earnings capacity, pain and suffering, and reasonable medical expenses.[271]

There are numerous specific torts, such as trespass, assault, battery, negligence, products liability, and intentional infliction of emotional distress, and all fall into three general categories:[272]

- *Intentional torts*: wrongs which the defendant knew or should have known would occur through their actions or inactions (e.g. intentionally hitting someone)

- *Negligent torts*: when the defendant's action were unreasonably unsafe (e.g. causing an accident by failing to obey traffic laws)

- *Strict liability:* wrongs do not depend on degree of carefulness by the defendant, but have to do with a specific action that causes damage (e.g. liability for making and selling defective products)

The term "toxic torts" refers to a wide variety of private and public claims, and a toxic tort action may be a civil lawsuit, an administrative action for cleanup of hazardous waste, a workers' compensation claim, or any of a number of other actions.[273] This area of law evolved in the gap between traditional tort law and public laws such as TSCA, OSHAct, and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).[274] For example, when CERCLA, commonly known as Superfund, was enacted in 1980 Congress declined to include statutory remedies for personal injuries.[275]

The definition of "toxic" varies, but is generally broader in legal use than it is in medical or scientific use. Toxic torts share several important and unique characteristics: [276]

- *Exposure to a toxic substance:* Claims usually result from the "release of and exposure to – or threatened release of and exposure to – one or more substances alleged to be toxic." The damage can be to a person or to property, and exposure can occur in many different ways, such as absorption, contact, ingestion, inhalation, implantation, or injection. Further, the exposure can be knowing, as with a prescriptive drug, or unknowing, such as a contaminated drinking water supply. Substances involved in toxic tort actions are typically those already regulated by the federal government.

- *Latency period*: Toxic tort cases can be uniquely challenging because the effects of exposure are usually not immediate. The classic example is asbestos, for which latency periods of 10 to 30 years are common. For this reason, states have had to change their statute of limitations for toxic exposure cases.

- *Scientific uncertainty and causation problems:* Developing a causal link between an exposure and the injury can be extremely difficult. Some diseases, like leukemia, exist at a background level in the population, and not just in people exposed to a specific chemical. Long latency periods also mean there could be other factors, and it is also difficult to gather evidence of an exposure that occurred decades ago. Finally, science is still unable to link many illnesses to their specific causes.

- *Reliance of expert scientific testimony:* While a general practitioner might be a sufficient expert witness for a traditional personal injury case, in toxic exposures cases, a treating physician is unlikely to know the cause of the illness or even about the exposure itself. Plaintiffs must often rely instead on statistical information and laboratory study results. Further, toxic tort claims can require testimony from numerous experts, making litigation very time consuming and costly.

- *Risk:* Risk is increasingly being accepted as a basis for claims. Plaintiffs and defendants frequently rely on statistical models that estimate the level of risk of illness from exposure to a substance.

- *Massive scope:* Toxic tort lawsuits often involve exposure affecting many people, either over a long period of time under a variety of circumstances (e.g. asbestos) or at the same time under the same circumstances (e.g. the attacks of September 11, 2001, when numerous people were exposed to a mix of chemicals, asbestos, and other substances. Judges are faced with decisions to make about the appropriateness of class action, or whether or not future claimants should be included in a settlement or judgment.

Why This Matters to Retailers
Example toxic exposure scenarios that might result in a toxic tort claim against a retail store might include:

- A customer is exposed to a toxic chemical in a retail store
- The retailer illegally disposes of chemicals
- An employee is exposed to a toxic chemical in a store, office, distribution center, or manufacturing facility

The first case is relatively unlikely, mainly because customers do not spend very much time in a store compared to the time they spend at home or at work. The chemical hazard level would have to be quite high in order to cause personal harm from only brief exposure and retailers typically do not carry extremely hazardous chemicals. That said, the number of cases of "multiple chemical sensitivity" is on the rise, and that could change the landscape for retailer responsibilities in the future.

Employees spend a significant amount of time in the work environment. However, employers are generally relatively safe from toxic tort claims because workers' compensation was created to handle most work related injuries and illness. Employees making workers' compensation claims are prohibited from bringing tort actions against their employers.[277] The exceptions typically occur when there is intentional misconduct on behalf of the employer. Intentional conduct standards vary by state, but the bar is typically fairly high.[278]

Appendix D: Current Industry Approaches to Chemicals Management

This section describes a variety of chemicals management methods and tools in use today, from regulatory to proactive. In particular, the four highlighted are:[279]

- *Material Safety Data Sheets*: product chemical safety and hazard information sheets prepared by a hazardous chemical or product manufacturer or importer

- *Restricted Substances Lists*: lists of chemicals (regulated and/or non-regulated) that a company prohibits its suppliers from incorporating into products

- *Standards, Certifications, and Labels*: standards that evaluate products against existing criteria and specifications, providing a stamp of approval that the products meet a high standard of environmental responsibility

- *Third Party Evaluation Tools*: systems that evaluate products against a large set of regulatory lists and scientific studies using customized software and extensive databases

We have deliberately kept the list of tools available short for several reasons. First and most important, these tools are most relevant to REI operations given that they allow users to analyze the chemicals present in noncommercial goods and building materials, two of the main components of operations that REI must address as part of any chemicals management plan. In addition, each tool was cited by at least one of the expert stakeholders interviewed for this project who have extensive experience analyzing chemical use in an industrial or commercial setting. Finally, although the tools have varying levels of complexity, all are specifically designed to facilitate the process of chemicals assessment; in other words, they provide a level of automation in the way that they allow users to easily assess ingredients and materials based on multiple authoritative lists of chemicals of concern.[280]

Material Safety Data Sheets (MSDSs)

A Material Safety Data Sheet (MSDS) is an information sheet prepared by a hazardous chemical substance or product manufacturer or importer. It is required by national health and safety guidelines in individual countries (such as OSHA in the United States). It describes the physical and chemical properties of a product, allowing a company to communicate information about that chemical that can then be used to protect workers during storage, handling, and use of the chemical. The laws governing MSDSs differ between countries.

In the U.S., chemical manufacturers and importers are required to obtain or develop an MSDS for each hazardous chemical they produce or import. This is defined as any chemical that comprises 1% or more of a product’s makeup, or greater than 0.1% if the chemical is a known carcinogen. Employers – including retailers whose employees regularly come in contact with potentially hazardous chemicals – must have MSDSs available in the workplace for any hazardous chemicals present.[281] These sheets are used primarily in occupational settings for chemical substances or mixtures and the products that contain them. Throughout the supply chain, an MSDS is typically the only document available for communicating and understanding hazard and toxicity data for a chemical ingredient.

Evaluation

MSDSs are the first step in a corporate health and safety program. Many companies do not pursue additional levels of chemicals management beyond this compliance step. However, several challenges with MSDSs limit their effectiveness as a risk management tool. Some of these challenges are:[282,283]

- Only those hazardous ingredients making up 1% or more of a product are required to appear on an MSDS (except for known carcinogens, for which the threshold is 0.1%)
- OSHA allows companies to apply for trade secret or proprietary information exemption for certain products, sometimes resulting in only partial product transparency
- MSDS typically lack sufficient chemical ingredient information and toxicological data for companies to effectively assess alternatives
- MSDS were primarily designed to provide information on acute occupational health hazards, as opposed to those throughout an entire product life cycle

Restricted Substances Lists (RSLs)

According the Green Chemistry and Commerce Council, "many retailers begin their efforts to improve product chemicals management with the development and use of an RSL."[284] A Restricted Substance List (RSL) is an inventory of the chemicals that an organization does not want in its own products or in the products it purchases. RSLs are developed by individual companies as well as by government agencies, NGOs, trade groups, and working groups.[285] The criteria used to create RSLs vary by organization. The most commonly listed chemicals are those that fall into one of the following categories: "acute human toxicity, carcinogenicity, mutagenicity, reproductive toxicity, endocrine disruption, ecotoxicity, and persistence and bioaccumulation."[286] Some RSLs include only chemicals that are regulated while others also include chemicals of concern that are not yet regulated. Additionally, some chemicals are restricted completely, while others are allowed to appear in products up to a specified maximum level.

After developing an RSL, some organizations use them only internally while others also make them publicly available.[287] RSLs are typically used as a guide for procurement staff and suppliers regarding which chemicals to avoid. In the most basic scenario, products containing chemicals appearing on an RSL are monitored while an organization works with its suppliers to find acceptable alternatives. In the best case scenario, the organization is able to work with a supplier to entirely eliminate the use of a chemical or the organization is able to find an suitable substitute on the market that does not contain the particular chemical.

Evaluation

An RSL provides companies with a public method for ensuring product safety and responsibility above and beyond what is legally required. It does so at a lower level of detail than the approaches mentioned later in this section, but also at a lower cost to the purchaser (which shares the burden with suppliers). Since they are more restrictive than MSDS and apply to a much wider range of products as defined by the purchasing company, RSLs can in turn be expensive to comply with. Therefore, it is best if suppliers take on the responsibility to do product testing, given that they have a much deeper understanding of the material inputs to a product. Complying with an RSL also adds time to the procurement cycle, given the additional due diligence it requires.

Examples

American Apparel & Footwear Association (AAFA)
The AAFA, a national trade association, developed and updates an RSL through its Environmental Task Force. The RSL was developed to help apparel and footwear companies, including retailers, develop responsible chemical management practices, specifically in the home textile, apparel, and footwear industries. It contains only legally regulated chemicals, but tracks regulations from around the world, including chemicals of concern that are currently only tracked by a small number of governments. Retailers that use the AAFA's RSL for their commercial product supply chain include The Gap, H&M, and Timberland.[288]

H&M
H&M has an RSL for commercial goods, but has also started to develop an RSL for noncommercial goods.[289,290] A select number of noncommercial goods suppliers have signed on to the RSL as part of their contract with H&M, and the company intends to increase the number of suppliers in the near future.[291] By doing so, H&M has shown that retailers are capable of looking outside of the product supply chain and into operations when seeking to improve chemicals management processes.

Standards, Certifications, and Labels

Description
This category describes standards that evaluate products against a set of criteria and specifications, providing a stamp of approval that products meet a high standard of environmental responsibility. Suppliers take on the responsibility of achieving certification. These standards are developed by third party organizations, both for and nonprofit, and are typically valid for a designated period of time before requiring renewal. Most standards are updated regularly, based on the latest research on toxic chemicals by toxicologists and industry experts.

Evaluation
Certifications and labels provide relatively easy to understand confirmation that a product meets a certain standard. However, given that they must be applicable across product categories or industries, they are typically not customizable to a particular company's needs. Furthermore, certifications are often focused on one category of products, such as cleaning products or building materials, thereby requiring companies to manage multiple certifications in order to cover their wide array of products.

Design for Environment[292]
The U.S. EPA's Design for Environment (DfE) program works with industry, environmental groups, and academia to provide critical information to consumers and companies regarding the chemical safety of products. It evaluates both the human health and environmental concerns associated with chemicals and processes. DfE certifies cleaning products that meet its standards by giving them a DfE label through its Safer Product Labeling Program; to date, more than 2,700 products have been given DfE approval.[293] It is regarded as one of the easiest methods to use and understand with regards to chemicals management, because companies can simply purchase products that have been DfE certified without having to invest more resources in understanding the details behind the certification.[294]

DfE provides several benefits:

- Uses the EPA's chemical expertise and resources to determine and recognize products that can be considered safe for human interaction;
- Defines best practices for particular processes, including auto refinishing, nail salon safety, and the installation of spray polyurethane foam in buildings;
- Continuously identifies safer alternative chemicals through a rigorous alternative assessments program.

The DfE label covers a long list of products, including all-purpose cleaners, automatic dishwasher products, carpet cleaners, conversion coatings, degreasers, dish soaps, floor-care products, graffiti removers, granite/stone cleaners, hand soaps, inkjet printing products, laundry products, kitchen/countertop cleaners, leather cleaners, metal cleaners/polishes, odor-removal products, pavement treatments, toilet bowl cleaners, upholstery cleaners, window/glass cleaners, and wood cleaners.[295] A purchasing retailer need not do anything besides request from its suppliers that any products procured be certified with the DfE label.

Although the DfE label allows purchasers to find products designed with "innovative, high-performing ingredients with the lowest inherent hazards," as of 2012 it still only applied to the cleaning products mentioned above (as opposed to building materials, paints, etc.).[296] Therefore, given that REI Operations also includes building materials, paints & solvents, and furniture, DfE alone would not be sufficient for managing and tracking chemicals within the entire scope of REI Operations. However, it provides an easy and relatively practical method for chemicals monitoring, and requires very little upfront knowledge on the subject.

