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CALL FOR PAPERS

SPECIAL ISSUE—WORKER HEALTH AND SAFETY TRAINING

New Solutions seeks high quality manuscripts for a special issue dedicated to worker health and safety training and education. Manuscripts will be accepted until December 28, 2011. Accepted papers will be published in November 2012.

Authors should address the occupational/environmental health policy implications of their research. Submitted manuscripts should reflect the authors' most current work.

Potential topic areas of interest include:

- Successful and innovative models of worker health and safety (H&S) training that help workers to play a meaningful role in setting health and safety policies and practices in the workplace. These should include discussions of barriers or obstacles encountered in the development and delivery of training, and also workers' ability to apply in the workplace what they learned in the training.
- Examples of worker empowerment as a result of the training, as well as evidence of how and why the goal of worker empowerment through training and education may be difficult to achieve.
- Models of training to engage workers (including immigrant workers), community members, and environmentalists to build capacity for improved environmental public health (including the work environment).
- Successes or difficulties with models where worker health and safety training and education are integrated with other important subjects in the curricula, such as labor, economic, or social policies.
- Innovative training and education programs to prepare non-English-speaking populations to respond to hazardous materials incidents and natural disasters in their communities and workplaces.

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- Discussions of the legal supports for H&S training—at the federal and state levels—particularly looking at how state and federal laws influence workplace policies and practices.
- Innovative evaluation of H&S training and education, and how the evaluation can be used to shape occupational and environmental health policies. These would include discussions of successes in overcoming obstacles to evaluating H&S training programs.
- The differences between worker training and worker education—and effective ways to integrate these efforts.

Manuscript submission guidelines

Each manuscript should:

1. Comply with *New Solution*'s Manuscript Guidelines, available at either:
   a. www.newsolutionsjournal.com
   b. http://baywood.com/authors/Guidelines/NS_Guidelines.pdf
2. Be submitted via the New Solutions web site at:
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      1. Please complete the author profile information for each author.
3. Have a core manuscript (that is, excluding abstract, acknowledgments, reference list, tables, and figures) length of 10 to 20 pages. Please paginate your submission consecutively starting with the title page.

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Special Issue: Designing a Chemically Safer Future

INTRODUCTION

A VISION FOR SAFER CHEMICALS: POLICY, MARKETS, COALITIONS, AND SCIENCE

JESSICA N. SCHIFANO

The problem of toxic chemicals and their adverse impacts on health and the environment, from production through disposal, is not new; however, our approach to solutions has evolved over time. For decades, those working to address chemical issues largely focused on identifying, characterizing, and controlling only the most hazardous chemicals. Ultimately, these efforts have not adequately succeeded at ensuring that all chemicals are developed, used, and managed in ways that are safe and healthy for people and the environment.

Over the last several years, leaders in government, business, advocacy organizations, and academia have begun to envision a new approach. Instead of attempting to assess and regulate each hazardous chemical as problems arise (what might be termed a problem-based approach), we are beginning to think about how to transition to safer alternatives (a solutions-oriented approach). We think of chemicals as part of the solution to a design problem, rather than chemicals as the problem itself. We think not only about the characteristics of chemicals that make them inherently hazardous, but also those that make them more benign. We embrace the need to perform particular functions of chemicals, but in ways that minimize impacts to human health and the environment. We recognize that tradeoffs associated with alternative options throughout their entire lifecycles will always exist and must be considered in substitution decisions. We understand that resource-intensive chemical regulations cannot alone address the tens of thousands of chemicals on the market or spur the transition to safer alternatives.

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VISION FOR A SAFER CHEMICALS FUTURE

A burgeoning sustainable production movement has been exploring new solutions to our problem of having toxic chemicals as the basis for our economies and the materials of our infrastructures. We need to develop our capacity, tools, and collaborations to transition to safer chemicals, industrial processes, materials, and products. We realize that we will still need to adequately address the legacy of damage that toxic chemicals have caused workers, communities, and ecosystems, and we will still need to respond to chemical problems as they arise. However, we hope that through a fundamental transition of the chemical enterprise we will be able to prevent such damage from occurring in the future.

ACHIEVING A SAFER CHEMICALS FUTURE

The goal of this issue of *New Solutions* is to bring together leading voices from various perspectives in order to highlight the widely agreed-upon need for the development and use of safer chemicals in our modern society. The authors illustrate how forward-thinking governments, businesses, and non-governmental organizations (NGOs) are already successfully working toward this objective by changing policy, shifting markets, building new coalitions, and transforming science, as detailed in the four sections of the issue.

Changing Policy

Bold, visionary chemicals management policies that promote the transition to safer alternatives are a key foundation for achieving a safer chemicals future.

The issue begins with the presentation of a new, ambitious vision for chemicals policies. Ken Geiser outlines the components of and describes the need for comprehensive chemicals policies that work within a systems framework, ensure adequate information flows through supply chains, phase out the most hazardous chemicals, progressively transition away from the remaining chemicals of concern by substituting safer chemicals and technologies, and invest heavily in a new generation of safer and more sustainable chemicals.

The next two articles detail various efforts at the local, state, and federal levels that attempt to advance this vision. Debbie Raphael and Chris Geiger detail the implementation of the City and County of San Francisco's Precautionary Principle Policy, which allows local government officials to act on early warning signs of harm. In effectuating this broad policy mandate, the City and County utilize a wide array of policy tools in order to evaluate the necessity of certain products and services, to look upstream in the chain of commerce to influence the design or products entering its local borders, and to promote the identification and use of safer alternatives.

Michael Belliveau examines the influence of recent state chemical policy reform developments on current efforts to reform obsolete federal chemicals

management laws. Over the last decade, state efforts have modeled a chemical policy framework to phase out unnecessary dangerous chemicals in favor of safer alternatives. By recapping this development, the article illustrates how the success of such efforts at the state level spurred the integration of hazard-based, substitution-driven thinking into current federal reform discussions.

Shifting Markets

Many forward-thinking businesses, in response to both regulatory and consumer pressures, are re-evaluating and reconsidering their approaches to supply chain management and product design. As Mark Rossi and colleagues demonstrate, businesses are not doing this work in isolation, but rather are engaging with a variety of stakeholders to achieve their goals. They detail how businesses and environmental organizations are collaborating to define and implement a proactive agenda for integrating safer chemicals into products. Together businesses and environmental organizations are charting a path to safer chemicals by sharing best practices, addressing technical aspects of safer chemicals substitution, and analyzing and supporting public policies that advance the rapid development and diffusion of greener chemicals in the economy.

Roger McFadden describes steps that one company, Staples, Inc., is taking to meet demand for products that are safer and more sustainable. These efforts include the implementation of a comprehensive and rigorous sustainable product design model to eliminate chemicals of concern at the design stage, as well as a strategy for the disclosure of bad actor chemicals in products supplied to the company. Although better chemicals management presents many new business opportunities, the article highlights the significant barriers the company faces in meeting the demand for safer and more sustainable products and presents some ways in which new collaborations and tools are helping the company to overcome these barriers.

Building New Coalitions

Often, environmental advocates, public health advocates, labor advocates, NGOs, and government officials work toward similar goals on parallel fronts, rather than through united efforts. The next two articles demonstrate how new coalitions, which bring together these constituencies, are successful in advancing the transition to safer chemicals.

Joe DiGangi describes how public interest NGOs combine their own vision for a toxics-free future with the objectives of multilateral environmental agreements to directly tackle chemical safety problems and push for a safer future. The article provides a number of examples where groups have effectively leveraged global chemicals agreements to advance chemical safety activities on the ground at the national level.

Andrew King highlights the development of a new coalition, integrating experience and expertise from community activism, environment, labor, public health, politics, and cancer prevention, to formulate a common strategy to address the continuing use and dissemination of toxic chemicals in Canada. Through these efforts, a first-in-the-country right-to-know bylaw was enacted in Toronto.

Transforming Science

New science is critical to advancing ambitious chemicals policies and shifting markets in the direction of safer alternatives. The four articles in this section describe some of the ways in which new scientific thinking helps to support a safer chemicals future.

Richard Clapp describes how the 2008–2009 President's Cancer Panel report provides official recognition of the significant contribution of environmental and occupational exposures to cancer etiology, thereby validating and reinforcing decades of efforts by advocates, scientific associations, and scientists documenting evidence of the environmental and occupational links to cancer and the need to prevent such exposures.

Rachel Massey and colleagues highlight the advances made in chemical categorization and prioritization under the Massachusetts Toxics Use Reduction Act. The article demonstrates how the use of statutory authority to designate Higher and Lower Hazard Substances has spurred the transition to safer alternatives.

Lothar Lissner and Dolores Romano underscore the importance of the systemic description and promotion of substitution options and processes for chemicals management and chemicals policy. The article details: the necessary role of substitution in chemicals policy; existing tools and methods for substitution; barriers to substitution; and new efforts designed to overcome these barriers.

Amy Cannon and John Warner discuss the transformative science of green chemistry and its capacity to invent safer chemicals, products, and processes. Although green chemistry and chemicals policy go hand in hand, the authors caution against the conflation of the two. They argue that as most alternative technologies do not yet exist, innovative solutions must be invented in order for chemical policies directing the use of safer alternatives to be successful. To spur the development of these solutions and advance the science of green chemistry, investments in research and development as well as educational reform efforts are necessary. Obviously, new government policies for industrial development will be needed to drive these investments.

Finally, the issue includes a document developed by The Gulf Future Campaign of the Gulf Restoration Network. This campaign was created shortly after the BP Deepwater Horizon oil disaster of 2010, with a mission of providing the long-term support needed to protect the environment and the distinct

culture of the Gulf Coast for future generations. This is a sharp reminder of why we need a safer chemicals future.

As this collection of articles describes, achieving a safer chemicals future requires that we rethink old ways of addressing chemical problems. This, in turn, will require major transformations of policy, markets, coalition-building, and science. Without advances in each of these areas, it will be difficult, if not impossible, to ensure a timely transition to safer chemicals, materials, products, and processes. It is up to each of us to determine what role we can play in making this transition a reality.

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Features – Changing Policy

REDESIGNING CHEMICALS POLICY: A VERY DIFFERENT APPROACH

KEN GEISER

ABSTRACT

The chemical policies of the 1970s were limited by the assumptions that lie at their foundation and focused narrowly on only the most hazardous chemicals. The effective management of chemicals requires policies that focus on the entire body of chemicals and the production systems that make them. The future will require comprehensive chemicals policies that work within a systems framework to phase out the most hazardous chemicals, progressively transition away from the remaining chemicals of concern by substituting safer chemicals and technologies, and invest heavily in a new generation of safer and more sustainable chemicals.

Keywords: chemicals policy, hazardous chemicals, systems thinking, green chemistry

The origins of our national chemicals policies trace their roots back to the 1970s, when leaders in Congress fashioned a framework of federal laws that set regulations on chemicals in air emissions, liquid effluents, products, and wastes. With this framework largely constructed, in 1976 Congress passed the Toxics Substances Control Act (TSCA) as a general "catch-all" statute to regulate chemicals directly wherever they present an unreasonable risk [1].

Although TSCA provides broad powers to the Environmental Protection Agency (EPA) regarding chemical notification, testing, market entry, restrictions, and recordkeeping, it has been largely regarded as a failure. While there

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have been many government and private evaluations, Government Accountability Office critiques, and Congressional oversight hearings, TSCA has never been redrafted. Many reasons have been put forward for TSCA's poor performance, ranging from poor management, conflicting requirements, limited resources, and overly tough burdens of proof to the intense hostility of the chemical industry [2].

The purpose of this paper is to present a sketch of a very different approach to chemicals policy than that constructed in the 1970s. The passage of time has allowed us to recognize the flaws and limits of the conventional approach. Now, some 40 years beyond the 1970s, we have arrived at a good point to reconsider and redesign the nation's chemicals policies. Whether we choose to do that through modest adjustments or a substantial overhaul depends upon our capacity to think broadly and boldly about how we frame the problem of chemicals in society and how much we can overcome the substantial commitment to conventional practice. This paper suggests that our ambitions should be bold.

FLAWS IN FEDERAL CHEMICALS POLICY

In order to understand fully the limits of current federal chemicals policy, it is worth stepping back to review the broader assumptions that were built into TSCA and other laws intended to directly control chemicals, such as the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) [3] and the Consumer Product Safety Act (CPSA) [4], which taken together, round out the basic framework for the nation's chemicals control policy. With the value of hindsight, much can be seen and now questioned about the assumptions and principles that were built into these laws.

Chemicals policies focused only on the most dangerous substances. With a strong belief in the market, the legislators who drafted the laws limited government intervention only to those areas where the market failed to protect public or environmental health. Industrial chemicals and consumer products long on the market were presumed to be safe. The pesticide law's presumption that a pesticide is dangerous was inverted by TSCA to mean that most industrial chemicals on the market—the existing chemicals—were not candidates for government regulations. This presumption of safety was even more pronounced under the consumer products law, where existing products were assumed to be safe until some study or incident proved otherwise.

Chemicals policies addressed chemicals one by one. Locked into the early statutes was a one-by-one orientation towards hazardous chemicals. While TSCA provided authority to restrict the manufacture and use of chemical groups or mixtures, in practice the EPA maintained a chemical-by-chemical approach that focused on the identification, testing, and management of individual substances. This same narrow focus pervades the pesticide and consumer product safety laws. When the Consumer Product Safety Commission considered the

hazards of phthalates in toys, it did so without addressing the potential hazards of other substances in toys such as lead, pesticides, or flame retardants or addressing their aggregate consequences.

Chemicals policies were fragmented with diverse requirements for chemicals in wastes, emissions, workplaces, and products. The separate chemical control laws covering pesticides, industrial chemicals, and chemicals in products differ in their coverage and authorities and differ further from the media-specific environmental protection laws. Rather than being drafted as an omnibus foundational framework for supporting and coordinating these statutes, TSCA was designed to defer to other statutes and function only where other laws provided inadequate protection. Thus, authority over chemicals is prescribed by over 20 statutes and divided among some 15 federal agencies, and even within the EPA there are separate sections for chemical emissions for air, water, and wastes.

Chemicals policies focused on limiting adverse chemical exposure rather than addressing the inherent hazards of chemicals. Focusing on risks was central to each of the chemical laws. However, a focus on risk in seeking safety often encourages exposure management and engineering controls rather than design changes that reduce or eliminate the need for hazardous chemicals. Unlike a focus on eliminating the intrinsic hazards of a process, a risk focus requires lengthy efforts to predict dose-responses and potential human exposures. However, real exposures over the lifecycle of a chemical are often hard to predict confidently, and a trust in exposure control gives comfort to the idea that chemicals are "properly used."

Chemicals policies used "sticks" without "carrots." Because the chemicals policies of the 1970s developed out of a need to protect health and the environment, they were designed to limit, restrict, and prohibit chemical uses, releases, and exposures. Setting restrictions was seen as the paramount government role; however, it was never balanced by parallel functions that reward and encourage safer and more sustainable technologies and practices. By focusing solely on the worst substances, government agencies were provided little authority or capacity to fund research, provide incentives, or otherwise promote safer alternatives and greener chemistries.

CHEMICALS, MATERIALS, PRODUCTS, SYSTEMS

Chemicals do not stand alone. They are constituents of materials, parts of products, and embedded in systems. Chemicals, the chemical industry, and the economy are all intertwined in a complex set of systems and subsystems such that changes—even quite minor changes, like closing down the production of a chemical—can have broad and sometimes quite indirect effects throughout the system. We need to develop policy interventions that respect the highly integrated and systemic ways in which chemicals are produced and chemical markets function.

This requires reframing the conventional definition of the chemicals problem: moving from a focus on single chemicals to a focus on systems of chemical production, use, and disposal, on families of chemicals, on sets of functions, and on collections of firms. This means better understanding of chemical and material production and use systems in order to identify critical leverage points that either inhibit or lead to change. This means paying closer attention to chemical markets and to financing and investing in chemical manufacturing. This means working more broadly through supply chains and encouraging dialogues along the value chain, whereby customers can talk to and plan with chemical suppliers, processors and manufacturers. And this means a different orientation of government: one that respects the power of government to regulate, but enlarges the role of government as a facilitator, information source, technical assistant, and promoter.

A systems approach more clearly recognizes the role of chemical distributors, product retailers, and large institutional product purchasers. Markets are driven by customer desires; however, in large complex societies, there are long chains of suppliers that determine and narrow the range of products from which consumers can select. Increasingly, large retailers, government agencies, and institutional group purchasing organizations are negotiating with suppliers for products free of chemicals of high public concern. Institutions such as Wal-Mart, Home Depot, CVS, Kroger, Carrefour, Consorta, Novation, Univar, Ashland Distributors, and the Pentagon could play a significant role in implementing chemicals policies [5].

Moving toward safer chemicals within systems of production, distribution, use, and disposal requires an understanding of life cycles. Chemicals flow through manufacturing and use systems, and chemicals are disposed of through system losses (dissipation) and through end-of-life processing and release to the environment. Life cycle considerations open up a more complete view of chemical relationships and the many points where a given chemical may create threats to human health or the environment. Life cycle assessment is a new formalized tool for such assessments, but often a simpler, more informal life cycle map or inventory may provide the necessary perspective.

By considering chemicals in systems, mapping the life cycle of chemicals, and engaging in dialogues with multiple parties along chemical and product supply chains, we can lay the foundation for a new, more comprehensive approach to chemicals policy.

SIX FEATURES OF A COMPREHENSIVE CHEMICALS POLICY

What can be meant by a comprehensive approach to chemicals policies? A simple definition of a comprehensive chemicals policy would be an inclusive, integrated, and prevention-oriented policy designed to achieve the use of

nonhazardous and sustainable substances in the design, manufacture, and application of products or services.

The goals of a comprehensive chemicals policy follow from the United Nations commitment to the sound management of chemicals put forth in the Rio Declaration of 1992 and reiterated at the 2002 World Summit on Sustainable Development, assuring "by 2020, that chemicals are used and produced in ways that lead to the minimization of significant adverse effects on human health and the environment . . . [such that] . . . threats posed by toxic chemicals are eliminated in one generation" [6].

Comprehensive chemicals policies may be government policies or corporate policies. The newly adopted REACH (Registration, Evaluation, and Authorization of Chemicals) regulation in the European Union is an impressive example of a comprehensive chemicals policy [7]. Canada and several U.S. states are implementing forms of comprehensive chemicals policy. However, there are an increasing number of leading firms that are instituting across-the-board chemicals policies that cover all of the substances in their production processes. Examples include firms such as Nike, Herman Miller, Interface, HP, Timberland, Volvo, Philips, and S. C. Johnson [8].

While there are variations among these emerging examples of comprehensive chemicals policy, there are six primary features that form a defining framework. These are:

1. *Comprehensive chemicals policies are inclusive and comprehensive.* They cover all chemicals—toxic and hazardous substances, as well as substances that are relatively benign.
2. *Comprehensive chemicals policies prioritize chemicals into tiers.* These tiers range from substances that are undesirable and should be avoided to those that are preferred.
3. *Comprehensive chemicals policies are hazard- rather than exposure-based*. Exposure considerations can be useful in screening chemicals or setting priorities, but the intrinsic hazards of a chemical, not the potential for exposure, is the primary consideration in determining the safety of a chemical.
4. *Comprehensive chemicals policies create and open access to information.* These policies promote the generation and disclosure of critical information on chemicals ranging from production volumes and uses to human and environmental health effects.
5. *Comprehensive chemicals policies transition chemical use from higher-hazard to lower-hazard substances.* These policies drive and guide the phase-out of the most dangerous chemicals and the substitution of safer alternatives.
6. *Comprehensive chemicals policies promote research and innovation.* These initiatives promote the development of safer and more environmentally compatible chemicals.

In the sections that follow, each of these features is described in more detail.

A Comprehensive and Inclusive Approach

Over the years, the assumption that the chemicals problem involved only a modest number of chemicals and these could be regulated one by one did not hold. As human and ecological toxicology data has become available, it has become evident that many chemicals, indeed most chemicals, present some hazardous properties, ranging from acute hazards to chronic human health hazards, eco-toxicity, and adverse effects on the atmosphere. The United Nations' Globally Harmonized System for the Classification and Labeling of Hazardous Substances (GHS) identifies 26 categories of physical, human, and environmental hazards. Add to this the new nanoscale chemicals that remain largely uncharacterized, and the number of potentially hazardous chemicals is substantial [9].

A comprehensive approach to chemicals policy needs to address chemicals in a holistic and systemic manner. Such an approach views an individual chemical within the context of the chemicals market and seeks to understand its production and function in a way that identifies the possible alternatives that could be substituted for it. A holistic approach to all chemicals sets those chemicals that are unacceptably dangerous in a broader perspective that recognizes that there are also many chemicals that are safer and perform multiple functions well. By shifting from a focus on chemicals one at a time to a focus on branches of chemical production and groups of chemicals that function similarly, more strategic regulations and programs that work compatibly with ongoing market trends could be developed. The chemical market becomes a central unit of analysis and a focus for change.

The European Union has taken a big step forward with the enactment of the REACH regulation. This major overhaul of European chemicals policy requires the registration of all chemicals on the commercial market. The regulation does away with the conventional distinction between existing chemicals and those just coming onto the market and creates a level playing field, such that all chemical manufacturers of all chemicals (above a one-ton threshold) must present chemical dossiers that offer a minimum base set of chemical information [7].

A Tiered Approach to Prioritization

Unlike a half-century ago, there is now a broad enough understanding to know what types of chemicals and families of compounds are more or less likely to be hazardous. For many substances, particularly the heavy metals, the halogens, and the aromatic hydrocarbons, we have substantial scientific laboratory-based and epidemiological study of their hazardous attributes. Structure/activity analysis and new computational toxicology models assist in estimating

the likely hazards of chemicals that exhibit certain common chemical structures when scientific studies are absent. An important function for government is the development and maintenance of a chemical classification system where all chemicals can be categorized as to their hazardous properties. The GHS offers an internationally recognized framework for implementing such a classification. This is not unreasonable. Working together, Health Canada and Environment Canada have completed a monumental effort to screen most all of the chemicals manufactured and used in Canada and have classified some 4,000 substances as high-hazard. With this as a foundation, the Canadian authorities are now setting priorities for addressing the chemicals of highest concern [10].

A holistic approach allows chemicals to be arrayed across a continuum ranging from the least to the most concerning. By creating tiers within the continuum and establishing a set of benchmark criteria for differentiating chemicals by their inherent properties, well characterized chemicals could be slotted into these tiers and grouped by level of concern into a landscape of chemical categories. Substances without sufficient information could be set aside in a category of "unknown concern." An illustrative typology presented in Figure 1 sets up five categories into which chemicals could be classified, such that priorities could be set and recommended strategies pursued.

While the government could formulate the framework, decision criteria, and rules for establishing a comprehensive categorization of chemical substances,

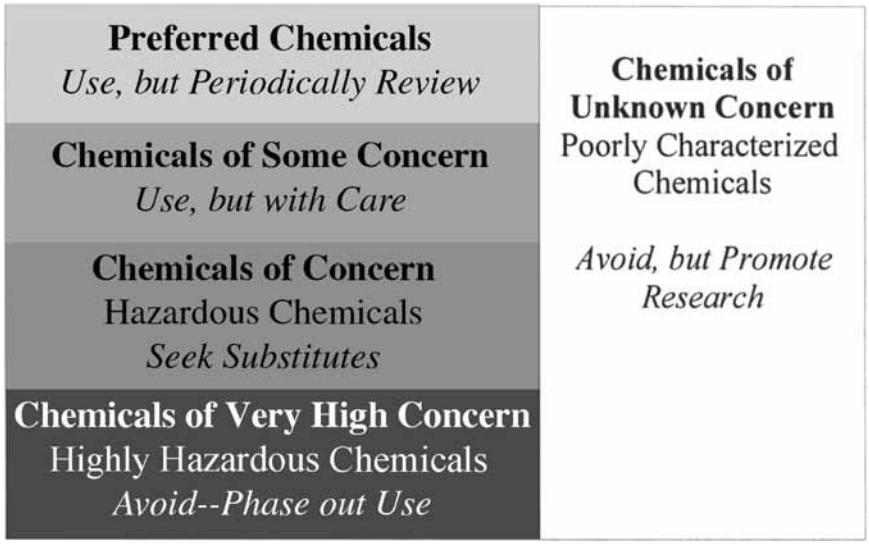

Figure 1. Comprehensive classification of chemicals.

it would be up to chemical producers and suppliers to categorize their chemicals and present evidence to support their characterizations. Such a classification would clarify what is known and not known about chemicals in use and lay out a framework for setting priorities for government attention. It would further identify where science and research should be targeted, either to characterize understudied chemicals or to develop safer alternatives. This tiered landscape would be valuable to chemical users in assisting them in converting from more to less concerning chemicals and to chemists designing safer chemicals or chemical production systems.

A Hazard-Based Approach

Since the 1980s the response to chemicals under TSCA and other chemical control laws has been informed by risk assessment and directed by risk management protocols. While, at the time, this created a better documented and more orderly approach, administrative commitments and judicial findings have locked chemical policy into this risk-based approach. A risk-based approach assumes, as given, that hazardous chemicals must be used and then directs government and business efforts to analyzing and managing those risks. Years of experience demonstrate that a risk-based approach often delays rather than promotes regulation, and diverts attention from more fundamental approaches to addressing chemical safety. The iconic tool for this is risk assessment; however, a risk-based approach is more than risk assessment. A risk-based approach often leads to risk management responses focused on managing and controlling the human and environmental exposure to hazardous chemicals. Expensive, and too often inadequate, pollution control technologies and personal protection equipment are often the result of a risk-based approach [11].

A risk-based approach has become fundamental to the way in which government regulates, business operates, and science is conducted. However, it is not the only way of understanding the chemicals problem or finding effective responses to it. Other approaches are available that can more directly address the threats of dangerous chemicals. Instead of conducting extensive chemical tests to determine what level of chemical exposure is acceptably safe, science could be directed towards developing inherently safer chemicals that could progressively replace chemicals of concern. This is the essence of a hazard-based approach. The objective is safer chemicals, not safer exposures.

Under a hazard-based approach, the focus is on the inherent hazards of a chemical. Inherent safety is a term often used in the chemical industry to describe "primary prevention" or the elimination of a hazard. This differs from "secondary prevention," which includes processes that seek to reduce the risk of a hazard, often by the use of technological barriers or managerial controls. Primary prevention involves preventing harms by using safer technologies, reducing emissions and wastes and eliminating workplace hazards. Here the focus is

on substituting safer chemicals for chemicals of concern and converting to cleaner and safer technologies, thereby reducing the threats of chemicals before exposure occurs. It is a fundamental tenet of prevention that reducing or eliminating a hazard is more effective, and often less costly overall, than constructing safeguards against it.

The principle of prevention seeks to reduce or eliminate the inherent hazards of a chemical either at the selection stage, prior to use and prior to exposure, or at the design stage, prior to manufacture, use, and exposure. In Europe this is called the "prevention principle" and it is often aligned with the precautionary principle. Like the precautionary principle, the prevention principle is anticipatory and proactive, reducing the probability of harm well before the harm can be experienced.

Washington, Maine, California, and Minnesota have all recently passed legislation authorizing special restrictions on chemicals of high concern [12]. While exposure considerations do still play a role in setting priorities among chemicals under a hazard-based approach, government responses are based on the intrinsic hazards of chemicals.

Generating and Disclosing Information

A comprehensive chemicals policy requires chemical producers and users to present sufficient information on the effects of chemicals, support the science that underlies that research, and ensure that the information is made available to all those who need it. Generally, there are three areas for information development. These are:

Information on the inherent characteristics of chemicals. In order to properly classify, prioritize, and regulate chemicals, a minimum set of chemical health and environmental effects information is needed for every chemical on the market. Such a base set of data should include the physical-chemical characteristics, the toxicological properties, the biological behavior, and the fate and transport characteristics in the environment

Information on the production, use, and life cycle of chemicals. In order to understand and account for how chemicals appear, change, and disperse in the economy, information is needed on the manufacture, importation, distribution, use, and disposal of chemicals across their life cycles.

Information on release and exposure of chemicals. In order to understand threats from chemicals and to prioritize attention and interventions, information is needed on the releases of chemicals as wastes and emissions, actual and potential human exposures to chemicals, and the presence of chemicals in environmental media, humans, and other organisms.

This information may be developed by government laboratories, universities, professional associations, and corporate research facilities, but the responsibility

for assuring that this information is generated and made available needs to rest with the chemical supplier—the manufacturer, importer, distributor, or vendor. Only by making the supply of sufficient information the responsibility of the chemical supplier can the true cost of a chemical be priced in the market. Past experience demonstrates that market incentives will not guarantee that adequate chemical information is generated or made available for all chemicals. The European Union's principle under REACH of "no data, no market" creates an effective incentive for information development and presentation.

A competitive business environment requires that certain chemical information submitted to the government be protected. But the massive overuse of confidential business information protections under the current chemicals control laws have deprived the market and the public of information critical to making sound decisions in selecting chemicals or buying products. The health and environmental effects of a chemical should never be classified as a trade secret, and government standards for protecting confidential business information should require sufficient justification and set time limits that require periodic re-applications.

Transitioning to Safer Alternatives

Those who drafted the chemicals control laws of the 1970s relied heavily on the regulatory powers of government to reduce the threats of hazardous chemicals. This was primarily a one-tool strategy. The regulatory approach made sense if the chemical problem was defined as eliminating a modest number of chemicals of high concern. However, if the problem is framed as a broader systems problem, then the task is to transition chemical manufacture and use from highly hazardous chemicals toward more preferred and safer chemicals. We need to think less about restriction and more about conversion.

This requires a campaign of many initiatives—working together to achieve a common goal. Government regulation must be one of those instruments, but so should new government investments and government assistance programs, as well as new tax and capital depreciation policies, new market incentives, new consumer services, and new partnerships among industries and among industries, universities, and governments.

Conventional government regulations are useful in restricting things, and with "chemicals of very high concern," use restrictions and production bans make sense. This should involve the persistent, bioaccumulative, and toxic chemicals as well as the carcinogens, mutagens, and reproductive toxins. Experience with licensing as required for pesticides that must be registered demonstrates an effective and orderly approach to the regulation of chemicals deemed hazardous, but not of such very high concern. The burden of proof is on chemical manufacturers and users to demonstrate that a substance meets a baseline of safety and, if it does not, proving that there are no other available alternatives.

However, government regulations cannot promote safer chemical substitution or chemical innovation without additional services. The Massachusetts Toxics Use Reduction Program uses government regulations to require that chemical manufacturers and users prepare plans on possible substitutions, but relies on the dedicated attention of government technical assistant agents, university trainers and scientists, and various forms of demonstration subsidies and public recognition programs to support conversions to safer chemicals or technologies [13].

The environmental advocacy community has been working over the past decade within several economic sectors to change chemistries, and these campaigns have demonstrated fairly successful transitions. The chemistries of the personal care products sector are being transformed by a market campaign focused on safe cosmetics. The products of the electronics sector are being transformed by "take back" campaigns and the European Union's and China's directives on waste electronics and restricted substances. The health care sector is being converted to safer chemistries by Health Care without Harm, an international coalition of hospitals, health care services, and advocates. Just as impressive is the way in which Wal-Mart and other progressive retailers are changing the chemistries of consumer products. There are important lessons here [14].

A comprehensive chemicals policy could adopt similar efforts and be organized around the conversion of economic sectors. Programs would be set up in targeted economic sectors with the objective of moving the material flows in that sector to safer and more sustainable chemistries. Efforts to phase out hazardous chemicals and substitute safer alternatives would make sense within a sector because there is an economic and technical logic to how specific chemicals are used within a given sector (and that logic might be quite different in another sector). Safer alternatives may be more readily diffused where early adopters within a sector model behavior for later adopters. Working within sectors can be coordinated with other programs to meet multiple objectives. Efforts to convert a sector on chemicals can reinforce efforts to convert that same sector on carbon emissions, water consumption, or workplace rights and reduce concerns that these are competitive objectives.

Promoting Innovation and Green Chemistry

A comprehensive chemicals policy should focus as much on developing higher-tier, preferred chemicals as on phasing out lower-tier chemicals of very high concern. As a consequence these policies serve as drivers for better chemical data collection and more science to develop new, safer, and more effective chemicals—chemicals that should be developed and synthesized through green chemistry principles [15].

Today, there simply are not enough alternative substances to serve as effective substitutes for chemicals of high concern. One leading green chemist claims that 65 percent of hazardous chemicals do not have green chemistry alternatives. Without more and better green chemicals and green engineering solutions, conversions to safer alternatives on a sufficient scale cannot succeed. The problem here is not only the absence of enough research in this area; there are not enough researchers. The number of chemists graduating from conventional higher-education chemistry programs has been declining for years. The number of green chemistry or green engineering programs in colleges and universities is very limited.

The government should establish a national green chemistry and engineering initiative with the same commitment and resources that once launched the Apollo Project. Such an initiative could be modeled on the National Nanotech Initiative that today offers over $2 billion annually in research support through 10 cooperating federal agencies. This new initiative should provide:

A federal extramural research program. Just last year, Congress established a Green Chemistry Basic Research Program at the National Science Foundation; however, no appropriations were provided [16]. A Green Chemistry Research and Development bill that would provide funding for green chemistry research has been languishing in Congress for five years [17]. Both these initiatives need attention.

Regional green chemistry and engineering centers. Funding for some four to six green chemistry and engineering centers that could involve consortia of universities, community colleges, state agencies, and professional organizations could offer critical facilitation services in helping smaller firms adopt inherently safer chemicals and technologies.

Aid to colleges and universities establishing green chemistry and engineering educational programs. The National Institutes of Health offer financial support for various graduate training programs to increase the number of well-trained health care specialists. These programs could serve as models for encouraging and supporting chemistry and engineering departments in creating new curricula and supporting students engaged in undergraduate and graduate green chemistry and engineering programs.

A NEW NATIONAL CHEMICALS AGENCY

A comprehensive chemicals policy requires a coordinated and integrated approach to chemical information generation, regulation, and promotion, and this will require reconsideration of current government structures. With some 15 federal agencies and many more state agencies responsible for chemicals management, it is reasonable to consider the need for a new central chemicals agency to promote cooperation and reduce inefficiencies. The Swedish

Chemicals Agency (KemI) in Sweden [18] and the new European Chemicals Agency in Helsinki [19] offer interesting models for no-regulatory government divisions that oversee chemical information (see Figure 2).

Such a new federal agency could be a nonregulatory division that serves as a focus for collecting and making accessible chemical information generated by chemical manufacturers and users and developing and managing the national categorization of chemical substances. In addition, the chemicals agency could serve to coordinate funding for the green chemistry and engineering initiative and help to promote new chemistry and engineering curricula.