<u>LEED Certification</u>

Leadership in Energy and Environmental Design (LEED), a building certification program offered by the U.S. Green Building Council (USGBC), provides building owners and operators with tools and a framework to identify and implement green building practices. Using a points-based system, LEED certification provides third party verification that a building "was designed and built using strategies aimed at achieving high performance in key areas of human and environmental health: sustainable site development, water savings, energy efficiency, materials selection and indoor environmental quality."[297] Buildings attain levels of LEED certification (certified, silver, gold, or platinum) by earning points based on a set of performance criteria.

Until early 2012, LEED certification contained two pilot credits – credits that serve as testing grounds for ultimately making their way into the official LEED certification system – related to chemical avoidance. As of March 2012, the USGBC combined these two credits to create one: Pilot Credit 54, entitled "Avoidance of Chemicals of Concern in Building Materials." This credit rewards projects that avoid building materials containing chemicals that can damage air quality, human health, and the environment, with a particular focus on toxic chemicals that are specifically linked to cancer and reproductive issues.[298] Similarly, Pilot Credit 62 is another new credit which emphasizes product transparency; it rewards projects that seek transparency from their suppliers, demanding disclosure of chemical compounds that meet Clean Production Action's Green Screen v1.2 Benchmark 1: Avoid Chemicals of High Concern criteria (see next section).[299]

As of June 2012, the introduction of the proposed LEED credits had been postponed for a year past their intended date due to concerns from the plastics, vinyl, and chemical industries that they are excessively restrictive and could eliminate hundreds of existing products in construction projects.[300]

Given that companies obtain LEED certification by accumulating credits, the credits mentioned here are primarily designed for and relevant to companies seeking LEED certification, such as the U.S. government's General Services Administration, which requires that any new building it builds be at a minimum LEED Gold certified.[301]

BlueSign
BlueSign is a certification system designed specifically for the textile manufacturing supply chain. It assesses the human and environmental health impacts of the products and processes that a manufacturer is responsible for, with criteria based on the lifecycle toxicological and ecological risks of the substances used as inputs to the manufacturing process. It uses national and international regulations on chemicals, such as REACH, to identify chemicals of concern. Products meeting all of the stringent BlueSign criteria are then validated with a BlueSign certificate of approval. Like most certifications, it is specific to one industry (textile), and requires significant investment from companies seeking compliance.[302]

Third Party Evaluation Tools

Third party evaluation tools allow companies more flexibility than certifications to evaluate chemicals within their commercial and noncommercial good supply chains or operations. These tools typically contain extensive databases made up of chemicals data generated by governments, scientific bodies, or academic studies. The tools are then capable of evaluating chemical ingredients in specific products against the data contained in their databases.

Unlike labels and certification programs, which provide a stamp of approval, these tools are more customizable and resource intensive to manage. They allow manufacturers and purchasers to evaluate the chemical makeup of thousands of products, customize criteria and weightings, and compare products, based on specific criteria, to make informed decisions about the makeup of products or materials.[303]

According to the Green Chemistry and Commerce Council,

> These third party evaluation systems can be used in a variety of ways. They are useful to ensure compliance with current regulations, and some of these tools can be used for comparing alternative chemicals to determine if a safer choice is available. When customizing these systems, a retailer must decide what types of hazard end points the tool will evaluate and how it will evaluate these end points – what authoritative lists of chemicals of concern will be used, what the criteria for evaluating the end points are, what the weighting and scoring of criteria are, and whether the scores are combined into a single score representing multiple reviewed end points.[304]

Examples

Green Screen for Safer Chemicals
The Green Screen for Safer Chemicals is a free, science-based method for comparative Chemical Hazard Assessment developed by Clean Production Action. Companies can use the Green Screen to identify chemicals of high concern, compare and rank the chemicals along a hazard index, and identify safer alternatives. Based on international regulations, hazard lists, and scientific literature, it utilizes 18 hazard end points to create a four stage benchmarking process, leading companies to eliminate toxic chemicals from their products.

Pharos Project
The Pharos Project is an open source evaluation system for a comprehensive list of building materials provided by the nonprofit Healthy Building Network. The tool contains the Building Product Library (BPL) and the Chemical and Material Library (CML). The CML contains specifications, risks, and hazards regarding nearly 20,000 chemicals; each product in the BPL is scored on a variety of environmental and health impact categories, and subsequently linked to its chemical and material ingredients listed in the CML.[305]

The Pharos Project provides several key capabilities. It first serves as a central repository for members seeking to enter or search for products or chemicals by name, keyword, or manufacturer. It then provides a detailed explanation of the contents of each product listed, as well as information regarding the chemicals in those products based on "40 authoritative hazard and warning lists."[306] It also contains a certification library, listing the details of more than 100 common product-related certifications and explaining how each impacts a product or chemical's score in the Pharos database. Finally, the Pharos Project contains a collaborative aspect, allowing members to share product lists and data internally or externally with other companies also using the system.

The Healthy Building Network states that the Pharos Project "does not compete with existing third party product certifications but rather helps [users] understand how to make best use of them in product selection."[307] While the various certifications available on the market address different aspects of the health and environmental impact of products, Pharos provides a repository to compare the risks that are most important to the user. With its extensive libraries that go well beyond common knowledge of toxic chemicals, Pharos allows its users to determine what is aspirational vs. what is realistic, carefully balancing meeting the needs of existing Restricted Substances Lists (RSLs) – in other words, playing catch-up – with defining where a company has the space to innovate and lead the charge.

Of the tools mentioned in this section, Pharos is the most relevant to REI operations given that it is specifically designed to assess the chemical makeup of building materials and paints & coatings. As of summer 2012, the BPL covered thermal insulation, standard paints, resilient flooring, wallboard, ceilings, high performance coatings, MDF/particleboard/wheatboard, carpet, decorative laminates, and adhesives; the Healthy Building Network intends to add wood flooring, roofing membranes, wooden and steel doors, and countertops soon after.[308]

GreenWERCS
GreenWERCS is a software solution that enables retailers and individuals to assess the chemical makeup of chemical intensive products by analyzing "the composition of individual products from ingredient data entered by manufacturers, examining its potential impact on human health and the environment."[309] It uses an ingredient-based visual ranking system that allows manufacturers to identify the human and environmental health impacts of the chemicals found within their products, based on 4,000 sources of data throughout the world.[310] The tool also enables retailers and distributors to begin to identify the chemicals in the products they are selling by increasing the transparency of those products, identifying such components as persistent, bioaccumulative, and toxic substances (PBTs) or endocrine disruptors.

Ultimately, GreenWERCS allows retailers to compare products based on the ingredients input by manufacturers into the system. Using their own customized sustainability goals, retailers can then make the most informed decisions on which products to purchase. This also puts retailers in a position to compare competing products, incentivizing suppliers to replace harmful chemical ingredients with safer ones.[311]

One of the major drawbacks of GreenWERCS is that chemicals that do not appear on any of its associated chemicals of concern lists are not accounted for, thereby suggesting that they are preferable to otherwise safer chemicals. This may be misleading, given that these types of chemicals may not have been sufficiently tested for human and environmental health hazards.[312]

A variety of companies have incorporated GreenWERCS into their operations, the most notable being Walmart, the world's largest retailer. Walmart uses GreenWERCS to assess the chemical makeup of products it sells that may be regulated under U.S. state or federal laws, and to provide guidance for the handling and disposal of chemicals in its products. Other companies, including West Marine, Halliburton, and Allergan Pharmaceutical, also use the tool.[313]

Perkins + Will Transparency Tools

Perkins + Will, an architecture firm with a strong history and reputation in green design, maintains a set of Transparency Lists intended to help architects and designers find alternatives to materials containing potentially harmful toxic chemicals in the design of buildings. The company maintains several lists, including: [314]

- *The Precautionary List*: This list includes substances that have been classified as harmful to human or environmental health by regulatory agencies, and that often appear in buildings. For each chemical, the Precautionary List specifies the known and suspected health effects, the origin, and any potential alternatives available on the market. The main premise of the list is to encourage architects, designers, and those working in construction to apply the precautionary principle when selecting building components, highlighting the uncertainty surrounding the dangers of many of the known toxic chemicals contained in products available on the market.

- *Asthma Triggers and Asthmagens List*: This list identifies Asthmagens – substances that are known to induce asthma – that are often found in the built environment. In particular, the list contains substances that "have identified human health impacts in the manufacturing, installation, and removal processes, as well as in the existing built environment." Much like the precautionary list, this list cites all products in which a chemical may be found; in addition, it links individual chemicals to the disease they cause.

- *Flame Retardants List*: This list identifies flame retardants that are often found in buildings. Perkins + Will states that it is "primarily informational and educational, and helps users understand not only where flame retardants are found in the built environment, but also if identified toxicity levels have a potential impact on human health."

Living Building Challenge[315]

The International Living Future Institute (ILFI) is an international NGO that manages several programs related to green construction. One of those programs, the Living Building Challenge, provides certification, information, and networking opportunities for builders seeking to incorporate sustainability into the built environment. It contains seven performance areas: Site, Water, Energy, Health, Materials, Equity, and Beauty. Buildings and projects are required to satisfy all the requirements of the challenge, which are somewhat simplified compared to comparable certification systems, in order to be certified. Among the ILFI's ambitious goals through this program is a challenge "to all design professionals, contractors and building owners to create the foundation for a sustainable future in the fabric of our communities" – hence the Living Building Challenge.[316]

Although the Living Building Challenge applies to a wide variety of building components outside the realm of chemicals management, many of its attributes are particularly relevant to retail operation buildings. First, it identifies different performance criteria for renovations (i.e., upgrades to components of existing structures), landscaping, and building (i.e., new construction or modification of an entire building). Within this, specific guidelines exist around such factors as air quality and materials. The air quality requirement, for example, stipulates that projects must (among other things) contain proper ventilation of rooms containing particular chemicals, while the Red List requirement stipulates that a project cannot contain any of the chemicals in a list of 14 of some of the most commonly regulated toxic chemicals.

The Living Building Challenge differs from comparable rating programs – most notably the LEED Certification system – in that it assesses buildings based on actual performance, rather than modeled or anticipated outcomes. Furthermore, the ILFI has made its best efforts to keep the requirements simple to measure and maintain by only focusing on the most relevant and high impact criteria.

One of the main drawbacks of the Challenge, however, is precisely the fact that it is so simplified and advanced. The Challenge is specifically designed for buildings that are built and managed by individuals with "leading edge technical knowledge [that are] well versed in advanced practices related to green building." While this simplifies the task of building managers who now need to focus on fewer needs and requirements, it presupposes that extensive sustainability-related work has already been put into a building.

SUBSPORT

The SUBSPORT project is an initiative in Europe aimed at developing an online portal for chemical alternatives assessment. It is jointly managed by several organizations, including two focused on occupational health and safety (The Kooperationsstelle Hamburg IFE GmbH (KOOP) in Germany and the Instituto Sindical de Trabajo Ambiente y Salud (ISTAS in Spain), and another focused solely on toxic chemicals management (ChemSec in Sweden). ChemSec also manages the Substitute It Now (SIN) List, a list of 378 chemicals of very high concern which consists primarily of PBTs and substances that are carcinogenic, mutagenic, or toxic to reproduction.[317]

SUBSPORT's main purpose is to serve as a central location for substance evaluation and alternatives assessment. It is specifically tailored to enabling manufacturers, suppliers, and purchasers to fulfill EU requirements regarding toxic chemicals, which have historically been more stringent and rapidly evolving than U.S. laws. It contains legal information about chemicals, a hazardous substances database, and detailed descriptions of hazardous substance identification criteria. Furthermore, it contains a robust list of case studies of real life examples in which companies have successfully substituted or found safer alternatives to hazardous toxic chemicals.

In addition to providing a chemicals assessment tool, SUBSPORT is similar to several of the other tools listed here in that it is intended to create a strong network of chemical substitution experts through online collaboration, active content development, and forums. It also provides training on key substitution methodologies and alternatives assessment methodologies.

Although SUBSPORT offers a wide variety of resources, it is specifically designed for EU-based companies seeking to comply with EU legislation. Therefore, it is less relevant to U.S.-based companies.

<u>SciVera Lens Chemical Safety Assessment Platform (CSA)</u>
SciVera develops Software as a Service (SaaS) solutions to enable manufacturers, suppliers, and their customers to make scientifically based business decisions. One of their two main products is the SciVera Lens Chemical Safety Assessment Platform (CSA), which gives customers a complete view of the toxicological hazard and risk inherent in a particular product.

CSA allows customers to input a product's full Bill of Materials (BOM) or Bill of Substances (BOS) – which contain the specific raw materials, subassemblies, and components of a particular product – into the CSA system.[318] The application then provides the user with a report detailing any regulatory restrictions, chemicals of concern, potential for exposure, and other related risks related to the chemicals of which the product is composed.

One of the main benefits of CSA is that its scientists review scientific literature, use expert judgment, perform data modeling, and consider exposure in addition to simply keeping track of and inputting information from existing databases and chemicals of concern lists. As a result, it provides a more rigorous and up to date set of data than comparable tools on the market.