A new nonregulatory chemicals agency would not replace the current regulatory agencies responsible for chemical testing, permitting, standard-setting, and compliance with chemical laws. Rather, a new central agency would serve as a

Swedish Chemicals Agency (KemI)

KemI is a supervisory authority under the Ministry of the Environment that works in Sweden and in the European Union to promote legislation and rules that contribute to achieving "a non-toxic environment." KemI keeps a product's register, maintains chemical hazard databases, approves pesticides, assesses the risk of chemicals, checks companies' compliance with applicable regulations, provides support to local authorities, and maintains statistical information on chemicals.

The European Union's Chemicals Agency

The new European Chemicals Agency's mission is to ensure consistency in chemicals management across the EU and to provide technical and scientific advice, guidance and information on chemicals.

Figure 2. Models of governmental chemicals agencies.

focal point and resource for chemical information and coordination among the many regulatory agencies.

COMPREHENSIVE CHEMICALS POLICY FOR THE FUTURE

If the United States is to achieve a sustainable economy, a dramatic overhaul of the ways in which chemicals are managed is needed. The environmental leaders of the 1970s established an array of chemicals policies through federal statutes that have done much to manage dangerous chemicals in air, water, and workplaces. However, there is a broad gap between the current status and the generational goal of a "non-toxic environment." To overcome this gap will require major revisions to current chemical policies.

TSCA and the other chemicals control laws need to be redrafted and amended. However, in addition to such law reform, the nation needs a broad and comprehensive overhaul of its chemicals management strategy based on a broader understanding of the chemicals problem and a different perspective on the solutions. This is the task that the Europeans set out in 2001 with the release of the White Paper that called for a comprehensive overhaul of the European Union's chemicals policy [20].

We could set about to work for a truly comprehensive chemicals strategy. Such a strategy, built from a systems perspective, would phase out the most hazardous chemicals and progressively transition away from the remaining chemicals of concern by substituting safer alternative chemicals and technologies. Well-resourced science and scientists must play a critical role here in generating chemical information and developing safer alternatives. This may appear like an overly ambitious mission. However, if we cannot envision it, if we cannot debate it and develop it, we will never achieve it. Now is a good time to engage that process.

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Features – Changing Policy

PRECAUTIONARY POLICIES IN LOCAL GOVERNMENT: GREEN CHEMISTRY AND SAFER ALTERNATIVES

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ABSTRACT

Local governments like the City and County of San Francisco have shouldered the burden of toxic chemicals released into the environment through the substantial costs of health care, environmental cleanup, and infrastructure to purify drinking water, manage wastewater, and manage solid waste. Cities can no longer afford to wait for federal regulation to prevent toxic chemicals from appearing in products used locally. San Francisco's Precautionary Principle Policy calls on the City to act on early warning signs of harm and to use the best available science to identify safer alternatives. Under its umbrella, a wide array of policy tools have been utilized including financial incentives through procurement contracts, certification and promotion of safer business practices, requirements for information disclosure, and bans and restrictions on the sale of products when safer alternatives are readily available. These policies can often become the models for regional, state, and national change.

Keywords: alternatives assessment, precaution, government

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While San Francisco is unique in many ways, including its political status as both a city and a county, the environmental and public health challenges faced by this local government are commonplace. It is not news that toxic chemicals commonly found in consumer products and used by local businesses are contaminating our air, water, and land. Evidence is mounting that these chemicals have made their way into our bodies and are potentially causing irreversible harm in the form of developmental diseases and cancer [1].

Furthermore, our federal system for regulating chemicals in commerce (the Toxic Substances Control Act) does not require full assessment of the hazards of chemicals before they are allowed in the products found in homes and businesses—and about 1,000 new chemicals are added annually to the already-long list of approximately 80,000 chemicals in commerce [1]. Thus the current regulatory structure controlling the chemical makeup of products in commerce leaves cities across the United States vulnerable to ongoing exposure to chemicals whose full long-term impacts are not understood.

END-OF-PIPE SOLUTIONS

Cities and counties represent the final resting place for products as they go from being considered useful and usable items into waste. Whether the disposal of unwanted products and materials is on land or in water, it is ultimately the responsibility of local jurisdictions to create and manage the infrastructure that prevents harmful chemicals from polluting our natural resources and protects the health of residents and the environment. The end-of-pipe systems developed to treat wastewater and solid waste cost city governments collectively billions of dollars every year. Despite this substantial investment, municipal waste management systems are unable to prevent the release of a wide array of potentially harmful chemicals into the environment. And whether the ultimate exposure to toxic chemicals found in products occurs in production, use, or disposal, local health systems funded by cities and counties are increasingly faced with the financial burden to deal with any resulting acute and chronic illness [2]. In the absence of an adequate federal system to safeguard public health and the environment from toxic chemicals in products, as well as an inadequate and costly reliance on end-of-pipe chemicals management strategies, cities like San Francisco are looking for policies and programs that will promote the use of safer alternatives and influence the way products are designed and delivered.

Wastewater Infrastructure

The federal government sets strict standards for the quality of the water that is discharged from wastewater treatment plants in order to prevent chemicals identified as *priority pollutants* from being released into surface waters [3, 4]. San Francisco, like all other municipalities, spends hundreds of millions of

dollars each year operating treatment plants for its sewer and stormwater system in order to maintain compliance with these standards.

However, wastewater treatment is an imperfect solution to toxic contamination. Most plants were built in the 1970s and 1980s, and therefore do not include processes required to remove more recent chemicals of concern, such as polybrominated diphenyl ether flame retardants (PBDEs), the antimicrobial triclosan, or the myriad pharmaceuticals that enter the waste stream. Although new monitoring studies reveal an ever-growing list of potentially harmful chemicals in the environment, we are limited in our ability to retrofit typical wastewater systems to capture them. It is estimated that, for Orange County in Southern California (with a somewhat smaller sewage treatment capacity than San Francisco), upwards of $485,000,000 would be required to construct a sewage treatment plant with the reverse osmosis and other technologies that would enable the capture of chemicals like PBDEs, triclosan, and other emerging pollutants [5].

In addition to the cost of cleaning up the liquid effluent, sewage treatment facilities must manage the solid fraction of the sewage, known as biosolids or sludge, which may contain the chemicals that are removed from the wastewater. San Francisco produces about 82,000 tons of biosolids each year [6]. Almost half of that material is shipped to agricultural land for use as fertilizer [7]. Increasingly, the potential for chemicals to migrate out of the sludge into the land where it is applied will present a challenge for cities in the coming years [8].

Solid Waste Infrastructure

Even with San Francisco's noteworthy recycling rate of 77 percent in 2009 [9], the City still deposits approximately 560 tons of waste into the local landfill each year. The State of California requires landfills constructed after 1988 to have special liners to prevent leakage. However, in the normal course of landfill operation, liquid leachate must still be collected and processed so as to prevent contamination of groundwater and surface waters. This leachate contains a wide array of chemicals originally found in the disposed products. For example, a recent study of the leachate coming out of three landfills in Maine showed the presence of 47 different pharmaceuticals [10]. Landfills across California that were constructed before the state's rigorous regulatory requirements took effect have been shown to contaminate adjacent aquifers and properties [11].

Even if a landfill is not within the borders of a particular city or county, local governments have faced liability under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) when landfills to which they had contributed became Superfund sites; in these cases, the local governments may be among the responsible parties identified to help cover costs for cleanup [12]. In addition, because of concerns over contamination from landfill leachate, the State of California has banned some classes of consumer products

containing heavy metals or other toxic constituents from disposal in municipal landfills. Examples of product categories currently banned from municipal landfills in California are fluorescent lights, paint, electronics, and household batteries. The financial burden to find alternate disposal paths for those products again falls on the shoulders of local governments. As knowledge of the toxicity of chemicals found in consumer products grows, the list of banned products and burden on local budgets to manage them safely is sure to grow as well.

Thus, federal and state regulations set the standards for the performance of waste management technologies, while local governments must raise the public funds to build and maintain them. Because end-of-pipe solutions such as wastewater treatment plants and landfills are expensive and cannot keep up with the ever-growing array of chemical constituents in the product waste stream, local governments have a significant interest in changing the paradigm for product manufacture by adopting the precautionary principle and increasing the availability and use of safer alternatives.

GREEN CHEMISTRY, THE PRECAUTIONARY PRINCIPLE, AND ALTERNATIVES ASSESSMENT

Influencing the paradigm for product manufacture can take many forms, including the promotion of extended producer responsibility or lobbying for broad, federal- or state-level chemicals policy reform. San Francisco enacted policies that look upstream in the chain of commerce to influence the design of products entering across its borders and promote the use of safer chemicals. Many of these policies fall under the umbrella of the Precautionary Principle, and also connect strongly to the themes of Green Chemistry.

While the clear set of Green Chemistry principles widely cited from the book by Paul Anastas and John Warner [13] offers an important roadmap for lab chemists and product designers, it does not serve as a useful policy tool for local elected officials seeking to protect public health through local initiatives. Yet the underlying themes within the Green Chemistry principles of reducing waste, eliminating toxic by-products, and maximizing efficiency are clearly shared by San Francisco policymakers and city staff alike. In addition, the imperative to proactively design chemical hazards out of new products has won support at the state level in California, through the Green Chemistry Initiative and the passage of AB 1879 and SB 509 [14].

San Francisco's formal policy commitment to the Precautionary Principle (and, by extension, to Green Chemistry) began in 2001. The City's elected officials are well aware of scientific studies that reveal the significant impact of chemicals on ecosystems and on human health, and support the concepts embraced by Green Chemistry as they relate to product redesign [15]. However, they lacked the scientific training to interpret scientific reports on toxics hazards, or to resolve conflicting research findings. The slow pace of the scientific process

presented additional challenges to policymakers, since data that unequivocally prove cause and effect can lag far behind earlier evidence of environmental degradation and public health impacts. Aware of these limitations—and faced with increasing pressure from community-based organizations to take action to prevent harm from toxic chemicals in the environment—San Francisco leaders directed the Department of the Environment to explore policy frameworks that would enable robust and defensible decision-making to protect public health in the face of such scientific uncertainty [16].

In early 2002, a group of local environmental organizations joined with San Francisco city staff and the San Francisco Commission on the Environment to craft the policy framework that would become the nation's first Precautionary Principle Ordinance [17]. The policy document was inspired by the frequent references to the Precautionary Principle found within European policy [18], the 1992 Rio Earth Summit Declaration [19], and the findings of the Wingspread Conference in 1998 [20]. In 2003 the Precautionary Principle Ordinance became the umbrella decision-making framework (Chapter 1) for a set of environmental laws known as the San Francisco Environment Code [21]. As stated in the Ordinance, the five key elements required for precautionary decision-making are:

1. *Anticipatory Action:* There is a duty to take anticipatory action to prevent harm. Government, business, and community groups, as well as the general public, share this responsibility.
2. *Right to Know:* The community has a right to know complete and accurate information on potential human health and environmental impacts associated with the selection of products, services, operations or plans. The burden to supply this information lies with the proponent, not with the general public.
3. *Alternatives Assessment:* An obligation exists to examine a full range of alternatives and select the alternative with the least potential impact on human health and the environment including the alternative of doing nothing.
4. *Full Cost Accounting:* When evaluating potential alternatives, there is a duty to consider all the reasonably foreseeable costs, including raw materials, manufacturing, transportation, use, cleanup, eventual disposal, and health costs even if such costs are not reflected in the initial price. Short- and long-term benefits and time thresholds should be considered when making decisions.
5. *Participatory Decision Process:* Decisions applying the Precautionary Principle must be transparent, participatory, and informed by the best available science and other relevant information.

An important emphasis of the final policy language was an affirmation of the shared responsibility of citizens, business groups, and local governments to make decisions that prevent harm before potentially irreversible damage is

done. What was needed was an implementation strategy. Without direct knowledge of the work of Warner and Anastas to develop a framework for "Green Chemistry," San Francisco created a policy in line with those principles that sought to drive the marketplace towards the development of safer, less toxic products and services. The mechanism selected to achieve this outcome was that of alternatives assessment.

While government decisions regarding the acceptability of products and services are traditionally based on a risk assessment/management approach, San Francisco selected alternatives assessment as a key tool for implementing the Precautionary Principle, based on the work of Dr. Mary O'Brien [22]. Alternatives assessments enable the comparison of negative impacts, benefits, efficacy, and costs of an array of potential product or service options. The available science for each alternative is considered, allowing decision-makers to select the alternative causing the least harm. O'Brien contrasts a traditional risk assessment, which evaluates a single chemical or process in isolation, to an alternatives assessment, where a wider net is cast for alternatives and, in her words, "instead of asking how much harm is allowable, we ask how little harm is possible" [22].

The San Francisco Precautionary Principle Ordinance links the use of an alternatives assessment with transparency and public process. The Precautionary Principle Ordinance calls on a product's proponents, such as chemical manufacturers, to provide complete information about the impacts of the product so that robust comparisons can be made and regrettable substitutions avoided. In addition, it declares that the most protective decisions result when the general public, or those most affected by a choice or an action, play a role in selecting the range of alternatives considered and the preferred alternative selected. This public process is especially important in cases where scientific uncertainty or missing data renders the decision less readily quantifiable.

San Francisco's implementation of the Precautionary Principle has resulted in a practical and effective decision-making process incorporating an alternatives assessment approach. The policies resulting from this approach have led to the reduction of toxic chemicals in commerce, whether they are used in city operations or in products and services offered in local stores and businesses.

SAFER PRODUCTS THROUGH LOCAL INCENTIVES

Perhaps the strongest driver for change in product formulation is the marketplace. When consumers demand a less toxic product, industry is usually willing and eager to meet that demand. Local governments have tremendous purchasing power and so can send important signals to the market regarding the need for safer alternatives. San Francisco spends upwards of $700,000,000 a year in the procurement of products and services. Thus, when San Francisco included health

and environmental criteria within its bid specifications, companies were quick to offer alternatives to the traditional fare.

To institutionalize this procurement philosophy, San Francisco adopted the Precautionary Purchasing Ordinance in 2005, which requires city departments to buy certain products from a list of "approved alternatives" established by the Department of the Environment [23].

This ordinance was influenced by San Francisco's long experience with environmentally preferable purchasing, and also by the experience of public agencies in Seattle (WA), Santa Monica (CA), and the state of Massachusetts, for example. The ordinance has in turn served as a resource and a model for other like-minded government entities across the country [24].

Pressure-Treated Wood

The selection of the least toxic pressure-treated wood for use in city playgrounds, piers, fences, and other outdoor applications serves as an excellent example of precautionary purchasing. Pressure-treated wood purchased by San Francisco was traditionally infused with the wood preservative, chromated copper arsenate (CCA). Measurements in several city parks revealed that the arsenic, which is a known human carcinogen [25], was leaching out of the wood and into sandboxes. Once on the surface of the wood or in the sand, the arsenic was available to end up on the hands and in the mouths of the young children who frequented those playgrounds. San Francisco was not unique in the use of arsenic-treated wood to construct outdoor play equipment [26], for this use of arsenic treated wood was, at that time, legal and met risk assessment standards set by the federal government. Once the leaching data were made available, the fact that it was perfectly legal to build play structures out of arsenic-treated wood did little to allay the concerns of the public and elected officials about the potential for harm in the long run.

It was impossible for city staff to prove that playing on these structures would lead a child to develop cancer some 30 years later, yet decision-makers determined it was important to take action to prevent harm. An alternatives assessment was performed comparing the impacts, costs, and efficacy of each available wood preservative [27] to determine if safer alternatives could be identified. The alternatives assessment revealed that for a significant majority of the applications of pressure-treated wood, arsenic was not a necessary ingredient and safer alternatives were readily available (e.g., copper-based compounds such as copper boron azole).

An exception to the determination that arsenic is *not* the safest alternative offers an interesting illustration of the robustness of the alternatives assessment approach. Careful examination of a wide array of leaching studies indicated that wood treated with arsenic was actually the least harmful alternative in marine ecosystems. For marine organisms, copper is of greatest concern, not

arsenic [27]. The arsenic appears to keep the copper bound more tightly to the wood and so greatly decreases the amount of copper entering into the seawater. As a result of this alternatives assessment, the Port of San Francisco continues to use arsenic-treated wood for pilings and pier supports. Thus a precautionary alternatives assessment did not lead to an automatic ban of a chemical or a product; the determination of the safest choice is necessarily done on the basis of specific applications.

There are many other examples in which San Francisco used a precautionary approach in the selection of goods and services including pest control products and techniques, computers, lighting, disinfectants, and janitorial supplies [23]. In each case, staff worked closely with end-users to ensure product efficacy, purchasing agents to ensure comparable cost, and the public to ensure that a wide range of alternatives were considered. San Francisco is not the only large institutional purchaser interested in safer products and services; governments, universities, and corporations across the country are using their purchasing power to send signals to the marketplace that the principles of Green Chemistry and alternatives assessment can be translated into safer products [28].

Professional Garment Cleaning

San Francisco's assessment of the chemicals used in professional garment cleaning (i.e., dry cleaning) provides an example whereby local government can reach beyond the range of its own contracting and procurement process and incentivize local businesses to move toward less toxic products and services. This project also provides a telling example of the challenges faced in completing an analysis when the federal government allows chemicals on the market with incomplete testing or hazard information.

The State of California recognized the significant toxicity of the traditional chemical solvent used in professional garment cleaning when it moved to phase out the use of perchloroethylene (perc) by 2020 [29]. San Francisco noticed the proliferation of garment-cleaning shops claiming environmental attributes as those shops began to purchase substitutes for the older perc machines. A number of technologies surfaced to replace perc-based systems including systems using hydrocarbon-based solvents, carbon dioxide, siloxane, or water. In order to make a scientifically defensible recommendation to local businesses regarding the technology that would best minimize harm, San Francisco conducted an alternatives assessment of the various garment-cleaning technologies available on the market.

As part of the alternatives assessment, a number of hazard characteristics—such as carcinogenicity, harm to reproductive or nervous systems, use of volatile organic compounds, and water use—were selected to compare the various solvent alternatives. Very early on in the process of comparing alternatives, the challenge of missing information or "data gaps" became apparent. Although city

staff and consultants assembled the initial analysis, they were not equipped to use complex computer simulations to fill in the missing information. Thus we were pleased to partner with the State of California Office of Environmental Health Hazard Assessment (OEHHA), which has a staff of trained toxicologists and epidemiologists. As a result of the joint effort, an alternatives assessment was finalized that compared not only health and environmental attributes, but also compared permit requirements, fees, and the costs of purchase and installation for each solvent alternative [30]. The analysis revealed that the clear choice to minimize harm at a comparable price was professional wet cleaning, which uses specialized washers and dryers that control revolutions, temperature, and moisture content of the clothes. Wet cleaning can be used for any clothes typically sent for dry cleaning.

This comprehensive analysis became the justification for San Francisco's incentive program to promote wet cleaning technology. At first there was great fear and resistance in the local business community regarding this new approach to garment cleaning. Scientific comparisons alone were not enough to drive the market, and nearly a year went by without any businesses changing over to wet cleaning. The City then partnered with the State of California Air Resources Board and the Bay Area Air Quality Management District to offer garment cleaners a grant that amounted to almost 50 percent of the cost of the wet cleaning equipment. Wet cleaners were also offered hands-on demonstrations and training in Chinese and Korean on the wet cleaning equipment, as well as outreach and promotional resources to help market their services to the general public. The result of this multi-faceted approach was the creation of 10 wet cleaning locations in San Francisco, with more expected to open as demand begins to grow and the deadline to switch out perc machines approaches. The impact of this effort is being felt beyond the borders of San Francisco and Los Angeles (where Occidental College's Pollution Prevention Program has been promoting wet cleaning for more than 10 years). With the leadership of scientists at the Institute of the Environment and Sustainability at the University of California Los Angeles, garment cleaners from around the region attended the demonstrations and trainings held in San Francisco, and wet cleaning technologies are now being adopted across California [31].

SAFER PRODUCTS THROUGH LOCAL MANDATES

Local governments also have the opportunity to drive the market toward the adoption of safer alternatives through legislation. While it is clear that state and the federal bodies have the largest potential impact through the statutory process, it is not uncommon for cities and counties to kick-start legislation using their local authority. Except in cases of specific preemption by federal or state law, cities and counties in the United States have the legal authority to adopt laws that protect the health, safety, and welfare of their residents. In fact,

local governments frequently serve as the "laboratories" or testing grounds for new policies and environmental initiatives. Examples in California of policies that moved from the local level to the state level include: smoking bans in restaurants, bans on the sale of mercury-containing fever thermometers, disclosure of mercury in lighting equipment, restrictions on the use of pesticides in public spaces, green building codes, and many more. Recently, San Francisco has utilized its legislative authority to adopt two laws that may affect the way products are designed or used—one through an outright ban and the other through the requirement to provide information at the point of sale.

Phthalates in Children's Products

In 2006, San Francisco followed the lead of the European Union and became the first entity in the United States to ban the sale of children's products that contain any of six types of phthalates [32]. Phthalates, used as an additive to make PVC plastic soft and pliable, were commonly found in children's toys and other products. Europe had first banned these chemicals from use in children's products in 1999 after concerns that small concentrations of the chemicals could leach out of the products and disrupt development of young children [33]. The European ban was re-evaluated and then strengthened in 2005 [34]. Like the European Union, San Francisco used the lens of the Precautionary Principle to look at alternatives and determined that phthalates were not inherently necessary in the manufacture of children's toys. After its local ban went into effect, San Francisco began implementation by educating retailers and setting up testing and enforcement protocols. However, when the State of California adopted a similar ban, the City was able to rescind its local law [35]. A few months later, a ban on phthalates in children's products based on the findings and language first developed in San Francisco was passed and signed into law by the United States Congress [36]. Thus, a local government can use its legislative authority to drive the adoption of Green Chemistry principles and mandate the use of safer alternatives well beyond its immediate borders.

Cell Phone Radiation

There are instances where a local government has very limited authority to change the way products are designed or evaluated for safety, but can still play a critical role in raising the profile of an issue. Such was the case when San Francisco investigated the issue of cell phone radiation. In this case, the United States Federal Communications Commission has the full authority to regulate cell phones and determine the maximum allowable levels of radiation that can be absorbed by the body and/or head of a cell phone user. San Francisco's Precautionary Principle Ordinance stresses the importance of acquiring complete and accurate information about a product as a way to help consumers make informed decisions. It was this emphasis on the importance of information

and "right to know" that led the Mayor and Board of Supervisors to pass a first-in-the-nation law that requires retailers of cell phones to post the maximum radiation levels absorbed by the head or body next to information on price and other features. The law, called the "Cell Phone Right to Know Ordinance" also requires that retailers provide supplemental information at the store to inform consumers about ways to reduce their exposure to cell phone radiation [37]. San Francisco's Cell Phone Ordinance helps consumers to do their own "alternatives assessment" and make informed decisions about the products they select for themselves or for their children.

CONCLUSION

Forced by a lack of effective regulatory action at the state and federal levels, cities such as San Francisco have developed innovative solutions to address the myriad issues presented to us by the use of toxic chemicals in commerce. We will continue to pilot and implement precautionary policies aligning with the principles of Green Chemistry to drive the redesign of products and services. Such efforts may be the only way out of the ever-growing costs of financial investments in disposal, cleanup, and ultimately the treatment of health impacts. Under the umbrella of San Francisco's Precautionary Principle Ordinance, city decision-makers utilize a wide array of tools from incentives to mandates that are based on alternatives assessments and seek to minimize the use of toxic chemicals, identify safer alternatives, and ensure that decisions are both robust and practical. As we employ these real-world applications of Green Chemistry principles, we find that we're not just digging ourselves out from under the undue challenges of toxic chemicals; we're also building the foundation of a safe chemicals future.

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Features – Changing Policy

THE DRIVE FOR A SAFER CHEMICALS POLICY IN THE UNITED STATES

MICHAEL E. BELLIVEAU

ABSTRACT

This article analyzes the history, policies and politics of the modern era of safer chemical policy reform in the United States. In the last decade, state laws have modeled a chemical policy framework to phase out unnecessary dangerous chemicals in favor of safer alternatives. These state drivers, along with market campaigns to reduce downstream business use of hazardous chemicals, have weakened the chemical industry's resistance to fixing the broken federal chemical safety system. The obsolete Toxic Substances Control Act of 1976 (TSCA) has failed to protect public health and the environment and has stifled innovation toward greener chemistry. Health advocates with a progressive policy vision tempered by legislative pragmatism have launched a TSCA reform campaign to challenge chemical industry power in a weak Congress. The opportunity and limits to winning meaningful TSCA reform are characterized and marked as a critical milestone on the path to a truly comprehensive safer chemical policy for the United States.

Keywords: toxic chemicals, policy, TSCA, safer alternatives

Nearly 50 years ago, Rachel Carson called for a federal chemical policy based on public data, the best science, and a search for safer alternatives: "The choice, after all, is ours to make. If, having endured much, we have at last asserted our 'right to know,' and if knowing, we have concluded that we are being asked

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to take senseless and frightening risks, then we should no longer accept the counsel of those who tell us that we must fill our worlds with poisonous chemicals; we should look about and see what other course is open to us" [1, pp. 277-278].

Yet in 1976, the federal Toxic Substances Control Act (TSCA) grandfathered 62,000 existing industrial chemicals in commerce without any restrictions on known hazards or mandatory health and safety testing to fill data gaps [2]. The statute handcuffs the U.S. Environmental Protection Agency (EPA) with an onerous burden of proof that prevents ready action. In 35 years, EPA has restricted some uses of only five of those chemicals and ordered testing for only about 200 more [3]. EPA's 10-year TSCA effort to ban most uses of asbestos, a known human carcinogen, was rejected by a federal court [4]. About 20,000 new chemicals have been introduced into commerce since 1976 without complete data on health and safety and only a rushed risk screening [3]. After years of critical review by government auditors and environmental health advocates, virtually everyone acknowledges that TSCA remains ineffectual and obsolete.

This article traces the development of two related drivers for modernizing U.S. chemical policy—the rise of state-based chemical regulation and the emergence of a national health-based campaign to overhaul the federal chemical law. It chronicles state and national policy efforts to fix our broken chemical safety system over the last decade, illustrating how the safer chemicals movement challenges the dominant risk assessment regime and chemical industry power.

This analysis examines safer chemicals reform primarily through a policy development lens, which necessarily limits its scope. Many essential elements to effecting change are touched on only in passing, including organizing for grassroots power, creative messaging around health, and leveraging the new science. While the critical importance of building a diverse unified coalition is emphasized, this article barely discusses the perennial challenge and success in incorporating environmental justice, workers' concerns, and women's voices. Market-based campaigns and corporate chemical policies, while not analyzed, are also crucial drivers for safer chemical policy reform [5]. Within these limits, the history of the reform movement unfolds.

THE VIRTUAL ELIMINATION OF TARGETED CHEMICALS (1998-2009)

Modern chemical policy reform in the United States developed at the state level, informed by parallel actions by the Scandinavian countries, the European Union (EU), and Canada. The state actions harkened back to effective national strategies of the 1970s, such as the phase-out of DDT, PCBs, and lead, before the U.S. lost its global leadership role in environmental policy [6]. Some recent examples help illustrate the development of state policy leadership on chemicals.

Mercury in Products—Common Sense Trumps Risk Assessment

In an ornate legislative committee room on the fourth floor of the State House in Augusta, Maine, a pivotal moment in chemical policy reform quietly unfolded one spring afternoon in 2001. The policy question was profoundly simple: do the inherent hazards of mercury justify a phase out of mercury-containing thermometers in favor of safer alternatives or should a quantitative risk assessment be conducted first to determine whether any restrictions are needed?

The self-appointed expert on the Natural Resources Committee was a State Representative who lectured his colleagues for 45 minutes on how to quantitatively assess the risks of mercury thermometers. With a mathematical flourish, he firmly concluded that mercury thermometers did not pose a significant risk to human health and should remain unregulated. Rather than question his assumptions, the Chair cited evidence that mercury was long-lived, built up to high levels in the food web, and was highly toxic to fetal brain development. Human exposure was too high and safer mercury-free thermometers were equally effective and available at comparable cost.

By an overwhelming vote margin, Maine became one of the first states to prohibit the sale of mercury-added thermometers. Within a few years, most mercury products were phased out in Maine [7]. By 2009, similar laws to phase out mercury in consumer products had been enacted or proposed in 32 states, 21, cities and four counties in the United States [8, p. 9].

PBDE Flame Retardants—When Do We Know Enough to Act?

In 1998, Swedish scientists puzzled over the mysterious spikes on the chromatogram. They labored to develop a new method to identify the unknown chemicals. They had discovered polybrominated diphenylethers (PBDEs), chemicals added to plastics to slow the spread of flames. When they looked at archived breast milk samples, shock waves resounded throughout the scientific community. PBDE levels in humans had increased exponentially in 25 years [9].

A European risk assessment characterized the penta mixture of PBDEs as persistent and bioaccumulative, but lacked enough toxicity data to establish safe levels of exposure [10]. Nonetheless, by 2003 the EU took precautionary action to ban penta and octa blends of PBDEs and phase out all PBDEs in electrical and electronic equipment, including the deca mixture.

In the United States, a California furniture fire safety standard had triggered massive use of penta in foam couch cushions, resulting in North American PBDE body burdens much higher than those in Europe [11]. The California legislature passed a measure in 2003 to ban penta and octa, which was followed closely by a similar measure in Maine. Chemical makers halted penta production by the end of 2004, but strongly defended their lucrative market

in deca. By 2007, Maine and Washington had banned deca in electronics, mattresses, and textiles. By 2010, nine more states had restricted PBDEs, and a federal bill proposed to extend the phase-out nationwide. Chemical makers finally struck a voluntary deal with EPA to halt deca production by 2013, some 15 years after the first alarm.

Not once during the decade of debate over PBDEs was enough information available to confidently establish a safety standard and show that it wasn't met. EPA's initial risk assessment of decaBDE was controversial and not completed until 2008 [12]. Yet a begrudging consensus emerged to phase out PBDEs without relying strictly on risk assessment, because of the chemicals' inherent hazardous properties and the availability of safer alternatives [13].

EARLY LESSONS FROM STATE-BASED CHEMICAL ACTIONS

Risk assessment proved of little value in deciding whether or to what extent to restrict products containing mercury or PBDEs. The states chose to phase out these chemicals whenever safer alternatives were demonstrably available, effective, and affordable. Mercury hazards and aggregate exposure were well known, but data gaps plagued mercury use in products. Although PBDE exposure was documented early, few data were available to characterize risk to health.

From this early state experience, four lessons emerged:

1. Risk assessment has limited value for safely managing chemicals of high concern
2. Such chemicals should be virtually eliminated through an expedited, orderly transition
3. Data gaps on chemicals are rampant and must be filled to inform policy action
4. Alternatives assessment enables effective decision-making on solutions and exemptions

Risk Assessment—A Helpful Driver, but a Poor Decider

Applying risk-based health standards still dominates chemical management decision-making. In 2000, the National Research Council confirmed the safety standard for protecting the fetus from neurodevelopmental toxicity that results when pregnant women are exposed to methylmercury. Assessing mercury risks was easy since data are relatively robust on the hazards, dose-response relationship, and exposures, unlike for PBDEs and most other chemicals. Due to the buildup of methylmercury in certain fish, about 8 percent of all American women consume mercury above the safety standard. About 300,000 American babies are born every year at risk of

subtle brain damage resulting from elevated methylmercury exposure in the womb [14].

The "risk cup" filled by aggregate exposure from all sources of mercury "overflows." Since less than 10 percent of the vulnerable group is exposed above the safety standard, wouldn't a modest pollution control strategy enable the standard to be met without phasing out mercury use?

A risk-based approach fails when used to decide where to draw the finish line in reducing exposure. Mercury, PBDEs, and other persistent, bioaccumulative, and toxic chemicals (PBTs) defy traditional risk assessment [15]. Since small amounts build up to higher and higher levels in the food web over time, continued low-level pollution remains dangerous. PBTs are long-lived in the environment and are global pollutants that travel long distances from their original sources. Like many chemicals, PBTs undergo complex changes that multiply the rampant uncertainty inherent in risk assessment, rendering firm safety conclusions ever-elusive [16, pp. 59-74].

Second, a risk-based approach tends to promote environmental injustice by averaging risks across populations and underestimating risks to various subgroups. In actuality, "hot spots" of disproportionate exposure routinely occur in a patchy distribution [17]. Risk assessment fails to consider cumulative risks resulting from concurrent exposure to other pollutants; to psychosocial stressors such as racism, poverty and violence; and to other risk factors such as poor nutrition, limited health care access, and pre-existing medical conditions [18, pp. 213-239; 19].

Risk assessment also creates a false sense of security, since no safe level of exposure can be assumed for lead [20], fine particulate matter [18, pp. 151-154], carcinogens [21], or endocrine disruptors [22]. The best science now supports rejection of a safety threshold for *all* noncancer effects, given the enormous human variability in susceptibility and exposure [18, pp. 127-187].

Over-reliance on risk assessment for decision-making also misses commonsense pollution prevention opportunities. Glass thermometers filled with mercury or plastic TV cases full of PBDEs are unneeded when safer alternatives are readily available.

In 2009, the National Academy of Sciences (NAS) cited the failure of risk assessment to support timely decisions or best solutions to environmental health threats [18]. NAS said that rather than determining an acceptable level of risk for a given exposure scenario, EPA should use risk assessment to characterize which solution is preferable among risk management options identified in advance [18, pp. 240-257]. This would align EPA science policy with similar methods such as technology options analysis, alternatives assessment, and substitution planning.

The fate of risk assessment reform remains controversial. The chemical industry has mounted a vigorous attack on the NAS report [23], and EPA has responded too slowly [24].

Virtual Elimination—Continuous Improvement through an Orderly Transition

A virtual elimination policy seeks to replace chemicals of high concern with safer alternatives over a reasonably achievable time period. Unlike a risk-based approach, virtual elimination embodies both continuous improvement and promotion of best practices. A virtual elimination policy translates voluntary approaches such as pollution prevention and toxics use reduction into mandates, overcoming the problem of motivating laggards to make changes.

For example, the New England Governors and Eastern Canadian Premiers opted for "the virtual elimination of the discharge of anthropogenic mercury into the environment" [25]. The bi-national International Joint Commission agreed that "the discharge of any or all persistent toxic substances be virtually eliminated" in the Great Lakes [26].

Three policy elements adopted for mercury, PBDEs, and other chemicals have informed federal chemical policy development. First, a *presumptive ban* on specific chemical uses was imposed where effective alternatives were available, usually through a prohibition on the sale of certain products containing the chemical. Second, *categorical exemptions* excluded certain critical uses upfront from the presumptive ban. Lastly, manufacturers were provided the option of *case-by-case exemptions*, which if granted allow for temporary relief from the ban.

With proper design and periodic updating, virtual elimination ensures an orderly transition to safer alternatives, striking a balance between a thoughtlessly disruptive ban and continued unnecessary use of a dangerous substance. The exceptions to the presumptive ban provide for a smooth transition and offer a pressure-relief valve that allows for flexible extensions of deadlines if effective, safer alternatives are not yet readily available for specific applications.

Categorical exemptions can be passive or explicit. For example, mercury-containing lighting was omitted from the presumptive phase-out because more energy-efficient alternatives were not then available. Certain uses of PBDEs, such as in industrial wire and cable, were explicitly exempted from the presumptive deca ban because safer alternatives were not available yet.

A case-by-case policy typically allows a manufacturer to petition for an exemption for up to five years based on a finding that for a specific use, technically feasible alternatives are not available at a comparable cost, or that continued use of the chemical provides a net benefit to the environment, public health or public safety when compared to available alternatives.

In federal policy, a virtual elimination strategy should be applied to PBTs and other high-hazard chemicals to which humans are likely to be exposed. To implement such a chemical policy requires information on chemical use, exposure potential, and availability of safer alternatives.

Chemical Use Data—A Critical Missing Link

A landmark law passed by nine states requires any person who intentionally adds mercury to a product to report the amount used and the number of units sold. The resulting public database provided the first detailed data on mercury use in the United States [27]. The use data directly informed the search for mercury-free alternatives and policy actions to reduce use in products.

Serious data gaps exist on the use of most chemicals in commerce (as well as on chemical hazards and exposures). Chemical manufacturers often do not understand the end use of their chemicals far down the supply chain [28, p. 12]. Product makers often cannot identify all the chemicals in the raw materials and components that they use [29]. Since no single entity knows all chemical uses, a comprehensive system for disclosing chemical use will be necessary to inform policy and market decisions on chemical management. Chemical use data are essential for characterizing both the potential for exposure and the availability of safer alternatives.

Alternatives Assessment—The Search for Effective Solutions

Banning mercury thermometers was politically easy, unlike driving other mercury products and PBDEs out of commerce. When Maine advanced sweeping legislation in 2002 to phase out mercury products, lighting manufacturers mounted a fervent opposition campaign and killed the bill. A year later, the state identified specific mercury-free alternatives that were functionally equivalent and commercially available at a comparable cost [30]. With the solutions identified, a new law to phase out mercury use in dozens of products sailed through without opposition. A proposed ban on deca met a similar fate until an alternative assessment showed the solutions.

An evolving alternatives assessment methodology guides the search for available, effective, and affordable alternatives to hazardous chemicals [31]. The Green Screen was adapted from EPA's Design for the Environment program to help identify inherently safer alternatives [32]. Properly motivating the search for inherently safer chemicals remains a central challenge.

THE RIPENING OF FEDERAL REFORM (2001–2008)

In 2001, seasoned anti-toxics activists launched a nationally coordinated media campaign to promote Bill Moyers' exposé of the chemical industry, *Trade Secrets*. The resulting Coming Clean collaborative provided an ongoing forum for sharing information and strategy among a diverse network of non-governmental organizations (NGOs) working for environmental and occupational health and justice at the local, state, and national levels. Its Policy

Workgroup adopted a progressive policy vision, the *Louisville Charter for Safer Chemicals: A Platform for Creating a Safe and Healthy Environment through Innovation*, in May 2004. The *Charter* detailed six needed reforms: 1) require safer substitutes and solutions; 2) phase out persistent, bioaccumulative, or highly toxic chemicals; 3) give the public and workers the full right-to-know and participate; 4) act on early warnings; 5) require comprehensive safety data on all chemicals; and 6) take immediate action to protect communities and workers [33].

At a national gathering in December 2004, advocates gave birth to the national campaign for chemical policy reform by adopting a bold 10-year goal to achieve progressive TSCA reform by January 1, 2015. Unfazed by the recent reelection of President George W. Bush, they celebrated safer chemical reforms underway in Europe, at the state level, and in the marketplace.

They also resolved to build a state-based alliance to advance model chemical policies at the state level as a strategy for driving federal reform. Within a few months, state advocates representing health-based coalitions in Maine, Massachusetts, New York, and Washington formed the State Alliance for Federal Reform of chemical policy (SAFER).

Lastly, after heated debate, conferees agreed to pursue TSCA reform legislation. Given the unfavorable political conditions, some argued that immediate federal action would undermine efforts to establish state-level policy precedents. Others asserted that a federal "message bill" would show solidarity with the campaign-in-progress to pass REACH, the landmark legislation to register, evaluate, authorize, and restrict some 30,000 chemicals in the European Union [34].

The Kid-Safe Chemicals Act Sends a Message?

The development of the TSCA message bill provoked a sharp policy disagreement. The Environmental Working Group (EWG) argued for a risk-based approach based on the 1996 Food Quality Protection Act, which relies on risk assessment to set pesticide exposure levels that pose a reasonable certainty of no harm [35]. Clean Production Action and the Ecology Center argued for a data-rich, hazard-based, and substitution-driven approach that followed the Louisville Charter, state and European chemical policies, and the new international Stockholm Convention on Persistent Organic Pollutants (POPs). Such an approach would require comprehensive data on all chemicals and systematically replace inherently hazardous chemicals with safer substitutes.

In July 2005, Senator Frank Lautenberg (D-New Jersey) introduced the Kid-Safe Chemicals Act (KSCA), which was also introduced by Representative Henry Waxman (D-California) in the House [36]. Siding with EWG, Congressional staff drafted a completely risk-based bill, although at least one staffer questioned the wisdom of establishing toxic chemical tolerances for babies.

KSCA would replace the TSCA standard of "unreasonable risk," which embodies cost-benefit analysis, with the strictly health-based "reasonable certainty of no harm." It would flip the burden of proof, from government having to prove harm, to the chemical industry having to prove safety. It would no longer require the least burdensome restrictions. KSCA called for widespread biomonitoring, and for risk-based safety determinations and use exemptions on priority chemicals.

Although KSCA awakened pent-up demand, the bills attracted few co-sponsors. EWG announced strong support while the chemical industry declared KSCA unworkable, dismissing the need for TSCA reform [37]. Many public health advocates lamented KSCA's failure to fill data gaps, phase out PBTs, or require safer alternatives. Congress held its first TSCA oversight hearing in 10 years, airing the case for closing gaps in data, safety, and technology [38].

KSCA died without fanfare as the Republican-controlled 109th Congress came to a close. Attempting federal legislation during the deepest depths of the Bush Administration was not a totally fruitless exercise. Virtually every policy difference and political tension within the environmental health movement surfaced, with time aplenty to organize and navigate forward.

Building the Chemical Action Pyramid

In September 2005, advocates gathered again on the shores of Lake Michigan to strive for a unified vision for federal chemical policy reform. Although no consensus was reached during the sometimes acrimonious debate, a possible hybrid approach sparked consideration. Using the old federal food pyramid and the Greenpeace plastics pyramid as a model, the Environmental Health Strategy Center (EHSC) sketched a chemical action pyramid.

At the red top of the chemical pyramid were the PBTs and other high hazard chemicals that would be phased out in favor of safer alternatives. A cautionary yellow middle tier was filled with other chemicals subject to risk-based safety determinations. The green foundation of the pyramid was the home for preferred chemicals. EWG reluctantly pledged to evaluate the concept of a "red top" phase-out of PBTs. But other advocates warned that relying on risk assessment for *any* hazardous chemicals would fail to provide full health and environmental protection.

Under the auspices of SAFER, design was begun on a hazard-based, substitution-driven chemical management system to inform model chemical policy development at the state level. In 2006, this policy research and analysis was published as an internal movement report, *A Framework for Chemicals Policy Reform* [39]. The chemical pyramid concept was fleshed out and a process flow addressed all chemicals in commerce in a systematic manner. Figure 1 illustrates the four tiers of the chemical action pyramid and the policy actions to be triggered.

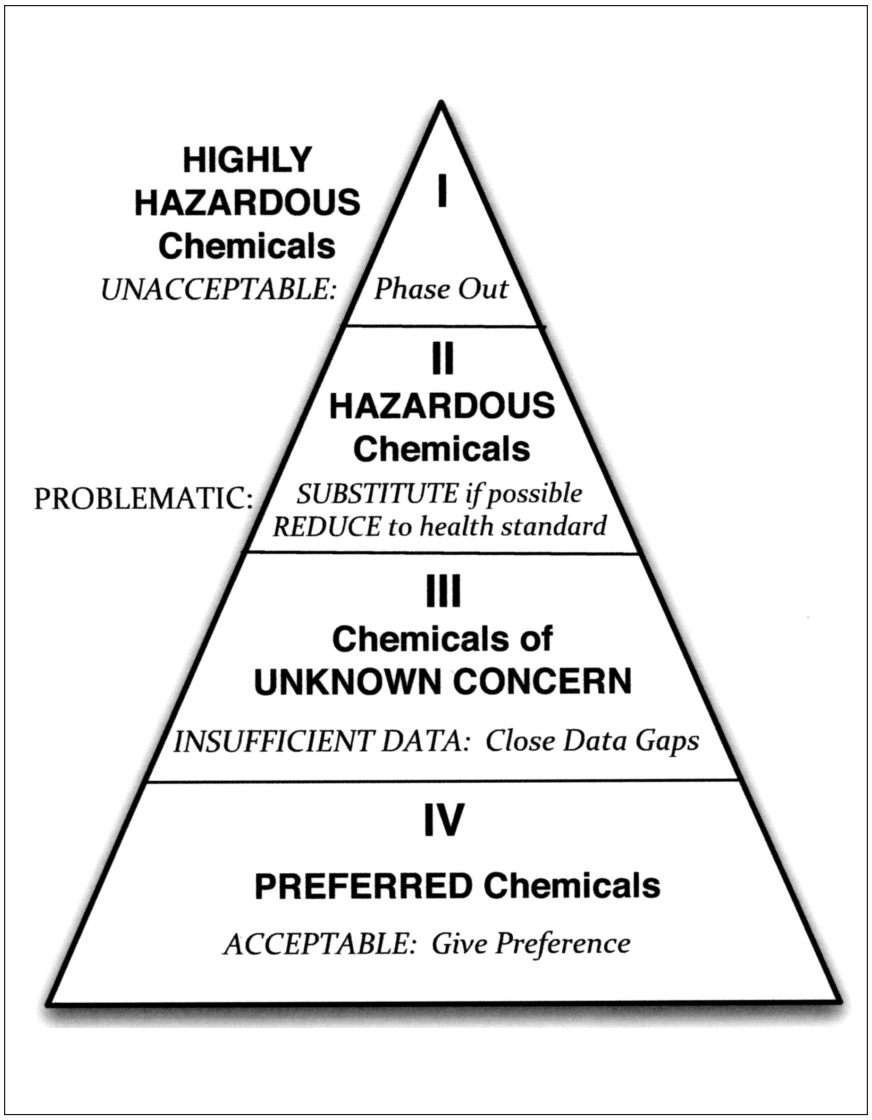

Figure 1. The chemical action pyramid.
Source: Mike Belliveau, Mark Rossi, and Laurie Valeriano, *A Framework for Chemicals Policy Reform: Issues in Model Policy Development,* July 2006, http://www.preventharm.org/Images/134/FrameworkChemPolicyRfrm.pdf (accessed February 20, 2011).

In Tier I, highly hazardous chemicals such as PBTs would be phased out unless safer alternatives were not available. Tier II hazardous chemicals would be safely substituted when possible or else exposure would be reduced to meet health-based safety standards. Chemicals of unknown concern would be temporarily assigned to Tier III until data gaps were closed through further safety testing and data gathering. Lastly, Tier IV identifies favored chemicals that are inherently low-hazard.

The *Framework* approach envisions an active role by government and industry in assessing the availability of safer alternatives and planning for substitution of hazardous chemicals. Time-limited exemptions would be provided if an alternatives assessment demonstrated that safer alternatives are not technically feasible and commercially available. The report cited policy precedents, including the federal Clean Air Act phase-out of ozone-depleting chemicals [40].

The *Framework* report focused on reducing inherent hazards rather than estimated risks, while acknowledging tension between a hazard-based system and the dominant risk-based regime for chemical management. While not specifically resolved, the authors "believe that developing a hazard-based chemicals policy that operates in addition to, rather than replaces, our existing risk-based system will move toward the safest chemicals more effectively" [39, p. 40].

Kid-Safe Chemicals Redux

In 2007, another major effort was made to unify NGOs in anticipation of action by the 110th Congress, which Democrats controlled for the first time since 1995. EWG and Coming Clean invited advocates to Washington, DC, to recommend specific improvements to the Kid-Safe Chemicals Act. EWG presented the case for continued reliance on KSCA without substantive changes as the most politically expedient and media-friendly path to success.

SAFER argued for a more health-protective yet politically feasible "dual track" approach in which high-hazard chemicals would be phased out in favor of safer alternatives, while other chemicals would be subject to a risk-based safety determination. The dual track mirrored the technology-based approach of past federal environmental laws, which requires best available solutions to reduce air and water pollution, backstopped by health-based safety standards.

Despite EWG protest, the dual-track approach captured the hearts and minds of attendees, including worker health and safety advocates and health groups. A delegation of policy experts representing diverse viewpoints was tasked with developing proposed consensus amendments to KSCA. Three strands of policy emphasis informed the NGO negotiations that followed.

The Environmental Defense Fund (EDF) argued for an information-rich TSCA that required a minimum dataset on hazards, exposures, and uses for all chemicals in commerce to inform both market and government decisions. EDF

had strong reservations about requiring safer alternatives without regard to chemical exposure, and burdening government with assessing alternatives.

EWG continued its unflagging support for a risk-based KSCA with significantly expanded biomonitoring. It opposed a minimum dataset and any safer alternatives mandates. EWG conceded its own analysis supported a PBT phase-out, but would not agree to such a policy.

EHSC, representing the SAFER perspective, advocated for a PBT phase-out and EPA authority to require demonstrably safer and effective alternatives. EHSC also argued for closing the KSCA loophole that would allow the industry to secure risk-based exemptions for individual chemical uses without considering the aggregate risks from all exposures to the chemical.

Internal negotiations resulted in near-unanimity, with policy recommendations supported by more than 20 organizations—not including EWG, which maintained an anti-coalitional posture that better served its self-interest. The so-called Integrated Proposal of 2007 was presented privately to Congressional majority staff as proposed amendments to KSCA of 2005. The changes would require an upfront minimum data set and a hazard-based categorization of all chemicals in commerce. A dual track was created to add hazard-based substitution in two ways.

First, PBTs and very persistent, very bioaccumulative chemicals detected in human umbilical cord blood would automatically fail the safety standard and be phased out. Exemptions were allowed for critical uses if safer alternatives were not yet available. Second, EPA would be authorized to require safer alternatives, if demonstrably available, for specific uses of priority chemicals. Aggregate exposure would include all sources, research on legacy chemicals would be funded, and safety standards would be applied to permitting and the workplace to ensure environmental justice. The amendments eliminated loopholes, reduced ambiguity, and improved workability.

Nearly a year of discussions and delay ensued before Senator Frank Lautenberg and Representatives Hilda Solis (D-California) and Waxman finally introduced the new Kid-Safe Chemicals Act of 2008 [41]. Although improved, the 2008 bill disappointed many. Table 1 summarizes the major policy differences between KSCA 2005, the NGOs' Integrated Proposal of 2007, and the new KSCA 2008. The new bill proposed a vague minimum dataset with no deadline for submission. Rather than triggering a phase-out, PBTs found in newborn babies would simply be prioritized for an earlier risk-based safety determination. No safer alternatives authority would be created or environmental justice concerns addressed, although biomonitoring was improved.

Although several NGOs endorsed the 2008 legislation, some SAFER state advocates withheld their support, asking instead that their Congressional delegations help strengthen the bill. The chemical industry joined the symbolic fray with its continued relentless opposition. No hearings were held or co-sponsorship drive mounted, and the legislation died with a thud.

Table 1. Comparative Analysis of Proposed TSCA Reforms (2005-2008)

Policy elements	KSCA of 2005	Integrated proposal 2007	KSCA of 2008
Categorizes all chemicals by hazard within 5 years	No	Yes	Yes
Requires submission of minimum data set	No	Yes—within 5 years	Yes—but no deadline
Names up to 300 priority chemicals by 18 months	Yes—and add some annually	Yes—and add 300 annually	Yes—and add 200 annually
Phases out PBTs & vPvBs if detected in cord blood	No	Yes	No—but PBTs prioritized
Consider low doses, timing of exposure & nano	No	Yes	Yes
Applies health-based risk standard to decide safety	Yes	Yes	Yes
Decides safety based on all uses and new information	No	Yes	Yes—but with less specificity
Requires compliance plan	No	Yes	No
Risk-based exemption for restricted chemical uses	Yes—and could be abused	Yes—tightens exemption	Yes—in between others
Authorizes EPA to require safer alternatives	No	Yes—when found available	No
Requires biomonitoring	Yes—by industry	Yes—by federal CDC	Yes—by CDC at industry cost
Include legacy chemicals in aggregate exposure?	No	Yes—and funds research	No
Applies safety standard to permits and workers?	No	Yes	No

vPvBs = very persistent, very bioaccumulative chemicals (without regard to toxicity).

Source: See proposed TSCA reform legislation: *Child, Worker, and Consumer-Safe Chemicals Act of 2005,* S. 1391, H.R. 4308, 109th Congress, 1st sess. (known as the *Kid-Safe Chemicals Act*); and *Kid-Safe Chemicals Act of 2008,* S. 3040, H. R. 6100, 110th Congress, 2nd sess.

The 110th Congress witnessed the power of alliance-building, along with isolating self-promoting contrarians, to shape a unified policy agenda, while rooting professional lobbying by national NGOs more strongly in the real-world experiences of constituencies directly affected by toxic chemicals. Yet, progressive Congressional Democrats failed to prioritize a winning wedge issue, displaying limited policy vision tempered by excessive political caution in challenging the chemical industry. With the November election of President Barack Obama and an expanded Democratic majority, the plate seemed set for real TSCA reform in the new 111th Congress.

THE STATES AS LABORATORIES FOR REFORM (2003–2010)

Meanwhile, parallel development of state chemical policy during the KSCA debates proved the political viability of substitution-driven comprehensive reform. In the last eight years, 71 chemical safety laws were passed in 18 states by overwhelming bipartisan margins. The pace and breadth of state restrictions on toxic chemicals has more than tripled during this period. The coordinated SAFER states strategy used the lack of a functioning federal program to drive state legislative phase-outs of chemicals such as PBDEs in consumer products, building toward broader state laws that established new state-based chemical management programs [42].

Comprehensive state chemical policies have been enacted in four states and are pending elsewhere. The Maine legislature passed the most comprehensive state chemical policy in the country, popularly known as the Kid Safe Products Act, in 2008, based on a model policy developed by SAFER [39] and recommendations by a Governor's Task Force [43]. Similar laws were enacted in the states of Washington and Minnesota, with California passing companion bills. Table 2 summarizes the major elements of comprehensive chemical policy in state law to date.

Maine's Kid Safe Products Act uses an elegant policy design to authorize state regulation of chemicals in consumer products within limited state fiscal resources [44]. First, the state must adopt a hazard-based list of chemicals of high concern, based on credible science and other government actions. Second, the state applies exposure-related factors to identify priority chemicals from the longer list. Third, the burden shifts onto manufacturers to disclose which products these priority chemicals are used in. The state can require manufacturers to formally assess the availability of safer alternatives or contract for an alternatives assessment at the product makers' expense. Finally, the state may prohibit the sale of a product that exposes children to a priority chemical if a safer alternative is available, effective, and affordable [45].

Despite a conservative Republican take-over of the Governor's office and Maine Legislature in the November 2010 election, the chemical industry coalition

Table 2. Summary of Comprehensive State Chemical Laws

Policy element	CA	ME	MN	WA
Type of products subject to regulation	Consumer	Consumer	Children's	Children's
Lists chemicals of concern based on hazard characteristics	No	Yes	Yes	Yes
Designates priority chemicals based on exposure potential	Yes	Yes	Yes	Yes
Requires reporting on priority chemical use	No	Yes	No	Yes
May require assessment of safer alternatives	Yes	Yes	No	No
May prohibit sale if alternatives available and exposure occurs	Yes	Yes	No	No
Applies health-based risk standard to decide on use restrictions	No	No	No	No
Manufacturers pay fees to offset program costs	No	Yes	No	No
Other policy provisions	Requires chemical data collection	May require additional chem. info	Limited to HPV chemicals	Requires report on policy options

HPV = High Production Volume chemicals, as identified by U.S. EPA.

Source: Environmental Health Strategy Center, "Fact Sheet—Maine as a Laboratory for Safer Chemicals Reform," http://www.preventharm.org/Content/135.php (accessed June 17, 2011).

failed miserably in its attempt to gut the Kid Safe Products Act in 2011. In fact, the law was upheld and even strengthened [46].

These comprehensive state chemical policies generate multiple outcomes. They authorize regulatory action to prevent exposure to dangerous chemicals in specific products, avoiding chemical-by-chemical legislative fights. By formally listing chemicals of high concern and priority chemicals, they incentivize voluntary actions in the marketplace to move toward safer alternatives. Through chemical use reporting requirements, they begin to fill critical data gaps.

The success of state chemical policy campaigns can be credited to several factors, including:

- a health frame—the campaigns were sharply framed around children's health, not the environment, as well as the health of key constituencies (e.g., women and workers);
- strong coalitions—diverse health-based coalitions were organized with capacity to apply targeted grassroots power, direct legislative advocacy, and strategic communications;
- a product focus—parents and policymakers easily related to chemical threats in the home from consumer products, which were less politically threatening to in-state industries;
- a split-the-opposition strategy—the out-of-state chemical companies and their allied national trade groups remained villains, not local businesses and green chemistry entrepreneurs; and
- bipartisan wins—a series of winning campaigns built confidence and a bipartisan consensus that protecting children's health from the chemical industry was good politics.

In political terms, state advocates transformed safer chemicals reform into a progressive wedge issue. Divisions within the business community were exploited to reduce political opposition. But more importantly, the Republican coalition was divided, weakening its alliance with big business. Republican legislators voted 73 percent of the time in favor of state chemical bills in the last eight years, out of the more than 9,000 roll call votes cast, despite unyielding chemical industry opposition [42]. This represents true bipartisan support from moderate Republicans as well as electoral fear of being tarred as voting to poison children with industrial chemicals.

By leveraging the failure of federal leadership to secure passage, state chemical policies also ripened the moment for federal reform, an original aim of the SAFER strategy. In fact, a senior Dow Chemical official lamented that "A patchwork of 50 different chemical management laws is not necessarily a good thing for the global competitiveness of this industry . . . the public lacks confidence in the federal chemical regulation statute, so we still need to do something" [47].

TRACTION NOT ACTION ON TSCA REFORM (2009-2010)

At the outset of the 111th Congress, TSCA reform advocates felt emboldened by the success of state chemical policy reforms and market campaigns and the election of Barack Obama as President. Two former state environmental agency directors were appointed to lead federal chemical management programs, EPA Administrator Lisa Jackson and her Assistant Administrator Steve Owens. Congressman Henry Waxman seized the reins of the House Energy and Commerce Committee. And the informal advocacy alliance that wrestled to overcome internal differences from 2005 to 2008 was beginning to congeal into a unified coalition.

That this reform opportunity was squandered ultimately speaks to the chemical industry's political power, the centrist timidity of the Obama Administration, and a weak Congress isolated from the common-sense wishes of American consumers for safer products. Yet this same Congress generated serious traction for TSCA reform and aired the first debate on workable legislation in 34 years. An effective national reform coalition and campaign was also launched, with new voices in health care, businesses, and the states helping to continue to drive reform.

In February 2009, the first oversight hearing on TSCA struck themes that dominated the chemical policy debate in the 111th Congress. Public health advocates eviscerated the broken chemical safety system [48]. The United Steelworkers union declared that: "Made in USA should be a guarantee, not a warning." The chemical industry tacked to the center, supporting TSCA "modernization" for the first time, but cautioning against quick, substantive action [49].

Environmental and public health advocates recommended a comprehensive set of proposed amendments to the Kid-Safe Chemicals Act of 2008 to majority staff in the spring of 2009. Adding political strength to the coalition and platform, environmental justice reforms were proposed for the first time to require EPA to address toxic hot spots, which are localized geographic areas of disproportionately higher exposure to toxic chemicals from many diverse sources. Labor unions pursued parallel recommendations, seeking "just transition" guarantees.

The safer alternatives agenda was narrowed to detailed, practical policy recommendations to phase out PBTs to which people are exposed, except for critical uses for which safer alternatives are not available. Expedited action was also called for to significantly reduce human exposure to other high-hazard chemicals prior to any risk-based safety determination. These two pathways reflected internal compromise in the face of Congressional staff resistance to safer alternatives.

In the summer, NGOs formally launched the Safer Chemicals, Healthy Families coalition, representing a united public front among national environmental groups, state-based environmental health advocates, the environmental

justice community, health-affected constituencies, health-care professionals, independent scientists, and sustainable businesses. Organized labor established a separate allied presence through the Blue-Green Alliance.

In August, the NGO coalition and the leading trade association of chemical manufacturers, the American Chemistry Council, issued competing principles for TSCA reform. Soon thereafter, EPA Administrator Lisa Jackson announced the Obama Administration's TSCA reform principles. These all showed alignment around the need for an effective law that led to timely government decisions on safer chemical management supported by adequate data [50-52]. However, their superficial similarity belied substantive differences. A false sense of agreement on the shape of needed reforms was carried into a House oversight hearing on prioritizing chemicals [53] and the first Senate TSCA oversight hearing in December [54].

Another House oversight hearing on TSCA and persistent, bioaccumulative, and toxic chemicals sharply illustrated one key policy difference [55]. The Natural Resources Defense Council called for an orderly phase-out of PBTs, since they defy traditional risk assessment and management approaches [15]. The chemical industry sought more delay. The EPA, while publicly conceding the serious threats posed by PBTs, privately reported that an internal White House deal prevented them from supporting a PBT phase-out even when human exposure was demonstrable. In exchange for dropping upfront cost-benefit analyses from TSCA, the Administration's principles were interpreted as strict adherence to risk-based standards [56].

Frustrated by the failure of Congress to act—and by the impression, fanned by industry, that all parties agreed in concept to limited TSCA reforms—Safer Chemicals, Healthy Families launched a "Don't be Duped" media campaign to distinguish real reform from phony reform (see Table 3) [57]. With a presence both inside and outside the chemical industry's premier conference on chemical regulation, GlobalChem 2010, advocates issued a banner message: "Chemical Industry—You Can't DUCK Real Reform" attached to a 20-foot tall inflatable rubber ducky, which symbolized the common products that expose children to toxic chemicals every day [58].

Senator Lautenberg finally introduced the Safe Chemicals Act of 2010 [59]. It never left the starting gate, mortally wounded by failed legislative strategy. The chemical industry scored a relatively weak bill, but never delivered a Republican co-sponsor as promised. The Senate majority decided not to move the bill without one, relieving Republican moderates such as the Maine Senators from engaging, even though a similar state law had already passed back home.

The House majority made two process concessions to the chemical industry, but all for naught. Representatives Bobby Rush (D-Illinois) and Henry Waxman issued their bill as a discussion draft rather than as formal legislation and conducted an intensive stakeholder process. The Toxic Chemicals Safety Act of 2010 was then introduced [60], followed by the only legislative hearing ever held

Table 3. Some Sharp Differences in TSCA Reform Platforms

Policy element	Protecting public health demands:	Yet the chemical industry wants:
Data	Public disclosure of safety information for all chemicals in commerce	Limited testing of a handful of chemicals, leaving us in the dark about most hazards
Restrictions	Expedited action to phase out or reduce the most dangerous chemicals	More lengthy and costly studies of chemicals already proven to be dangerous
Safety	Deciding safety based on real-world exposure to all sources of toxic chemicals	An assumption that we are exposed to only one chemical at a time, and from one source at a time

Source: Safer Chemicals, Healthy Families, "don't be duped," http://saferchemicals.org/dont-be-duped/index.html (accessed February 20, 2011).

on TSCA reform. The chemical industry aggressively opposed the House bill to such an extreme that it contradicted its own principles for TSCA reform [61].

Public health advocates strongly supported the Rush/Waxman bill, which substantially if imperfectly responded to the entire policy platform of Safer Chemicals, Healthy Families [62]. Unlike the 2008 KSCA, the House bill would require the greatest practicable reductions in exposure to PBTs, a provision added by majority staff at the eleventh hour only after a credible threat by NGOs to oppose the bill. The bill required EPA to develop action plans on toxic hot spots and to follow the NAS on risk assessment. New chemicals were treated like existing chemicals, and incentives were created to introduce inherently low-hazard chemicals and safer alternatives to chemical uses [63].

Downstream companies that use chemicals played an increasingly important role in advocating for their own interests apart from the chemical industry [64]. As a result, the bill required chemical manufacturers to disclose the identity of chemicals and other chemical information down the supply chain [65]. A mid-sized construction materials company executive testified in support of the legislation, undermining the chemical industry's efforts to paint the bill as anti-business [66]. Even the chemical formulators, such as Proctor & Gamble, broke ranks with the chemical manufacturers to support reporting on their own chemical use [67, 68].

Despite serious traction and policy development during the 111th Congress, the House and Senate failed to act on TSCA reform, or even to mark up a bill for a Committee vote. Congress let slip the best opportunity to overhaul the

chemicals law since 1976. Certainly the chemical industry flexed its muscles to finally kill TSCA reform [69]. But the reform effort also fell victim to other factors, including a legislative calendar dominated by contentious debates over climate change, health care, and later the BP oil disaster, inadequate Congressional staff resources dedicated to the task, a lack of institutional knowledge about TSCA, broken promises by the chemical industry, and failed legislative strategies by the bill's sponsors and the Administration.

THE TORTUOUS PATH TO VICTORY

In November 2010, a red tide swept the nation. Republicans regained control of the House and narrowed their margin in the Senate, reflecting a rise in conservative power and Tea Party influence. The chemical industry invested heavily in the 2010 election. They reported $3 million in direct campaign contributions [70], and spent untold millions more anonymously, thanks to the *Citizens United* decision by the U.S. Supreme Court. In 2010 alone, the chemical industry fielded 531 lobbyists and spent $50 million to advance its federal legislative agenda [71].

Despite these poor conditions, a smart campaign could win passage of compromise TSCA reform legislation in the 112th Congress. Legislation often follows the path of least resistance. The status quo must become even more painful to the chemical industry. And continued inaction must incur a political price for members of Congress. Reform then becomes the preferred option.

Significant elements within the chemical industry want TSCA reform. The public does not trust the industry or its products [72, pp. 5, 9]. The industry abhors the patchwork quilt of state chemical policies [47]. They decry "retail regulation" by downstream companies whose corporate chemical policies result in "de-selection" of chemicals [73]. Significantly ramped up state policy and market-based campaigns will help drive major chemical companies to the table.

As the 2012 general election approaches, the political advantage of legislative action on TSCA reform will become more apparent. The White House and Democratic leaders must finally recognize safer chemical reform as a wedge issue. Increasing media attention will highlight concerned moms as consumers and voters, and the unfolding new science on chemical health hazards. Republicans must come to fear losing their jobs in 2012 if they vote against protecting children's health from toxic chemicals. A savvy campaign will enhance these political factors.

Direct negotiations with the chemical industry are desirable and necessary. Public health advocates and the chemical industry each hold enough power to block reforms perceived as favorable to the other side. Leaders of both the chemical industry and the NGO coalition have met many times to discuss chemical policy reform. Ramped up state, market and political drivers

will transform this dialogue into serious negotiations that can lead to a compromise agreement.

A possible grand bargain to resolve the legislative debate over TSCA reform could require:

- A minimum dataset for *all* chemicals, but tiered to production levels and other factors;
- A sorting of existing chemicals into three groups for 1) expedited action to reduce use of high-hazard chemicals with widespread exposure such as PBTs, 2) an EPA safety determination on priority chemicals with the burden of proof on industry, and 3) no immediate action on other inherently low-hazard, low-exposure chemicals;
- A compromise health-based safety standard based on aggregate exposure that triggers restrictions on specific chemical uses, taking alternatives and costs into account.

Such a legislative outcome may be possible. In 2011, an early Senate oversight hearing examined TSCA with renewed vigor, and Senator Lautenberg introduced a substantially improved bill that includes the chemical action pyramid concept crafted five years earlier [74]. A Senate floor vote seems likely by the end of the year. The House Energy and Commerce Committee now chaired by Fred Upton (R-Michigan) will consider at least piecemeal TSCA reform later in the year. Such action could lead to a conference committee compromise and final votes before the 2012 election, or at least set the stage for completion in the next Congress.

REFLECTIONS ON THE STRUGGLE FOR SAFER CHEMICALS REFORM

Federal chemical policy reform is inevitable. All the drivers will continue to build unabated until Congress acts. How quickly and how well Congress does that job will be the ultimate measure of success of the national campaign for safe chemicals reform. Although still a work in progress, some lessons learned are worth examining now. A legislative advocacy truism provides a useful analytical framework: relationships trump the frame of reference and politics trumps them both.

The Frame

The campaign has used mastery of the policy merits of TSCA reform and the growing body of science on health threats of toxic chemicals to appeal effectively to a broad spectrum of the public. The health case for chemical policy reform has been so clearly framed that everyone supports reform. The campaign was forced to distinguish between real reform and phony reform, which will remain an ongoing challenge. The campaign illustrated how our broken federal

safety system hurts consumers clamoring for protective state-level policies and downstream businesses hungry for more information on chemicals in the supply chain.

Effectively rebutting chemical industry claims that TSCA reform will kill jobs and stifle innovation presents perhaps the greatest challenge in reaching those with a personal point of view that prioritizes economic growth. A helpful response recently exposed the chemical industry for shedding U.S. jobs, underinvesting in research and development, and overspending on pollution controls [75]. More work will be needed to sharpen communication of the business case for TSCA reform, including how innovation in green chemistry solutions will be unleashed by federal regulation of toxic chemicals.

The campaign must continue to strike a balance between its reasonable face, open to negotiated compromise, and a harder-edged truth-telling about meaningful reform.