Appendix E: Google Case Study

Background

Google, Inc. is one of the most recognizable companies in the world and a leader in the high-technology and Internet search sectors. But while most people are "Googling," they are probably not considering what's in the air being breathed by the company's more than 32,000 employees. Google's management spends a lot of time thinking about indoor environmental quality (IEQ), though, and has charged its Real Estate & Workplace Services Green Team with creating "the healthiest, most productive work environment possible for Googlers around the world." [319] As part of this wide-reaching goal, Google is attempting to eliminate known toxicants from its buildings.

Why does a technology company decide to become a leader in green building?

The story behind Google's recent initiatives to remove toxic chemicals from its built environment begins back in 2007. At the time, a team of University of California-Berkeley researchers was working on the Black Cloud digital learning curriculum in an effort "to bring suspense to environmental studies in high schools." As part of the curriculum, air-quality sensors were hidden at environmentally critical locations in students' neighborhoods, and students were asked to track them down by learning to associate air-quality data with human activities in specific locations.[320] The Black Cloud team visited Google headquarters for a presentation and brought some of the sensors with them. Google co-founder Larry Page was so intrigued that he borrowed a sensor and performed some basic tests in his own company's buildings. He discovered volatile organic compounds (VOCs) in the air, but no one knew the source or sources. Although VOCs are commonly found in buildings, it made the people at Google wonder: "Why should we have to worry about air quality in our workspace? How can we eliminate the dangerous things in the air?"

In 2009, the Living Building Challenge published its "Red List" – a list of materials and chemicals that should be phased out of use due to health and toxicity concerns.[321] Google combined this list with the U.S. EPA's priority list of chemicals and planned a pilot project to address the issues that intrigued Larry Page.[322] The company's first pilot project took place in 2010, and it was soon discovered that the

International Living Building Institute's
Living Building Challenge Red List:

Asbestos
Cadmium
Chlorinated Polyethylene and Chlorosulfonated Polyethlene
Chlorofluorocarbons (CFCs)
Chloroprene (Neoprene)
Formaldehyde (added)
Halogenated Flame Retardants
Hydrochlorofluorocarbons (HCFCs)
Lead (added)
Mercury
Petrochemical Fertilizers and Pesticides
Phthalates
Polyvinyl Chloride (PVC)
Wood treatments containing Creosote, Arsenic or Pentachlorophenol

Source: International Living Building Institute. "The Standard." April 2010. Living Building Challenge. 23 March 2013 <https://ilbi.org/lbc/LBC%20Documents/lbc-2.1>.

Action Plans Issued by EPA:

Benzidine Dyes
Bisphenol A (BPA)
Hexabromocyclododecane (HBCD)
Methylene Diphenyl Diisocyanate (MDI)
Nonylphenol and Nonylphenol Ethoxylates
Perfluorinated chemicals (PFCs)
Penta, octa, and decabromodiphenyl ethers (PBDEs) in products
Phthalates
Short-chain chlorinated paraffins
Toluene Diisocyanate (TDI)

Source: Existing Chemicals Action Plans. U.S. Environmental Protection Agency. 23 March 2013. <http://www.epa.gov/oppt/existingchemicals/pubs/ecactionpln.html>.

biggest barrier to success was lack of information in the marketplace about the chemical compositions of building materials and products. Despite the challenges, before the end of 2010 Google made Red List compliance a requirement for all North American construction and building projects. The requirements went into effect globally in 2012.

Google's Approach

Google developed the *Healthy Materials Program* to identify and select products and materials for all new construction or renovation projects.[i] The program included a robust screening process to determine which products adhere to Google's requirements, which was built upon three main platforms:[323]

(1) *Disclosure:* All vendors are required to provide product ingredient information to Google for every point in the supply chain through a standardized questionnaire.[ii]
(2) *Public Transparency:* Vendors that manufacture products that are addressed in the Pharos Project database are then required to share the information through the Pharos Project, an open-source building materials evaluation platform.
(3) *Toxics Elimination:* Google based its toxicant elimination practices upon the precautionary principle.[iii] The list of prohibited chemicals was developed from existing, credible sources. The primary sources were the EPA's Chemicals of Concern list and Living Building Challenge's Red List.

Any vendor seeking to supply materials to Google must meet all three elements. Any time there is a product category for which no vendors are able to fully eliminate toxicants, Google selects a vendor that is at a minimum willing to disclose ingredients through the Pharos Project. Since Google made it a requirement in 2010, everything the company has built in North America since then has been through this screening process.

Rationale

Google's ultimate goal is to eliminate potentially hazardous chemicals and toxicants from the work environment. Anthony Ravitz, Google's Real Estate and Workplace Services Green Team Lead, said the company's decision to take on these goals was driven primarily by its "focus on the health and vitality of its employees." Avoiding illnesses from potentially dangerous materials sounds simple enough, but it's difficult to know everything that's in materials like carpet and paint. "We need better transparency," Ravitz said. "We don't have complete information about what's in our products. It's not readily available. Until we have that, it will be difficult to make the best decisions."[324]

Rather than filling the information gaps by utilizing risk-based assessments, which require significant scientific expertise related to human health, toxicology, chemistry, and biology, robust conclusive data (which largely does not exist), and considerable resources to conduct such

---

[i] Google does not currently apply this process to existing building materials because it is often challenging to identify and impractical to replace many building materials after construction. For example, removing all PVC (polyvinyl chloride) plumbing would be extremely expensive and disruptive to business activities.
[ii] The questionnaire is publicly available at: https://docs.google.com/spreadsheet/viewform?formkey=dDV2WmNQa0Fsc1lNZDRMR0FlZHUyNXc6MQ
[iii] According to the Science and Environmental Health Network, "all statements of the Precautionary Principle contain a version of this formula: When the health of humans and the environment is at stake, it may not be necessary to wait for scientific certainty to take protective action." (Precautionary Principle. Science & Environmental Health Network. 28 December 2012. <http://www.sehn.org/ppfaqs.html>.)

assessments on a vendor-by-vendor basis, Google opted instead to pursue a simplified precautionary approach. This approach identifies chemicals of concern and essentially dictates that those chemicals are not to be included in Google construction projects. The list of sources comes from credible bodies, thus eliminating the need to develop chemicals expertise internally.[325]

Results

The Healthy Materials Program enabled Google to drastically reduce the use of common toxic chemicals, such as mercury and lead, in new construction, while only using paints, sealants, adhesives, carpets, and furniture with the lowest possible levels of VOCs and other chemicals of concern. Google recognizes it is nearly impossible today to completely eliminate toxicants from its work environments, and therefore focuses on improving transparency and disclosure. Like the small but growing contingent of companies addressing chemicals impacts in operations or the supply chain, Google hopes transparency will stimulate greater demand for toxicant-free products.[326] The main challenge remains access to information in the marketplace, which is precisely what Google is hoping to change through its program.

One of the other challenges with the Healthy Materials Program is its cost, since it requires project teams to spend significant time to issue, compile, and evaluate disclosure documents from all vendors. Ravitz reported that construction costs have indeed increased. However, Google's continued commitment to the Program is evidence that the costs have not been prohibitive and that the company still believes it will result in noticeable increases in employee productivity and decreases in health care expenses.

Another key lesson from the program is that the change to Red List elimination required significant training for its construction, design and development teams. Initially, Google directed architects and contractors to avoid products containing the chemicals of concern; however, the teams struggled because they had no prior experience obtaining this information, and no established method to do so. As a result, Google learned that it needed to equip its design teams with questions to ask and provide suggested alternative products from the outset.

The Future

Google constructs new buildings at an astonishing pace, which gives suppliers an incentive to provide Google the information it asks for.[327] In some product categories, though, there are still few alternatives for those in the market for sustainable, toxicant-free building materials and Google knows it cannot single-handedly transform the building-materials industry. Therefore, it encourages other organizations to join it in sending a clear market message to manufacturers and collaborates with other companies and non-profit stakeholders to increase transparency and improve standards.[328]

In late 2012 Google was involved in two major announcements made during the U.S. Green Building Council's (USGBC) Greenbuild Conference & Expo, the world's largest such event dedicated to green building. The first announcement was a $3 million grant from Google that "will focus on three areas that will spur the creation of healthier indoor environments and encourage market transformation in the building materials industry: supporting research on building materials and health, developing new transparency tools, and engaging stakeholders from across the industry."[329] The other was regarding the launch of the Healthy Product Declaration Collaborative's first open standard format for reporting content and hazards in building products. Google is one of the Collaborative's 46 founding sponsors and Ravitz volunteers on its Board of Directors.[330]

Google believes there are clear benefits for companies to join them. The first risk factor Google lists in its annual report highlights just how important employee productivity is to the company's success: "We face intense competition. If we do not continue to innovate and provide products and services that are useful to users, we may not remain competitive, and our revenues and operating results could be adversely affected."[331] Google attracts top talent in many ways, but it undoubtedly gives itself a competitive advantage by working toward a toxicant-free work environment. While the benefits are difficult to quantify, a healthier, safer work environment could pay great dividends by allowing Google to continue attracting and retaining employees in the future. Furthermore, Google sees its effort as part of a larger opportunity to push the broader market for building construction and maintenance in a safer, cleaner, and toxicant-free direction over time.

Appendix F: Kaiser Permanente Case Study[332]

Background
Kaiser Permanente, a nonprofit organization based in Oakland, California, is the largest integrated healthcare delivery program in the United States, serving 8.6 million members and employing roughly 172,000 people across more than 450 facilities.[333] Its vision is "to be a leader in total health by making lives better" and the company takes a holistic view of healthcare, recognizing the need for preventative care and fully healing environments.[334]

Why did Kaiser Permanente decide to address chemical content in purchased products?
Kathy Gerwig, Kaiser Permanente's VP of Workplace Safety and Environmental Stewardship, remarks, "We spend billions of dollars every year on products. Yet we suffer the same problems that individual consumers face as they try to buy products that don't contain harmful chemicals. We want to shift the burden of assessing what is safe from downstream users like us to upstream manufacturers."[335]

Kaiser Permanente's Approach
Kaiser Permanente uses Five Guiding Principles in chemicals management. These Guiding Principles align closely with green chemistry approaches supported by Clean Production Action and the OIA.

Guiding Principle 1: Understand product chemistry
Kaiser Permanente resolves the lack of a standard definition of "chemicals of high concern" by outlining its own list: PBTs, halogenated flame retardants, phthalates, PVC, BPA, latex, mercury, and all chemicals listed as carcinogens and reproductive toxicants under California Proposition 65 are included. Given its sizable purchasing power, Kaiser Permanente requires suppliers to disclose whether a product contains chemicals of high concern within contract proposals. It also asks suppliers whether safer alternatives are available. Kaiser Permanente recognizes that this is a high touch approach, necessitating a great level of supplier oversight and education, and trains its purchasing staff accordingly.

Kaiser Permanente recently implemented a sustainability scorecard to gain a clearer understanding of its product chemistry. In addition to questions regarding waste, energy, recycling, and other common environmental concerns, the scorecard asks: "Do you have a commitment to know all of the chemical and material ingredients, above 100 ppm, of products sold by your company and its subsidiaries in the United States? If yes, is the list publicly available or available through a third party?" The scorecard requires vendors to answer stock keeping unit level questions regarding specific chemicals of high concern as well.

Through rigorous supplier engagement, Kaiser Permanente is able to gain substantial insight into the ingredients and materials involved in the products it purchases.

Guiding Principle 2: Assess and avoid hazards
Once the supplier relationship has been established and product chemistry understood, Kaiser Permanente works with its supply chain to reduce risk. Kaiser Permanente asks that suppliers eliminate hazardous chemicals wherever possible, substituting safer alternatives and minimizing exposure. Additionally, Kaiser Permanente "encourages suppliers to … redesign products and processes to avoid the use and/or generation of hazardous chemicals"[336] Further, Kaiser Permanente urges its vendors to address Scope 3 impacts of toxic chemicals further into the tiers of its supply chain.

SKU level questions related to chemicals	Yes/No
Designed or sized for neonatal or pediatric applications?	
Free of intentionally added latex in any material touched by patients or practitioners?	
All homogenous electronic parts compliant with all EU RoHS Directive's restricted limits (excluding exemptions)?	
Free of intentionally added Bisphenol A or Bisphenol A derived chemicals (including thermal paper)?	
All homogenous materials contain less than 1000 ppm of bromine and chlorine- based compounds?	
Free of Polyvinyl Chloride?	
Free of any intentionally added phthalate, including DEHP6?	
Free of any intentionally added California Prop 65 Chemical greater than threshold or warning level? If no to (A), List Chemical Abstracts Service (CAS) #'s (separated by ",")	
Does not create OR become hazardous waste on its own or when aggregated?	
Free of intentionally added antimicrobial/ antibacterial agent?	

Guiding Principle 3: Commit to continuous improvement
Kaiser Permanente uses its framework to evaluate both product and process chemistry, and guide purchasing decisions accordingly. The company helped promote industry progress on safer chemicals by contributing to the development of the Green Guide for Healthcare.

Guiding Principle 4: Support industry standards that, in Kaiser Permanente's opinion, eliminate or reduce known hazards and promote a greener economy, including support for green chemistry research and education

Guiding Principle 5: Inform public policies and be part of the public dialogue that advances the implementation of the above principles

Rationale
According to Healthy Building Network, "Chemicals of concern … affect the health and productivity of staff; the healing environments for patients and visitors; and our communities and planet. Lifecycle emissions from the extraction, production, use, and disposal of the materials, up and down stream, affect healthcare system members/patients, visitors, staff, and the larger community's health in their homes, offices, and at play."

As an integrated healthcare company, Kaiser Permanente understands the importance of robust measures to mitigate these risks. The company views green chemistry as an valuable tool in building overall community health: "Our commitment to preventative health care leads us to be concerned with the use of toxic chemicals in products."

Results
To date, Kaiser Permanente has successfully eliminated chemicals of concern from many of its product categories. It has done so by identifying and choosing safer alternatives and even catalyzing new product design. For example, to avoid latex and PVC, Kaiser Permanente purchases nitrile exam and surgical gloves. With this switch, Kaiser Permanente vastly expanded the market for and lowered the cost of nitrile gloves across industries.

Similarly, in 2004 Kaiser Permanente announced its commitment to avoid PVC in facilities and supplies. Partnering with the Healthy Building Network, the company issued a challenge to create a safer alternative in carpeting materials. Manufacturer Collins & Aikman (C&A) rose to the occasion, developing a new line of carpet with an alternative backing made of recycled and recyclable PVC-free plastic.[337] C&A was awarded an exclusive contract for carpeting Kaiser Permanente facilities, and several other major companies followed with PVC-free options.[338]

In another instance, to achieve 95% mercury-free facilities, Kaiser Permanente pushed for tungsten replacements in several medical devices. There is now mounting evidence, however, that tungsten may also be hazardous to human health. Kaiser Permanente made the decision to switch to a safer alternative based on the information available. This example demonstrates the lack of scientific study and consensus regarding the majority of chemicals, and the corresponding need for a dynamic, flexible, responsive, and proactive chemicals management strategy.

Kaiser Permanente's actions have shown that a sustainability leader with considerable purchasing power can substantially lower barriers for smaller companies to address chemicals impacts. "Kaiser Permanente's commitment to avoid PVC due to its environmental health hazards is helping drive a growing market demand for safer alternatives to PVC that are competitively priced and superior in performance," remarked Tom Lent, Policy Director at Healthy Building Network. "C&A's new PVC-free carpet and Shaw's commitment to stop production of PVC carpet are encouraging signals that manufacturers are responding to customers' increasing concern with the environmental health impact of their products."[339]

The Future

Even Kaiser Permanente recognizes that some external hurdles to chemicals management remain too high: "Despite Kaiser Permanente's purchasing leverage, we experience limitations in achieving our goal of using products and materials that are environmentally sustainable." To facilitate better decision-making and to help elevate external awareness, the company invests in chemicals research. It also works toward progress within the healthcare industry and lobbies for policy change, and Gerwig has testified several times before Congress.[340]

Kaiser Permanente recognizes its successes, and intends to continue building momentum for eliminating chemicals of concern from its supply chain. Tom Cooper, National Manager of Sustainable Building Design and Research, recently said, "Many manufacturers are surprised to learn from our questions how much they don't know about their own products. But we are seeing a profound impact as a result. We are getting safer products without sacrificing quality or price, and that is what is going to really transform the market."[341]

Appendix G: REI Operations Goods Requiring MSDSs

Product	Product
fire ribbon 3.75 oz	Cygolite MiLion 200 LI-USB HMT
century propane cylinder 16.4 oz	Cygolite MiLion 150 LED LI-USB
diamond super match fire starters/safety	Universal Repair Kit
strike anywhere diamond pocket matches	INNOV MOUNTAIN PIPE MTB PUMP
diamond safety kitchen matches	INNOV AIR CHUCK ELITE
lithium AA battery	INNOV PROFLATE 16
MCNETT AQUASEAL	INNOV REPAIR & INFL. WALLET
vittoria mastik one professional rim cement	Kids climbing helmet w/light and batteries
VELOX TUBULAR PATCH KIT	V-Holder Contour HD 1080 pixel Camera
tri-flow aerosol spray 4 oz.	GEAR AID EXPLORER REPAIR KIT
tri-flow squeeze bottle 2 oz.	Gear Aid Camper Repair Kit (Seam Grip)
SEAM GRIP SEAM SEALER	GEAR AID SEAM GRIP .25OZ PAIR
white lightning chain lube 4 oz.	SAWYER PERMETHRIN AEROSOL
crown camp fuel, 1 qrt.	Ultra Belt Accu 4 Headlamp
crown camp fuel, 1 gal	Petzl Accu 4 Battery
crown denatured alcohol 1 qrt.	RipCurl Wet suit w/lithium battery
rei storm matches/safety	Coleman Signature LED Mini Lantern
pedros oranj peelz 16 oz	Sigma BC509 Bike Computer
counter assault aerosol 8 oz.	Sigma BC1009 Bike Computer
tectron exteme sport shoe guard/aerosol	Sigma BC1009 STS Wireless Computer
fire paste 3.75 oz.	Sigma BC1609 STS Cad Wireless
GEAR AID BACKCOUNTRY REPAIR KIT	BC1909 STS Heart Rate / Cadenc
pedro's ice wax chain lube, 12 oz. aerosol	SIGMA BC2209 STS MHR WRLSS CMP
ecotech degreaser aerosol 12 oz.	BENS 30% DEET ECO SPRAY 6.0 OZ
finish line ecotech degreaser 20 oz.	NATRAPEL PICARIDIN PUMP 1.0 OZ
teflon plus dry style lubricant 2 oz.	FINISH LINE CERAMIC WAX LUBE
teflon plus dry style lubricant 4 oz.	FINISH LINE 1-STEP CLEAN/LUBE
teflon plus aerosol 8 oz.	BB ULTRA MIST SPORT SPF50 6 OZ
snow peak giga power fuel 110 grams	Earthmate PN-60w GPS with Spot/ 4 lithium metal batteries
Universal Klister Aerosol 150ml	Earthmate PN-60 GPS
MSR isopro canister, 8 oz	Go-Pro Rechargable Battery
esbit pocket stove w/fuel tablets	Battery Bakpac
esbit solid fuel tablets	Nite Ize Task Lite LED Headlamp (White)
park chain gang cleaning kit(includes 8 oz. bottle)	Magellan Explorist GPS (Gray/Green)
white lightning clean streak 14 oz.	#ZEFAL CO2 CARTRIDGE 2 PK.
innovations big air-1 pk. 86 g	F4 Liquid Fluoro Wax
snow peak giga power fuel, 220 grams	BD Ascension Gold Label Adhesive
tectron wet guard aerosol 11 oz	coleman Go Ready Hand Sanitizer
shoe glue	Expilion 250 USB Bike Light
Valve Kit	Pressure Drive Cfh Pump w/C02 cartridge
NYLON TENT REPAIR KIT	Ziplit
eveready lithium AA battery 4 pk	Quicksilver vest w/batteries
MCNETT AQUASEAL & COTOL 240	Quicksilver vest w/batteries
coleman fuel, I gallon	Quicksilver vest w/batteries
KATADYN MICROPUR TABLETS	Minewt 350 Bike Light
MSR isopro canister, 4 oz	Pro 700 LED Bike Light
ultraflate plus/16g C02 cylinder	Stella 300
citrus biosolvent cleaner 20 fluid ozs.	Stella 400 Dual
duracell lithium 2032 coin cell	Seca 700 Race
duracell lithium 2016 coin cell	Expilion 180 USB Bike Light
original white lightning lube 8 oz.	Mitycross 320 Bike Light

base cleaner 1000ml	Mitycross 400 Bike Light
swix F4 glide wax aerosol 150 ml	Trident X 600 Bike Light
powered inflation kit road	Apex Pro 10 Headlamp
white lightning epic lube	Atc 9k Helmet Camera/Lithium-Ion Outside Unit
Banana Boat sport spray spf 30	Cxr725 2-Way Radios
ultraflate patch kit	Cxr925
duracell 123 lithium battery 2 pk	HERO 960 HD,
duracell lithium 2430 coin cell	Hd Hero Naked, None
primus power gas 220 gram canister	Nite Ize Domelit LED
primus power gas 450 canister	Explorist 510 Gps
energizer AAA lithium battery 4 pk.	Explorist 610 Gps
energizer AAA lithium battery 2 pk	Explorist 710 Gps
msr super fuel 1 quart	Bug-Eye Headlight for Kids (Loose lithium)
bear counter assault 290grams	Contour GPS, BLACK
mini c02 tire inflator	Safety Kitchen Matches
innov. Proflate 16	Seca 900 Race C
chain cleaning kit	Seca 700 Race C
white lightning trigger chain	JetPower Crunchit Fuel 100 gram
finish line speed clean	Lithium Battery For Atc9K
AMK MTN COMPREHENSIVE 1ST AID/with matches	JetPower Fuel 450 gram
JET POWER FUEL	Fluid Belt Pack With C02 Cartridge
REI SLEEPING PAD REPAIR KIT	Helios PFD With C02 Cartridge
Primus Power Gas	RK5 Rearm Kit 24 gram C02 Cartridge
PA CHLORINE DIOXIDE TABS 20-PK	Sherpa 50 Battery
PA CHLORINE DIOXIDE TABS 30-PK	Sherpa 50 Adventure Kit
HART BENZOCAINE BURN SPRAY .5O	Emergency Kit With Safety Matches
duracell 2025 coin cell lithium	Emergensy Kit With Safety Matches
finish line metro cleaner aerosol 12 oz.	Emergency Kit 2 Person 2 With Matches
KATADYN MICROPUR 20-PACK	Watershield, 10.5 Oz aerosol
Time and Temperature Digital D	Kevlar Skid Plate Kit
NOVARA PATCH KIT	Centauri 1000 Bike Light
tectron spray deodorizer	HD Lithium-Ion Battery
LIFELINE WATERPROOF SURVIVAL KIT	Natural Insect Repellent Pump
INNOV 2ND WIND ROAD AL MINI	Lemon Eucalyptus Pen Sized Pump
INNOV 2ND WIND ROAD CARBON	Natural Insect Repellent Pen
HART TINCTURE OF BENZOIN 1 OZ	Connect
REI REPAIR KIT - SLPING PAD	Explorist 310 GPS
Boeshield T-9 lube	Stormproof Match Kit
INNOV MICROFLATE NANO W/16G CT	Primus 250 Gram Butane Fuel Cartridge
PARK CITRUS CHAINBRITE 16 oz.	Yak Glue Inside Bilge Pump
Tectron Sno seal 7 oz.	Celestron Trekguide Compass
CR123 LITHIUM BATTERY 2-PK	Battery CR2016 3V CoinCell 2Pk
JETPOWER FUEL 230 GM	Battery CR2025 3V CoinCell 2Pk
Coleman EXP CR123 Packaway LED	Battery CR2032 3V CoinCell 2Pk
Petzl Signal	Battery CR2430 3V Coin Cell
12 gram threaded cartridge	Specialty Batteries 123 6 Pk
12 gram nonthreaded cartridge	Specialty Batteries 123 12 Pk
16 gram threaded cartridge	Fitscan Bc577F Body Analyzer
16 gram nonthreaded cartridge	Montana 600 GPS
INNOV 2ND WIND MTB W/16G CT	Montana 650 GPS
Park starter kit adhesive	Garmin Montana 650t GPS
OLD TOWN SKID PLATE KIT	I63 Base Cleaner WScrub 150 Ml
NATRAPEL PICARIDIN 8 HR LOTION	I61 Base Cleaner Aerosol 70 Ml
Garmin Nuvi 500 GPS	Rino 650 GPS
COLEMAN PROPANE W GREEN KEY	Rino 655t
SWIX F4 LIQUID 80MM DAB ON WAX	Minewt Pro 750 Bike Light