The Relationships

The health of the growing NGO coalition, a foundation for successful campaigning, requires building trust and overcoming differences to present a powerful, sustainable united front. That necessarily requires isolating dysfunctional dissenters, sharing credit with strategic partners, and matching member capacity to campaign needs.

Although the coalition can't retain ex-Congressmen as lobbyists as the chemical industry does, much can be made of direct relationships that coalition members have established with Members of Congress and their staff. Because the coalition taps partners in more than 30 states in addition to Hill-centric national advocates, there are many personal constituent relationships to leverage. These must grow in breadth and depth to outpace the inside access of the chemical industry.

The Politics

This is winning terrain for the coalition, once it succeeds in breaking through the competitive noise and diminished sense of what's possible that plagues the Beltway bubble. Savvy polling, celebrity lobbying, and a growing media drumbeat have begun to receive political attention. Next up should be grassroots mobilization and media action in states and districts where key Senators and Representatives are up for re-election in 2012, with special attention to battleground states in the presidential contest. Should the campaign credibly threaten to make safer chemicals for healthy families an election issue, the reform agenda should be unstoppable.

No single Congress can deliver what American society truly needs—a just transition to safe chemicals and sustainable materials, an economy at peace with the planet, good jobs for healthy people, livable communities, and justice for

all. Yet, 10 years of strategic organizing has placed an effective, progressive Toxic Substances Control Act within reach for the first time in 35 years.

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Features – Shifting Markets

BUSINESSES AND ADVOCACY GROUPS CREATE A ROAD MAP FOR SAFER CHEMICALS: THE BIZNGO PRINCIPLES FOR CHEMICALS POLICY

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ABSTRACT

This paper details how businesses and environmental organizations are collaborating to define and implement a visionary agenda for integrating safer chemicals into products, describing the challenges they confront and how they are overcoming those challenges. The framework for this assessment is the Principles for Chemicals Policy developed by the Business-NGO Working Group for Safer Chemicals and Sustainable Materials (BizNGO). The four principles—1) knowing and disclosing chemicals in products, 2) assessing and avoiding hazards, 3) committing to continuous improvement, and 4) supporting public policies and industry standards—while appearing to be straightforward, are, in fact, very complex to implement in practice. Together businesses and environmental organizations are charting a path to safer chemicals by sharing best practices, addressing technical aspects of safer chemicals substitution, and analyzing and supporting public policies that advance the rapid development and diffusion of greener chemicals in the economy.

Keywords: safer chemicals, chemicals policy principles, business, NGO, collaboration, innovation, green chemistry, toxics use reduction, pollution prevention, informed substitution, alternatives assessment

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The 21st century is a time for innovative and sustainable solutions to global environmental threats, including the accumulation of hazardous chemicals in the ecosphere. Over the past four decades, chemicals and their impact on human health and the environment have been the focus of many advocacy campaigns. Media reports of toxic chemicals in products, food, our bodies, wildlife, and house dust continue to drive consumer demand for chemically safe products and government regulation [for example, see 1, 2]. In response, some businesses continue to react defensively, claiming that exposures do not cause harm, that voluntary regulation is sufficient, and that safer alternatives will cost jobs and create a competitive disadvantage. For example, the president of the American Chemistry Council, Calvin M. Dooley, recently testified before Congress that the proposed safety criterion in legislation to reform the Toxic Substances Control Act of 1976 would set "such an impossibly high hurdle for all chemicals in commerce that it would produce technical, bureaucratic, and commercial barriers that would stifle the manufacturing sector,'" [3]. This "economy versus environment" response assumes that we live in a zero-sum world where investments in clean production and healthy products come at the expense of economic development.

Proactive business leaders, however, realize that toxic chemicals are not necessary for, and often impede, economic success. They know that toxic chemicals in manufacturing and products present a business risk, and the long-term sustainability of their organizations depends on responding before consumer demand shifts and regulations emerge [4]. They are developing chemical management plans to reduce the use of highly hazardous chemicals and adopting tools and strategies to help them move to safer alternatives. In this economic model, investments in safer alternatives are necessary for sustainable economic growth.

This paper details how businesses and advocacy organizations are collaborating to define and implement a visionary agenda for integrating safer chemicals into products, the challenges they confront, and how they are overcoming those challenges. The frame for this assessment is the Principles for Chemicals Policy developed by the Business-NGO[1] Working Group for Safer Chemicals and Sustainable Materials (BizNGO) [5].

THE EVOLUTION OF BizNGO— THE BUSINESS-NGO WORKING GROUP FOR SAFER CHEMICALS AND SUSTAINABLE MATERIALS

In 2006, Clean Production Action had researched best business practices for integrating safer chemicals use into company policies, culminating in the report, *Healthy Business Strategies for Transforming the Toxic Chemical Economy* [4]. In

[1]Nongovernmental organizations (NGOs) are nonprofit organizations.

that report, Greiner et al. extracted from six case studies a range of strategies employed by leading companies to manage chemicals and materials in their products. The study found that, while the companies' individual actions to address toxic chemicals vary, their best practices, when gathered together, define the terrain of healthy chemical strategies:

- identify all chemicals in products;
- eliminate high-hazard chemicals;
- strive to use only green chemicals;
- commit to product redesign;
- take responsibility for products cradle-to-cradle;
- adopt internal chemical policies, including the precautionary principle;
- work collaboratively with environmental advocates; and
- publicly support government reform of chemical policies [4, p. 52].

At the time of the release of *Healthy Business Strategies*, advocacy organizations were conducting market campaigns to transform chemical and material use in specific industry sectors. These market campaigns, which are still active today, engage the electronics, health care, personal care, and building sectors because of their power to transform markets through purchasing and end-of-life product management decisions [6]. For example, Health Care Without Harm, an international coalition striving for ecologically sound and healthy health care practices, has worked for 15 years with hospital systems and group purchasing organizations to change the chemical selection decisions of medical device manufacturers [6, p. 6].

Seeing the alignment between the best practices of business leaders and the vision and demands of the market campaigns, Clean Production Action convened 22 organizations in October 2006 to discuss opportunities for mutually promoting safer chemicals and sustainable materials. At the meeting, participants, which included HP (Hewlett-Packard), Dell, Kaiser Permanente, Nike, Whole Foods Market, Health Care Without Harm, the Healthy Building Network, the Breast Cancer Fund, the Ecology Center and the Electronics Take Back Coalition,[2] agreed to form BizNGO and penned its mission: To promote the creation and adoption of safer chemicals and sustainable materials in a way that supports market transitions to a healthy economy, healthy environment, and healthy people.

A UNIQUE COLLABORATION

BizNGO has become a safe haven for honest, credible, noncompetitive, and technical discussions across diverse stakeholders. Within BizNGO are

[2]In 2006, the Electronics Take Back Coalition went by the name of Computer Take Back Coalition.

participants from companies, environmental NGOs, government agencies, and universities. Businesses range from small, mission-driven companies like Method and Seventh Generation to very large, multinational corporations like HP and Staples, Inc. to major institutional purchasers like Kaiser Permanente, Catholic Healthcare West, Premier, and Novation. Advocacy organizations cover a similar range, from the Ecology Center in Michigan and the Environmental Health Strategy Center in Maine to national organizations like the Breast Cancer Fund and the Natural Resources Defense Council [7].

Business leaders greatly value dialogue with NGOs. As Michael Passoff, Senior Program Director for As You Sow stated, "NGOs such as Clean Production Action and the BizNGO group have been useful in working cooperatively with corporations to set benchmarks and policies that are more realistic based on both the current science and the risk to shareholders. . . . In fact, I would say that the NGOs are doing a better job of pointing companies to safer products than the industry trade associations are" [8].

NGOs are often at the forefront of identifying the next chemical of concern. The business-NGO dialogue helps companies understand public trends in human and environmental health concerns with chemicals, as well as the rationale for these concerns—providing manufacturers with an early warning process. The cross-sectoral representation of NGO groups allows business leaders to understand the priorities of the environmental health movement, which helps inform their work to advance safer chemicals and products within their companies. In return the NGO participants value the insights that companies have into the challenges and opportunities that businesses face in demanding more information from their supply chain and incorporating safer chemicals and materials into their products. This adds value and effectiveness to the work of both companies and the advocacy community.

BizNGO also facilitates rich business-to-business (B2B) conversations across industry sectors, with representation ranging from chemical formulators to original equipment manufacturers to institutional purchasers. Such B2B communication of chemical-level information down the supply chain to article manufacturers and institutional buyers is critical for making informed decisions on the health and environmental impacts of the products used by consumers. The synergy of having only companies that are downstream users of chemicals within BizNGO is strategic and intentional. These companies have unique needs, as compared to chemical manufacturers, in terms of both managing chemicals in products and promoting appropriate public policy initiatives.

Chemical manufacturers differ from downstream users because their chemicals are their products. They've invested significant capital into current manufacturing plants and their goal is to maximize production as long as possible. Downstream users, however, are not wedded to any single chemical. Instead they want function—for example, flame retardancy or pliability in plastic—at a reasonable cost. If they can find an alternative solution at equivalent performance

and cost, they can switch without increased costs and sales may increase due to substituting a safer alternative for a toxic chemical. Also, downstream users, being closer in the supply chain to final consumers, are held liable to a greater extent for product safety. Downstream users need information on chemical ingredients and their associated hazards to make wise product design decisions. Chemical manufacturers, on the other hand, often consider the composition of chemical products and their hazard characteristics as investments to be protected.

THE BizNGO PRINCIPLES FOR CHEMICALS POLICY

In 2008, after a year of discussions and many revisions, BizNGO released its Principles for Chemicals Policy [5]. The Principles are a set of aspirational goals designed to guide internal business decisions for advancing safer chemicals through product design, purchasing specifications and corporate decision making:

- Principle #1: Know and disclose chemical ingredients in products.
- Principle #2: Assess and avoid hazards.
- Principle #3: Commit to continuous improvement.
- Principle #4: Support public policies and industry standards that advance the first three principles.

The Principles were refined and agreed upon through a consensus-driven dialogue within BizNGO. The most challenging discussion centered on BizNGO Principle #1, to "disclose" product chemistry. In the end, BizNGO participants agreed with the ideal that chemical ingredients should be disclosed and that the current market trajectory is towards greater chemical and material transparency, but they recognized that this ideal may not be achievable or desirable in every instance. Thus the participants qualified "disclose" to state that manufacturers will "increase as appropriate the transparency of the chemical constituents in their products, including the public disclosure of chemicals of high concern" [5]. The category "chemicals of high concern" comprises substances that are any of the following: 1) persistent, bioaccumulative and toxic (PBT); 2) very persistent and very bioaccumulative (vPvB); 3) very persistent and toxic (vPT); 4) very bioaccumulative and toxic (vBT); 5) carcinogenic; 6) mutagenic; 7) reproductive or developmental toxicants; 8) endocrine-disrupting; or 9) neurotoxic. "Toxic" (T) includes both human toxicity and ecotoxicity.

The BizNGO Principles present a vision of where organizations should be, not necessarily where they are today. While a handful of leading companies are well on the path to implementing them, no single organization currently achieves all the BizNGO Principles. As Greiner et al. wrote in *Healthy Business Strategies*, "Companies that understand the need to assure product safety to customers, investors and other stakeholders see the issue not as how to be compliant with regulatory requirements, but instead as a catalyst for creating

value" [4, p. 10]. Among the endorsers of the Principles are HP, Staples, Catholic Healthcare West, Construction Specialties, Kaiser Permanente, Method, Novation, Premier, Seventh Generation, Brooks Running, and Whole Foods Market [5]. BizNGO participants are now finalizing a how-to-guide to help companies chart success in implementing the Principles (discussed below under Principle #3).

Principle #1—Know and Disclose Product Chemistry

A significant barrier to implementing green chemistry at the user level is the lack of information on chemical constituents in products. Downstream users are often frustrated by their suppliers' use of confidential business information to block access to information on chemicals in products, and current regulations do not require this transfer of essential data [9]. Ingredient transparency in products is an essential element in implementing the principles of green chemistry [10]. While this is especially true of chemicals of high concern to human health or the environment, downstream users ultimately need to know the identity of all chemical ingredients in products. Increased transparency with regard to chemical ingredients in products is needed up and down the supply chain.

The statement of Principle #1 (see box) that "Manufacturers will identify substances used and associated with and used in a product across its lifecycle" is a medium-range goal that will emerge with advances in data gathering and knowledge. In the interim it commits companies to developing a deeper understanding of the chemistry of their products and the life cycle impacts of chemical production, use, and disposal.

The intent of Principle #1 is that formulators, manufacturers, and assemblers will know all the chemical constituents intentionally added to their product, as well as any residuals of high concern, and will commit to understanding the life cycle impacts of the chemicals in their products. A residual is a trace amount of a chemical or chemicals that are incidental to manufacturing. Residuals are not

BizNGO Principle #1:
Know and Disclose Product Chemistry

Manufacturers will identify the substances associated with and used in a product across its lifecycle and will increase the transparency of the chemical constituents in their products, including the public disclosure of chemicals of high concern. Buyers of products will request product chemistry data from their suppliers.

part of the intended chemical product, but are present because of factors such as the nature of the synthesis and engineering pathways used to produce the chemical.[3] Formulators, manufacturers, and assemblers will also commit to disclosing as much of this information as possible down the supply chain. The responsibility of product purchasers is to request these data from their suppliers, to reinforce this information flow.

Seventh Generation, for example, "believes full ingredient transparency is necessary for consumers to verify the health and safety of the cleaners they use. We fully disclose the ingredients in our products on the label, including explanations of each ingredient in a format guided by federal requirements for cosmetics. In addition, the ingredients and material safety data sheets (MSDSs) are available on our website, as are disclosures of trace materials that may be present when known" [11].

For more complicated products, such as consumer electronics, which involve hundreds of components from thousands of suppliers, the acquisition of full chemical ingredient disclosure from upstream suppliers is more complicated. Seagate Technology, the world's largest manufacturer of hard disk drives, is striving for full material disclosure from its suppliers. Hard disk drives comprise several hundred individual components that Seagate purchases from 250 to 300 suppliers. Seagate's implementation of an automated Compliance Assurance System requires its component suppliers to report on all substances present, regardless of whether or not the substance is "restricted" by Seagate [12].

As Dr. Patricia Beattie, formerly the Director of Chemical Risk Management—Environmental Services for General Motors, emphasizes, "Business-to-business communication of chemical-level information down the supply chain through to article and end-product manufacturers is critical for making informed decisions on the health and environmental impacts of the products used by Americans" [13].

Principle #2—Assess and Avoid Hazards

Knowing chemical ingredients in products is a prerequisite to implementing Principle #2—a company cannot assess the hazards of chemicals in a product without knowing the chemical ingredients. Assessing all the chemical ingredients in a product, in turn, is essential to avoid the surprise of learning that a product is suddenly under public scrutiny for its potential risks to human or environmental health. Often a "new" chemical becomes of concern to a company because its product contains the chemical, but the company did not include it among its list of restricted substances.

[3]Residuals include: unintended by-products of chemical reactions that occur in product formulation and chemical synthesis, impurities in an ingredient that may arise from starting materials, incompletely reacted components, and degradation products.

BizNGO Principle #2:
Assess and Avoid Hazards

Manufacturers will determine the hazard characteristics of chemical constituents and formulations in their products, use chemicals with inherently low hazard potential, prioritize chemicals of high concern for elimination, minimize exposure when hazards cannot be prevented, and redesign products and processes to avoid the use and/or generation of hazardous chemicals. Buyers will work with their suppliers to achieve this principle.

By understanding the hazardous properties of all chemicals used in their processes and products, companies are better informed to implement toxic use reduction measures. These actions, in turn, position a company to stay ahead of regulation, both government and retail, and position it favorably with respect to advocacy campaigns, avoiding negative publicity and damage to its brand.

For formulators, manufacturers, and assemblers, Principle #2 entails assessing the hazards of chemicals in products, prioritizing chemicals for reduction or elimination, and conducting alternative assessments (see box). The Toxics Substances Control Act, the principal statute regulating industrial chemicals in the United States, does not require chemical producers, either U.S. or foreign, to generate and disclose robust information on the toxicity of the vast majority of chemicals in commercial circulation. Given this lack of information about chemicals in products, businesses that use chemicals may find it difficult to identify and choose safer alternatives.

To avoid the myriad problems associated with the use of toxic chemicals, companies typically target a short list of "chemicals of high concern" for their products, such as persistent, bioaccumulative toxicants (PBTs), and then expand the list to a broader number of chemicals, such as those on California Proposition 65 list [14]. Companies may also use the popular ChemSec Substitute It Now (SIN) list of chemicals of very high concern [15].[4]

Kaiser Permanente, the largest managed health care organization in the United States, strives "to purchase products that do not contain PBTs such as mercury or polybrominated diphenyl ethers (PBDEs), carcinogens like formaldehyde or reproductive toxicants like di-2-ethylhexyl phthalate (DEHP) [16]." For an assessment of corporate restricted substance lists, see the Green Chemistry and Commerce Council report, "An Analysis of Corporate Restricted Substance

[4]ChemSec is a European nonprofit organization with the goal of a toxics-free environment by 2020.

Lists (RSLs) and their Implications for Green Chemistry and Design for Environment" [17].

Some businesses are moving beyond negative lists to positive lists, identifying the types of chemicals they prefer as opposed to what they want to avoid. For example, Construction Specialties, a mid-sized building products company, is seeking to meet the demands of building owners, architects, contractors, and building occupants who "increasingly are selecting products made with chemicals that have low to no toxicity" by "using chemicals that are inherently safer for humans and the environment" [18]. Nike released its report, *Nike Restricted Substances List (RSL) and Sustainable Chemistry Guidance*, in March 2010, which "encourages all suppliers to use the Principles of Green Chemistry [10] to inspire innovation. These principles are a part of an overall concept of sustainability. Designing and producing materials around these principles can be used at any stage in the supply chain to improve sustainability as well as protect the consumer, worker, and the environment" [19].

To assess chemical hazards and identify safer alternatives to chemicals of high concern, companies are increasingly turning to the Green Screen for Safer Chemicals. The Green Screen benchmarks chemicals into categories of low, moderate, or high concern [20]. One BizNGO participant, HP, is now the global leader in using the Green Screen [21, p. 73]. The Green Screen assesses chemicals and their degradation products against a suite of human health and environmental endpoints. Each chemical goes through a rigorous assessment and is assigned to one of the following:

- Benchmark 1: Avoid—Chemical of High Concern;
- Benchmark 2: Use but Search for Safer Substitutes;
- Benchmark 3: Use but Still Opportunity for Improvement; or
- Benchmark 4: Prefer—Safer Chemical.

HP has found the tool to be robust, replicable and workable for their suppliers. Other original equipment manufacturers and their suppliers, including chemical manufacturers, are now committed to piloting the Green Screen, and it is HP's goal to standardize the use of this tool within the global electronics sector.

Avoiding chemicals of high concern means specifying and selecting safer alternatives. Safer alternatives range from chemical, material, or product substitutions to systematic change that eliminates the need for the chemical. In their Alternatives Assessment Framework, Rossi, Tickner, and Geiser emphasized the nested relationship between chemical, material, and product substitutions (see Figure 1) as well as the opportunity for systematic change [22].

Principle #3—Commit to Continuous Improvement

Even companies with the strongest commitment to reducing the hazard of chemicals in their products face challenges meeting their goals over time. Policies

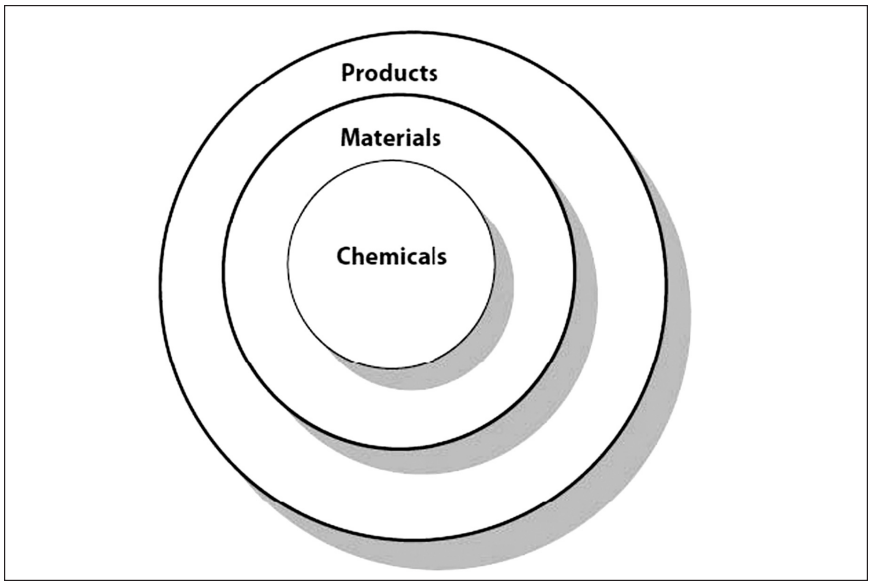

Figure 1. Nested relationship among chemicals, materials, and products. **Source**: Mark Rossi, Joel Tickner, and Ken Geiser, Lowell Center for Sustainable Production, *Alternatives Assessment Framework of the Lowell Center for Sustainable Production*, 2006, http://www.sustainableproduction.org/downloads/FinalAltsAssess06_000.pdf (accessed March 14, 2011).

may be developed by corporate leadership, then not fully implemented in all areas of the company. Alternatively, one individual may become the "chemicals expert," then leave the company, only to have chemical initiatives lag.

Establishing corporate policies, goals, and procedures is essential to the successful implementation of any corporate program. As Richard Liroff emphasized in his article on corporate benchmarking, "Foresighted corporations can engage in a systematic review of chemicals in products, work with their suppliers to reduce or eliminate product toxicity, and respond creatively to the growing demand for environmentally preferable goods" [23].

In writing Principle #3 (see box), BizNGO participants echoed Liroff's emphasis on the importance of systematic integration of the Principles into corporate policies and guidelines. For example, Catholic Healthcare West, the eighth largest health care system in the United States, is systematically integrating safer chemical selection into its purchasing decisions: "contractual obligations with manufacturers, suppliers and distributors to avoid identified chemicals of concern, disclose processes that use chemicals of concern even if the chemicals used in the processes are not a part of the end product and substitute safer

BizNGO Principle #3:
Continuous Improvement

Establish corporate governance structures, policies and practices that create a framework for the regular review of product and process chemistry, and that promote the use of chemicals, processes, and products with inherently lower hazard potential.

alternatives identified through hazard analysis. We develop goals and metrics to measure our progress and evaluate our results, and share our successes and lessons learned with others" [24].

BizNGO participants are currently developing a guide that describes a series of benchmarks for implementing BizNGO's four principles in company policy and practice. The implementation guide will identify best (and better) practices that lead to the implementation of each of the four principles. The guide is designed as a resource for internal evaluations of progress toward achieving the principles as well as an external document for communicating progress toward increased use and promotion of safer chemicals. It will specify best practices for product manufacturers and purchasers and give clear benchmarks for charting progress over time.

Principle #4—Support Public Policies and Industry Standards

While companies may be diligent in their initiatives to reduce the use of chemicals of concern in their products and manufacturing processes, they may be reluctant to speak publicly about their efforts and to openly support policy change. Within companies, there may be a lack of understanding between government or public affairs staff and staff who are working to implement chemical or design changes. By announcing goals to reduce toxicity in some way, companies may open themselves to public criticism if they are unable to meet the goals in a stated timeframe. Companies may not wish to break rank with trade associations advocating that existing chemicals policy is sufficient. Companies may also simply see advocating for policy change as outside their mission.

Public policies and industry standards[5] must change to accelerate the development and use of safer alternatives to chemicals of high concern. Greiner et al. highlighted the fact that a business's position on public policy reflects its overall

[5]Examples of industry standards include the Electronic Product Environmental Assessment Tool (EPEAT) for electronics and the Global Reporting Initiative (GRI) for corporate sustainability reporting requirements.

BizNGO Principle #4:
Support Public Policies and Industry Standards that:

Advance the implementation of the above three principles, ensure that comprehensive hazard data are available for chemicals on the market, take action to eliminate or reduce known hazards and promote a greener economy, including support for green chemistry research and education.

commitment to implementing a safer chemicals program across the organization: from product design and manufacturing to purchasing to government affairs [4, p. 47]. Integrating support for authentic safer chemicals policy initiatives into corporate chemical policy programs represents a significant departure from the status quo of downstream users conceding the public policy domain to chemical manufacturers.

The participation of downstream users of chemicals in the policy debate is critical to creating policies that meet the unique needs of companies that use chemicals or manage chemicals through the products they purchase (see box for key elements of policy reform as expressed by BizNGO in Principle #4). As Bob Sussman, the U.S. Environmental Protection Agency's senior policy counsel, emphasized at a Washington, D.C., meeting of business and NGO leaders, downstream companies "occupy a unique position at the end of the value chain, where the rubber meets the road. . . . Your voice is critical. We want to encourage you to stay in the game and to help shape the end product" [25].

While each participant in BizNGO approaches public policy initiatives from its unique organizational position, their positions are informed by Principles #1 and #2. For example, the mid-sized specialty building products manufacturer and BizNGO participant, Construction Specialties, specified that chemicals policy reform will complement the green building movement if it:

- provides comprehensive hazard and toxicity data for all chemicals on the market;
- requires greater disclosure of chemicals of high concern in products;
- prioritizes chemicals of high concern such as PBTs for early action; and
- promotes safer alternatives [18].

In 2010, BizNGO participants worked to integrate greater chemical ingredient disclosure requirements across the supply chain into TSCA reform. In testimonies, conferences, and publications, participants emphasized how requiring chemical ingredient disclosure across the supply chain would level the playing field for all companies; lower business expenses and risk; increase trust among

consumers, employees, communities, and investors; and improve transparency throughout the supply chain. As Howard Williams of Construction Specialties testified on July 29, 2010 at the House Hearing on the HR 5820—Toxic Chemicals Safety Act of 2010: "Identifying the chemical composition of our products is a costly and time-consuming process. . . . [Although this is] a profitable and responsible thing to do," he explained, gathering ingredient information "needlessly delays product development and places an indirect cost burden on the consumer" [3]. BizNGO participants succeeded in integrating supply chain disclosure of chemical ingredients into HR 5820; however, subsequently that bill died in the 111th Congress [26].

CONCLUSION

The BizNGO Principles for Chemicals Policy offer businesses a clear roadmap for integrating greener and safer chemicals into their organizational policies, operating processes, and product designs. They are an organizational analogue—guiding organizational decision-making to safer chemicals—to the 12 Principles of Green Chemistry, which offer chemists a "benign by design" framework to synthesize more eco-compatible molecules.

The co-development of the Principles by BizNGO participants resulted in a framework for advancing best practices across industry sectors in managing chemicals in products. As downstream users of products, BizNGO participants are leading a transformation in the market for chemicals, materials, and products. They are generating broad change by acting through their own supply chains to demand information on: 1) the identity of chemicals in products; 2) the inherent hazards of those chemicals; and 3) whether safer alternatives are available for these chemicals of high concern.

At the same time, opposition to these demands is significant. Upstream chemical suppliers either do not have data on human and environmental health effects of the chemicals they sell or they refuse to share that information with their customers. Significant data gaps in hazard information exist for the great majority of chemicals, not just those suspected to be of high concern, which in turn stymies informed substitution to greener chemicals. U.S. chemicals policy reform to improve transparency and accountability in the chemicals market is now a campaign focus for environmental NGOs. The voice of downstream users of chemicals gives regulators and legislators a more balanced view of the business risk associated with incomplete information, and it helps correct the assumption that new regulation is bad for business. Without the voice of leading companies who are committed to greener chemicals, innovation is stifled within the political space.

The BizNGO Principles for Chemicals Policy support this demand for reform by providing a vehicle for downstream users of chemicals to articulate what they need from their chemical suppliers. It is likely that successful suppliers will

be those who learn quickly how to meet these demands, well ahead of policy reforms. In addition, the Principles incorporate corporation-wide decisions on public policy. This integration is intentional, in that it motivates both companies and advocacy organizations to clearly articulate how new chemicals policies and environmental regulations can most effectively meet the chemical information needs of companies and the public, to assess chemicals for their hazardous properties, and to promote the development and adoption of safer alternatives.

These Principles, while appearing to be very basic, are complex to implement in practice. This highlights the contribution of BizNGO and its collaborative working groups. Through this safe interactive space, participants exchange best practices, discuss technical aspects of safer chemicals substitution, and analyze and support policy options for the most expedient way to advance greener chemicals uptake in the economy.

Success in the movement to safer chemicals will require transformations in both business and public policies. The BizNGO Principles for Chemicals Policy contribute to this transformation by articulating the needs of both downstream business users of chemicals and the environmental health advocacy movement. The process of co-development of the BizNGO's four Principles and the collaborative ongoing work to advance the Principles provides a model for others working to address the human and environmental health concerns associated with chemicals and to support a market transition to a healthy economy, healthy environment, and healthy people.

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Features – Shifting Markets

THE BUSINESS CASE FOR TRANSITIONING TO SAFER CHEMICALS

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ABSTRACT

Emerging domestic and international chemical regulations and a heightened consumer awareness of chemicals of concern in products is challenging American businesses to reevaluate and reconsider their approaches to supply chain management and product design. Some of these companies recognize business opportunities and are responding proactively with innovative strategies and tactics. This article describes steps that Staples Inc., the world's largest office products provider, is taking to meet demand for products that are safer and more sustainable. In trying to meet the demand for safer products, Staples faces significant barriers, including the complexity of supply chains, data gaps, and confidential business information. New collaborations between companies, government, and advocates, and improved tools and criteria for defining safer products enhance the ability of businesses, like Staples, to meet new consumer demands.

Keywords: chemicals management, chemicals of concern, green chemistry, product ingredient disclosure, retailers, safer alternatives

We all take risks. It's a part of our everyday lives, and a part of day-to-day business. But assessing and effectively managing risk has challenged American business as of late. Risk analysts report that key indicators and warning signs

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often precede accidents. Businesses that recognize and respond appropriately to these indicators can avoid or minimize adverse externalities and impacts to businesses, customers, and communities.

Some American product makers, businesses, and downstream users are responding to indicators, warning signs, and risks—in the form of chemical exposure and human health impacts. If companies misjudge these risks and warning signs, it could mean, yet again, that American businesses lose an opportunity to demonstrate innovative leadership, build a stronger, more sustainable future, and create shared value for their business, customers, and communities.

Some organizations are confronting these risks head-on and see the value of taking a proactive and collaborative approach to managing chemicals in their supply chains. This article describes how Staples views the challenge of alternatives assessment and outlines the steps the company is taking to offer safer and more sustainable products.

GROWING DEMAND FOR TRANSPARENCY AND SAFER ALTERNATIVES

Chemicals are not created equal when it comes to human and environmental health. One chemical may facilitate a cure for cancer while another chemical may cause a cancer. The lack of understanding of the low-dose or cocktail effects of various chemicals, along with the scarcity of toxicity data, has obscured a clear delineation between a chemical of cure and a chemical of harm.

A lack of chemical information can have the unintended consequence of allowing unwanted chemicals to enter products, business supply chains, homes, the environment, or the human body. Retailers and distributors are scrambling to respond sufficiently to a growing awareness and demand by downstream users for greener and more sustainable products that are free of chemicals that pose a serious risk to human and environmental health.

In April 2010, a panel of cancer experts appointed by President George W. Bush sounded an alarm when they reported, “In effect, our lives have become a giant, uncontrolled experiment on the relationship between toxic chemicals and our health” [1]. Downstream users are troubled by two biomonitoring and body burden studies recently published by the U.S. Centers for Disease Control and Prevention (CDC) and the Environmental Working Group (EWG). The studies revealed low levels of a significant number of chemicals of high concern in breast milk and in the umbilical cord blood of newly born babies [2–3]. Consumer concerns were elevated when some of the same chemicals of high concern detected in these biomonitoring studies were also detected in consumer products collected from the shelves of major retailers [4–5].

There is confusion and uncertainty about the relationship between chemicals of high concern detected in products and biomonitoring studies. The lack of scientific certainty about a direct correlation has caused a disagreement among

experts on how to tackle the issue. One group of experts will argue that there is no need to be overly concerned or take action until a direct correlation is proven with scientific certainty. Another group of experts will argue that since human health is at issue, a more immediate precautionary approach should be taken. Downstream users find this disagreement between experts perplexing. The uncertainty and lack of agreement between experts has led a growing number of consumers to ask product makers, retailers, and distributors to be more transparent about chemicals in products. Consumers in essence are asking suppliers: tell us what chemicals of high concern are in your products and let us decide if we want to allow them into our homes, businesses, or supply chains.

POTENTIAL RISKS TO BUSINESSES, CONSUMERS, AND COMMUNITIES

Business reputation, profitability, and brand integrity can be negatively impacted when undisclosed or unknown chemicals of very high concern are discovered in products. For example, toy makers and retailers experienced adverse economic consequences generated by supply chain disruption, product recall, replenishment costs, and company remediation costs when lead was discovered in several children's toys [6–7].

Retailers and distributors can potentially inherit—and are forced to confront—a host of risky issues related to chemicals of concern in products and their supply chains. Retailers risk losing customers or the confidence of customers if they sell them products with undisclosed chemicals of high concern. The awareness of American consumers about the risks associated with a lack of chemical information and disclosure is growing. A survey conducted by the Safer Chemicals, Healthy Families Coalition found that 84 percent of Americans expressed concern when they were told that the U.S. Environmental Protection Agency (EPA) has mandated testing of barely 200 out of the more than 80,000 chemicals that have entered the market. It is clear that American consumers want to know more about chemicals of concern in the consumer products they are buying and using [8]. An emerging green market includes eco-labeling, green product ratings systems, random testing by consumer watchdog groups, and monitoring by regulators to detect undesirable chemicals in products. The growing consumer awareness and regulatory trend toward ingredient disclosure has many product makers, retailers, and distributors scrambling to find ways to respond.

BENEFITS OF DISCLOSURE AND SAFER ALTERNATIVES

Identifying and disclosing chemicals in products will not only help businesses meet a growing demand by downstream users, but will also help them manage

risk, verify compliance, inform decision-making, discover innovative opportunities, and offer more sustainable choices to customers.

Many suppliers are embracing an increased chemical transparency policy that is comprehensive and inclusive, places a priority on eliminating hazards, encourages innovation, and rewards disclosure. Some businesses, such as Kaiser Permanente, have incorporated the precautionary principle as part of their safer alternatives policy. Kathy Gerwig, Kaiser Permanente's Vice President for Workplace Safety and Environmental Stewardship, has been a strong advocate for transitioning towards safer alternatives. She noted that at Kaiser Permanente, "we've taken a cautious approach to materials, meaning that where there is credible evidence that a material we're using may result in environmental or public health harm, we should strive to replace it with safer alternatives" [9]. This prudent precautionary approach can act as a catalyst to begin the process of shifting toward safer alternatives. For example, Staples took action to eliminate polyvinyl chloride (PVC) from its own brand packaging materials after recognizing there was credible evidence that the material may result in environmental harm.