Bio-Green Lube 2 oz.	Wide Angle Scuba Seri
SUREFIRE CR123A 6-PK LITHIUM	Expilion 350 USB Rchrgble Lt
SEAM GRIP REPAIR KIT	Expilion 400 USB Rchgble Lt
Showroom Polish Aerosol	Turbo 740 XML LED Bike Light
REPEL MAX 40% DEET AEROSOL 2PK	Turbo Mini 330 Bike Light
LIFELINE UL SURVIVAL KIT/matches	Mitycross 380 OSP Bike Light
Spotsatell (Orange/Black)	Mitycross 480 OSP Bike Light
Spotsatell (Silver)	TridenX 750 OSP Bk Lt
ESBIT EMERGENCY STOVE W/FUEL	Expilion 170 USB Rechrgble Lt
FINISHLINE BIKE WSH-LUBE/AEROSOL KIT	Contour+, SILVER
PEDROS MINI PIT KIT 2.0	GXT5000 Pro Series GMRS, BLACK
SAWYER SUNBLOCK/REPELLNT SPRAY	Stella 600 Dual
SAWYER SUN BLOCK W/REPELLENT	Summit Ser. Video Snow G Class
Petzl Ultra Headlamp (Loose Lithium-Ion Battery)	3 oz. Premium Butane/Lotus Gas lighter refill
Cygolite Mitycross 350 LED HRM	Lemon Eucalyptus Pump 4 Oz.
BUTANE FUEL QUADRUPLE REFINED	Hd2 Outdoor Hero Camera
ORION POCKET ROCKET	Ultraflate Plus CO2 Inflator
MCMURDO 20 C LITHIUM BATTERY FOR PLB	Wireless Gear Alert System
REVIVEX THUNDERSHIELD PRO 5 OZ Aerosol	Extra Gear Tag
INNOV 2ND WIND ROAD CARBONMINI	Extra InCar Alerter
PowerTap Wired Comp System (loose-coin lithium batteries)	20g Threaded Cartridge
SWIX EASY GLIDE LIQUID-	Tire Repair & Inflation Wallet
Kinetic Power Computer Wireless	Proflate Elite Tire Inflator w/ Co2 cartridge
GoPro Digital Helmet Hero	Fenix PD32 2 CR123A Batteries /flashlight
Cygolite Mitycross 300 LED	

Endnotes

[1] Harvey, Michelle. Environmental Defense Fund. Personal correspondence. 14 August 2012.
[2] “Newsroom: REI Announces 2011 Revenues and New Member Growth.” REI, Inc. 14 March 2012. <http://www.rei.com/about-rei/newsroom/2012/rei-announces-2011-revenues-and-new-member-growth.html>.
[3] “REI Overview.” REI, Inc. 12 June 2012. <http://www.rei.com/about-rei/business.html>.
[4] Myers, Kirk. REI, Inc. Personal interview. 28 October 2011.
[5] “GHG FAQ.” Greenhouse Gas Protocol. 14 August 2012. <http://www.ghgprotocol.org/calculation-tools/faq>.
[6] Ibid.
[7] Anastas, P. T., & Warner, J. C. (2000). *Green chemistry: theory and practice*. Oxford University Press, USA.
[8] “Green Chemistry”. Chemistry Explained. 1 December 2012. <http://www.chemistryexplained.com/Ge-Hy/Green-Chemistry.html>.
[9] Ibid.
[10] Cameron, J., & Abouchar, J. (1991). Precautionary Principle: A Fundamental Principle of Law and Policy for the Protection of the Global Environment, The.*BC Int'l & Comp. L. Rev.*, *14*, 1.
[11] “Formaldehyde and Wood.” Healthy Building Network. 4 August 2012. <http://www.healthybuilding.net/formaldehyde/>.
[12] Massey, R. I., & Use, J. G. H. M. T. (2008). *Toxic substances in articles: the need for information*. Nordic Council of Ministers
[13] Ibid.
[14] Ibid.
[15] National Center for Chronic Disease Prevention and Health Promotion. "The Power of Prevention: Chronic Disease ... the Public Health Challenge of the 21st Century." 2009.
[16] Safer Chemicals, Healthy Families. "The Health Case for Reforming the Toxic Substances Control Act." n.d.
[17] Lichterman, Joan. “Preventing Toxic Exposures: Workplace Lessons in Safer Alternatives.” Health Research for Action: Perspectives July 2010.
[18] Ibid.
[19] “Mercury.” United States Environmental Protection Agency. 7 February 2012. 7 June 2012. <http://www.epa.gov/hg/about.htm>.
[20] “Healthy Building Materials.” City of Seattle Department of Planning & Development. 12 June 2012. <http://www.seattle.gov/dpd/cms/groups/pan/@pan/@sustainablebldging/documents/web_informational/dpdp016429.pdf>.
[21] “Enhance Indoor Environmental Quality.” WBDG Sustainable Committee. 10 September 2012. 10 October 2012. <http://www.wbdg.org/design/ieq.php>.
[22] “Employee Well-Being." City of Seattle Department of Planning & Development. 12 June 2012. <http://www.seattle.gov/dpd/cms/groups/pan/@pan/@sustainablebldging/documents/web_informational/dpdp016428.pdf>.
[23] “Indoor Air Facts No. 4 (revised): Sick Building Syndrome.” United States Environmental Protection Agency. February 1991. 7 June 2012. <http://www.epa.gov/iaq/pdfs/sick_building_factsheet.pdf>.
[24] Dadd, Debra Lynn. (2011). *Toxic Free*. New York: Penguin.
[25] Ibid.

[26] Duncan, David Ewing. “The Pollution Within.” National Geographic, June 2006.
[27] “Worst in Class Chemicals.” Healthy Building Network. 2012. 8 June 2012. <http://www.healthybuilding.net/target_materials.html>.
[28] “Overview: Office of Pollution Prevention and Toxics Programs.” Battelle. 12 June 2012. <http://www.chemicalspolicy.org/downloads/TSCA10112-24-03.pdf>.
[29] “What is TSCA?” Safer Chemicals Healthy Families. 28 April 2012. <http://www.saferchemicals.org/resources/tsca.html>.
[30] Chemical Regulation: Comparison of U.S. and Recently Enacted European Union Approaches to Protect against the Risks of Toxic Chemicals. United States Government Accountability Office Report to Congressional Requesters. GAO-07-825. August 2007.
[31] Presentation of Findings From A Survey of 825 Voters in 75 Swing Congressional Districts. Safer Chemicals Healthy Families. 2010. 28 April 2012. <http://www.saferchemicals.org/PDF/resources/schf-poll-final.pdf>.
[32] “The Safe Chemicals Act of 2011.” Safer Chemicals Healthy Families. 28 April 2012. <http://www.saferchemicals.org/resources/safechemicalsactof2011.html>.
[33] Esty, Daniel C. and Andrew Winston. “Green to Gold: How Smart Companies Use Environmental Strategy to Innovate, Create Value, and Build Competitive Advantage.” Yale University Press, 2006.
[34] Greenpeace. “Dirty Laundry: Unravelling the corporate connections to toxic water pollution in China.” 13 July 2011. Greenpeace. 10 October 2012. <http://www.greenpeace.org/international/en/publications/reports/Dirty-Laundry/>.
[35] Besieux, Martin. “Full marks for Marks & Spencer.” Greenpeace. 11 November 2012. 23 November 2012. <http://www.greenpeace.org/international/en/news/Blogs/makingwaves/full-marks-for-marks-spencer/blog/42722/>.
[36] “Toxics Reduction Working Group.” United States Environmental Protection Agency. 8 June 2012. <http://www.epa.gov/columbiariver/trwg.html>.
[37] Werther Jr., William B. and David Chandler. *Strategic Corporate Social Responsibility as Global Brand Insurance.* Business Horizons 48-4, July-August 2005. p. 317-324.
[38] “Employee Well-Being.” City of Seattle Department of Planning & Development. 12 June 2012. <http://www.seattle.gov/dpd/cms/groups/pan/@pan/@sustainablebldg/documents/web_informational/dpdp016428.pdf>.
[39] Wyon, D.P. The effects of indoor air quality on performance and productivity. Indoor Air, v14. August 2004. p. 92-101.
[40] Singh, A., Syal, M., Grady, S. C., & Korkmaz, S. (2010). Effects of green buildings on employee health and productivity. *American journal of public health*, *100*(9), 1665.
[41] First, I., & Khetriwal, D. S. (2008). Exploring the relationship between environmental orientation and brand value: is there fire or only smoke?.*Business Strategy and the Environment*, *19*(2), 90-103.
[42] Hieb, J.M. CH2MHill and Department of Energy. Chemical Lifecycle Management Cost. June 2012.
[43] Hieb, J.M. CH2MHill and Department of Energy. Chemical Lifecycle Management Cost. June 2012
[44] Pacific Northwest Pollution Prevention Resource Center. “Using Regulated Chemicals? Watch Your Profits Evaporate.” March 2008. 25 October 2012. <http://www.pprc.org/pubs/factsheets/laund2.html>.

[45] "Commercial Real Estate Update – Spring 2010." U.S. Green Building Council. 1 June 2012. <http://www.usgbc.org/ShowFile.aspx?DocumentID=7189>.
[46] Insurance Journal. "Fireman's Fund Introduces Green Building Coverage." Insurance Journal. 16 November 2010. 1 June 2012. <http://www.insurancejournal.com/news/national/2006/10/16/73335.htm>.
[47] Lent, Tom. "Meeting the new LEED Pilot Library chemical avoidance credit." Pharos Project. 16 November 2010. 1 June 2012. <http://www.pharosproject.net/blog/detail/id/84>.
[48] "Greening America's School – Costs and benefits." U.S. Green Building Council. 1 June 2012. <http://www.usgbc.org/ShowFile.aspx?DocumentID=2908>.
[49]"Fiduciary Guide to Toxic Chemical Risk." The Investor Environmental Health Network. 12 June 2012. <http://www.iehn.org/filesalt/Fiduciary.pdf>.
[50] Arny, Michael. "The Economics of LEED for Existing Buildings." Leonardo Academy. 12 June 2012. < http://www.nfmt.com/handouts/2009/W221.pdf>.
[51] "REI Overview." REI, Inc. 12 June 2012. <http://www.rei.com/about-rei/business.html>.
[52] Myers, Kirk. REI, Inc. Personal interview. 28 October 2011.
[53] "Chemicals Management: CMWG Vision." Outdoor Industry Association. 10 March 2012. < http://www.outdoorindustry.org/responsibility/chemicals/index.html >.
[54] "Retailer Portal: Tools to Evaluate Chemical Ingredients in Products." Green Chemistry and Commerce Council. September 2011. 1 June 2012. <http://www.greenchemistryandcommerce.org/downloads/RetailerPortal.pdf>.
[55] Ibid.
[56] "OSHA MSDS (Material Safety Data Sheet) Regulations." Environment, Health, and Safety Online. 1 October 2012. <http://www.ehso.com/msds_regulations.php>.
[57] "Retailer Portal: Tools to Evaluate Chemical Ingredients in Products." Green Chemistry and Commerce Council. September 2011. 1 June 2012. <http://www.greenchemistryandcommerce.org/downloads/RetailerPortal.pdf>.
[58] "Frequently Asked Questions." Chemical Safety Associates. 01 June 2012. <http://www.msdsprep-csa.com/FAQ/FAQ.html#Q5>.
[59] "Retailer Portal: Tools to Evaluate Chemical Ingredients in Products." Green Chemistry and Commerce Council. September 2011. 1 June 2012. <http://www.greenchemistryandcommerce.org/downloads/RetailerPortal.pdf>.
[60] "Restricted Substances Lists." Green Chemistry and Commerce Council. 1 June 2012. <http://www.greenchemistryandcommerce.org/RSLnotice.php?rslprods=-14-12->.
[61] "American Apparel & Footwear Association (AAFA) Restricted Substances List (RSL)." Green Chemistry and Commerce Council. 1 June 2012. <http://www.greenchemistryandcommerce.org/retailer.companies.php?prodid=14>.
[62] "Our Conscious Actions." H&M. 1 June 2012. <http://about.hm.com/content/hm/AboutSection/en/About/Sustainability/Commitments/Use-Resources-Responsibly/consciousactions.html>.
[63] "H&M Chemical Restrictions." H&M. 14 December 2009.
[64] "Our Conscious Actions." H&M. 1 June 2012. <http://about.hm.com/content/hm/AboutSection/en/About/Sustainability/Commitments/Use-Resources-Responsibly/consciousactions.html>.
[65] "Design for the Environment: An EPA Partnership Program." Environmental Protection Agency. 1 June 2012. <http://www.epa.gov/dfe/>.
[66] Harvey, Michelle. Environmental Defense Fund. Personal interview. 25 January 2012.

[67] "bluesign standard." bluesign. March 2010. 1 July 2012. <http://issuu.com/bluesign/docs/name2d68c4/2?mode=a_p>.
[68] "Retailer Portal: Tools to Evaluate Chemical Ingredients in Products." Green Chemistry and Commerce Council. September 2011. 1 June 2012. <http://www.greenchemistryandcommerce.org/downloads/RetailerPortal.pdf>.
[69] Ibid.
[70] Harvey, Michelle. "Parting the Chemical Curtain with GreenWERCS." Greenbiz. 27 October 2009. 1 June 2012.
[71] "GreenWERCS". Green Chemistry and Commerce Council. 1 June 2012. <http://www.greenchemistryandcommerce.org/retailer.companies.php?prodid=2>.
[72] "GreenWERCS Case Study: WalMart." The Wercs. 1 November 2012. <http://www.thewercs.com/sites/default/files/walmart_casestudy_final_no_crops.pdf>.
[73] "Pharos." Healthy Building Network. 1 June 2012. <http://www.pharosproject.net/>.
[74] "Pharos: Frequently Asked Questions." Healthy Building Network. 1 June 2012. <http://www.pharosproject.net/about/faq>.
[75] "Environmental Stewardship: Healing the planet with environmental stewardship." Kaiser Permanente. 15 June 2012. <http://info.kaiserpermanente.org/communitybenefit/html/our_work/global/our_work_6_saferchemicals.html>.
[76] Ibid.
[77] "SC Johnson's Greenlist remove 61+ million pounds of VOCs." CSRWire. 16 January 2008. 15 June 2012. <http://www.csrwire.com/press_releases/22883-SC-Johnson-s-Greenlist-remove-61-million-pounds-of-VOCs>.
[78] "Opportunities in Safer Chemicals." Investor Environmental Health Network. 1 July 2012. <http://iehn.org/overview.opportunities.php>.
[79] Inglin, Karen. REI, Inc. Personal interview. 27 October 2011.
[80] Ibid.
[81] Myers, Kirk. REI, Inc. Personal Interview. 28 October 2011.
[82] Nuwer, Rachel. "Check Your Receipt: It May Be Tainted." The New York Times. 1 November 2011. 5 August 2012. <http://green.blogs.nytimes.com/2011/11/01/check-your-receipt-it-may-be-tainted/>.
[83] Ibid.
[84] Ibid.
[85] Ibid.
[86] OIA CMWG Vision. OIA Chemicals Management Working Group. 25 October 2012.
[87] OIS CM Framework Indicators. OIA Chemicals Management Working Group. 3 July 2012.
[88] Ibid.
[89] Myette, Kevin. REI, Inc. Personal Interview. 28 October 2011.
[90] "GHG FAQ." Greenhouse Gas Protocol. 14 August 2012. <http://www.ghgprotocol.org/calculation-tools/faq>.
[91] Ibid.
[92] Ibid.
[93] Myers, Kirk. REI, Inc. Personal Interview. 28 October 2011.
[94] Powers, Joe. REI, Inc. Personal Interview. 28 October 2011
[95] Ibid.
[96] "MSDS 6631CR: DuPont™ Teflon™ Chain-Saver Dry Self-Cleaning Lubricant – Aerosol."

DuPont™ Lubricants & Greases. 8 April 2008. 28 December 2012. <http://msds.dupont.com/msds/pdfs/EN/PEN_09004a35802b4fc7.pdf>.
[97] "Occupational Safety and Health Guideline for Heptane." Occupational Health and Safety Administration. 28 December 2012. <http://www.osha.gov/SLTC/healthguidelines/heptane/recognition.html>.
[98] "Chemicals in the Environment: Cyclohexane (CAS No. 110-82-7)." U.S. Environmental Protection Agency's Office of Pollution Prevention and Toxics. September 1994. 28 December 2012. <http://www.epa.gov/chemfact/f_cycloh.txt>.
[99] "Perfluorooctanoic Acid (PFOA) and Fluorinated Telomers: Frequent Questions." U.S. Environmental Protection Agency. 28 December 2012. <http://www.epa.gov/oppt/pfoa/pubs/faq.html>.
[100] "Bio Green G-10 MSDS." Dumonde Design Group, Inc. 20 April 2008. 28 December 2012. <http://www.dumondetech.com/dumonde/wp-content/uploads/2010/10/G-10-Bio-Green-MSDS-10.13.10.pdf>.
[101] "Review: Dumonde Tech G-10 Bio-Green Chain Lubricant." Competitive Cyclist. 28 December 2012. <http://www.competitivecyclist.com/review-lubricants-maintenance/Dumonde-Tech-G-10-Bio-Green-Chain-Lubricant.1017.html>.
[102] "Seal Hard MSDS." L&M Construction Chemicals, Inc. 23 August 2010. 17 June 2012. <http://www.lmcc.com/products/msds/sealhard.pdf>.
[103] "Technology Transfer Network Clearinghouse for Inventories & Emissions Factors. Emissions Factors & AP 42, Compilation of Air Pollutant Emission Factors: Chapter 11." EPA. July 1998. 18 June 2012. <http://www.epa.gov/ttnchie1/ap42/ch01/final/c01s04.pdf>.
[104] "Natural Gas Combustion." U.S. Environmental Protection Agency Technology Transfer Network Clearinghouse for Inventories & Emissions Factors. July 1998. 28 December 2012. <http://www.epa.gov/ttn/chief/ap42/ch01/final/c01s04.pdf>.
[105] "The Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation Model." Argonne National Laboratory Transportation Technology R&D Center. Version 1, 2011. Argonne National Laboratory. 17 July 2012. <http://greet.es.anl.gov>.
[106] Heath, C., & Heath, D. (2010). *Switch: How to change things when change is hard*. Crown Business.
[107] "Videos About Toxic Chemicals in Our Lives." I Am Not a Guinea Pig. 8 July 2012. <http://notaguineapig.org/what-you-can-do/videos/>.
[108] National Center for Chronic Disease Prevention and Health Promotion. "The Power of Prevention: Chronic Disease ... the Public Health Challenge of the 21st Century." 2009.
[109] "Public Opinion: Americans Want More Protection from Safer Chemicals." Safer Chemicals Healthy Families. 3 February 2012. <http://www.saferchemicals.org/resources/opinion.html>.
[110] James, R. C., Roberts, S. M. and Williams, P. L. (2003) General Principles of Toxicology, in Principles of Toxicology: Environmental and Industrial Applications, Second Edition (eds P. L. Williams, R. C. James and S. M. Roberts), John Wiley & Sons, Inc., Hoboken, NJ, USA.
[111] Ibid.
[112] Ibid.
[113] "The NRC Risk Assessment Paradigm." United States Environmental Protection Agency. 14 October 2008. 15 October 2012. <http://www.epa.gov/ttnatw01/toxsource/paradigm.html>
[114] James, R. C., Roberts, S. M. and Williams, P. L. (2003) General Principles of Toxicology, in Principles of Toxicology: Environmental and Industrial Applications, Second Edition (eds P. L. Williams, R. C. James and S. M. Roberts), John Wiley & Sons, Inc., Hoboken, NJ, USA.

[115] Dadd, Debra Lynn. (2011). *Toxic Free*. New York: Penguin.
[116] "The Dose Makes the Poison." Yale ChemSafe. 7 June 2012. <http://learn.caim.yale.edu/chemsafe/references/dose.html>.
[117] James, R. C., Roberts, S. M. and Williams, P. L. (2003) General Principles of Toxicology, in Principles of Toxicology: Environmental and Industrial Applications, Second Edition (eds P. L. Williams, R. C. James and S. M. Roberts), John Wiley & Sons, Inc., Hoboken, NJ, USA.
[118] Ibid.
[119] Ibid.
[120] Ibid.
[121] OIA CMWG Framework Indicators. OIA Chemicals Management Working Group. 25 October 2012.
[122] Dadd, Debra Lynn. (2011). *Toxic Free*. New York: Penguin.
[123] James, R. C., Roberts, S. M. and Williams, P. L. (2003) General Principles of Toxicology, in Principles of Toxicology: Environmental and Industrial Applications, Second Edition (eds P. L. Williams, R. C. James and S. M. Roberts), John Wiley & Sons, Inc., Hoboken, NJ, USA.
[124] "Public Health Assessment Guidance Manual (2005 Update): Chapter 6: Exposure Evaluation: Evaluation Pathways." CDC. 30 November 2005. 7 June 2012. <http://www.atsdr.cdc.gov/hac/phamanual/ch6.html>.
[125] James, R. C., Roberts, S. M. and Williams, P. L. (2003) General Principles of Toxicology, in Principles of Toxicology: Environmental and Industrial Applications, Second Edition (eds P. L. Williams, R. C. James and S. M. Roberts), John Wiley & Sons, Inc., Hoboken, NJ, USA.
[126] Ibid.
[127] OIA CMWG Framework Indicators. OIA Chemicals Management Working Group. 25 October 2012.
[128] James, R. C., Roberts, S. M. and Williams, P. L. (2003) General Principles of Toxicology, in Principles of Toxicology: Environmental and Industrial Applications, Second Edition (eds P. L. Williams, R. C. James and S. M. Roberts), John Wiley & Sons, Inc., Hoboken, NJ, USA.
[129] Anastas, Paul T. and John C. Warner. (1998). *Principles of Green Chemistry: Theory and Practice*. Oxford: Oxford University Press.
[130] Dadd, Debra Lynn. (2011). *Toxic Free*. New York: Penguin.
[131] Ibid.
[132] Manikkam, M., Guerrero-Bosagna, C., Tracey, R., Haque, M. M., & Skinner, M. K. (2012). Transgenerational actions of environmental compounds on reproductive disease and identification of epigenetic biomarkers of ancestral exposures. *PLoS One*, *7*(2), e31901.
[133] Sen, D. J., Shishoo, C. J., & Lahiri, A. (2011). Three musketeers of genotoxicity: carcinogen, mutagen & teratogen. *NSHM Journal of Pharmacy and Healthcare Management*, *2*, 13-25.
[134] Ibid.
[135] Ibid.
[136] Dadd, Debra Lynn. (2011). *Toxic Free*. New York: Penguin.
[137] Sen, D. J., Shishoo, C. J., & Lahiri, A. (2011). Three musketeers of genotoxicity: carcinogen, mutagen & teratogen. *NSHM Journal of Pharmacy and Healthcare Management*, *2*, 13-25.
[138] Ibid.
[139] Chemically Induced Alterations in Sexual and Functional Development: The Wildlife/Human Connection. Eds. T. Colborn and C. Clemet. Princeton Scientific Publishing, Princeton, NJ 1992.
[140] "Getting toxics out of what we buy." Environmental Defense Fund. 10 October 2012. <http://www.edf.org/health/chemicals/getting-toxics-out-what-we-buy>.

[141] “Fourth National Report on Human Exposure to Environmental Chemicals.” CDC. 2009. 8 June 2012. <http://www.cdc.gov/exposurereport/pdf/FourthReport.pdf>.
[142] Dadd, Debra Lynn. (2011).*Toxic Free*. New York: Penguin.
[143] Ibid.
[144] Ibid.
[145] Ibid.
[146] Truhaut, R. (1977). Ecotoxicology: objectives, principles and perspectives.*Ecotoxicology and Environmental Safety*, *1*(2), 151.
[147] “Ecotoxicity Database.” United States Environmental Protection Agency. 9 May 2012. 8 June 2012. <http://www.epa.gov/opp00001/science/efed_databasesdescription.htm>.
[148] “Multimedia Strategy for Priority Persistent, Bioaccumulative, and Toxic (PBT) Chemicals.” United States Environmental Protection Agency. 18 April 2011. 8 June 2012. <http://www.epa.gov/pbt/pubs/fact.htm>.
[149] “Using Safer Chemicals in Products Supports Preventative Health Care.” Kaiser Permanente. 10 October 2012. <http://www.saferchemicals.org/PDF/resources/KaiserPermanente_casestudy.pdf>.
[150] Erler, C., & Novak, J. (2010). Bisphenol A exposure: human risk and health policy. *Journal of pediatric nursing*, *25*(5), 400-407.
[151] Rubin, B. S., & Soto, A. M. (2009). Bisphenol A: Perinatal exposure and body weight. *Molecular and cellular endocrinology*, *304*(1), 55-62.
[152] Zoeller, T. R. (2010). Environmental chemicals targeting thyroid. *Hormones (Athens)*, *9*(1), 28-40.
[153] Soto, A. M., & Sonnenschein, C. (2010). Environmental causes of cancer: endocrine disruptors as carcinogens. *Nature Reviews Endocrinology*, *6*(7), 363-370.
[154] Using Safer Chemicals in Products Supports Preventative Health Care. Kaiser Permanente. 10 October 2012. <http://www.saferchemicals.org/PDF/resources/KaiserPermanente_casestudy.pdf>.
[155] “Facts About Benzene.” Centers for Disease Control and Prevention. 22 February 2006. 12 June 2012. <http://www.bt.cdc.gov/agent/benzene/basics/facts.asp>.
[156] “Benzene: What is benzene?” American Cancer Society. 5 November 2010. 12 June 2012. <http://www.cancer.org/cancer/cancercauses/othercarcinogens/intheworkplace/benzene>
[157] “Tox Town: Toluene.” National Library of Medicine. 15 November 2012. 23 November 2012. <http://toxtown.nlm.nih.gov/text_version/chemicals.php?id=30>.
[158] Ibid.
[159] Ibid.
[160] Ibid.
[161] “Formaldehyde and Cancer Risk.” National Cancer Institute at the National Institutes of Health. 10 June 2011. 16 June 2012. <http://www.cancer.gov/cancertopics/factsheet/Risk/formaldehyde>.
[162] “Using Safer Chemicals in Products Supports Preventative Health Care.” Kaiser Permanente. 10 October 2012. <http://www.saferchemicals.org/PDF/resources/KaiserPermanente_casestudy.pdf>.
[163] “Tox Town: Phthalates.” National Library of Medicine. 15 November 2012. 23 November 2012. <http://toxtown.nlm.nih.gov/text_version/chemicals.php?id=24>.
[164] Ibid.