Communities get economic as well as health benefits when products containing chemicals of concern are replaced with safer alternatives. A recent report by Columbia University professor Peter Muening found that the state of New Jersey could save as much as $27 billion in costs by keeping children free of lead poisoning [10].

Product makers are at a crossroads. For nonregulated chemicals, a product maker can currently choose to disclose or not disclose. Many product makers resist public disclosure of ingredients and view it as a business risk. They view their ingredients as trade secrets, intellectual property, or confidential business information and fear that public disclosure of this information could pose a financial risk to their enterprise. However, a growing number of product makers and businesses recognize there is a regulatory trend toward requiring public disclosure of ingredients. These companies view this as an opportunity to develop new approaches that generate greater innovation and growth by getting ahead of regulations. These companies also know that transparency is important to their customers. For example, a product maker's unwillingness to disclose could result in being locked out of selling their products to consumers and businesses that place a high value on transparency and disclosure [11].

STAPLES' STRATEGY FOR TRANSITIONING TO SAFER ALTERNATIVES

Staples is committed to helping ensure a healthy environment for future generations. From innovative, environmentally friendly products to carbon and energy initiatives, Staples strives to make it easy for customers, associates, and the communities it serves to work together in protecting the environment.

This includes offering customers a wide assortment of environmentally preferable products, operating their business in a sustainable manner, and providing recycling and other services to help customers meet their environmental goals [12]. Staples views the transition to safer alternatives and more sustainable materials as part of its commitment to help ensure a healthy environment for future generations, and recognizes the need for a strategy to create an orderly transition to meet customer demand for products that are safer and more sustainable.

At the same time, Staples understands the complexity of and challenges associated with collecting, managing, and accurately reporting progress. Despite these challenges, Staples recognizes the value of being informed about materials in the products it distributes and uses in its operations.

Staples, in collaboration with nongovernmental organizations (NGOs), government partnership programs, and its suppliers is working to transition to and offer a wide assortment of alternative products that are designed using green chemistry. The Business-NGO Working Group for Safer Chemicals and Sustainable Materials (BizNGO) is an organization developing tools to help companies transition more effectively toward safer alternatives. For example, businesses and NGOs in the working group collaborated to develop guiding principles for chemicals policy, which outline the path to greener and safer chemicals [13]. Staples embraced these principles as guidance to transition towards more sustainable and safer materials and products.

Staples' specific strategy for transitioning to safer chemicals, materials, products, and processes is twofold. First, for products for which Staples owns the design and full formulation, a comprehensive and rigorous sustainability product design model is used to eliminate chemicals of concern at the design or redesign stage of a product. Secondly, for products for which Staples does not own the design or full formulation, suppliers are asked to disclose whether specific undesirable chemicals are intentionally added to products—so that Staples can transition to safer alternatives.

Transitioning to Safer Alternatives When Staples Owns the Design and Full Formulation

At Staples, Green Chemistry means the design of products and processes that reduce or eliminate the use and generation of hazardous substances [14]. One area in which Staples has made significant progress in eliminating the use and generation of hazardous substances and transitioning to safer alternatives is in their own brand of cleaning products. Cleaning products are beneficial and can help improve the health of the built environment, maintain a safe workplace, preserve assets for building owners, and maintain overall aesthetics. At the same time that Staples acknowledges these benefits, it recognizes that some traditional cleaning product formulations contain undesirable chemicals identified in green

cleaning product standards including Green Seal, UL Environmental, and the Design for the Environment (DfE) Safer Product Labeling Program at EPA.

The commitment by Staples to design its own brand of safer cleaning products has its origin in 2009 when Staples acquired Coastwide Laboratories, with headquarters near Portland, Oregon. Coastwide is a nationally recognized leader and formulator with a long history of designing cleaning products with safer alternative ingredients. Scientists and engineers at Coastwide adopted a rigorous green chemistry and product design model, resulting in the development of safer, high-performance products. While formulators such as Coastwide Laboratories do not synthesize chemicals per se, the ingredient choices made by scientists at Coastwide and Staples have resulted in the development of a growing number of safer alternatives and more sustainable products in their research laboratory.

Staples Design Objectives and Strategy

A fundamental principle in Staples' safer alternatives strategy is to acknowledge clearly that designing or offering a safer alternative does not necessarily signify that the current product is unsafe. The product transition pathway is most often from safe to safer and rarely from unsafe to safe. Informed substitution is a worthwhile objective and can avoid the unintended consequences of regrettable substitution. But lately, Staples is finding success in shifting the discussion with suppliers away from making substitutions for chemicals of concern in products to one focused on making alternatives assessment a fundamental component of product design.

The company's design strategy includes several key components. First, Coastwide Laboratories/Staples created a rigorous sustainable product design system to set positive, realistic, and measureable criteria for product efficacy and human and environmental health benefits. The system requires a credible, independent, scientifically informed, third-party review of all ingredients being considered for use to understand the potential human and environmental health and life cycle impacts. The system strategy takes a hazard-based approach and places a priority on the elimination of the unwanted chemical at the product design stage. Once life cycle impacts and hazards are evaluated, safer alternatives are identified, and cost analysis and performance are assessed. For example, full formulation disclosure is submitted to scientists at the EPA DfE Partnerships for Safer Chemistry where a Green Screen is conducted to assess and compare the chemical of concern with the safer alternative [15, 16].

The sustainable product design strategy used by Staples moves well beyond simple ingredient substitution. It results in innovative new formulations with remarkable and surprising benefits due to ingredient synergies. For example, Staples scientists applied this sustainable product design strategy to build a product for cleaning mass transit vehicles. The resulting formulations were

benign hybrid surfactant systems designed to preserve the efficiency of function while reducing toxicity, and to ensure that at the end of their function they do not persist in the environment and that they break down into innocuous degradation products.

It was the collaboration with chemical suppliers, combined with the Clean Production Action (CPA) Green Screen, that led Staples scientists to discover a way to design cleaning products without the use of problematic ingredients such as alkyl phenol ethoxylates, nonyl phenol ethoxylates, and 2-butoxyethanol traditionally used to formulate cleaning products. The alternatives assessment indicated that specific plant-derived surfactants, cornstarch glucose, and natural fatty alcohols qualified as safer, cost-neutral alternatives without sacrificing performance.

Another example of how Staples is applying this collaborative product design approach with its own brand is the design of safer plastic alternatives in its packaging materials, avoiding the need for polyvinyl chloride. Staples based its safer plastic materials selection on a Plastics Scorecard developed from alternatives assessment conducted by CPA, in conjunction with BizNGO. Staples is transitioning to safer alternatives including, high- and low-density polyethylene, polypropylene, and bio-based plastics in addition to non-plastic alternatives such as recycled paperboard.

Transition to Safer Alternatives When Staples Does Not Own Design or Formulation

Many products in Staples' supply chain are provided by product makers and suppliers that own the formulation and design. In order to meet the growing market demand for products that are safer and more sustainable, Staples also needed a strategy to transition to safer alternatives in products where Staples does not own full formulation or control product design. In October 2010, Staples publicly announced its "Race to the Top" sustainability strategy, which included a list of restricted substances that Staples identified on a "Bad Actors" list. The strategy focuses on key supplier collaboration by asking suppliers to compete not only in terms of product quality and cost but also by finding innovative solutions for product manufacturing, packaging, and distribution that reduce impacts on the planet. One of the primary benefits of Staples' "Race to the Top" strategy is to build sustainability into products throughout the Staples' supply chain. Suppliers were asked to review the Staples "Bad Actors" chemical list, disclose to Staples if any of their products contains a chemical from the list, and offer safer alternatives. If the supplier has an effective and cost-neutral safer alternative, then the product is preferred. However, if a supplier does not currently offer a functional equivalent that is cost-neutral, then the supplier is asked to disclose its plans and timeline, if any, for transitioning to a safer alternative.

Suppliers are encouraged to validate their claims using analytic test methods where possible and to use a credible, independent third-party or other reliable way to verify the claims. The supplier is invited to offer an explanation of why the unwanted chemical or ingredient is intentionally added or known to be present in the product.

Staples' strategic objective is to collaborate with suppliers and ask them to provide and/or conduct a Green Screen alternatives assessment to identify and compare potential chemical and non-chemical alternatives. Staples is developing a sustainability scorecard with suppliers. The scorecard will capture chemical information, track actions taken, and identify timelines to transition to safer alternatives.

There is not always a readily available safer alternative for identified "Bad Actor" chemicals. For example, Staples attempted to identify a safer alternative for bisphenol A (BPA) in thermal paper. After discovering that there currently were no clear safer alternatives for BPA in thermal paper, Staples encouraged EPA DfE to begin a BPA Alternatives in Thermal Paper Partnership. The EPA DfE brought together a broad set of stakeholders to identify and assess safer alternatives for BPA in thermal paper. The EPA DfE project has revealed a number of potential safer alternative candidates. A Green Screen is being conducted to identify the best candidates, which will then undergo a more comprehensive alternatives assessment. Some are concerned that there currently may not be a viable safer alternative for BPA in thermal paper. If this were to be confirmed, then Staples would argue that this is an excellent business opportunity for product makers to apply green chemistry principles and design a safer alternative to meet the emerging market demand.

BARRIERS TO A TRANSITION TO SAFER ALTERNATIVES

The transition to safer alternatives is challenging. Obtaining hazard and exposure data on current chemicals and alternatives can be demanding.

Complex and Multi-Tier Supply Chain

The supply chain and value chain can be fragmented and complex. For example, Staples may buy a product from a supplier, and that supplier in turn may have assembled or formulated its product by using chemicals and materials sourced from a number of other suppliers. Those suppliers are likely to get their chemicals and materials from other suppliers, and so on. Retailers often refer to these levels of suppliers as tiers. Tier 1 is the direct supplier from which the retailer buys the product, Tier 2 is that supplier's supplier, and so forth.

When suppliers fail to or choose not to disclose chemical information in their materials or products to the next supplier (tier) in the supply chain, then that supplier will not know the chemical is present and cannot disclose it to the next supplier (tier) in the supply chain. This can create information and disclosure gaps and obscure transparency and /or accountability, making it unclear who owns the responsibility for sharing chemical information.

Disclosure of chemicals of concern throughout the entire supply and value chains from sourcing to disposal can help protect businesses against the unintended consequences of regrettable substitution and claims of "greenwashing."

Cost of Managing Chemical Information

Obtaining, managing, and validating chemical information can be time-consuming and costly to retailers and distributors. It is challenging for retailers to identify suppliers and/or chemicals in products beyond its Tier 1 or Tier 2 suppliers. Staples and other businesses are tackling this challenge by making disclosure a part of the compliance relationship with suppliers. This extended supplier responsibility for disclosing chemical information down the supply chain is being embraced by many businesses as a more economically efficient and effective way to collect and manage chemical information from tier to tier.

Data Gaps

The primary source used by businesses to communicate chemical information and assess risk and the safety of a product or chemical throughout the supply chain is the material safety data sheet (MSDS). Yet businesses have reported that many MSDSs are unreliable. For chemical mixtures, materials, and products, MSDSs rarely contain a complete list of chemical ingredients. In addition, the Occupational Safety and Health Administration (OSHA) sets the minimum reportable level at 10,000 ppm for hazardous chemicals and 1,000 ppm for carcinogens, thus exempting from disclosure chemicals of concern that are present in products below these *de minimis* levels. This can create an enormous burden for retailers and distributors when their business customers require full disclosure of ingredients. Some businesses also rely on information gathered from public product databases. Regrettably, many of these databases gather their information exclusively from material safety data sheets, making the information in the database only as reliable as the original MSDS source document.

Retailers face an additional challenge when products like toys for kids, jewelry, water bottles, and thermal paper receipts reportedly contain undesirable chemicals, yet there is no national regulatory requirement for the makers of these products to disclose the presence of chemicals of concern. These types of products are typically not regulated by OSHA and therefore do not require an

MSDS. And even if companies voluntarily offer an MSDS for these types of products, the information and ingredient disclosure requirements are nominal.

Confidential Business Information (CBI) Declaration

There are legitimate reasons for businesses to seek confidential business information (CBI) protection. However, invoking CBI privilege may protect one business's intellectual property while at the same time increasing the risk of unknown, unwanted, and unintended exposure to a downstream user or business. Invoking proprietary and trade secret protection for ingredients or substances which are chemicals of high concern and thereby not disclosing their presence in a product can increase the risk to downstream users, consumers, and communities. Staples respects a supplier's desire to protect CBI that is legitimate. However, when chemicals of high concern are part of the CBI claim, Staples asks the supplier to at least disclose the chemical of concern.

OVERCOMING OBSTACLES WITH COLLABORATION AND CERTIFICATION

Suppliers were initially skeptical and reluctant to share chemical ingredient information because they viewed it as proprietary. Eventually, suppliers offered chemical ingredient disclosure, but there were significant data gaps for environmental fate, human toxicity, hazard, and exposure data on the chemical ingredients. Staples' goal is to understand how best to determine and validate what chemicals are safer and thus prevent regrettable substitutions. To do this, Staples needed a reliable and credible way of comparing and assessing safer alternatives against ingredients listed as chemicals of concern.

The EPA's DfE Safer Product Labeling Program and CPA's Green Screen were selected by Staples to help identify safer alternatives. These two programs helped Staples to evaluate ingredients and select safer alternatives for its products by establishing hazard criteria and processes for comparative hazard evaluation [15–16]. The EPA DfE program collaborated with environmental advocacy groups, NGOs, GreenBlue Institute, International Sanitary Supply Association (ISSA), cleaning products formulators, and manufacturers of cleaning ingredients to develop the CleanGredients database, a program of the GreenBlue Institute. This database identifies safer ingredient alternatives that have potential human health and safety benefits when compared to existing chemical ingredients [17]. Staples also uses independent, third-party reviewers and certification organizations, including Green Seal, to certify compliance with appropriate Green Seal product certification standards [18].

Leading businesses are overcoming these obstacles by collaborating with colleagues in the Green Chemistry and Commerce Council (GC3) and BizNGO

to identify ways to more effectively gather chemical data from their supply chains. Specifically, Staples and other GC3 and BizNGO member companies are working together to develop tools and provide a forum for leading businesses all along the supply chain to discuss and share chemical data needs, challenges, strategies, and approaches [19].

Beyond cleaning products, Staples collaborates with other businesses, academic institutions, and NGOs to find new green chemistry solutions to shared problems. Through the GC3, Staples and other participating companies have begun a new partnership project with the Lowell Center for Sustainable Production and the University of Massachusetts Lowell to evaluate plasticizers used in polyvinyl chloride (PVC) and non-PVC applications for wire and cable products. Ultimately, this business and academic partnership model may serve as an example for approaching other problems shared by businesses in the future [19].

CONCLUSION

International and domestic regulatory policy responses and consumer demand for safer alternatives are compelling businesses up and down the supply chain to ask their suppliers to go above and beyond regulatory compliance and voluntarily disclose chemicals in products.

As a result, American businesses have the opportunity to establish and maintain a leadership position which sends a positive message to consumers. A safer alternatives approach built on transparency, disclosure, and collaboration is good for business. An effective and modernized safer chemicals program would allow American business to do what it does best—innovate, grow, and create the best products. Staples "Race to the Top" sustainability and chemicals management strategy creates a credible and collaborative framework to innovate, collaborate with suppliers, create sustainable solutions, identify safer alternatives, and advance green chemistry [20].

American businesses will improve their chance of prospering in this ultra-competitive global market by designing and offering safer alternatives. Pollution prevention, green chemistry, and in turn, safer chemicals and products, are a part of the suite of benefits and shared values that we can create for our businesses, our customers, and our communities. As Dr. Philip Kotler of Northwestern University's Kellogg School of Management noted, "Today, most companies are guilty of strategy convergence—namely undifferentiated strategies. To win, companies must pursue meaningful and relevant positioning and differentiation" [21]. Ultimately, competitive marketplace innovation is what will improve our products, with green chemistry and safer alternatives policies guiding product design.

Enhanced standards for safer alternatives will clearly contribute to improved worker health, enhanced user safety, and higher levels of environmental

stewardship. But in this era that Dr. Kotler describes as one of increasing "strategy convergence," where one company looks pretty much like its competitor(s), a reputation for leadership in safer alternatives may provide what Kotler describes as "meaningful and relevant positioning and differentiation" upon which enduring brands are built, and what Dr. Michael E. Porter defines as a "sustainable competitive advantage" that carries directly to a firm's bottom line [22].

Safer products mean reduced risk, global compliance, and meeting or adapting to the trends, needs and demands of downstream users. Everybody wins with safer products: the worker who makes them, the retailer who sells them, the consumer who uses them, and the environment that inherits them.

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Movement Solutions – Building New Coalitions

SECRECY IS TOXIC—BUILDING COMMUNITY RIGHT-TO-KNOW IN CANADA'S LARGEST MUNICIPALITY

ANDREW KING

ABSTRACT

The regulation of toxic chemicals in Canada has undergone many twists and turns in the last 40 years. This paper describes the emergence of a new alliance, one which brought together people from a broad range of backgrounds to formulate common strategy to address the continuing use and dissemination of toxic chemicals, especially carcinogens. In just over a decade, Canada's largest municipality, Toronto, adopted a bylaw which introduced a comprehensive scheme for community right-to-know about toxic chemicals being used, released, and disposed—the first in the country. The bylaw represents the success of a network that integrated experience and expertise from community activism, environment, labour, public health, politics and cancer prevention.

Keywords: community right-to-know, occupational cancer, environmental cancer, community activism

Ontario is Canada's second largest province by area and largest by population. As of 2009, its economy accounted for 37 percent of the total Canadian economy and nearly half of Canadian manufacturing; major products include motor vehicles, steel, electrical appliances, machinery, chemicals, and paper.

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Agriculture, forestry, and mining have also played a major role in Ontario's economy. The United States accounts for over 80 percent of all Ontario exports [1].

The Ontario economy has generated many environmental issues. According to the North American Commission on Environmental Cooperation, in 2002 Ontario's total toxic chemical releases on- and off-site to the environment ranked fourth behind only Arizona, Texas, and Indiana [2]. Toronto is the capital of Ontario and Canada's most populous city with over 2.5 million residents; it is also the seventh largest urban region in North America in the heart of a densely populated area called the Golden Horseshoe, with over 8 million inhabitants.

Canadian governance has some important features that influence prevention in occupational and environmental health. First, Canada is a federation and its constitutional law emphasizes the separation of federal and provincial jurisdictions. Health, environment, and labour are primarily provincial responsibilities. Although the federal government at times has been active in creating national standards, its ability to do so in these areas is limited to interprovincial or international impacts and the use of its authority in other realms. For example, Canada's principal federal environmental law, the Canadian Environmental Protection Act (CEPA), is based on the federal government's criminal jurisdiction. Under CEPA the federal government does have the authority to ban and restrict certain chemicals found to be toxic. Canada's National Pollution Release Inventory—the requirement that companies with emissions over a certain standard report their releases of specified toxic chemicals—is based in CEPA. However, CEPA does not address occupational exposures, nor can it restrict what happens inside the workplace.

It is the provinces who have the primary responsibility for health, environment, and labour. In Ontario, health is divided into two ministries: one is responsible for primary and long-term health care, and the other for health promotion and prevention and the public health system. Public health historically exercised limited responsibility for environmental health. The Ministry of Environment provides the regulatory function, setting standards and allowing emission permits, but exercises no direct environmental health mandate. The Ministry of Labour is responsible for enforcing occupational health and safety legislation but has limited its responsibility in occupational health to reviewing occupational exposure limits and material safety data sheets.

HISTORY OF ACTIVISM

Ontario has a long history of community activism to prevent occupational and environmental cancers. Occupational cancers were a key focus of unions in the mines, steel mills, and factories of the 1960s and 1970s. That movement continued into the 1990s, revitalized by continuing evidence from northern Ontario of the higher rates of cancer among hard rock miners as well as growing

concerns among auto workers regarding metalworking fluids. Both the United Steelworkers Union and the Canadian Auto Workers led campaigns to pressure employers and government to pay more attention to occupational cancers in their industries. This movement spread throughout the Ontario labour movement with support from the Ontario Federation of Labour, extending to construction workers, firefighters, and others. The Occupational Health Clinics for Ontario Workers (OHCOW), a labour-sponsored network of occupational health clinics, were a key resource, providing the technical expertise to expose tragedies like the Holmes Foundry in Sarnia, where in the 1970s workers were routinely exposed to asbestos above prevailing standards and by the late 1990s were suffering asbestos-related diseases [3].

Union advocacy, organizing, and political pressure have been successful in forcing the Ontario workers compensation system to recognize many victims of occupational cancer. A network of experienced union advocates and sympathetic experts, both inside and outside government, was built over the years. Success in compensation was not mirrored, with some exceptions, by elimination of exposures. Although the right to know the chemicals they are working with had been achieved for workers in the 1980s, its potential for prevention was not pushed by government. In late 1987, under pressure from unions, the provincial Ministry of Labour established a Joint Steering Committee on Hazardous Substances in the Workplace (JSC) with a mandate to establish a more effective process for prevention. Over a period of eight years (1987–1994), despite thousands of hours of meetings and expenditures of more than $2 million, the committee was unable to make any consensus recommendations [4, 5].

Environmentalists were facing even more frustrations in trying to advance protection of health from environmental exposures. Efforts to bring in community right-to-know legislation in the 1980s dissipated when the Workplace Hazardous Materials Information System (WHMIS) was adopted for workplaces.[1] Although focused on workers' right to know, the legislation in Ontario contained provisions empowering a Medical Office of Health to order the release of information on chemicals from a workplace on request from a member of the community. Remarkably, no such order was ever made until 2000.

Although environmental activists worked with victims of cancer and other illnesses who lived near industrial facilities or legal and illegal waste disposal sites, had contaminated well water and soils, had played in radioactive dumps as children, had been exposed to pesticide spraying, or lived under transmission lines or electromagnetic fields, neither science nor advocacy was able to establish direct cause-and-effect link between the health effects which individuals suffered and their environmental exposures [6]. The provincial cancer registry

[1] The WHMIS was created by a rare federal and provincial agreement, in Ontario's case by amendment to the Occupational Health and Safety Act, on June 29, 1987.

was primarily focused on cancer treatment. When it was confronted with claims of environmental cancers, it minimized concerns. For many years the Canadian Cancer Society took the same position.

For the most part, the occupational and environmental health movements have been separate in Ontario. When both emerged in the 1960s and 1970s, the movements had a number of significant crossovers, especially around mining and steelmaking. From time to time, efforts were made to forge more lasting relationships, most notably initiated by the journal *New Solutions*, which sponsored a conference in Toronto in September 1994 [7]. While leading activists in both movements recognized common ground, especially around toxic chemicals, collaboration had been limited [8].

COMING TOGETHER

By the mid 1990s, concerns from environmental and occupational health activists converged in campaigns to address pesticides, chemical exposures to children, and breast cancer. At the national level, the Canadian Labour Congress environment committee reached out to a number of environmental groups. The first efforts to establish municipal bylaws to restrict use of cosmetic pesticides had begun with the community of Hudson in Quebec in 1991, marking a shift away from a focus on the federal government as a source of effective controls [9]. This in turn led a number of local coalitions to undertake successful campaigns to restrict pesticides. In July 1997 the first World Congress on Breast Cancer was held in Kingston, Ontario, galvanizing many activists, predominantly women, from a wide variety of backgrounds, and raising concerns about both environmental and occupational exposures.

Growing evidence of the increasing numbers of childhood cancers brought together concerned researchers, lawyers, and physicians with support from the Canadian Environmental Law Association and the College of Family Physicians to develop a detailed review of research into the greater susceptibility and exposure of children to environmental contaminants. The Workers' Health and Safety Centre, a labour-sponsored occupational health and safety training centre, produced a video "They Speak in Whispers," highlighting workers' concerns that their children were suffering cancers as a result of exposure to chemicals. Both environmentalists and occupational health activists were engaging a broader audience—those in public health, the Cancer Society, and the new provincial cancer authority, Cancer Care Ontario.

PRIMARY PREVENTION OF CANCER TASK FORCE

An opportunity to build on the emerging connections occurred in 1995 with the report of the Ontario Primary Prevention of Cancer Task Force (the Task Force). Although the report came out just as Ontario elected a Conservative and

pro-business government, the Task Force was the product of the prior New Democratic Party (NDP) government and in particular its activist Minister of Health, Ruth Grier. Previously Minister of Environment, she took advantage of her responsibility for cancer policy to convene the Task Force to develop a plan for primary prevention. Prior to the Task Force, primary prevention had been only a tiny part of the province's cancer plan.

The Task Force was chaired by Anthony Miller, a highly respected epidemiologist, and was made up primarily of doctors and academics with a broad range of interests in prevention, including occupational and environmental causes. The Task Force mandate was to advise the Minister on an action-based, effective, and feasible plan for the primary prevention of cancer. While acknowledging that cancer was a complex disease, the Task Force report stated that cancer in many instances is preventable.

The Task Force recognized that many of the eventual benefits of cancer prevention may be delayed, and that there may be substantial barriers to immediate action. The Task Force urged action now. Scientific understanding of the causes of cancer may be imperfect, but there is no excuse for delaying action in response to our current knowledge [10, p. 1].

The Task Force identified prevention as a central part of cancer control. Unfortunately, the resources dedicated to prevention were small in comparison to those dedicated to treatment. This might make sense if cancer were easy to treat or if treatments were highly effective. The Task Force noted that treatments for advanced cancers are seldom curative and reinforced its central proposition that investment in prevention was worthwhile [10, p. 10].

The Task Force reviewed the evidence regarding 12 different risk factors, both occupational and environmental. Regarding the former, the Task Force comments were short, recognizing the research that had been done to date, supporting existing efforts, and advocating pretesting of chemicals before use [10, pp. 26–28]. To some extent, this recognized the strength of evidence and the significant progress which had been made in recognizing occupational cancers. It also reflected the lack of participation by labour in the Task Force process.

Environmental risk factors were quite different. The Task Force provided a much more detailed review of the evidence on environmental pollutants and human cancer, known and suspected carcinogens in the environment and human exposure, and the challenges of proof [10, pp. 29–39]. It was a succinct and comprehensive justification for action on environmental carcinogens, building on prior work and focusing on action. The Task Force engaged representatives of public health, the Canadian Cancer Society, and environmentalists.

The report provided recommendations—and a strategy for ensuring the implementation of its recommendations—regarding all 12 risk factors. The strategy engaged the provincial public health system as well as the recently reformed cancer registry, now called Cancer Care Ontario, and it included the creation of

a provincial Cancer Prevention Network to coordinate [10, p. 53]. This was a key breakthrough and provided permission for those in official, nongovernmental, and personal locations to work together.

The Task Force report was directed to the public health system for implementation. Although the Chief Medical Officer responsible for public health at the provincial level was himself very conservative and opposed to the idea that toxic chemicals had any significant impact on health, the delivery of public health in the community is the responsibility of the local Medical Officers of Health (MOH). A number of these local MOHs were much more sensitive to environmental health issues. Some MOHs had been involved in the Task Force and were involved in the growing debate around the use of ornamental pesticide use (a subject which the Task Force had also recognized). These local MOHs are governed by a local Board of Health, made up of elected representatives from the municipal councils and community representatives. The staff who worked in the community were often sympathetic to the growing public concern about environment and cancer. This network gave support to the Task Force's implementation strategy.

Prior to the Task Force report, there had never been such a comprehensive cancer prevention initiative from government, including environmental and occupational risk factors. At the same time there were many inside and outside government, in many different agencies and locations, for whom the strategy provided an opportunity to move forward. The impetus from the Task Force allowed those people to reach out and build important alliances. Spurred on by a meeting sponsored by Toronto Public Health (TPH) in February 1998 to create a Toronto Cancer Prevention Council, along with a grant from federal Health Canada, a small group of women worked together to initiate a cancer prevention campaign. Joined by labour and other activists, the workshop came together in March 1999 at McMaster University at a conference entitled "Everyday Carcinogens." The workshop allowed the participants to explore further the recommendations of the Task Force and expand the network of interested and engaged activists.

Underlying these developments was a growing frustration with federal and provincial levels of government. Environmentalists' experience with pesticides regulation at the federal level is what led, in part, to a change in strategy to focus on local governments. A neoliberal agenda which emphasized business interests, deregulation, and cutting social spending had taken over. In 1995, the right wing agenda hit Ontario with full force with the election of the Harris Conservative government. There was a radical shift to the right with extensive cuts to the environment and labour ministries, especially in relation to any capacity to protect human health and funding for community or nongovernmental organizations. Municipalities offered an alternative forum. Although their powers were limited, municipalities had a mandate to protect public health and the authority to pass bylaws, as was upheld by the Quebec Superior

Court in the Hudson pesticides case in 1993 and ultimately confirmed by the Supreme Court of Canada in 2001.

By the late 1990s, the growing evidence of adverse health impacts, including cancer due to occupational and environmental exposures, was apparent to many, especially those whose work or activism engaged them in health protection, whether located in a union, public health, or a cancer prevention or environmental group. While some tried to continue the old strategy of devaluing concerns and sowing doubt, many more were trying to find new ways in which to develop alliances with others. This created a broad, diverse network of sympathetic people in many different locations. At the same time, action was refocused to the municipal level as a site where progress could be made.

THE TORONTO CANCER PREVENTION COALITION

The establishment and evolution of the Toronto Cancer Prevention Coalition (TCPC) is well documented in a report prepared on its 10th anniversary. Entitled *Ten Years Later: The History and Development of the Toronto Cancer Prevention Coalition*, the document was written by Valerie Hepburn, an early leader and participant [11]. From its initial founding in 1998, the TCPC engaged supportive Medical Officers of Health and city councilors with community activists, labour, nongovernmental organizations, public health practitioners, and researchers. Key staff within TPH played important roles guiding the coalition and keeping it on track. By capitalizing on the Task Force report and the mandate which it gave to public health, the TCPC has been able to garner financial support and human resources from a number of official organizations and utilize official processes to move forward its agenda.

The TCPC is organized around the 12 risk factors identified in the Task Force report. Each risk factor has its own working group and a representative from each working group sat on the steering committee. TPH provided core staff support and the regional cancer centre provided funding for specific projects including the initial council reports. In general, each working group produced a report that provided an analysis and set of recommendations. The coalition as a whole worked on advancing those recommendations. Public meetings were held to disseminate the reports and discuss strategies for future action.

The establishment of the TCPC was the result of a formal direction from the Board of Health to the MOH to report on activities in relation to the Task Force recommendations. That decision evolved into consultations and workshops that ultimately gave rise to the recommendation to create a citizens' coalition which was, in turn, ratified by the Board of Health. While appearing to some to be an exercise in bureaucracy, the process legitimated the participation of people from

within city government as well as external organizations who otherwise would have found it difficult to take part in or provide support for the campaign.[2]

Environmental groups who had been involved in the Task Force process were early participants in establishing an environmental carcinogens working group. Labour was later to the table, not having been as involved in the Task Force report. Initially a separate occupational carcinogens working group was established.

The critical moment for both working groups was the decision in 1999 to work together, creating one occupational and environmental carcinogens working group (OE Working Group). It arose as all working groups were tasked with producing a report on the status of primary prevention relating to their assigned risk factor, the first major task of coalition members.

The occupational carcinogens working group proposed that it join with the environmental carcinogens working group to produce a joint report. The rationale was simple and compelling. First, both groups were dealing with the same chemicals from the same source. However one described it, the principal problem for both worker and community health was the use and emission of chemicals in industrial production and products. As the eventual report stated,

> Since so many environmental carcinogens (cancer-causing substances) originate in the workplace and are then emitted into the air, water or land, replacing these hazardous materials with cleaner products and processes will protect the health of both workers and the surrounding community. In recognition of this fact, the Environmental and Occupational Working Groups of the Toronto Cancer Prevention Coalition are presenting a joint report.
>
> Linking environmental and occupational factors allows us to address the full life cycle of these hazardous substances. A life cycle approach encompasses three stages: manufacture (when workers can be exposed to high levels of carcinogens and when factories emit large quantities into the local environment); use (when the general population can be exposed to these toxins in the air, water and soil); and disposal (when carcinogens escape containment to contaminate the surrounding area and/or become pervasive in the environment).

Second, there was a common concern that both occupational and environmental exposures were affecting our children, either indirectly through their parents or directly through lifetime exposures. It is common sense to be concerned that substances known to cause cancer in adults after higher exposures at work, may cause cancer in children at much lower levels when those exposures are occurring from the moment of conception.

Third, in both cases, current strategies for prevention were not working. Pollution prevention strategies which eliminate carcinogens at the source are the

[2] A full list of past and present members of the coalition can be found on the website of Toronto Public Health at http://toronto.ca/health/resources/tcpc/tcpc_membership.htm.

logical public policy response to such a life cycle analysis, since the current system of attempting to regulate the use, release, and disposal of known and suspected carcinogens, rather than preventing their creation in the first place, has proven ineffective [12, p. 5].

There was a fourth, unstated reason. Combining the two perspectives strengthened both. Evidence of environmental cancers was considered "weak" by many. By linking to the occupational evidence, which in most cases was much stronger, the report could make the argument that it did not need either to reprove carcinogenicity or accept that there was not enough evidence in cases of environmental exposures. Indeed, as the alliance proceeded, the argument was reframed to point out the inadequacy of prevention of "known" carcinogens as defined by the International Agency for Research on Cancer (IARC) and other recognized lists, regardless of whether the source of exposure was at work or in the community. On the other hand, many assumed, as was suggested in the Task Force Report itself, that occupational exposures were a thing of the past, well under control and affecting only a very small group of people. The link to environment and the community strengthened the overall case for prevention. Together, the OE working group was able to reach out to a much larger audience and network. This created support that was greater than the sum of its parts.

Forging solidarity was a critical task. Although many subscribe to the old adage that "you cannot write a report by committee," in this case it was the only way. The process strained relations and certainly put the main authors to the test, but in the end, it produced a result that everyone would support. The process integrated research with policy and practice. Occupational health practitioners were familiar with combining research findings with the "balance of probabilities," enabling them to more effectively utilize the precautionary principle and weight-of-evidence as tools for drawing inferences. Some environmentalists wanted the report to push further into less well defined territory. Public health staff questioned some conclusions. Academics and doctors suggested that the report was policy, not science. Every concern was carefully considered and, to the extent possible, addressed. The two principal authors—Keith Stewart, an environmental policy expert, and Lou Riklik, an occupational hygienist—were able to deal with a seemingly endless list of edits while holding fast to the principal objective, a sound basis for sound recommendations. In the end only one participant withdrew from the process.