[165] "Phthalates Action Plan Summary." United States Environmental Protection Agency. 25 July 2012. 23 November 2012. <http://www.epa.gov/oppt/existingchemicals/pubs/actionplans/phthalates.html>.
[166] "Perfluorochemicals (PFCs) Fact Sheet." Centers for Disease Control and Prevention. November 2009. 12 June 2012. <http://www.cdc.gov/biomonitoring/pdf/PFCs_FactSheet.pdf>.
[167] "Perfluorinated Compounds (PFCs) and Human Health Concerns." Healthy Building Network. April 2009. 15 June 2012. <http://www.healthybuilding.net/healthcare/2009-04-20PFCs_fact_sheet.pdf>.
[168] "Polybrominated Diphenyl Ethers (PBDEs) Action Plan Summary." United States Environmental Protection Agency. 7 August 2012. 10 October 2012. <http://www.epa.gov/oppt/existingchemicals/pubs/actionplans/pbde.html>.
[169] Rudolf, John Collins. "Leapfrogging Feds, Wal-Mart Bans Controversial Flame Retardant." The New York Times. 7 March 2011. 8 June 2012. <http://green.blogs.nytimes.com/2011/03/07/leapfrogging-feds-wal-mart-bans-controversial-flame-retardant/>.
[170] "Polybrominated Diphenyl Ethers (PBDEs) Action Plan Summary." United States Environmental Protection Agency. 7 August 2012. 10 October 2012.
[171] "Flame Retardants Found in U.S. Coastal Ecosystems Nationwide." National Oceanic and Atmospheric Administration. 9 September 2011. 12 August 2012. <http://oceanservice.noaa.gov/news/weeklynews/apr09/pbde.html>.
[172] Duncan, David Ewing. "The Pollution Within." National Geographic, June 2006.
[173] "Getting toxics out of what we buy." Environmental Defense Fund. 10 October 2012. <http://www.edf.org/health/chemicals/getting-toxics-out-what-we-buy>.
[174] "Polycyclic Aromatic Hydrocarbons (PAHs)." Agency for Toxic Substances and Disease Registry. September 1996. 15 June 2012. <http://www.atsdr.cdc.gov/tfacts69.pdf>
[175] "Heavy Metals: Mercury, Arsenic, and Lead." Washington Toxics Coalition. 12 June 2012. <http://watoxics.org/chemicals-of-concern/heavy-metals>.
[176] Ibid.
[177] Allchin, Douglas. "The Poisoning of Minamata." 17 August 2012. <http://www1.umn.edu/ships/ethics/minamata.htm>
[178] "Pressure Treated Wood." Healthy Building Network. 2012. 17 August 2012. <http://www.healthybuilding.net/arsenic/index.html>
[179] "Inorganic Arsenic: TEACH Chemical Summary." United States Environmental Protection Agency. 1 August 2007. 12 June 2012. <http://www.epa.gov/teach/chem_summ/Arsenic_summary.pdf>
[180] Smith, A. H., & Smith, M. M. H. (2004). Arsenic drinking water regulations in developing countries with extensive exposure. *Toxicology*, *198*(1), 39-44.
[181] "Inorganic Arsenic: TEACH Chemical Summary." United States Environmental Protection Agency. 1 August 2007. 12 June 2012.
[182] Max, Arthur. "Jaw-dropping levels of heavy metals found in whales." Boston.com. 25 June 2010. 18 June 2012. <http://www.boston.com/news/science/articles/2010/06/25/jaw_dropping_levels_of_heavy_metals_found_in_whales/>.
[183] "Pesticides." Washington Toxics Coalition. 12 June 2012. <http://watoxics.org/chemicals-of-concern/pesticides-1/pesticides>.

[184] Zimmer, Carl. “Two Studies Point to Common Pesticide as a Culprit in Declining Bee Colonies.” The New York Times. 29 March 2012. 17 August 2012. <http://www.nytimes.com/2012/03/30/science/neocotinoid-pesticides-play-a-role-in-bees-decline-2-studies-find.html>.
[185] Kahn, Jennifer. “Nanotechnology’s Big Future.” National Geographic, June 2012.
[186] Ibid.
[187] Sass, J. (2007). *Nanotechnology's invisible threat: Small science, big consequences*. Natural Resources Defense Council.
[188] Dreher, K. L. (2004). Health and environmental impact of nanotechnology: toxicological assessment of manufactured nanoparticles. *Toxicological Sciences*, *77*(1), 3-5.
[189] “Worst in Class Chemicals.” Healthy Building Network. 8 June 2012. <http://www.healthybuilding.net/target_materials.html>.
[190] “Overview: Office of Pollution Prevention and Toxics Programs.” 24 December 2003. <http://www.chemicalspolicy.org/downloads/TSCA10112-24-03.pdf>.
[191] “Key Federal Laws: Toxic Substances Control Act (TSCA).” ChemAlliance.org. 28 April 2012. <http://www.chemalliance.org/tools/?subsec=25&id=6929>.
[192] “Summary of the Toxic Substance Control Act.” U.S. Environmental Protection Agency. 28 April 2012. <http://www.epa.gov/lawsregs/laws/tsca.html>.
[193] “Overview: Office of Pollution Prevention and Toxics Programs.” U.S. Environmental Protection Agency. January 2007. 28 April 2012. <http://www.epa.gov/oppt/pubs/oppt101c2.pdf>.
[194] “Key Federal Laws: Toxic Substances Control Act (TSCA).” ChemAlliance.org. 28 April 2012. <http://www.chemalliance.org/tools/?subsec=25&id=6929>.
[195] “Chemical Testing and Data Collection.” U.S. Environmental Protection Agency. 28 April 2012. <http://www.epa.gov/oppt/chemtest/>.
[196] Overview: Office of Pollution Prevention and Toxics Programs.” U.S. Environmental Protection Agency. January 2007. 28 April 2012. <http://www.epa.gov/oppt/pubs/oppt101c2.pdf>.
[197] “Toxic Chemical Substance Inventory.” U.S. Environmental Protection Agency. 28 April 2012. <http://www.epa.gov/oppt/existingchemicals/pubs/tscainventory/>.
[198] Ibid.
[199] Ibid.
[200] “Overview: Office of Pollution Prevention and Toxics Programs.” U.S. Environmental Protection Agency. January 2007. 28 April 2012. <http://www.epa.gov/oppt/pubs/oppt101c2.pdf>.
[201] “Issuance of Revised Enforcement Response Policy for TSCA §§ 8, 12, & 13.” United States Environmental Protection Agency. 31 March 1999. 1 December 2012. <http://www.epa.gov/enforcement/waste/documents/policies/erp8_12r.pdf>.
[202] “EPA Fines Violators for Failure to Report Chemical Data.” US Environmental Protection Agency. 24 July 2012. <http://yosemite.epa.gov/opa/admpress.nsf/d0cf6618525a9efb85257359003fb69d/48f1bc6ddd355fe285257a44005e28ec!OpenDocument>.
[203] Overview: Office of Pollution Prevention and Toxics Programs.” U.S. Environmental Protection Agency. January 2007. 28 April 2012. <http://www.epa.gov/oppt/pubs/oppt101c2.pdf>.

[204] "Toxic Chemical Substance Inventory." U.S. Environmental Protection Agency. 28 April 2012. <http://www.epa.gov/oppt/existingchemicals/pubs/tscainventory/>.
[205] Overview: Office of Pollution Prevention and Toxics Programs." U.S. Environmental Protection Agency. January 2007. 28 April 2012. <http://www.epa.gov/oppt/pubs/oppt101c2.pdf>.
[206] Ibid.
[207] Ibid.
[208] Ibid.
[209] "Toxic Chemical Substance Inventory." U.S. Environmental Protection Agency. 28 April 2012. <http://www.epa.gov/oppt/existingchemicals/pubs/tscainventory/>.
[210] Ibid.
[211] Overview: Office of Pollution Prevention and Toxics Programs." U.S. Environmental Protection Agency. January 2007. 28 April 2012. <http://www.epa.gov/oppt/pubs/oppt101c2.pdf>.
[212] Culleen, L. "The Importance of Evaluating Information Acquired in Litigation for Regulatory Purposes." Pesticides, Chemical Regulation, and Right-to-Know Committee Newsletter, Vol. 7, No. 2, August 2006, Section of Environment, Energy, and Resources, American Bar Association. <http://www.arnoldporter.com/resources/documents/Larry_Culleen_two.pdf>.
[213] Overview: Office of Pollution Prevention and Toxics Programs." U.S. Environmental Protection Agency. January 2007. 1 December 2012. <http://www.epa.gov/oppt/pubs/oppt101c2.pdf>.
[214] Ibid.
[215] Ibid.
[216] Schierow, Linda-Jo. "The Toxic Substances Control Act (TSCA): Implementation and New Challenges." Congressional Research Service. 28 July 2009. 28 April 2012. <https://portal.acs.org/preview/fileFetch/C/CNBP_023612/pdf/CNBP_023612.pdf>.
[217] "TSCA at Twenty, Chemicals in the Environment: Public Access Information." Issue 4 (Fall 1996). U.S. Environmental Protection Agency. 28 April 2012. <http://www.epa.gov/oppt/cie/archive/issue04j.htm>.
[218] "Overview: Office of Pollution Prevention and Toxics Programs." U.S. Environmental Protection Agency. January 2007. 28 April 2012. <http://www.epa.gov/oppt/pubs/oppt101c2.pdf>.
[219] Ibid.
[220] "The Business Case for Comprehensive TSCA Reform." Safer Chemicals Healthy Families. 5 April 2012. <http://www.saferchemicals.org/resources/business.html>.
[221] "High-Risk Series: An Update (GAO-09-271)." United States Government Accountability Office, 2009. <www.gao.gov/new.items/d09271.pdf>.
[222] Ibid.
[223] "The Business Case for Comprehensive TSCA Reform." Safer Chemicals Healthy Families. 5 April 2012. <http://www.saferchemicals.org/resources/business.html>.
[224] "The Promise and Limits of the United States Toxic Substances Control Act." Lowell Center for Sustainable Production. 20 October 2003. <http://www.chemicalspolicy.org/downloads/10-03_Chemicals_Policy_TSCA.pdf>.
[225] Denison, Richard A. Elements in TSCA Reform. Environmental Law Reporter. January 2009.
[226] "What is TSCA?" Safer Chemicals Healthy Families. 28 April 2012. <http://www.saferchemicals.org/resources/tsca.html>.

[227] Toxic Chemicals Regulation. Environmental Defense Fund. Internal Presentation. 23 June 2012.
[228] Sass, Jennifer and Rosenberg, Daniel. “The Delay Game: How the Chemical Industry Ducks Regulation of the Most Toxic Substances.” The Chemical Industry Delay Game. October 2011. Natural Resources Defense Council. 28 April 2012. <http://www.nrdc.org/health/thedelaygame.asp>.
[229] Ibid.
[230] Ibid.
[231] Overview: Office of Pollution Prevention and Toxics Programs.” U.S. Environmental Protection Agency. January 2007. 1 December 2012. <http://www.epa.gov/oppt/pubs/oppt101c2.pdf>..
[232] Denison, Richard A. Elements in TSCA Reform. Environmental Law Reporter. January 2009.
[233] Ibid.
[234] Culleen, L. “The Importance of Evaluating Information Acquired in Litigation for Regulatory Purposes.” Pesticides, Chemical Regulation, and Right-to-Know Committee Newsletter, Vol. 7, No. 2, August 2006, Section of Environment, Energy, and Resources, American Bar Association. <http://www.arnoldporter.com/resources/documents/Larry_Culleen_two.pdf>.
[235] Chemical Regulation: Comparison of U.S. and Recently Enacted European Union Approaches to Protect against the Risks of Toxic Chemicals. United States Government Accountability Office Report to Congressional Requesters. GAO-07-825. August 2007.
[236] The Health Case for Reforming the Toxic Substances Control Act. Safer Chemicals Healthy Families. January 2010.
[237] Presentation of Findings From A Survey of 825 Voters in 75 Swing Congressional Districts. Safer Chemicals Healthy Families. 2010. 28 April 2012.
[238] “The Safe Chemicals Act of 2011.” Safer Chemicals Healthy Families. 28 April 2012. <http://www.saferchemicals.org/resources/safechemicalsactof2011.html>.
[239] Toxic Torts in a Nutshell. Fourth Edition. Jean Machhiaroli Eggen. 2010.
[240] “About OSHA.” US Department of Labor. 3 March 2012. <http://www.osha.gov/about.html>.
[241] Toxic Torts in a Nutshell. Fourth Edition. Jean Machhiaroli Eggen. 2010.
[242] “Hazardous and Toxic Substances.” US Department of Labor. 3 March 2012. <http://www.osha.gov/SLTC/hazardoustoxicsubstances/index.html>.
[243] Toxic Torts in a Nutshell. Fourth Edition. Jean Machhiaroli Eggen. 2010.
[244] Ibid.
[245] Ibid.
[246] Ibid.
[247] Ibid.
[248] Ibid.
[249] Ibid.
[250] “Hazard Communication Guidelines for Compliance. OSHA 3111” Occupational Safety and Health Administration. Washington, D.C.: U.S. Department of Labor. 2000.
[251] Ibid.
[252] Toxic Torts in a Nutshell. Fourth Edition. Jean Machhiaroli Eggen. 2010.
[253] Ibid.
[254] “Hazardous and Toxic Substances.” US Department of Labor. 3 March 2012. <http://www.osha.gov/SLTC/hazardoustoxicsubstances/index.html>.

255 “About Labor and Industries.” Washington State Department of Labor & Industries. 3 March 2012. <http://www.lni.wa.gov/Main/AboutLNI/>.
256 Toxic Torts in a Nutshell. Fourth Edition. Jean Machhiaroli Eggen. 2010.
257 Ibid.
258 Ibid.
259 “Hazard Communication.” US Department of Labor. 3 March 2012. <http://www.osha.gov/dsg/hazcom/index2.html>.
260 Tickner, J., and Y. Torrie. "Presumption of Safety: Limits of Federal Policies on Toxic Substances in Consumer Products. 2008." *Lowell Center for Sustainable Production: Lowell, MA USA*.
261 Ibid.
262 Ibid.
263 Ibid.
264 Ibid.
265 “H.R. 4040 (110th): Consumer Product Safety Improvement Act of 2008.” Govtrack.1 November 2007. 1 November 2012. <http://www.govtrack.us/congress/bills/110/hr4040>.
266 Tickner, J., and Y. Torrie. "Presumption of Safety: Limits of Federal Policies on Toxic Substances in Consumer Products. 2008." *Lowell Center for Sustainable Production: Lowell, MA USA*.
267 Ibid.
268 The Health Case for Reforming the Toxic Substances Control Act. Safer Chemicals Healthy Families. January 2010.
269 Tickner, J. "Assessment and prioritization of chemicals: policy options for states and the federal government." *Options for State Chemicals Policy Reform: A Resource Guide, Lowell Center for Sustainable Production, Lowell, MA* (2008): 100.
270 “Tort Law: An Overview.” Cornell University Law School. 4 March 2012. <http://www.law.cornell.edu/wex/tort/>.
271 Ibid.
272 Ibid.
273 Toxic Torts in a Nutshell. Fourth Edition. Jean Machhiaroli Eggen. 2010.
274 Ibid.
275 Ibid.
276 Ibid.
277 Ibid.
278 Ibid.
279 “Retailer Portal: Tools to Evaluate Chemical Ingredients in Products.” Green Chemistry and Commerce Council. September 2011. 1 June 2012. <http://www.greenchemistryandcommerce.org/downloads/RetailerPortal.pdf>.
280 Ibid.
281 “OSHA MSDS (Material Safety Data Sheet) Regulations.” Environment, Health, and Safety Online. 1 October 2012. <http://www.ehso.com/msds_regulations.php>.
282 “Retailer Portal: Tools to Evaluate Chemical Ingredients in Products.” Green Chemistry and Commerce Council. September 2011. 1 June 2012. <http://www.greenchemistryandcommerce.org/downloads/RetailerPortal.pdf>.
283 “Frequently Asked Questions.” Chemical Safety Associates. 01 June 2012. <http://www.msdsprep-csa.com/FAQ/FAQ.html#Q5>.

[284] “Retailer Portal: Tools to Evaluate Chemical Ingredients in Products.” Green Chemistry and Commerce Council. September 2011. 1 June 2012. <http://www.greenchemistryandcommerce.org/downloads/RetailerPortal.pdf>.
[285] “Restricted Substances Lists.” Green Chemistry and Commerce Council. 1 June 2012. <http://www.greenchemistryandcommerce.org/RSLnotice.php?rslprods=-14-12->.
[286] “Retailer Portal: Tools to Evaluate Chemical Ingredients in Products.” Green Chemistry and Commerce Council. September 2011. 1 June 2012. <http://www.greenchemistryandcommerce.org/downloads/RetailerPortal.pdf>.
[287] Ibid.
[288] “American Apparel & Footwear Association (AAFA) Restricted Substances List (RSL).” Green Chemistry and Commerce Council. 1 June 2012. <http://www.greenchemistryandcommerce.org/retailer.companies.php?prodid=14>.
[289] “H&M Chemical Restrictions.” H&M. 14 December 2009.
[290] “Our Conscious Actions.” H&M. 1 June 2012. <http://about.hm.com/content/hm/AboutSection/en/About/Sustainability/Commitments/Use-Resources-Responsibly/consciousactions.html>.
[291] “Our Conscious Actions.” H&M. 1 June 2012. <http://about.hm.com/content/hm/AboutSection/en/About/Sustainability/Commitments/Use-Resources-Responsibly/consciousactions.html>.
[292] “Design for the Environment: An EPA Partnership Program.” Environmental Protection Agency. 1 June 2012. <http://www.epa.gov/dfe/>.
[293] Ibid.
[294] Harvey, Michelle. Environmental Defense Fund. Personal interview. 25 January 2012.
[295] “Design for the Environment: An EPA Partnership Program.” Environmental Protection Agency. 1 June 2012. <http://www.waterrecoverysystems.com/uploads/DfE_Fact_Sheet.pdf>.
[296] “EPA Design for Environment (DfE) Safer Product Labeling Program.” Green Chemistry and Commerce Council. 1 June 2012. <http://www.greenchemistryandcommerce.org/retailer.companies.php?prodid=15>.
[297] “LEED.” US Green Building Council. 15 June 2012. <http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1988>.
[298] “New and Updated Credits Introduced into LEED Pilot Credit Library.” US Green Building Council. 6 March 2012. 1 June 2012. <http://www.usgbc.org/News/PressReleaseDetails.aspx?ID=4797>.
[299] “LEED Pilot Credit Library: Pilot Credit 62: Disclosure of Chemicals of Concern.” US Green Building Council. 1 June 2012. <http://www.usgbc.org/ShowFile.aspx?DocumentID=18548>.
[300] Ho, Catherine. “Potential changes to green building standards rile chemical, vinyl trade groups.” Washington Post. 24 June 2012. 1 July 2012.
[301] “Sustainable Design.” US General Services Administration. 1 July 2012. <http://www.gsa.gov/portal/content/104462>.
[302] “bluesign standard.” bluesign. March 2010. 1 July 2012.
[303] “Retailer Portal: Tools to Evaluate Chemical Ingredients in Products.” Green Chemistry and Commerce Council. September 2011. 1 June 2012. <http://www.greenchemistryandcommerce.org/downloads/RetailerPortal.pdf>.

[304] “Retailer Portal: Tools to Evaluate Chemical Ingredients in Products.” Green Chemistry and Commerce Council. September 2011. 1 June 2012. <http://www.greenchemistryandcommerce.org/downloads/RetailerPortal.pdf>.
[305] “Pharos.” Healthy Building Network. 1 June 2012. <http://www.pharosproject.net/>.
[306] Ibid.
[307] Ibid.
[308] Ibid.
[309] Harvey, Michelle. “Parting the Chemical Curtain with GreenWERCS.” Greenbiz. 27 October 2009. 1 June 2012.
[310] “GreenWERCS”. Green Chemistry and Commerce Council. 1 June 2012. <http://www.greenchemistryandcommerce.org/retailer.companies.php?prodid=2>.
[311] Ibid.
[312] Ibid.
[313] Ibid.
[314] “Transparency: Encouraging Material Health in the Built Environment.” Perkins+Will. 1 June 2012. <http://transparency.perkinswill.com/Main>.
[315] “Living Building Challenge 2.1: A Visionary Path to a Restorative Future.” International Living Future Institute. May 2012.
[316] Ibid.
[317] “Subsport: Substitution Support Portal.” Subsport. 1 June 2012. < http://www.subsport.eu/>.
[318] Reid, R. Operations Management. 2002. pp. 457-458.
[319] “Google Green - Campus Operations.” Google. 2012. 12 May 2012 <http://www.google.com/green/efficiency/oncampus/#building>.
[320] “The Black Cloud.” UC Berkeley. 3 June 2012 <http://studio.berkeley.edu/bc/>.
[321] International Living Building Institute. “The Standard." April 2010. Living Building Challenge. 3 June 2012. <https://ilbi.org/lbc/LBC%20Documents/lbc-2.1>.
[322] “Existing Chemicals Action Plans.” United States Environmental Protection Agency. 1 July 2012. <http://www.epa.gov/oppt/existingchemicals/pubs/ecactionpln.html>.
[323] “Google Green - Campus Operations.” Google. 2012. 12 May 2012 <http://www.google.com/green/efficiency/oncampus/#building>.
[324] Hiskes, Jonathan. “Google drops red list building materials, vendors listen up.” Sustainable Industries. 2 May 2011. 21 June 2012. <http://sustainableindustries.com/articles/2011/04/google-drops-red-list-building-materials-vendors-listen>.
[325] Ravitz, Anthony. Green Team Lead, Real Estate Google. Personal interview. 23 April 2012.
[326] Ibid.
[327] Fox, Linda. “Change in the Making: The Future of Building Materials.” World Green. Leonardo Academy. 21 June 2012. <http://www.worldgreen.org/home/wg-feature-articles/8391-change-in-the-making-the-future-of-building-materials.html>.
[328] Ravitz, Anthony. Green Team Lead, Real Estate Google. Personal interview. 23 April 2012.
[329] Katz, Ashley. “U.S. Green Building Council Announces Grant from Google to Catalyze Transformation of Building Materials Industry and Indoor Health.” 14 November 2012. USGBC. 23 March 2013. <http://new.usgbc.org/articles/us-green-building-council-announces-grant-google-catalyze-transformation-building-materials>.

[330] "First Open Standard Format for Reporting Content & Hazards in Building Products Launched." 9 November 2012. Health Product Declaration Collaborative. 23 March 2013. <http://www.hpdcollaborative.org/pdf/121108_hpd_PR.pdf>.
[331] Google Inc. "Form 10-K." 31 December 2011. EDGAR. United States Securities and Exchange Commission. 3 June 2012 <http://www.sec.gov/Archives/edgar/data/1288776/000119312512025336/d260164d10k.htm>.
[332] "Using Safer Chemicals in Products Supports Preventative Health Care." Kaiser Permanente. 10 October 2012. <http://www.saferchemicals.org/PDF/resources/KaiserPermanente_casestudy.pdf>.
[333] Ibid.
[334] Ibid.
[335] "KP: Shift responsibilities to upstream manufacturers." California Department of Toxic Substances Control. 2010. 10 October 2012. <http://www.dtsc.ca.gov/kp.cfm>.
[336] "Using Safer Chemicals in Products Supports Preventative Health Care." Kaiser Permanente. 10 October 2012. <http://www.saferchemicals.org/PDF/resources/KaiserPermanente_casestudy.pdf>.
[337] "Latest PVC-free carpet lines signal environmental health considerations are driving markets away from PVC." Healthy Building Network. 14 June 2004. 11 October 2012. <http://www.healthybuilding.net/pvc/pvc-free_carpet.html>.
[338] Roundtable on Environmental Health Sciences, Research, and Medicine. "6 Champions for Change." *Green Healthcare Institutions: Health, Environment, and Economics, Workshop Summary*. Washington, DC: The National Academies Press, 2007.
[339] "Latest PVC-free carpet lines signal environmental health considerations are driving markets away from PVC." Healthy Building Network. 14 June 2004. 11 October 2012. <http://www.healthybuilding.net/pvc/pvc-free_carpet.html>.
[340] "Environmental Stewardship." Kaiser Permanente. 11 October 2012. <http://info.kaiserpermanente.org/communitybenefit/html/our_work/global/our_work_6_saferchemicals.html>.
[341] Walsh, Bill. "The Transformation in Buying." Healthy Building Network. 11 October 2007. 10 October 2012. <http://www.healthybuilding.net/news/071011transformation-buying.html>.