There was no magic bullet either to the process or to resolving differences. Conclusions were vetted by each participant and, on a number of occasions, the draft report was reviewed by outside experts recommended by a concerned participant. The working group met repeatedly to review and discuss the different drafts. The OE working group was guided by two co-chairs, one representing environment and the other the occupational perspective. Both co-chairs worked tirelessly to maintain a strong sense of collaboration and trust among the

participants as well as seeking effective ways to resolve differences. In the end it was the comfort level of the participants and the organizations that they represented which decided the outcome. It was the common commitment and collegiality of those involved that made the process work.

The report was finished and submitted in May 2001. In the end, as important as the written report was, it was the common understanding which the participants of the process developed that enabled the working group to move forward as a single entity.

The process reinforced relationships between individuals and established bonds of collaboration which carried on in later opportunities. Subsequently, when the body responsible for cancer policy in Ontario, Cancer Care Ontario, established the Provincial Cancer Prevention and Screening Council (another recommendation of the Task Force) and needed to produce a cancer prevention plan for the province, it turned to the example of the TCPC. For advice on occupational and environmental carcinogens, it drew from the experience of the OE Working Group [13]. When Canada established its national cancer strategy, leading members from the OE Working Group helped to establish, and became members of, the group that became the National Committee on Environmental and Occupational Exposures.

Of particular importance to the effectiveness of the OE Working Group was the role played by two community-based organizations—the Toronto Environmental Alliance (TEA) and the Occupational Health Clinic for Ontario Workers. While individuals from many other organizations played key roles, TEA and OHCOW provided the additional resources needed to make the project work for the working group. TPH provided the umbrella, the connections to the Toronto City Council, and the support for the coalition as a whole. It was TEA and OHCOW which provided key technical and logistical assistance. TEA is Toronto's core community-based environmental organization, with experience and expertise engaging with the city's council and government. Through its network, local neighbourhoods and councilors were engaged with the project. OHCOW's hygienists, nurses, and physicians provided ongoing technical support with a very practical application.

The report of the OE Working Group made a series of recommendations to the coalition, the MOH, the city government and beyond. The recommendation that the OE Working Group decided to make central to its work following the delivery of its report was community right-to-know (CRTK),

> We fully endorse the principle of right-to-know. In its broadest sense, community right-to-know is a system of public access to information on the use of toxic chemicals and their release into the environment, as well as their impact on human and environmental health. In encouraging the development of community right-to-know, the Board of Health and City Council should:
>
> a) Encourage the Medical Officer of Health to support the City Solicitor in the development of the community right to know bylaw, and report back to

> the Board of Health on its development and implementation by the end of 2001 [12, pp. 53–54].

The decision by the OE Working Group to focus on CRTK was a strategic one. The need for a CRTK bylaw had been identified in 1985, and again in the City of Toronto's Environmental Plan in 2000. Since then, little had been done to develop and implement a comprehensive right-to-know strategy. Members' experience suggested that existing data sources and systems did not adequately reflect the total level of carcinogens in the community given thresholds and other limitations, nor did they allow for identification of specific sources. This latter concern was reinforced by the TPH report on the "Ten Key Carcinogens in Toronto Workplaces and Environment: Assessing the Potential for Exposure" in March 2002 in response to the OE Working Group's original findings. The "Ten Key Carcinogens" report highlighted cases where workers' exposure to several carcinogens was significantly above "a background level" and noted that existing data suggested that "nine of ten carcinogens are present in outdoor air at levels that approach and frequently exceed those deemed "tolerable" by outside agencies [14].

CRTK was seen as a key strategy for several reasons—it honoured public and worker rights; it would assist in identifying priorities for action and in targeting regulatory initiatives; it could encourage voluntary action to improve environmental performance; it would allow for tracking of trends and progress in reducing the use and release of carcinogens; and it would aid in research. The underlying agenda was to encourage local industry towards pollution prevention through a mandatory system of reporting that was within the jurisdiction of the municipal government to pass a by-law, and that would be visible to everyone.

The OE Working Group then undertook a pilot project in one of Toronto's communities to demonstrate the value and importance of community right-to-know. The working group understood strategically that it needed a practical example of the value of the recommendations that the committee had made. Several key members agreed to work on the project and submit a proposal for funding from the regional cancer centre. After considerable deliberation a neighbourhood was chosen that had a history of environmental concerns and activism, one which had over the years developed its own community group and had been involved in campaigns to address emissions from industry and from the local waste management incinerator. The community of South Riverdale was deliberately chosen because it was reasoned that if community right-to-know were needed here, it would be even more useful in communities with less history and experience.

The subsequent report in December 2004 validated the OE Working Group's assumptions. Even though the South Riverdale neighbourhood had a rich history of environmental concern and activism, and even though it had an

Environmental Liaison Committee with local government, planning officials, industry, and elected representatives, people still could not access the information they wanted, whether about the environment or the workplace [15]. This report was presented to city staff and formed the basis of TPH recommendation in January 2005 that the MOH explore and report on practical and effective strategies for increasing public access to information on toxic chemicals in Toronto, including consideration of the feasibility of a CRTK bylaw [16].

In June 2006, a public health consultation document on a proposed community right-to-know program—Environmental Reporting and Disclosure—was released [17]. More than 250 supportive responses were received from communities and organizations. In February 2007, the OE Working Group hosted a public meeting at the Steelworkers Hall in downtown Toronto. Chaired by well known journalist Michele Landsberg and featuring Devra Lee Davis and Ken Geiser, "Reducing the Burden of Toxic Chemicals" attracted over 100 people and gave additional support to the CRTK bylaw campaign. TEA developed a map showing the reported emissions ward by ward across the city as party of its "Secrecy is Toxic" community campaign in support of a CRTK bylaw. Thousands of these leaflets were distributed, and community meetings were held across the city to build support.

The response of industry did not emerge until, towards the end of the process, TPH began active consultations. The Toronto experience with a pesticides control bylaw, a process also led by TPH, had shown that segments of industry organized by trade associations and consultants would organize opposition. TPH preemptively organized several public meetings with industry to discuss its proposed initiatives. The most powerful participants were the chemical-producing companies organized by the Canadian Chemical Producers' Association (CCPA). Their position was that the program was unnecessary. Their members were already complying with and, in most cases, exceeding the objectives of the TPH proposal. Their concern was for small and medium-sized companies that did not have the resources to comply. They also argued that federal and provincial programs already existed and wanted to avoid duplication. TPH responded by commissioning a technical report that demonstrated that only 3 percent of Toronto's industrial, commercial, and public operations were publically reporting; that 56 percent of releases to air, water and land were not reported; and that 77 percent of releases to air were not reported [18].

In June 2008, after extensive consultations, the MOH provided a comprehensive report to the Board of Health outlining the elements of a proposed bylaw. On December 3, 2008 Toronto Council passed a CRTK bylaw, and on January 1, 2010, the Environmental Reporting, Disclosure and Innovation program came into effect. Now known as ChemTRAC [19], the program is well underway, with the first report for emissions in 2010 due this year.

REFLECTIONS AND OBSERVATIONS

The success of the CRTK by-law initiative is rooted in the constructive engagement of Toronto Public Health, the Board of Health, and the City Council by an organized group that was able to leverage its expertise and experience with the support of a larger community coalition to achieve a well defined and defended objective, improving human health. The process took more than 10 years. Implementation of the ChemTRAC program that the bylaw enabled is still underway. The OE Working Group was able to build on previous coalition work, especially the campaigns for Toronto bylaws banning smoking and cosmetic pesticide use. A number of the members of the OE Working Group and the TCPC had been involved in these earlier campaigns.

The OE Working Group found ways to use everyone's abilities without compromising their responsibilities to their employers. Those in government or agencies who could not be involved in advocacy were able to identify ways in which they could make a contribution, be it advice, research or supporting complementary efforts within their workplace. The working group members were able to separate their roles so that advocacy could take place without fracturing the coalition. TEA lobbied city councilors without jeopardizing working group members who were employed by the city. Public meetings took different forms—some promoted by TEA, some by TPH, and some by TCPC. TCPC allowed the OE Working Group to have a broader base of support, engaging members from the broader coalition. In this way, the CRTK campaign was able to maintain active community engagement which appealed to public support, making it difficult for those opposed to undermine or distort.

The role of Toronto Public Health and, in particular, the leadership of the Medical Officers of Health, Dr. Sheila Basrur and her successor Dr. David McKeown, was crucial. They created the Toronto Cancer Prevention Coalition and with it the opportunity for constructive engagement as opposed to confrontation. Projects of the working group were strategically chosen to set examples that TPH could utilize internally or in dealing with other departments of city government or external stakeholders and, when necessary, could build on.

Working with TPH was critical to success in another way. The mandate of TPH is health protection and promotion. The decisions of the MOH and Board of Health to implement the Task Force report, to create and support the work of the coalition, was built on their understanding that it would improve health outcomes and reduce the risk of cancer for the people of Toronto. Although responsive to industry concerns and those of city departments promoting economic development, TPH was not seduced by business complaints that CRTK was unnecessary, too costly for small and medium businesses, and an expense for the city. These arguments were persuasive on face value to Departments of Economic Development, the Ministry of Environment, and the Ministry of Labour, whose mandate was business-oriented. TPH was more critical. While

acknowledging there were challenges, TPH built on industry's own admissions that controlling toxic chemicals was a good idea. TPH responded to business by evaluating its arguments, and by addressing concerns of smaller and medium-sized business through consultation, technical support, and provision of easy-to-use tools to calculate reporting requirements.

In the end CRTK succeeded because it was not about information made available just so environmental groups and labour could use it to attack the companies individually. CRTK succeeded because it was clearly about getting industry to reduce its use of toxic chemicals and had the support of a wide group of community and governmental agencies. The slogan "You cannot manage what you do not measure" became "You can reduce and eliminate when you do measure." TPH, TCPC, and the OE Working Group were convinced that by requiring the reporting of chemical use and emissions, the majority of the companies would take steps to reduce what they use or find alternatives. The TEA slogan "Secrecy is toxic" captured the mood succinctly and effectively. And the public supported them.

The dialogue created between the participants to build the strategy and execute it increased mutual understanding. It would be too much to suggest political understanding shifted. The work was an explicit challenge to an economic model that promoted growth and allowed risk to be shifted onto workers and the community. Early steps were taken to adopt and integrate ideas of a green economy, one in which impact on human health and employment practice were considered central.

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Movement Solutions – Building New Coalitions

CIVIL SOCIETY ACTIONS FOR A TOXICS-FREE FUTURE

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ABSTRACT

Participation of civil society in efforts to protect public health and the environment from chemical exposure is often undertaken in the context of major multilateral environmental agreements, especially in developing and transition countries. However, often there is confusion about what these agreements mean in practice and how civil society actually effectively contributes to their implementation. This paper will explore how public interest nongovernmental organizations (NGOs) and civil society organizations in developing and transition countries have shaped and used multilateral environmental agreements to advance chemical safety issues nationally and how, in turn, these multilateral agreements have shaped NGO agendas. The emphasis is on how public interest NGOs and civil society organizations have utilized key elements of chemicals agreements in their chemical safety activities on the ground. Obstacles faced by NGOs, tools and methods used, and case studies of successful activities are discussed.

Keywords: chemicals, environment, NGOs, treaties

A variety of developments have stimulated actions to address chemical safety issues, and NGOs have played an important role in addressing how these challenges have been tackled. Increasing awareness and public concern over

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harms to human health and the environment from toxic chemicals helped trigger the formation of active public interest NGOs and civil society groups. Governmental responses to these issues resulted in key global chemicals agreements which play a major role in policy formation in developing and transition countries.[1] Currently, NGOs in developing and transition countries find themselves in the middle of a rapid shift to increasing production and use of chemicals.

Unfortunately, developing and transition country governments often do not have the infrastructure and capacity to manage chemicals effectively. In response, NGOs combine their own vision for a toxics-free future with the objectives of chemicals agreements to tackle chemical safety problems directly and push for a safer future. In addition, NGOs often contribute expertise, data, and knowledge to chemical safety policy discussions that would not otherwise be presented. As a result, NGOs can often become effective resources and contribute to national policy design. In this regard, NGOs stand in contrast to other participants in these processes who necessarily must represent the sectoral interests of individual governments, regions, and/or industry groups. This paper will provide background on global chemicals agreements and shifts in chemicals production and explore how NGOs have faced chemical safety challenges by putting various international policies into practice at the national level.

THE SHIFT IN CHEMICALS PRODUCTION AND USE TO DEVELOPING AND TRANSITION COUNTRIES

The chemical industry plays a significant role in the global economy with sales in 2007 of more than three trillion U.S. dollars [1]. While most chemicals production occurs in developed countries, a steadily increasing share of world production has shifted to developing and transition countries [2]. In fact, by 2020 developing countries are expected to lead in high-volume chemicals production [3]. The United Nations Environment Programme (UNEP) notes rapidly rising import and use of chemicals in developing countries and estimates that by 2020, they could account for one-third of global consumption [4]. Almost all developing countries are increasing their use of pesticides and industrial chemicals, including substances contained in consumer and commercial products such as plastics, paints, adhesives, dyes, metals, and so forth. As a result, synthetic chemicals and other potentially toxic materials represent a large and growing fraction of developing countries' consumer, commercial, and industrial waste streams. This rapid growth of production and consumption of chemicals in developing countries occurs against a backdrop of insufficient infrastructure to

[1] In United Nations terminology, "transition countries" refers to developing countries and countries with economies in transition.

adequately protect public health and the environment. The increasing recognition that exposures to toxic chemicals have become a significant source of injury to human health and the environment triggered a series of important global agreements on chemicals.

GLOBAL CHEMICALS AGREEMENTS

There have been several key global chemicals agreements that address health, environment, and development. In 1992, heads of state met in Rio de Janeiro, Brazil, for the United Nations Conference on Environment and Development, and committed to comprehensive chemical safety objectives in Chapter 19 of Agenda 21. In the next two decades, the three primary chemicals conventions were negotiated and adopted: the Basel, Rotterdam, and Stockholm Conventions [5–7]. All three treaties have wide applications, but each also has special considerations for the needs of developing countries and countries with economies in transition. The Basel Convention seeks to protect developing countries from becoming destinations for waste dumping. The Rotterdam Convention grants developing countries the right to consent to or reject the importation of certain hazardous chemicals. The Stockholm Convention seeks to protect human health and the environment by reducing and eliminating persistent organic pollutants (POPs), a special class of substances that are persistent, toxic, bioaccumulative, and travel long distances. In many regions, countries need to deal with POPs legacy problems from chemicals production or receipt of donated chemicals which later became obsolete stockpiles and contaminated sites, threatening communities and natural resources. Developing countries are eligible for a financial mechanism that seeks to provide resources for planning and implementing the treaty.

In 2002, heads of state at the World Summit on Sustainable Development (WSSD) in Johannesburg, South Africa, called for development of a global strategic plan to ensure that by 2020, chemicals are used and produced in ways that minimize significant adverse effects on human health and the environment.

More recently, ministers and representatives of the private sector and civil society adopted the Strategic Approach to International Chemicals Management (SAICM) in Dubai in 2006 in a meeting convened by the United Nations Environment Programme. The first paragraph of the agreement clearly identifies chemical safety as a necessary component of the international development agenda: “The sound management of chemicals is essential if we are to achieve sustainable development, including the eradication of poverty and disease, the improvement of human health and the environment and the elevation and maintenance of the standard of living in countries at all levels of development” [8].

These key chemicals agreements established common priorities for action and enhanced opportunities for cooperation among governments and NGOs. They have also helped catalyze awareness of problems and raised expectations

about resolving them. However, the global chemicals agreements often play different roles in developed and developing countries. Developed countries have the resources and infrastructure to establish comprehensive regulatory policies on chemicals, and the drivers for doing so are often internal to the country. In contrast, global policies on chemicals are much more significant to establishing national policies and authorities in developing and transition countries that lack adequate infrastructure and resources. For example, the Stockholm Convention financial mechanism provided $500,000 (U.S.) to developing countries to develop plans for national implementation of the treaty. Prior to this, there were very limited funds available to outline priority actions on POPs. In this way, global chemicals agreements have become important drivers for action on chemical safety in developing and transition countries on the part of both governments and civil society.

CIVIL SOCIETY CATALYZES A VISION FOR CHEMICAL SAFETY IN DEVELOPING AND TRANSITION COUNTRIES

Chemical safety became an important issue in many developing and transition countries as a result of the negotiation and adoption of the three chemicals conventions, along with other chemical safety initiatives. Civil society and public interest NGOs working on chemical safety issues emerged in the 1970s with groups such as the Pesticide Action Network [9]. However, the number of groups dramatically increased in the 1990s and later as the issues became more prominent. Global NGO networks formed during this period include the Basel Action Network (BAN) [10], the Global Alliance for Incinerator Alternatives (GAIA) [11], Health Care Without Harm (HCWH) [12], and IPEN [13]. This paper will focus on the activities of the IPEN network.

Establishing a Vision for the Elimination of Persistent Organic Pollutants (POPs)

The negotiation of the Stockholm Convention triggered the formation of IPEN in 1998 before the first negotiating meeting in Montreal, Canada. Over 100 NGO representatives adopted a POPs Elimination Platform that listed important characteristics of an effective treaty [14]. The Platform included a key idea for regulatory policy on POPs: "The goal of a global POPs convention must not be defined as the 'better management of risks associated with POPs' . . . as POPs by their very nature are unmanageable substances." This idea came to be expressed in the Convention's goal of POPs elimination, which was finalized in 2001. The POPs Elimination Platform guided the participation of the international NGO network at all negotiating meetings and helped shape the Stockholm Convention's final provisions.

From 2004 through 2006, IPEN executed a global project on Stockholm Convention implementation called the International POPs Elimination Project (IPEP). This was a medium-sized Global Environment Facility (GEF) Project entitled "Fostering Active and Effective Civil Society Participation in Preparations for Implementation of the Stockholm Convention."[2] IPEP helped more than 350 NGOs in 65 developing and transition countries in their efforts to prepare for Convention implementation. Examples of the project are described below.

A Declaration for a Toxics-Free Future

In 2006, more than 400 public interest NGOs and civil society organizations from 70 countries adopted the IPEN Declaration for a Toxics-Free Future [15]. This declaration declared the objective of achieving a ". . . Toxics-Free Future, in which all chemicals are produced and used in ways that eliminate significant adverse effects on human health and the environment, and where persistent organic pollutants (POPs) and chemicals of equivalent concern no longer pollute our local and global environments, and no longer contaminate our communities, our food, our bodies, or the bodies of our children and future generations." This IPEN Declaration touches upon key elements of civil society's vision for chemical regulatory policy including precaution; phase-out and prohibition; substitution; waste management; children's health; public participation; right-to-know; no data, no market; polluter pays; ecological agriculture; and the life cycle approach. These policies, along with awareness of SAICM itself, became the centerpiece of a subsequent outreach campaign to more than 1,000 organizations in over 100 countries [16].

POLICY INTO PRACTICE

Civil society actions on chemical safety cover all major areas of key chemicals agreements. These areas include development and implementation of national policies, waste minimization and elimination, obsolete stockpiles of chemicals, contaminated sites, compliance, public awareness-raising, chemicals in products, and right-to-know through pollutant release and transfer registries (PRTR).

Development and Implementation of the Stockholm Convention at the National Level

Implementation of the Stockholm Convention on Persistent Organic Pollutants takes place through National Implementation Plans (NIPs). Article 7 of the

[2] The GEF is an independent financial organization that provides grants to developing countries and countries with economies in transition for projects related to biodiversity, climate change, international waters, land degradation, the ozone layer, and POPs.

Convention states that Parties shall, where appropriate, ". . . consult their national stakeholders, including women's groups and groups involved in the health of children, in order to facilitate the development, implementation and updating of their implementation plans" [7].

Public interest NGOs have been especially keen to participate meaningfully in NIP development and implementation as a realization of the treaty and Rio Principle 10, which points out the importance of civil society participation in decision-making processes: "Environmental issues are best handled with the participation of all concerned citizens, at the relevant level. At the national level, each individual shall have appropriate access to information concerning the environment that is held by public authorities, including information on hazardous materials and activities in their communities, and the opportunity to participate in decision-making processes. States shall facilitate and encourage public awareness and participation by making information widely available. Effective access to judicial and administrative proceedings, including redress and remedy, shall be provided" [17]. Unfortunately, not all governments recognize the importance of civil society participation in NIP preparations. In these cases, NGOs have tried to provide useful inputs into the process and/or serve as a watchdog mechanism on the effectiveness of treaty implementation. In some countries, NGOs have had very important roles in preparation of the NIPs. For example, in Chile the NGO RAP-Chile participated directly in the NIP Coordination Committee, in four technical working groups that generated government policies on key aspects of treaty implementation: polychlorinated biphenyls (PCBs), contaminated sites, obsolete pesticides, and public awareness-raising. RAP-Chile included in its work a national rural indigenous women's organization, Asociacion Nacional de Mujeres Rurales e Indigenas (ANAMURI) and public interest NGOs (Alianza por una Mejor Calidad de Vida, Observatorio de Conflictos Ambientales, and Corporación de Investigación en Agricultura Alternativa). Altogether, in a three-year period when many NIPs were being prepared, 88 NGOs affiliated to IPEN participated in NIP preparation in some way in 53 countries.

Zero Waste

Waste issues represent important parts of the Stockholm Convention and the SAICM agreement, which specifically refers to "zero waste resource management, waste prevention, substitution and toxics use reduction, to reduce the volume and toxicity of discarded materials" [8, p. 102]. Governments can also play a visible, demonstrable role in chemical safety practices through implementation of procurement and recycling policies that affect waste generation and handling. NGOs working in this area try to establish a cradle-to-cradle circular approach which seeks to eliminate waste, not manage it.

An example of NGO actions in this area is the Zero Waste Kovalam project by Thanal in the Indian state of Kerala. Thanal and others began the project to avoid the construction of a municipal waste incinerator. The project was implemented with a two-pronged work plan: 1) assessment of the capability of biogas plants for biodegradable materials (resource recovery) and 2) training of women's groups on alternatives to materials such as plastics (materials substitution). This was followed by the creation of a "Zero Waste Center" in 2003 and sub-projects including "poison-free farming," water conservation, and community capacity-building. The project created more than 150 jobs, effectively cancelled a possible POPs-generating incinerator, implemented materials substitution to prevent POPs formation, and created sustainable waste management and livelihoods. In February 2006, the Pacific Asia Travel Association awarded Zero Waste Kovalam its Environmental Award.

Obsolete Stockpiles

Identification, safe storage, and remediation of obsolete pesticide and PCB stockpiles are important issues that countries must deal with to fulfill Stockholm Convention objectives expressed in NIPs. NGO efforts in this area have pioneered identification and characterization activities so that expert clean-up can take place.

Obsolete pesticide stockpiles are a severe problem in Africa and in countries in the region of Eastern Europe, the Caucasus, and Central Asia due to the large quantities of toxic chemicals and the dilapidated conditions of storage which lead to environmental and human exposure. Authorities estimate that more than 50,000 tons of pesticides were buried in both Africa and countries of the former Soviet Union [18]. NGO efforts in this area include identification of unauthorized storage sites in Armenia, Azerbaijan, Kyrgyzstan, Moldova, Russia, Ukraine, and Uzbekistan that were not previously part of government inventories [19]. NGOs have also performed detailed sampling and analyses of sites to trigger safe storage and clean-up. For example, in Tanzania, the NGO AGENDA performed sampling studies of water and sediments in a community surrounding an obsolete DDT storage site to provide specific data for remediation activities [20]. This study helped attract international attention and resources to begin the clean-up process.

In the examples above, NGOs generated data about POPs contamination and highlighted Convention obligations to attract governmental, public, media, and international attention to the problem. This is a vital component to realizing the Convention, as obsolete stockpiles are often forgotten liabilities.

Contaminated Sites

Contaminated sites and patterns of practice leading to pollution represent important areas of concern for public interest NGOs and key chemicals

agreements including Article 6 of the Stockholm Convention and items 47, 48 and 243 of the SAICM Global Plan of Action. Key NGO priorities include identification, characterization, and remediation of sites.

Some NGOs have carried out very detailed work on contaminated sites. For example, the Sustainable Development Policy Institute (SDPI), an NGO in Pakistan, became concerned about a dilapidated former DDT factory located in Northwest Frontier Province near the Kabul River, a drinking water source for more than 800,000 people. Together with researchers from Peshawar University, SDPI performed a monitoring study of soil, sediments, water, and bags of powder around the Nowshera factory; results showed widespread contamination in the factory area [21]. After discussing the matter with local authorities, hospitals, and educational institutions, SDPI successfully proposed that clean-up of the site be added to Pakistan's activities under Stockholm Convention implementation.

Compliance

The wide geographical dispersion of NGOs, and their closeness to communities, can often permit them to perform detailed investigations of compliance with government laws regulating chemicals. For example, in Indonesia, NGO Gita Pertiwi determined the circulation of 37 pesticides (including POPs pesticides) that are prohibited by the Indonesian government. The surveys involved field visits and discussions with farmers, as well as interviews with the pesticide committee in the farming department. Research was conducted on three islands: Java, Sumatra, and Kalimantan. The team found pesticides that were only for designated use being freely sold; unclear labeling; pesticides with expired circulation permits; use of unlicensed pesticides; a lack of worker training regarding health impacts or dangers; a lack of protective equipment for sprayers; and random dumping of used pesticide containers. The results of the research were produced as a national report about the current circulation of information regarding the prohibited pesticides [22].

Raising of Public Awareness

Chemical safety and POPs issues are typically not public or policy priorities. However, the Stockholm Convention recognizes the important role of civil society in public information, awareness, and education. Article 10 of the Convention states that each Party shall, within its capabilities, promote and facilitate, "Public participation in addressing persistent organic pollutants and their health and environmental effects and in developing adequate responses, including opportunities for providing input at the national level regarding implementation of this Convention" [7]. NGOs can provide relevant, easy-to-understand materials for a variety of public stakeholders including the media, farmers, women, students, health care practitioners, incinerator operators, municipal workers, community-based organizations, agricultural workers, academics, government

officials, and others. For work on the Stockholm Convention this means explaining what POPs are, what objectives and provisions are included in the Stockholm Convention, and possible solutions to POPs in the country. An important part of NGO awareness-raising activities has been to produce materials in both UN and local languages. For example, in Paraguay, materials were produced in Guaraní, an indigenous language, as well as Spanish. In India, reports and activities were conducted in Bengali, Hindi, Telugu, Malayalam, and Punjabi. This has helped dissemination and increased stakeholder participation. In one global IPEN project, NGOs in 52 countries produced 150 public-awareness-raising activities on the Stockholm Convention [23].

Chemicals in Products: Lead in Paint

There is increasing concern about chemicals in consumer products that can result in exposure during use and then later when the products become wastes. A classic example is lead in paint, which many believed was a problem of the past. In 2008, the Indian NGO Toxics Link tested paints in India and found high levels of lead in enamel paints. In a follow-up, Toxics Link partnered with IPEN to conduct a study in ten countries that examined lead in paints from Belarus, Brazil, Mexico, Nigeria, Philippines, Senegal, South Africa, Sri Lanka, Tanzania, and Thailand [24]. To everyone's surprise, the study found that nearly 70 percent of the enamel paint samples had lead concentrations exceeding the U.S. standard of 90 ppm, and half of them had concentrations greater than 1,500 ppm. Toxics Link and IPEN acted on these findings by successfully proposing action on the matter at Forum VI of the Intergovernmental Forum on Chemical Safety, a forum focused on assessment and management of chemicals that grew out of the Rio Earth Summit. The body approved the Dakar Resolution for Elimination of Lead in Paints in 2008, which proposed that a global partnership be established to eliminate lead in paint [25]. Several months later, Toxics Link and IPEN successfully proposed that lead in paint be one of four emerging policy issues taken up at the Second International Conference on Chemicals Management (ICCM2) in the SAICM process. The global community agreed with the NGO proposal and decided to establish a global alliance to eliminate lead in paint, jointly led by the United Nations Environment Programme and the World Health Organization and with the active participation of NGOs, governments, and the private sector [26, 27].

Right-to-Know through Pollutant Release and Transfer Registers

Pollutant release and transfer registers (PRTR) have become an essential information tool for driving toxics use reduction by making emissions information from industrial facilities public. The SAICM Global Plan of Action lists eight concrete actions on PRTR development and use relevant to implementation

[8, pp. 69–70, 83–84], and the Kiev PRTR protocol of the Aarhus Convention explicitly mentions consultation with ". . . national stakeholders, including women's groups and groups involved in the health of children, in order to facilitate the development, implementation and updating of their implementation plans" [28]. One example of an NGO that has completed activities in this area is Arnika in the Czech Republic. Arnika participated extensively in the design and implementation of PRTR in the country beginning in the 1990s, long before the country became an EU Member State. To help instigate the process, Arnika worked to generate more than 10,000 signatures on a petition that called for PRTR and included local authorities and scientists as signatories. The chemical industry opposed the process initially but finally conceded that the PRTR could cover 50 substances. Currently, the PRTR has 93 substances, including POPs, metals (including mercury), solvents, ozone-depleting substances, chemicals harmful to aquatic organisms, greenhouse gases, gases that cause acid rain, some pesticides (including atrazine, for example) and some inorganic substances (including asbestos). Formaldehyde and styrene are both part of the Czech PRTR, though this is not required by the European Union. Arnika has also published a "worst polluters" list each year using PRTR data [29]. The PRTR and subsequent publicity are credited with helping to make significant improvements in reducing emissions.

CONCLUSIONS

NGOs and NGO networks have played positive and critical roles in the processes where chemical safety policies are debated and established. NGOs often contribute expertise, data, and knowledge to the discussion that would not otherwise be presented. In addition, NGOs can often win trust and credibility as independent voices whose well-considered proposals and interventions are motivated by idealism and principle, and by genuine concern for the broad public interest. Furthermore, NGOs can be allies of a local or national authority that may wish to attract more attention to a particular chemical safety threat that is not considered a priority for action by decision makers. As a result, NGOs can often become effective resources and contribute to national policy design. In this regard, NGOs stand in contrast to other participants in these processes who necessarily must represent the sectoral interests of individual governments, regions, and/or industry groups.

Principal global agreements and many governments and intergovernmental institutions now at least formally acknowledge that public interest NGOs and other civil society organizations have an important participatory role to play in developing and implementing chemical safety policies and programs—in both national and in international policy-setting processes. In a number of cases where NGOs have been actively engaged, the outcomes of the policy process have

been much more successful, far-reaching, and visionary than would probably otherwise have been possible.

Despite the wide range of activities, meaningful NGO participation remains as much an exception as it is the rule. In some cases, international and national policy-setting processes welcome participation by industry lobbyists but block opportunities for meaningful participation on the part of independent public interest representatives. In other cases, however, the limiting factor is the incapacity of the NGO community, including lack of information about specific chemical issues, lack of experience in developing appropriate responses, and financial constraints.

Highly motivated NGOs are already working in support of chemical safety objectives in all parts of the world. In many cases, they work with little or no support. Since some governments reject support of NGO activities on chemicals, global cooperation is important for those who struggle at the local level. With only modest inputs of additional support, this movement has the potential to achieve substantial global reforms in policy and practice over the next decade. Success in this field, in turn, can provide good case examples demonstrating how to empower civil society toward achieving positive reform at the global level and also within specific countries.

NGOs are already contributing to achieving the 2020 SAICM goal in many ways, including campaigns directed at ending polluting practices, exposing the presence of toxic chemicals in consumer products, promoting ecological agriculture, monitoring humans and the environment for toxic substances, promoting waste minimization and elimination, and campaigning for regulations and programs to protect against chemical exposure in the work place. The goal of achieving a future where chemical exposure is no longer a source of harm to human health and the environment unites these varied efforts in a coherent whole which is shared by NGOs around the world.

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CHEMICALS POLICY IN THE 2008–2009 PRESIDENT'S CANCER PANEL REPORT

RICHARD CLAPP

ABSTRACT

The President's Cancer Panel 2008-2009 report, *Reducing Environmental Cancer Risk: What We Can Do Now*, was a watershed event in the U.S. chemicals policy process. The report, which was released after two years of public meetings and input from a variety of scientists and organizations, concluded that the national cancer program has not adequately addressed "grievous harm" from chemical carcinogens. Consistent with public health principles, it recommended that a prevention-oriented approach to regulating chemicals should replace the current "reactionary" approach. Various responses of cancer organizations and spokespeople in the aftermath of the release of the report are described. The report explicitly supports the type of policy reform contemplated in the Toxic Chemicals Safety Act of 2010, which failed to pass in the 111th Congressional session. In the absence of meaningful action at the federal level, the report will still provide strong support for state and local policy initiatives in coming years.

Keywords: cancer, occupation, environment, policy

EDITORS' NOTE

The links between environmental and occupational exposures have been recognized for centuries; however, strong acknowledgment of these links in U.S.

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government policies has been limited and generally weak. Now though, the 2008–2009 President's Cancer Panel report, *Reducing Environmental Cancer Risk: What We Can Do Now*, provides official recognition of the significant contribution of environmental and occupational exposures to cancer etiology. Our understanding of the links between these exposures and cancer dates back to the 1700s, when Sir Percival Pott documented that chimney sweeps had elevated rates of scrotal cancer associated with exposure to soot. Knowledge of the relationship between occupational and environmental exposures and cancer has evolved significantly since that time. While the mechanisms of cancer etiology have not been well understood, there is increasing evidence that many substances used in manufacturing and everyday products may increase the risk of cancer, whether exposures occur in utero, in childhood, or in adulthood. More than 400 substances are recognized by the International Agency for Research on Cancer as known or suspect carcinogens. Yet there is still significant controversy as to the relative contribution that environmental and occupational exposures play in our increasing overall cancer burden. Despite President Nixon's call for a war on cancer and significant investments in cancer research, the mainstream cancer community continued to focus on addressing genetics and social factors as causes, fundamentally ignoring the preventable role of occupational and environmental exposures.

The publication of the President's Cancer Panel report validates and reinforces decades of efforts of advocates, scientific associations, and scientists documenting evidence of the environmental and occupational links to cancer and the need to prevent such exposures. In particular, the panel found that a significant portion of cancers are related to environmental and occupational factors. The panel noted the inadequacies of current research, policy structures, and funding mechanisms to identify and prevent occupationally and environmentally induced cancers and suggested that precautionary actions are needed. The President's Cancer Panel report is a landmark in its vision and recommendations. The report justified the need for visionary policies such as the 1958 Delaney Clause of the Federal Food, Drug, and Cosmetics Act, which prohibited any chemical food additive, including pesticides, found to induce cancer in humans or animals, and the 1977 Occupational Safety and Health Administration's Generic Cancer Standard, which identified zero exposure as the only safe level of exposure to carcinogens.

The following article details the development of this seminal report, as well as the responses to it to date. The President's Cancer Panel report has the potential to fundamentally shift cancer policy, as well as chemicals policy, in the United States and beyond. As such, it also is likely to be politically marginalized and/or attacked so as to prevent it from driving national environmental public health policy. Ensuring that this report is a strong driver for primary exposure and pollution prevention policies will take the continued dedicated efforts of the public health, labor, and environmental movements, as well as aligned

environmental health scientists. We hope that this introduction to the President's Cancer Panel report encourages readers to study and use it to advance healthy and sustainable modes of production and consumption.

Editors: Jessica N. Schifano and Craig Slatin

The President's Cancer Panel, which reports directly to the President, has provided guidance on the direction of the National Cancer Program since it was created in 1971. The panel members for the most recent report include two eminent scientists, Dr. LaSalle Leffall and Dr. Margaret Kripke. Dr. Leffall is the Charles Drew Professor of Surgery at the Howard University College of Medicine and a former President of the American Cancer Society, the Society of Surgical Oncologists, and the American College of Surgeons. Dr. Kripke is Professor of Immunology and the Vivian Smith Chair Emerita at the University of Texas M. D. Anderson Cancer Center in Houston. Typically, there is a third member of the President's Cancer Panel who is a public cancer advocate, but this position was vacant during the 2008–2009 period. The panel members were backed by staff at the National Cancer Institute, led by the Executive Secretary of the President's Cancer Panel, Dr. Abby Sandler. Previous reports have had titles such as *Promoting Healthy Lifestyles* [1], *Translating Research into Cancer Care: Delivering on the Promise* [2], and *Living Beyond Cancer: Finding a New Balance* [3]. The 2008–2009 report, *Reducing Environmental Cancer Risk: What We Can Do Now* [4], was prompted by the growing body of research on—and growing public concern about—cancer risks associated with environmental contaminants. The growing body of research has been summarized in review articles which have appeared in U.S. and European journals over the past several years [5-7]. Public concern has grown in parallel with this research. The Panel and the National Cancer Institute staff considered this in the discussions that led them to address the topic in their 2008–2009 report. According to Dr. Margaret Kripke, "this is a subject that's of huge public interest at the moment" [8].

When informed of the proposed topic by a government employee, a group of scientists and cancer prevention advocates associated with the cancer working group of the Collaborative on Health and the Environment (CHE) committed themselves to provide input. The group responded to a call by National Cancer Institute staff for recommendations and nominated a number of individuals, some of whom were eventually invited to make presentations to the Panel. The CHE group also organized a Consensus Statement on Cancer and the Environment [9], which was initially signed by 10 scientists and three organizations prior to the first public meeting of the President's Cancer Panel and eventually by 160 individuals and organizations. This statement was provided to the NCI staff and provided further context for the Panel's work. The following will

describe the process that the Panel followed, the main conclusions of its report with respect to chemicals policy reform, the reactions of major cancer prevention groups in the United States, and the possible ways in which the report may be used in future federal, state, and local initiatives.

THE PROCESS OF GATHERING INFORMATION

Between September 2008 and January 2009, the President's Cancer Panel convened four meetings to assess the state of environmental cancer research and received testimony from 45 invited experts. The first meeting was on the topic of Industrial and Manufacturing Exposures, and the panel heard presentations from a series of scientists from academic institutions, government agencies such as the National Institute of Environmental Health Sciences and the National Institute for Occupational Safety and Health, and nongovernmental organizations. A woman with mesothelioma, who was the wife of an asbestos worker, testified from the audience. In my presentation at this first meeting I recommended, among other things, "a new system to manage chemicals that avoids introducing industrial agents that increase cancer risk into our workplaces and environments . . . [and supports] policy and market-based efforts to identify safer alternatives to known industrial agents that increase cancer risk. . ." Dr. David Kriebel advocated a prevention-oriented and cautionary approach to environmental chemicals policy instead of the current system guided by the "reactionary principle" [10]. Several others pointed to the large numbers of workers exposed to carcinogenic substances, and Dr. Chris Portier, then Director of the National Toxicology Program, described a new way of evaluating the carcinogenicity of whole classes of chemicals. Jeanne Rizzo, President of the Breast Cancer Fund, noted that the personal care and fragrance industry exposes workers and consumers to a large variety of carcinogenic chemicals.

In the following three months, meetings focused on the topics of Agricultural Exposures, Indoor/Outdoor Air Pollution and Water Contamination, and Nuclear Fallout, Electromagnetic Fields and Radiation Exposure. A variety of speakers from academic institutions and government agencies made presentations at these meetings, as well. A particularly important presentation by Dr. Mahadevappa Mahesh emphasized the large doses of radiation being given to patients getting CT scans. Some of the presentations were included in two special issues of *Reviews on Environmental Health* [11, 12]. Summaries and minutes of each meeting were posted on the National Cancer Institute web site, and the NCI staff accepted additional input for approximately six months after the final session in January 2009. The report, which was released on May 5, 2010, summarizes the Panel's findings based on the testimony received and also contains additional information gathered by the Panel and staff itself.

In brief, the Panel found that the true burden of environmentally induced cancer has been grossly underestimated. *Reducing Environmental Cancer Risk* states that the National Cancer Program has not adequately addressed the "grievous harm" from environmental carcinogens. It calls the burden of cancer resulting from environmental and occupational exposures "unacceptable," noting that these cancers are preventable through national action. The main text of the report concludes with the following statement: "The requisite knowledge and technologies exist to develop alternatives to many currently used chemical agents known or believed to cause or promote cancer. Many chemists require additional training to understand environmental hazards and reformulate products. Importantly, 'green chemistry' alternative products themselves require longitudinal study to ensure that they do not pose unexpected health hazards" [4, p. 100].

The report then continues with its first recommendation: "1. A precautionary, prevention oriented approach should replace the current reactionary approaches to environmental contaminants in which human harm must be proven before action is taken to reduce or eliminate exposure. Though not applicable in every instance, this approach should be the cornerstone of a new national cancer prevention strategy that emphasizes primary prevention, redirects accordingly both research and policy agendas, and sets tangible goals for reducing or eliminating toxic environmental exposures implicated in cancer causation. The proposed Kid Safe Chemicals Act introduced in the 110th Congress, or similar legislation, has the potential to be an important first step toward a precautionary chemicals management policy and regulatory approach to reducing environmental cancer risk. Optimally, it should shift the burden of proving safety to manufacturers prior to new chemical approval, in mandatory post-market studies for new and existing agents, and in renewal applications for chemical approval" [4, p. 103]. The recommendation also lists the agencies and stakeholders that the panel suggests should be involved in establishing these new policies. They start with the President, Congress, and then agencies such as the EPA, OSHA, the FDA, the Department of Agriculture, state governments, and industry. Ten additional policy recommendations are made, covering topics such as the need to harmonize regulation of carcinogens by different agencies, the need to reduce unnecessary medical radiation exposures, the need to address the unequal burden of carcinogenic exposures by vulnerable populations and in high-poverty areas, and support for green chemistry.

PUBLIC HEALTH VIEW

This President's Cancer Panel report reflects the basic attitude and principles of public health, and environmental and occupational health in particular. The concept of primary prevention, or preventing harmful exposures from occurring in the first place, is fundamental to public health. The adage, "an ounce of

prevention is worth a pound of cure" is embedded in the teaching of public health and is implied in the hierarchy of controls practiced in the field of industrial hygiene. It is sometimes noted that the major improvements in population health over the past two centuries have occurred after implementing primary prevention measures such as water disinfection, food hygiene practices, and safe handling of human wastes. The Panel's call for safer alternatives to chemical carcinogens in products and processes is a modern version of the long-standing call for primary prevention that resonates well in the public health community. This is especially pertinent in the United States, where cancer is the second leading cause of death and the most feared disease in the public's mind. The Panel's support for a new chemicals policy parallels similar developments in the European Union (most notably, the Registration, Evaluation, Authorization and Restriction of Chemicals, or REACH[1], and the Paris Appeal[2]) and in Canada.[3]

MEDIA AND PUBLIC RESPONSE

One of the first commentaries on the Panel's report came from Nicholas Kristof in his May 5th *New York Times* column [13]. He noted, among other things, that the "President's Cancer Panel is the Mount Everest of the medical mainstream." He said the report "calls on America to rethink the way we confront cancer, including much more rigorous regulation of chemicals . . . The report blames weak laws, lax enforcement, and fragmented authority, as well as the regulatory presumption that chemicals are safe unless strong evidence emerges to the contrary." Kristof notes that the report addresses bis-phenol A (BPA) as a substance that has "raised alarm bells for decades" and that "the panel's point is that we should be prudent in such situations, rather than recklessly approving chemicals of uncertain effect. The Cancer Panel report will give a boost to Senator Feinstein's efforts [to ban BPA from food and beverage containers]. It may also help the prospects of the Safe Chemicals Act, backed by Senator Frank Lautenberg and several colleagues, to improve the safety of chemicals on the market."

On the same day, the report was publicly attacked by epidemiologist Dr. Michael Thun of the American Cancer Society, by epidemiologist Dr. Graham Colditz, at the Washington University School of Medicine, and by Dr. Elizabeth Whelan, president of the industry-funded American Council on Science and

[1] REACH is the new European Community Regulation on chemicals and their safe use (http://ec.europa.eu/environment/chemicals/reach/reach_intro.htm).

[2] The Paris Appeal was launched in 2004 by the French-based Association for Research and Treatments Against Cancer (http://www.ideaireland.org/parisappeal.htm).

[3] Likewise, the Canadian Cancer Society has issued its own precautionary appeal (http://www.cancer.ca/British%20Columbia-Yukon/Prevention/Environment%20and%20you.aspx?sc_lang=en).

Health. All three critics defended the outdated estimates of the proportion of cancer from occupational and environmental exposures. Colditz explicitly warned that talking about environmental and occupational exposures would distract the public from the important causes of cancer such as smoking, diet, and lack of exercise. This debate was repeated in news stories, editorials, commentaries, radio interviews, and blogs for several weeks following the initial release. Cancer organizations such as the Lung Cancer Alliance and the Breast Cancer Fund praised the report. Medical journals such as *The Lancet*, *JAMA* and the *Journal of the National Cancer Institute* carried brief accounts and commentaries. National media such as *Time*, *USA Today*, *Business Week,* and the Public Broadcasting System ran stories or interviews. Alternative media such as the Huffington Post, the Daily Kos, and In These Times ran longer pieces. Countless local newspapers and organizational blogs carried stories about the report.

Environmental organizations and individuals in the Collaborative on Health and the Environment participated in a May 18, 2010 conference call with Dr. Abby Sandler in which she discussed the main findings and recommendations of the report. She noted that although the Panel and staff are located within and get support from the National Cancer Institute, their reports are advisory to the President and do not necessarily reflect government policy. She said that the Panel itself would not be actively involved in trying to implement the recommendations of the report, because "that's not what they do." The impact of the report will depend on what people in the advocacy community and others make of it. She noted that other reports by the President's Cancer Panel, including the one titled *Translating Research into Cancer Care,* had made a substantial impact, and a previous report on lifestyle factors has provided strong support for tobacco taxes in many states.

The implications of the recommendations of the President's Cancer Panel for chemicals policy reform are clear. The current system under the Toxic Substances Control Act (TSCA), for example, exemplifies the reactionary principle of requiring incontrovertible proof of harm in humans before a chemical can be restricted or banned. It puts the burden on the public, or government agencies, to marshal the evidence, and it has clearly failed in respect to pervasive and persistent chemicals such as BPA and perfluorinated compounds. The precautionary approach recommended by the Panel would instead require acting on early warnings without waiting for incontrovertible proof of harm, putting the burden on the chemical manufacturers to marshal the evidence, supporting more vigorous alternatives assessment and green chemistry, and involving the affected public more deeply in the decision-making process. This would indeed be a paradigm shift for chemicals policy in the United States, and it would parallel efforts in Europe and in some individual states.

At this point, barely a year after its release, it is difficult to judge the overall impact of the report and the subsequent publicity on the overall effort to reform

chemicals policy in the United States. One organization, Health Care Without Harm, issued a news release on July 28, 2010, the day before hearings on the Toxic Chemicals Safety Act of 2010 [14]. In their release, they noted that "Earlier this year, the President's Cancer Panel issued a dire warning about the role chemicals play in the development of some cancers, and called on the president to use the power of his office 'to remove the carcinogens and other toxins from our food, water and air that needlessly increase health care costs, cripple our Nation's productivity, and devastate American lives'" [15]. Although the 111th Congressional session ended without action on the proposed Act, this is the type of statement that will undoubtedly recur in future hearings on chemicals reform bills. In the meantime, progress may continue to be made at the state and local levels. This has been the case in other areas, such as childhood lead poisoning prevention efforts in cities and states in the 1970s, the Massachusetts Toxics Use Reduction Act in the 1980s, and the California Green Chemistry Initiative in the past decade. There are ample opportunities for the President's Cancer Panel 2008–2009 report to provide support for chemicals policy and cancer prevention initiatives at the local and state levels. In addition, several of the individuals and organizations providing input to the President's Cancer Panel have given briefings and testimony in the past year and will continue to urge chemicals policy reform in the coming decade.

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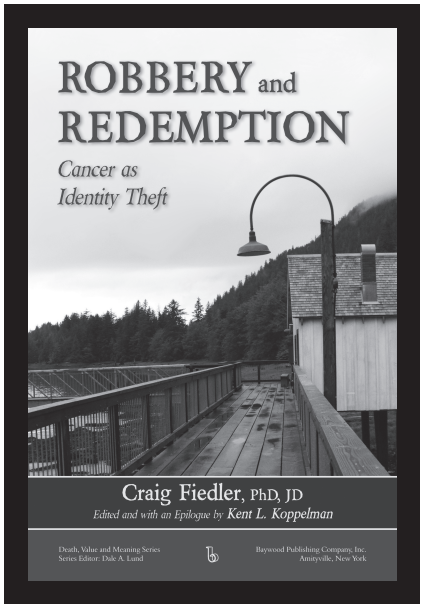

Craig Fiedler wanted to be an advocate for vulnerable people. After earning his law degree he worked in legal services in Appalachia before deciding that he wanted to advocate for people with disabilities. He earned his Ph.D. in special education, then taught about and advocated for this vulnerable population until he was diagnosed with lung cancer. Now he, too, was a vulnerable person, and one of the first challenges he faced was his discovery that those who knew he had cancer perceived him primarily in terms of his disease—he had suddenly lost his identity as professor, lawyer, author, advocate, husband, and father. Craig refused to relinquish that identity, and he used his unique sense of humor and insights gained from his work with special needs people to regain some control over his life, such as his insistence that his doctors view him as a collaborator in his medical care and not as a "victim" of cancer. Craig described his medical care with an eye for detail that people familiar with cancer treatments will readily appreciate. He knew that he would lose the battle with cancer, and in this book he shares the life lessons he learned. Despite the death sentence cancer represented, he could still say: "My cancer has given me FREEDOM I never had." He used that freedom to write this book, and all who read it will be the beneficiaries of the wisdom, humility, and compassion of this extraordinary man.

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HIGHER HAZARD SUBSTANCES UNDER THE MASSACHUSETTS TOXICS USE REDUCTION ACT: LESSONS FROM THE FIRST FOUR YEARS

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HEATHER TENNEY
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ABSTRACT

The Massachusetts Toxics Use Reduction Act (TURA) has achieved significant reductions in toxic chemical use in Massachusetts, using a combination of regulatory and voluntary measures. Historically the program has regulated only users of relatively large quantities of toxic chemicals, with services provided to facilities of all sizes on a voluntary basis. Statutory amendments adopted in 2006 created an authority to designate Higher and Lower Hazard Substances (HHS and LHS). The HHS designation extends TURA program requirements to smaller quantity chemical users. This article reports on experiences from the first four years of implementing this new authority. A case study of trichloroethylene is provided as an example. The article also discusses steps taken to regulate *n*-propyl bromide, a drop-in substitute for TCE that is minimally regulated at the federal level. TURA program experiences may be of interest to other jurisdictions that are working to reach small-quantity chemical users, and to categorize and prioritize chemicals.

Keywords: chemicals, categorization, trichloroethylene, *n*-propyl bromide

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The Massachusetts Toxics Use Reduction Act (TURA), in force since 1990, has achieved significant reductions in toxic chemical use in Massachusetts, using a combination of regulatory and voluntary measures. Toxics use reduction is a form of pollution prevention. It focuses on finding ways to reduce or eliminate the use of toxic substances, avoiding the need for end-of-pipe pollution control or later remediation of contaminated sites.

Under TURA, regulated facilities must pay an annual fee, provide an annual report on toxic chemical use, and conduct toxics use reduction (TUR) planning every two years. A few key environmental policy principles are embodied in TURA. One is the focus on chemical use. Many statutes focus only on chemical emissions; in contrast, TURA requires reporting of all chemical uses, even if there are no emissions outside the facility, on the principle that any toxic chemical use presents a hazard. TURA embodies right-to-know principles by providing public access to information on chemical use at TURA-covered facilities. Another key principle is that TURA works to reduce risk by reducing the use of all inherently hazardous substances, rather than relying on quantitative risk assessment to identify areas for risk reduction. Finally, TURA is grounded in the principle that planning in itself is valuable. While the TUR planning process is mandatory, implementation of TUR options discovered through planning is voluntary.

TURA program activities are implemented by three agencies: the Massachusetts Department of Environmental Protection (MassDEP), the Office of Technical Assistance and Technology (OTA), and the Toxics Use Reduction Institute (TURI). These agencies work in conjunction with an Administrative Council, composed of government agency heads or their representatives; an Advisory Committee, composed of citizen stakeholders; and a Science Advisory Board (SAB) [1].

Historically the program has regulated only medium-sized facilities, although it has provided services to facilities of all sizes on a voluntary basis. This characteristic has been noted as a limitation of the program [2]. The original TURA legislation contained provisions to extend reporting and planning requirements to smaller users in some cases. However, these original provisions were cumbersome and were not implemented.

Statutory amendments adopted in 2006 created a new way for the TURA program to regulate facilities that use smaller amounts of highly toxic chemicals, by creating an authority to designate Higher and Lower Hazard Substances (HHS and LHS). Designating a substance as HHS lowers the threshold for application of TURA program requirements, bringing smaller-quantity chemical users into the program.

The designation of HHS and LHS, and resulting program activities, have yielded a number of important benefits. By bringing smaller-quantity chemical users into the program, the HHS designation has facilitated the program's work with these facilities, which previously could be reached only through

voluntary projects. The program agencies have used the HHS designations as an opportunity to focus and coordinate activities, conducting targeted outreach to stakeholders on these chemicals, analyzing alternatives, and offering a range of services to help facilities reduce the use of these chemicals. The program agencies have also taken the opportunity to assess potential unintended consequences. In particular, the program has undertaken an assessment of substances that could be used as alternatives for HHS, and has taken steps to regulate toxic chemicals that could be used as substitutes for HHS.

Data from the first year of reporting under the HHS designation for one chemical, trichloroethylene, indicate that a significant percentage of total use of HHS in Massachusetts is now occurring among facilities that individually are using smaller amounts of these chemicals. This finding confirms that extending program requirements to facilities using smaller amounts of chemicals is essential in order to achieve the broader goal of protecting health and the environment by reducing the use of toxic chemicals.

This article describes the history and goals of the creation of this new authority under the TURA program, summarizes activities the program has undertaken in the first four years, and evaluates results to date. The experience of the first few years of implementation supports the view that these designations, and associated program activities, are essential to continued progress in reducing toxic chemical use in Massachusetts.

SCOPE OF TURA PRIOR TO THE 2006 AMENDMENTS

The chemicals that are reportable under TURA are identified in a list of Toxic or Hazardous Substances. This list was originally created by combining two federal lists: the chemicals reportable under the Toxics Release Inventory (TRI) created by the Emergency Planning and Community Right-to-Know Act (EPCRA 313), and the chemicals listed under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA). The TURA program has modified the list over time by adding and removing chemicals.

TURA requirements apply to facilities that are in specified sectors, have 10 or more full-time employee equivalents (FTEs), and use a listed chemical at or above a specified quantity. For most chemicals, the quantity threshold is 25,000 lbs/yr for facilities that manufacture or process a chemical, and 10,000 lbs/yr for facilities that "otherwise use" a chemical (i.e., use a chemical in a way that does not lead to its inclusion in the final product; for example, as a cleaning agent). The thresholds for chemicals defined within TRI as persistent, bioaccumulative, and toxic (TRI PBTs) are lower [3]. As shown in Table 1, the thresholds are either 10 lbs/year or 100 lbs/year for most TRI PBTs, depending on the chemical, and 0.1 grams per year for dioxin [4].

Table 1. Reporting Thresholds for TRI/PBTs

Chemicals	Reporting threshold
Polycyclic aromatic compounds (PACs); lead; lead compounds	100 lbs.
Benzo(g,h,i) perylene; mercury; mercury compounds; polychlorinated biphenyls (PCBs)	10 lbs.
Dioxin and dioxin-like compounds	0.1 grams

Prior to the 2006 amendments, for all non-PBT chemicals, facilities manufacturing or processing less than 25,000 pounds of a listed chemical per year, or "otherwise using" less than 10,000 pounds, were completely outside the scope of TURA requirements. This meant that the TURA program had no regulatory option to address a potentially significant portion of chemical use in the state.

Creation of the More and Less Hazardous Chemical Lists

In the late 1990s, a consensus emerged within the TURA program and the regulated community that it would be helpful to divide the TURA list into categories, distinguishing among chemicals by level of toxicity. There were at least two distinct motivations for this effort.

One motivation was the increasing recognition that certain chemicals were of particularly grave concern and required focused attention. A second motivation was that the SAB wanted to take a more nuanced approach to its consideration of de-listing petitions. Industry representatives had requested the de-listing of a number of chemicals from the TURA list. Advocates of de-listing argued that certain chemicals should be removed from the TURA list because they were clearly less toxic than others. Although there were differences of opinion on whether these chemicals should be de-listed, there was broad agreement that it would be helpful to distinguish them from chemicals of higher concern. Categorizing the list helped the SAB to differentiate between chemicals that warranted removal from the list and those that, in the SAB's opinion, should be retained despite being less hazardous than other chemicals on the list.

In this context, the TURA program decided to create an informational categorization of chemicals. In 1999, the SAB created three categories within TURA's larger list of Toxic or Hazardous Substances: "more hazardous

chemicals," "less hazardous chemicals," and all remaining chemicals (designated "uncategorized"). All the chemicals on the TURA list have now been reviewed and placed in one of these three groups. This initial categorization was created strictly as a guide to help industry in making decisions. It had no regulatory implications. It continues to be maintained as an informational resource for companies. There are currently 90 "more hazardous chemicals" and 23 "less hazardous chemicals," out of the larger list of 1,300 chemicals and chemical categories that are reportable under TURA [5].

STATUTORY AUTHORITY TO CATEGORIZE CHEMICALS: HIGHER AND LOWER HAZARD SUBSTANCE DESIGNATIONS

The 2006 amendments created a regulatory category of Higher Hazard Substances (HHS, corresponding to the informational category of "more hazardous chemicals") and Lower Hazard Substances (LHS, corresponding to the informational category of "less hazardous chemicals.")

Goals of the Amendments

In writing the statutory amendments that created the authority to designate higher- and lower-hazard substances, policymakers had two broad goals:

1. *Formalize the distinctions among toxic chemicals created by the informational lists, and introduce incentives for substitution.* Categorizing chemicals by hazard level helps to guide industry toward safer options, and can be used as the basis for developing both positive and negative incentives to motivate industry to shift from more toxic to less toxic chemicals.
2. *Extend TURA program reporting and planning requirements to smaller users.* Extending TURA program reporting requirements to smaller users makes it possible to determine where chemicals of high concern are being used. It also requires smaller users to conduct planning, which facilitates the identification of practical options to reduce their use of these chemicals, and motivates these users to make use of technical assistance, grants, and other services provided by the TURA program. As a result, the benefits of toxics use reduction planning and implementation, already documented among larger users, can be extended more effectively to these smaller users.

Provisions of the Amendments

For HHS, the threshold for the TURA requirements drops to 1,000 lbs/yr. In addition, the TURA program may raise the per-chemical fee charged to facilities that use these substances. For LHS, the amendments provide for a fee

reduction,[1] creating a small financial incentive for facilities to adopt LHS as substitutes for HHS or uncategorized chemicals.

The amendments create the authority to designate up to 10 HHS and 10 LHS each year. Chemicals proposed for these designations must be drawn first from the existing informational lists of "more hazardous chemicals" and "less hazardous chemicals," respectively.

Process Overview: How HHS and LHS are Designated

The process of designating HHS and LHS is defined in general terms by the statute, but has been refined by program staff in the course of implementation.

The SAB, using scientific information compiled by staff members at the Toxics Use Reduction Institute, proposes a subset of chemicals from its existing "more hazardous" and "less hazardous" lists for possible designation as HHS or LHS, respectively.

The implementing agencies then review the list of chemicals proposed by the SAB in order to select priorities. The agencies may take account of considerations such as the number of facilities expected to be affected by the designation and the program's ability to offer useful services to help facilities reduce use of the chemical.

The Institute, in consultation with OTA and MassDEP, prepares a detailed policy analysis for each selected substance. The policy analysis includes a discussion of the science considered by the SAB; trends in the use of the substance by TURA filers; how the chemical is regulated at the state, federal, and/or international levels; what opportunities exist for toxics use reduction; and what challenges are likely to be faced by facilities working to reduce or eliminate their use of the chemical. It also includes an estimate of the number of facilities likely to be brought into the program through the lower chemical quantity threshold, and potential unintended consequences that could result from the designation.

This policy analysis is presented to the TURA Advisory Committee, whose members provide additional information based on their expertise, and pose additional questions for research. Finally, the Institute, in consultation with MassDEP and OTA, brings a recommendation to the TURA Administrative Council, which decides through a vote whether to designate a HHS or LHS. If the Council votes in favor of a designation, a regulatory process follows (draft regulations, comment period, and final regulations). Figure 1 shows the TURA decision-making process in schematic form.

[1] All fees paid under TURA are calculated as the sum of a base fee plus an $1100 per-chemical fee, not to exceed a set maximum based on facility size. The LHS designation eliminates the per-chemical fee for the chemical in question. It does not affect the base fee.

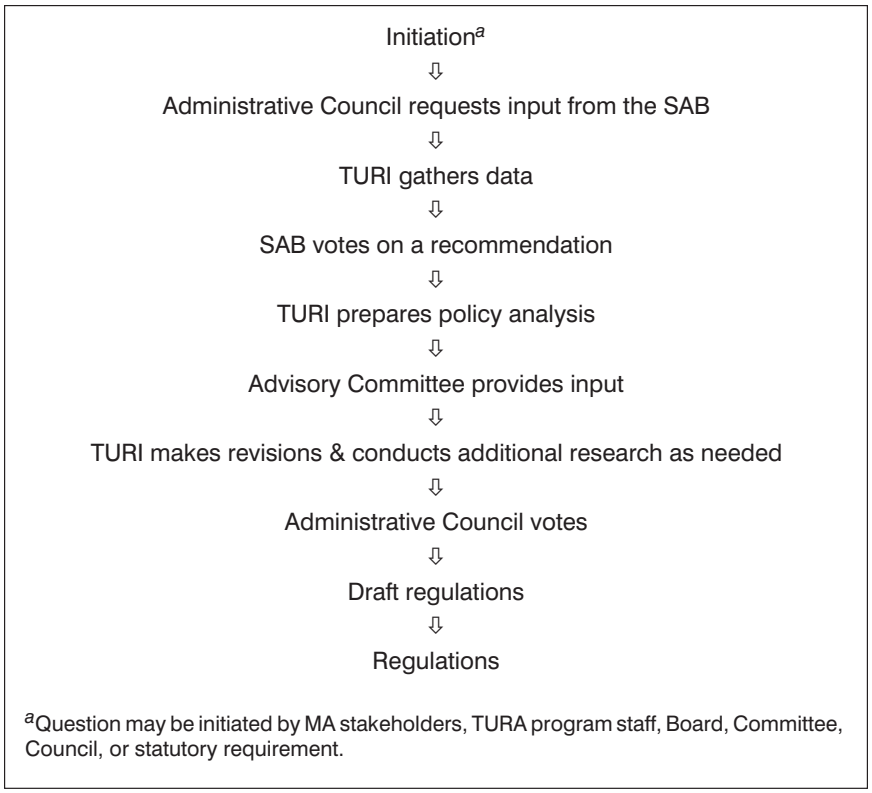

Figure 1. TURA decision-making process.
Source: Toxics Use Reduction Institute, *Decision Making Under TURA: Process Overview and Reference Guide* (Toxics Use Reduction Institute Methods and Policy Report #28, December 2010).

THE FIRST FOUR YEARS: DESIGNATION OF FOUR HHS AND TEN LHS

The amendments provided for automatic designation of the TRI PBTs as HHS. This designation was effective for the 2007 reporting year. It had no immediate practical implications for Massachusetts facilities, because these chemicals were already reportable at lower thresholds, and the program has not yet taken action to raise fees for HHS.

Going beyond these automatic designations, in 2007 the SAB recommended 11 potential HHS and 10 potential LHS. The HHS were selected on the basis of high concern and the SAB members' professional judgment that they were a high priority from a hazard perspective.

The implementing agencies, in consultation with the Advisory Committee and Administrative Council, then selected a smaller number of chemicals from within this list, and completed the designation process according to the decision-making steps outlined above. As shown in Table 2, in 2007 the program designated three HHS (trichloroethylene, cadmium, and cadmium compounds). In 2008, the program designated one HHS (perchloroethylene) and three LHS (iso-butyl, sec-butyl, and n-butyl, alcohol). In 2009, the program designated seven LHS and no HHS. In 2010, the program reviewed a possible HHS designation for formaldehyde, but deferred decision-making until 2011. In 2011, the TURA Administrative Council voted to separate hexavalent chromium compounds from the larger Chromium Compounds category, and to designate hexavalent chromium compounds as HHS. The Council also voted to designate formaldehyde as a HHS. Draft regulations incorporating these decisions are expected to be promulgated later in 2011.

Table 2. HHS and LHS Designations, 2007-2010[a]

Chemical	Year regulations adopted	Year requirements are effective
HHS		
TRI PBTs	2006 (Automatic)	No new requirements
Trichloroethylene	2007	Reporting[b]: 2008; planning: 2010
Cadmium	2007	Reporting: 2008; planning: 2010
Cadmium compounds	2007	Reporting: 2008; planning: 2010
Perchloroethylene	2008	Reporting: 2009; planning: 2012
LHS		
Isobuyl alcohol	2007	2008
See-butyl alcohol	2007	2008
n-butyl alcohol	2007	2008
Butyl acetate	2009	2010
Isobutyl acetate	2009	2010
Ferric chloride	2009	2010
Ferric sulfate	2009	2010
Ferrous chloride	2009	2010
Ferrous sulfate (heptahydrate)	2009	2010
Ferrous sulfate	2009	2010

[a]Reporting requirements are effective the year after regulations are adopted to designate a HHS. Planning requirements go into effect later. Designations shown in this table are current as of December 2010.

[b]Reports are submitted in July of the following year (e.g., July 2009 for reporting year 2008).

For chemicals designated as HHS, reporting requirements are effective the year after regulations are adopted, and planning requirements are effective later. (Because planning occurs on a two-year cycle, the timing is variable. If regulations are adopted in an even-numbered year, planning is required two years later. If regulations are adopted in an odd-numbered year, planning is not required until three years later.)

CASE STUDY: TRICHLOROETHYLENE (TCE)

Trichloroethylene (TCE) is a solvent used in a range of industries, including electroplating, metal products, machinery manufacturing and repair; paper, pulp, and rubber manufacture; semiconductor production; and auto maintenance; as well as in some consumer products and pesticides [6].

TCE poses significant and well-understood hazards to human health and the environment [6]. The TURA program, like many other pollution prevention programs in the United States and around the world, has worked steadily to help facilities reduce or eliminate their use of TCE in a wide range of applications. The TURA program selected it as one of the first chemicals considered for HHS designation in part because significant progress has been made in reducing TCE use among large companies, and there may be ample opportunity to prompt similar progress by smaller facilities. The TURA program did not know how many facilities might be using TCE below the existing use thresholds, but suspected that the number might be significant.

To make a decision about designating TCE as a HHS, the TURA program analyzed existing scientific, regulatory, and technical information about TCE; estimated the number of facilities likely to be using TCE above the 1,000-pound annual use threshold; and analyzed opportunities available for TCE users to reduce or eliminate TCE use.

Background on TCE

TCE is subject to multiple federal regulations, including reporting requirements under the Toxics Release Inventory; classification as a hazardous substance under the Clean Water Act; regulation as a Hazardous Air Pollutant under the Clean Air Act; and regulation as hazardous waste under the Resource Conservation and Recovery Act [6–9]. Some states have taken active steps to regulate TCE more stringently. California regulates TCE as a carcinogen under its Safe Drinking Water and Toxics Enforcement Act of 1986 (Proposition 65), and prohibits the sale and use of automotive repair products including TCE or certain other toxic chlorinated solvents [6, 10–11]. TCE is treated as a priority chemical internationally as well, and is banned for use professionally and in consumer products in Sweden [12].

There are many ways to reduce or eliminate the use of TCE. For cleaning applications, options include aqueous and semi-aqueous systems; nonchlorinated solvent systems; mechanical cleaning processes; and emerging technologies such as laser cleaning. In some cases, firms can eliminate the need for cleaning/degreasing entirely by redesigning the production process. For adhesive formulations, alternatives to TCE include terpenes, water-based adhesives, and solid adhesives. Many alternatives are available for use in paints as well [6].

Trends in TCE Use in Massachusetts

Responding both to regulations and to the availability of extensive technical assistance, facilities regulated under TURA have reduced their TCE use significantly over time. There was a 90 percent reduction in TCE use by the core group of industries that were in the TURA program over the period 1990–2005.[2] The TURA program also tracks a core group that has met TURA reporting requirements since 2000. This group reduced TCE use by 70 percent over the period 2000–2007. By 2007, just nine facilities were reporting TCE use under TURA. Trends in TCE use over time are shown in Table 3.

The First Year of HHS Reporting: Information about Smaller TCE Users

Based on experiences of TURA program staff, the TURA program had reason to believe that there was continuing TCE use below existing thresholds at a number of facilities, and that this TCE use was associated with significant occupational exposures. However, prior to the HHS designation, TURA lacked data on uses below 25,000 lbs/yr for manufacturing or processing, or 10,000 lbs/yr for otherwise using TCE. This information became available for the first time when facilities submitted their reports for 2008, the first year in which TCE was reportable as a HHS.

In 2008, 20 facilities entered the program under the new, lower reporting threshold of 1,000 lbs/yr. Two of these filers were completely new to the program. The rest either had been in the program at some point in the past, or were currently subject to filing requirements for other chemicals [4]. Table 4 provides information on these facilities by sector.

TURA filers reported using a total of 563,073 pounds of TCE in 2008. Of this amount, 117,380 pounds was reported by the facilities that entered the program due to the new reporting threshold. Thus, these facilities accounted for nearly 25 percent of the total amount of TCE reported in 2008. This finding confirms the TURA program's hypothesis that by 2008, a significant portion of TCE use in the state was occurring below the previously existing thresholds.

[2] This is an absolute reduction, not a production-adjusted reduction.

Table 3. Trends in TCE Use, 2000–2008

Reporting year	Trichloroethylene (lbs)
2000	1,742,305
2001	1,393,981
2002	1,234,011
2003	1,052,806
2004	1,085,571
2005	834,462
2006	770,538
2007	604,671
2008	536,073[a]

[a]117,380 pounds due to lower reporting threshold.

The majority of the facilities that reported TCE use were in the "otherwise use" category, indicating that they are likely to be using TCE in cleaning applications. Since the alternatives to TCE use in cleaning are well understood, this finding also indicates that there are significant opportunities to assist these facilities in shifting to safer alternatives.

AFTER HHS DESIGNATION: TURA PROGRAM SERVICES FOR HHS USERS

After designating a chemical as HHS, the TURA program uses a variety of industry and government databases, as well as outreach through industry and government communication channels, to identify facilities that need to be informed about the designation, and to provide services to help facilities reduce or eliminate their use of the HHS. Program services include on-site technical assistance; laboratory assistance; grants to Massachusetts facilities; demonstration sites showcasing toxics use reduction innovations at individual facilities; publications and information resources; sponsorship of university research; research conducted by TURA program staff members; and programs facilitating information flow up and down industry supply chains. Examples of some of these activities are shown in Table 5.

Table 4. Facilities Reporting TCE Due to the 1,000-Pound Threshold in 2008

SIC code – industrial sector	Number of facilities reporting due to 1,000 lb threshold in 2008	Use category
2899 Chemicals and chemical preparations	1	Processed
3086 Plastics foam products	1	Processed
5169 Chemicals and allied products – wholesale	1	Processed
3471 Plating, polishing & 3479 metal coating	7	Otherwise used
3823 Process control instruments	2	Otherwise used
34xx Fabricated metal	2	Otherwise used
2834 Pharmaceutical preparations	1	Otherwise used
3089 Plastic products NEC	1	Otherwise used
3264 Porcelain electrical supplies	1	Otherwise used
3624 Carbon and graphite products	1	Otherwise used
3931 Musical instruments	1	Otherwise used
3993 Signs and advertising specialties	1	Otherwise used

ADDITIONAL POLICY IMPLICATIONS OF HHS DESIGNATIONS: REGULATING *N*-PROPYL BROMIDE AND OTHER ALTERNATIVES TO HHS

In regulating toxic chemicals, it is important to avoid a situation in which facilities unknowingly shift to less regulated alternatives that pose equally serious hazards. A number of efforts to regulate toxic chemicals of high concern have produced unintended consequences in which businesses shifted to chemicals with equally significant adverse effects [13–15].

Table 5. TURA Program Services for HHS Users

Services	Examples
On-site technical assistance	On-site technical assistance provided to facilities using trichloroethylene[a]
Laboratory assistance	TURI's Surface Solutions Cleaning Laboratory provides services to TCE users on an on-going basis, helping to identify and test application-specific alternatives.
Grants	Grants provided to dry cleaning facilities to demonstrate successful elimination of perchloroethylene (one per year, 2008-2011).
	Grants offered to facilities switching from vapor degreasing with TCE to an aqueous cleaning system.
Demonstration sites	Each grant recipient also serves as a demonstration site, providing training for other facilities in the sector.
Publications, research, and information resources	TURI published an updated fact sheet on trichloroethylene in 2008.
	TURI will produce a fact sheet on nPB (a drop-in substitute for TCE and PCE) in early 2011.
	TURI's Surface Solutions Cleaning Laboratory maintains an online Cleaner Solutions database that facilities can search for process-specific chemical substitutes.
Research	Prior to the HHS designation, OTA published a report on barriers to TCE reductions, identifying obstacles to switching away from TCE.
Supply chain coordination	The TURA program plans to initiate work in 2011 to help facilities communicate with customers, including the U.S. military, whose specifications require continued use of TCE.

[a]Since TCE was made a HHS, OTA has visited and developed recommendations for 18 facilities using TCE.

The chemicals that have been the focus of the TURA program's first efforts at designating higher-hazard substances are no exception. In particular, there is growing concern nationwide that many facilities are replacing chlorinated solvents, such as TCE and perchloroethylene (PCE), with *n*-propyl bromide (nPB, also known as 1-bromopropane). TCE and PCE are both regulated as hazardous air pollutants under the Clean Air Act, among many other regulations at the national level; nPB, in contrast, is not regulated at the federal level, although it is regulated by some states.[3] nPB does, however, pose significant health concerns, including reproductive toxicity, neurotoxicity, and potentially carcinogenicity [16–19].

As part of the analysis surrounding the designation of TCE and PCE as higher-hazard substances, the TURA program identified nPB as a significant concern. From field work and site visits, TURA program staff members were aware that many facilities were already shifting from these chlorinated solvents to nPB. nPB was a drop-in replacement, requiring no change in technology, and was largely unregulated. Facilities were unlikely to know, based on government regulation, that nPB was a significant concern. Furthermore, even if they were aware of these concerns from their own research, there was still an incentive to shift to nPB because it was minimally regulated.

In order to discourage substitutions of this kind, the TURA program added nPB to its list of Toxic or Hazardous Substances in 2009. Starting in reporting year 2010, facilities in TURA-covered sectors processing or manufacturing nPB in quantities of 25,000 pounds or more, or otherwise using nPB in quantities of 10,000 pounds or more, are subject to TURA reporting, planning, and fee requirements. Based on the available data, the TURA Science Advisory Board did not categorize nPB as "more hazardous"; however, its categorization could be changed in the future if warranted by emerging data.

In addition to adding nPB to the TURA list, TURA staff members are reaching out actively to facilities that are using or may be considering use of nPB, and the TURA program has developed additional educational materials on nPB.

Moving beyond the example of nPB, the Institute has undertaken to establish a process to promote the adoption of safer alternatives to HHS more generally, by conducting a detailed analysis of the environmental health and safety profiles of other chemicals that could potentially serve as substitutes for HHS. There are many possible alternatives for TCE, and the SAB is currently in the process of reviewing the science on several classes of chemicals to determine whether any additional substances warrant addition to the TURA list.

[3] nPB is on California's Proposition 65 list, and on Pennsylvania's Hazardous Substances List.

PRIORITY USER SEGMENTS: A REGULATORY TOOL FOR REACHING THE SMALLEST FACILITIES

In addition to creating the HHS and LHS designation authority, the 2006 amendments updated a provision of TURA that had not previously been used: the authority to designate Priority User Segments (PrUS).[4] A PrUS is a production process that uses a higher-hazard substance and that the program believes deserves special attention. Designation of a PrUS has several important results. Among them, the 10-FTE threshold is eliminated, so that facilities with any number of employees can be covered by TURA requirements if they use regulated chemicals in above-threshold quantities. In addition, facilities can be required to submit supplemental data; and MassDEP "may set performance standards for priority user segments."

Under the amendments, a Priority User Segment can be designated only for a chemical that has been designated as a HHS. The statute allows the state a maximum of four years within which to complete the Priority User Segment designation.

The program has not yet designated a Priority User Segment. In 2010, the Office of Technical Assistance, which has primary responsibility for providing recommendations to the Administrative Council on implementation of the Priority User Segment provisions, evaluated the TRI PBTs to determine whether any should be considered for this designation. OTA found that due to statutory limitations, TURA could not reach the uses of greatest concern, even with the PrUS designation. For example, TURA covers only certain industrial codes (leaving out municipalities, schools, hospitals, and many commercial operations such as shooting ranges). For this reason, OTA recommended against designation of PrUS for these substances, and recommended instead that other policy options be considered to address the PBT uses of concern [20].

The program will consider trichloroethylene, cadmium, and cadmium compounds next for possible Priority User Segment designation. Since they were designated as HHS in calendar year 2007 and the designation went into effect for reporting year 2008, the Priority User Segment designation would have to be completed in calendar year 2011, taking effect in 2012.

NUMBER OF DESIGNATIONS PER YEAR: A STRATEGIC DECISION

One of the strategic decisions the program needed to make in embarking on implementation of the HHS and LHS substance designations was the pace at

[4] Prior to 2006, the statute provided for designating PrUS but not for designating HHS. The amendments introduced the authority to designate HHS, and linked the HHS designation with the PrUS designation. Under the 2006 amendments, a PrUS can be designated only for a process that involves use of a HHS.

which to pursue the designations. The program has statutory authority to designate up to 10 in each category per year.

However, there were several reasons to move more slowly. First, the program decided to conduct a detailed analysis of each chemical before proposing it for designation as a HHS. This research was a rate-limiting factor because each designation required significant staff time. Second, the program made a judgment that given limited total program resources, it would make sense to focus on a smaller number of higher-hazard substances and provide as much intensive assistance to facilities as possible for that substance. Third, there is a limit of four years within which to designate a priority user segment after designating a HHS. Thus, it could have been counterproductive to designate a large number of HHS at once because it might then have been impossible to conduct the necessary analysis within the required time frame for possible designation of priority user segments.

CHEMICAL CATEGORIZATION AND PRIORITIZATION: THE MASSACHUSETTS EFFORT IN CONTEXT

The adoption of the 2006 amendments to TURA, and the first years of implementation of the new authorities created by these amendments, have been contemporaneous with efforts to categorize and prioritize chemicals in a number of jurisdictions. Canada conducted a multi-year effort to categorize and prioritize all chemicals on the market in Canada, culminating with the identification of approximately 4,000 high-priority chemicals for which additional regulatory action would be considered. REACH, the European Union's comprehensive regulatory structure for chemicals, adopted in 2007, creates a process for designating substances that are subject to authorization requirements. In the years since REACH was adopted, the EU has been developing a list of candidate substances that may become subject to authorization requirements. At the federal level in the United States, proposed legislation to reform the Toxic Substances Control Act includes provisions related to categorization and prioritization of chemicals. At the state level, Maine, Washington, and California have adopted laws providing for the categorization and prioritization of chemicals used in consumer products.

Each jurisdiction has undertaken the categorization and prioritization effort in the context of specific goals, and the processes have varied considerably. The Canadian process systematically reviewed every chemical on the market. The Maine and Washington processes drew upon the results of other jurisdictions' efforts to build lists of high-priority chemicals, with a focus on those that might be found in children's products.

The Massachusetts process of categorizing chemicals (originally into the informational "more hazardous chemicals" and "less hazardous chemicals" lists, later into the regulatory Higher Hazard Substance and Lower Hazard Substance lists) is not exhaustive. The Massachusetts process began with the

existing list of Toxic or Hazardous Substances and developed hazard subcategories within it. In contrast, the Canadian process, for example, included a review of all chemicals on the market regardless of existing information about their toxicity. The informational lists developed as a result of this work may be useful to other states seeking to create similar lists, and can be used in combination with the results of categorization efforts in other jurisdictions. In addition, the modified Delphi process used by the TURA program's Science Advisory Board in its categorization work may be a useful model for other states undertaking similar efforts.

The process of adding chemicals to the regulatory Higher Hazard and Lower Hazard Substance lists has been slow, reflecting the TURA program's decision to conduct significant analysis for each substance prior to designation. As a result, the current Higher Hazard Substances list is not comprehensive, but rather includes a small number of chemicals that have been selected for early attention based on implementation opportunities as well as scientific considerations.

It is also important to note that the Massachusetts process has simultaneously pursued two goals, which are only loosely connected with one another. One goal is to categorize and prioritize chemicals. The other goal is to lower the reporting threshold for selected chemicals, in order to extend the reach of the TURA program. In this way, the Massachusetts effort differs from efforts that are focused purely on categorization and prioritization, such as the Canadian effort.

The Massachusetts effort differs from the categorization and prioritization efforts in Maine and Washington because TURA program regulations apply only to industrial facilities. The Maine and Washington categorization and prioritiza\tion efforts, in contrast, are focused primarily on regulation of consumer products.

The HHS list itself has also been useful beyond Massachusetts. For example, amendments adopted in 2010 to Maine's Toxics Use and Hazardous Waste Reduction law require Maine to develop a list of priority toxic chemicals by July 1, 2011. Starting in July 2013, users of more than 1,000 lbs/yr will be required to file reports and conduct pollution prevention planning. The amendments require that Maine consider the Massachusetts list of higher hazard substances, among other sources, in developing its own list of priority toxic chemicals [21].

Categorization and prioritization efforts are also relevant for the TURA program's work in the area of alternatives assessment. Many TURA program services are focused on helping companies not only to reduce or eliminate their use of hazardous chemicals, but also to make well-informed choices about what chemicals or processes to adopt instead. The theme of identifying alternatives that are both viable and safer runs through many TURA program activities. These range from one-on-one laboratory assistance helping facilities to identify safer cleaning solutions, to publication of formal alternatives assessment studies that provide a systematic review of a wide range of alternatives to a specific toxic chemical for a specific application.

At least in principle, chemical categorization has the potential to play a key role in helping companies to make wise decisions about chemical use. A categorization that identifies chemicals that are safer has the potential to help companies choose those chemicals in production decisions up front, avoiding difficulties later. Within the Massachusetts list, chemicals categorized as LHS are considered a better choice than those designated as HHS or those that are uncategorized, although all the chemicals on the list are toxic or hazardous. Massachusetts has not, however, taken the additional step of identifying safer chemicals that are not on the list of Toxic or Hazardous Substances.

CONCLUSIONS

Over the period 2007–2010, Massachusetts has worked to implement the new authorities created by the amendments to TURA adopted in 2006, including the authority to designate HHS and LHS. It is too early to assess the program's success in encouraging smaller users of HHS to reduce or eliminate their use of these toxic chemicals. As of December 2010, just two years of reporting data are available for smaller users of TCE and cadmium, and only one year of data is available for smaller users of PCE. However, the designation process has already produced important results.

As shown in the case study of TCE, chemical use reporting under the HHS for TCE has shown that, in fact, at least a quarter of total TCE use is occurring in quantities that were previously under the radar of the TURA program. Preliminary results for perchloroethylene indicate that an even larger portion of PCE use is occurring at small facilities. Similar findings are likely for other HHS going forward.

The HHS designation has drawn additional attention to chemicals of high concern and brought additional facilities into the regulatory sphere of the TURA program. As smaller HHS users become subject to TURA program requirements, there are greater opportunities for the program to learn how the HHS are being used and to provide targeted program services to encourage toxics use reduction. The HHS designation process has also led to other important policy activities, in particular the focus on safer alternatives and further analysis of other chemicals that could be used as alternatives to substances designated as HHS.

There are many open questions about how program activities will unfold in the years ahead. It remains to be seen whether the TURA program will continue to designate one or two HHS per year, or whether the pace will accelerate or slow. It also remains to be seen whether fees will be raised for HHS, and whether the program will take the step of designating one or more priority user segments. However, within the first years of implementation, it is already clear that the authority to designate HHS, and the accompanying program services, are key to continued progress in reducing the use of toxic chemicals in Massachusetts.

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SUBSTITUTION FOR HAZARDOUS CHEMICALS ON AN INTERNATIONAL LEVEL—THE APPROACH OF THE EUROPEAN PROJECT "SUBSPORT"

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ABSTRACT

The systematic description and promotion of substitution options and processes is an underdeveloped and often missing element in chemical management and chemical policy discussions. This article describes major barriers and drivers for substitution, and concludes that more specific information can be an essential instrument to overcome those barriers. It also explains the development and features of a large information tool under development called SUBSPORT, an abbreviation for Substitution Support Portal. SUBSPORT is a three-year European project which aims at providing authorities, industry, and stakeholders with information on alternatives for the effective substitution of hazardous chemicals. It will help companies meet the substitution requirements expressed in national, European Union, and international legislation. SUBSPORT will make information available in four languages.

Keywords: substitution, hazardous chemicals, support portal

Substitution is a preferred risk reduction strategy in environmental policy and in workers' health and safety legislation. Replacing harmful substances and

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processes with less harmful ones or with nonchemical alternatives is widely acknowledged as a very effective strategy to reduce, minimize, or even eliminate risks. Additionally, substitution of dangerous chemicals with less dangerous ones is recognized as an optimal way to overcome the difficulties of complex chemicals regulations.

The Substitution Support Portal or SUBSPORT, is an information tool planned and initiated by a group of university, nonprofit, for-profit, and government institutions that provide substitution support and guidance: Kooperationsstelle Hamburg IFE (Germany), ISTAS (Spain), Chemsec (Sweden and international), and Grontmij (Denmark) with the support of the Lowell Center for Sustainable Production (United States). The idea behind this three-year project was to compile practical experiences in the promotion and support of substitution and to join efforts in the creation of a portal to help companies, governments, workers, and consumers overcome challenges to substitution, as well as providing practical information that would cover as many sectors and hazardous chemical applications as possible.

DEFINING SUBSTITUTION

An understanding of the SUBSPORT Project and its objectives requires a broad understanding of the concept of substitution and the ways in which its key factors have been defined. The term "substitution" is used in legal documents, but without precise definition in its practical and political sense. The perceptions of different stakeholders vary widely, especially regarding the issue of whether substitution should be a "fundamental principle," a "duty to both manufacturers and users," a "preferred risk reduction strategy," or "just another tool for managing the same level of risk."

Some examples of definitions by different stakeholders illustrate this inconsistency. The European Chemical Industry Association (CEFIC) regards substitution as "the replacement of one substance by another with the aim of achieving a lower level of risk" [1]. CEFIC's focus is on controlling risk and not on reducing the intrinsic hazards of a substance. According to this notion, substitution is not a preferred risk reduction strategy but only one strategy of equal standing among many others, such as technical and organizational solutions, including the personal protection of exposed individuals. Chemical enterprises follow this conceptual approach. For example, the chemical company BASF states on its website that "substitution is one option among others of controlling human health and environmental risks. BASF applies substitution as part of its product stewardship policy and Responsible Care® commitment" [2].

The views of the international advocacy group Greenpeace on substitution are significantly different from those of the chemical industry and are much more

focused on eliminating hazards and on systematic replacement of all hazardous chemicals. The organization notes: "The Principle of Substitution states that hazardous chemicals should be systematically substituted by less hazardous alternatives or preferably alternatives for which no hazards can be identified" [3]. This statement indicates that this nongovernmental organization's (NGOs) trust in risk reduction measures other than replacement of hazardous chemicals is low; its political goal is elimination of hazards at the source by the transition to safer alternatives.

It is noteworthy that most political and legal definitions of substitution combine aspects of both hazard elimination and risk reduction. The European Parliament defines the substitution principle as: "the promotion of safer practices and substances," that is, both the handling ("practices" that achieve risk reduction) and the hazards caused by the intrinsic properties of a substance ("substances") shall be reduced [4]. A similar approach is used in the Swedish Environmental Code, which defines substitution as the replacement of hazardous substances. It states that:

> Persons who pursue an activity or take a measure, or intend to do so, shall avoid using or selling chemical products or biotechnical organisms that may involve risks to human health or the environment if products or organisms that are assumed to be less dangerous can be used instead [5].

Over time, the terms "hazard" and "risk" have been replaced by the more neutral term "concern" in legal and scientific definitions of substitution. Charlie Auer, former director of the U.S. Environmental Protection Agency's Office of Pollution Prevention and Toxics, offered this formulation in 2006: "Informed substitution is the considered transition from a chemical of particular concern to safer chemicals or non-chemical alternatives" [6].

Meanwhile, significant European chemical legislation like the Registration, Evaluation and Authorization of Chemicals (REACH) also uses the term "concern" and leaves open the interpretation of whether the "concern" should be reduced by risk reduction or hazard elimination measures (substitution). Preamble 12 of the REACH legislation expresses it this way: "An important objective of the new system to be established by this Regulation is to encourage and in certain cases to ensure that substances of high concern are eventually replaced by less dangerous substances or technologies where suitable economically and technically viable alternatives are available" [7].

Finally, some scientists have added to this definition that the process of substitution needs to achieve a functional equivalent for the replaced substance. In 2003 Joachim Lohse and Lothar Lissner defined substitution as "the replacement or reduction of hazardous substances in products and processes by less hazardous or non-hazardous substances, or by achieving an equivalent functionality via technological or organisational measures" [8].

SUBSPORT considers substitution as a primary measure to reduce risks arising from the use of dangerous chemicals in products and processes. Substitution can support risk reduction for the environment, workers, consumers, and public health. Substitution can be accomplished by the use of an alternative, less hazardous substance as well as through changes to technologies that eliminate the need for hazardous chemicals. We do not consider the reduction of exposures to dangerous substances—for example, by means of protective or containment measures like extraction or waste water treatment plants—to be substitution.

Despite the various definitions and the different levels of support for the concept among stakeholders, there is a common understanding that substitution can be used to reduce chemical concerns through the replacement of hazardous chemicals or through technology change. However, there are still barriers to the effective implementation of the concept. The key question is therefore how to integrate the concept into chemicals management frameworks and make it operational for chemical manufacturers and users. First, we examine how substitution is treated in legal frameworks.

SUBSTITUTION IN CHEMICALS REGULATION FRAMEWORKS

Substitution requirements are common in international, European, and national chemicals legislation [9]. Selected international and European legislation illustrates the variety of approaches toward substitution. At the international level, several agreements on chemicals include substitution requirements. The Stockholm Convention on Persistent Organic Pollutants (POPs) aims at eliminating and phasing out the most hazardous POPs to protect human health and the environment from the impacts of these chemicals. To do so, it establishes the requirement to use substitute or modified materials, products, and processes to prevent the formation and release of POPs. The Persistent Organic Pollutants Review Committee (POPRC) is in charge of reviewing chemicals proposed to be included in this Convention. The POPRC must carry out risk management evaluations of substances, which includes an evaluation of alternatives [10].

The Rotterdam Convention specifies reduction targets for volatile organic chemical (VOC) emissions from stationary and mobile sources and suggests measures to be applied, including substitution of hazardous substances by other chemicals or by different technologies. Some examples of specific sectors and products where substitution may be considered are presented, but examples of substitution are not provided [11]. By requiring the phase-out and elimination of specified ozone depleting substances, the Montreal Protocol stimulated the search for substitute substances and technologies. All parties have to describe their strategies and plans to comply with the provisions, targets, and schedules of the Protocol, while collaborating in finding safer alternatives and making them generally available [12].

The Strategic Approach to International Chemicals Management (SAICM), a United Nations policy framework to promote chemical safety around the world, includes among its objectives: "To promote and support the development and implementation of, and further innovation in, environmentally sound and safer alternatives, including cleaner production, informed substitution of chemicals of particular concern and non-chemical alternatives" [13].

Many pieces of European legislation have promoted substitution of chemicals for environmental and worker protection. For example, an important goal of REACH is to encourage and, whenever possible, to ensure that substances of very high concern are eventually replaced by less dangerous substances or technologies if economically and technically viable alternatives exist [7, Article 60]. In the occupational safety and health area, the EU Chemical Agents Directive and the EU Carcinogens and Mutagens Directive establish substitution as the preferred option to prevent risks caused by chemical agents at workplaces. Also several pieces of environmental legislation include substitution requirements, such as the Biocide Directive [14] and the VOC Directive [15]. For example, the VOC Directive considers substitution the first option in preventing VOC emissions, and special attention is paid to the substitution of carcinogens, mutagens, and chemicals toxic to reproduction when used separately or in preparations. Other technical measures to reduce emissions should be taken only "where appropriate substitutes are not available."

In many European legal texts, a hierarchy of control and risk reduction measures is outlined, with substitution as the most effective and radical measure at the top of this hierarchy, followed by technical and organizational measures, and ending with a more or less passive protection of the target media against chemicals, be it the protection of water, soil, air, wildlife, or human beings. Typical wording in such legislative texts is "Substitution shall by preference be undertaken" in the EU Chemical Agents Directive [16] or "The employer shall reduce the use of a carcinogen or mutagen at the place of work, in particular by replacing it, in so far as is technically possible . . ." in the EU Carcinogens and Mutagens Directive [17].

Unfortunately, this legal preference does not include a detailed definition of how substitution should be practically implemented, compared to other legally acceptable solutions, such as personal protective equipment. As a result legislators have left it to regulatory authorities, companies, and other stakeholders to implement one of the legal options; and stakeholders are rarely obliged to justify their decision for solutions at lower levels of the prevention hierarchy—that is, technical solutions like encapsulation or as a last resort, personal protective equipment. Substitution is therefore a legal preference but in fact is not implemented on a broad scale.

Meanwhile, some legislators have recognized this approach of leaving the choice of risk reduction measures up to implementing bodies as unsatisfactory and ineffective. As a result, more detailed regulations (related to specific sectors

or chemicals) have been introduced. The legislative approach to substitution has shifted to include requirements for the assessment of alternatives, in a prescriptive way (as a technical rule to be followed, or as guidance), for example in the REACH guidance for substitution of substances of very high concern or in the German TRGS 600 (Technical Rule for Hazardous Substances) regulatory framework for substitution (see Table 1). Under REACH, for example, all applicants for authorisation should provide an analysis of alternatives considering their risks and the technical and economic feasibility of substitution [7, Article 60]. An example of how TRGS has been used is a comparison of a standard brake cleaning process in auto repair workshops with three alternative solutions that use less hazardous substances. Several health and safety and environmental risks as well as technical criteria, organizational requirements, and costs are described for all the processes of brake cleaning—the conventional one and the three alternatives. Such detailed descriptions for alternatives assessment offer both companies and authorities guidance on how to assess substitution and how to compare advantages and disadvantages of alternatives to a conventionally used chemical. Experience has shown that legal mandates for substitution alone may not lead to substitution actions in practice without technical and research support, particularly when other risk reduction options are legally acceptable.

SUBSTITUTION IN PRACTICE

Legal requirements are undoubtedly the first step in promoting chemical substitution. Replacing harmful substances and processes with less harmful ones or with nonchemical alternatives is seen from the perspective of legislation as one of the most effective strategies of risk reduction—a reduction of risk at the source. Substitution is also seen as a critical means to overcome limits of pollution controls and command and control regulations. However, the concept of substitution seems to have had a limited impact on chemicals management, particularly in the workplace. Substitution is often considered by enterprises as a complex risk reduction strategy with unpredictable costs and consequences (see box) [18–21].

Substitution is carried out in companies in various manners—according to a Dutch study—from sporadic substitution activities (a substitute is well promoted and easily available on the market) to a more systematic approach of identifying and implementing substitutes [22]. Although legislative requirements are recognized by companies as a key driver for substitution, other factors contribute as well, such as vendors' knowledge, management's commitment, supply chain requirements, costs of worker protection and environmental protection, and pressure from the public or from workers, among others.

For example, for small and medium-sized enterprises, with very limited chemical information, assistance provided by vendors is an important driver.

Facade Cleaning

Facade cleaning is one of the sectors using highly toxic and dangerous chemicals manually in an open process. The decision about the techniques and chemicals used is mainly taken by the cleaning companies, based on their experience and skills, and in some the use of chemicals is regulated by standards for restoration. The cleaning tasks are different at every construction site and sometimes even within one facade. Cleaning companies prefer a strong and "one-for-all" product in order to ensure the success of their operations.

There are two main alternatives to conventional cleaners, which are based on acids, strong alkalines, chlorinated solvents, and aromatic solvents. Chemical substitutes are, for example, dibasic esters and similar chemicals with high effectiveness but slow mode of operation. The second and more common route is to switch to mechanical treatment with pressurized or heated water. Water-based high-pressure cleaners operate at a pressure of 70 to 200 bars, with machines using between 5 and 25 liters of water per minute. Both cold-water high-pressure cleaners and hot-water high-pressure cleaners are used, and for special purposes detergents are injected at around 1 to 5 percent.

The major advantage of both alternatives clearly is the reduction of chemical hazards for the environment and the workers. These advantages have to be balanced against the disadvantages: the use of less aggressive chemicals reduces the speed of the working process, full compliance with common regulations or standards for restoration might not be achieved, and the experience of workers with these new technologies is not as great as with conventional chemicals. Pressurized or heated water has other disadvantages: accident risks for workers (contact with high-pressure water and/or hot water), the generation of considerable amounts of wastewater, costs of energy for hot-water cleaning, threat of freezing, and premature decay or oxidation of masonry.

However, only specialised suppliers (e.g., of disinfectants) have the knowledge to provide their customers with safer products. This substitution process led by suppliers is a common model in supplier-client arrangements for smaller manufacturers, where users have limited information on chemicals.

Substitution led by users can be found where large companies—large in respect to their sector-specific market power—develop a policy of substitution and compel their suppliers to eliminate or reduce certain hazardous chemicals. A typical situation can be found in the auto industry and the large electric appliances industry, where suppliers are forced by their customers to apply "black," "grey," and "white" lists of chemicals with subsequent requirements for substitution and reduction. Restricted substances lists are a common way large firms are requiring substitution in their supply chains in response to both

Table 1. Tools and Databases on Substitution, Either Standalone or as Part of Chemical Management Tools

Tool or database	Description
BASTA (Sweden) http://www.bastaonline.se/	BASTA is a database of the Swedish construction industry to accelerate the phasing out of hazardous construction products.
CatSub (Denmark) http://www.catsub.dk/	This website is a catalogue of examples of substitution of hazardous chemicals—case stories describing successful substitutions with less hazardous chemicals. The case stories primarily come from companies, occupational health services, and the Danish Working Environment Authority.
CHEMSEC-SIN List (Sweden) http://www.chemsec.org/list	The aim of the SIN (substitute it now) List is to ensure that the REACH Authorisation procedure is an effective tool to fast-track the most hazardous substances for substitution and to facilitate toxic use reduction by businesses and other actors.
Cleaner Solutions Database (United States) http://www.cleanersolutions.org/	This online tool for solvent substitution in surface cleaning was created by the Surface Solution Laboratory (SSL) at the Massachusetts Toxics Use Reduction Institute (TURI). It links performance evaluation to specific testing parameters and environmental assessments based on the testing performed at the lab.
CLEANTOOL (German) http://www.cleantool.org	CLEANTOOL is a Europe-wide interactive database for parts cleaning, metal surface cleaning, and component cleaning and degreasing, based on real processes in numerous European companies.
COSHH Essentials (United Kingdom) http://www.coshh-essentials.org.uk	This method was developed by the UK Health and Safety Executive (HSE) to help firms comply with UK and European regulations on hazardous chemicals in the workplace. The method is used to determine the appropriate control measures for a given task. It can be used to compare alternatives by determining hazard levels for different substances and products.
EMKG (easy-to-use workplace control scheme for hazardous substances) (Germany) http://www.baua.de/en/Topics-from-A-to-Z/Hazardous-Substances/workplace-control-scheme.pdf	EMKG, developed by the Federal Institute for Occupational Safety and Health (BAuA) provides advice on controlling the use of chemicals.

Table 1. (Cont’d.)

Tool or database	Description
EU-OSHA Dangerous substances website (European Union) http://osha/europa.eu/en/topics/ds	This website provides background information and case studies, including substitution cases.
GISBAU/GISCHEM/GISMET (Germany) www.gisbau.de www.gischem.de www.gismet.de	GISBAU/GISCHEM/GISMET provide interactive access to occupational safety and health data and instructions for more than 30,000 chemical products and preparations when a chemical product consists of only one substance like hydrochloric acid.
IFCS Substitution and Alternatives Case Studies, Examples and Tools) (International) http://www.who.int/ifcs/documents/standingcommittee/substituti7on/en/index.html	This website, developed by a working group of the Intergovernmental Forum on Chemical Safety, provides a set of case studies, examples, and links to tools on chemical substitution and alternatives assessment.
IMDS (International Material Data System) (International) http://www.mdsystem.com/index.jsp	The IMDS is a material data system of the automobile industry. All chemical materials used for car manufacture are archived and maintained. In this way it is possible to meet the obligations placed on car manufacturers, and thus on their suppliers, by national and international standards, laws, and regulations.
KEMIguiden (Sweden) http://www.prevent.se/kemiguiden/	KEMIguiden is a Swedish interactive support tool for small and medium-sized enterprises to facilitate an easy achievement of compliance with legislation.
PAN Pesticides Database–Alternatives to Pesticides (International) http://www.pesticideinfo.org/Alternatives.html	This page provides links to organizations that provide information on nontoxic or least toxic approaches to pest management.
PPGEMS (United States) http://www.turi.org/library/other_online_resources/web_links_at_p2gems__1	This database of the Toxics Use Reduction Institute provides links to websites offering information about technologies, emerging technologies, or technology change tools that support pollution prevention.
RiseTox (Spain) http://www.istas.net/risctox/index.asp	ISTAS has developed several online tools to help safety representatives prevent chemical risks, including a database on hazardous properties of 100,000 substances (RiscTox), a database on alternatives for substitution (Alternativas), and a tool to assess and compare alternatives.

Table 1. (Cont'd.)

Tool or database	Description
Stoffenmanager (Netherlands) https://www.stoffenmanager.nl/default.aspx	Stoffenmanager is an interactive support tool for Dutch small- and medium-sized enterprises, to facilitate easy achievement of compliance with chemical legislation.
SUBSPORT (European Union) http://www.subsport.eu	SUBSPORT is a publicly available internet portal that constitutes a source of information on alternative substances and technologies, and of tools and guidance for substance evaluation and substitution management. The portal's main goal is to support companies in fulfilling substitution requirements deriving from agreements and legislation. A first version is expected for 2012 in four languages.
Substitution-cmr (France) http://www.substitution-cmr.fr/	A tool for all professional actors in the area of substitution, Substitution-cmr, created by the French Agency for Environmental and Occupational Health Safety (ANSES) is especially designed to replace category 1 and 2 carcinogens, mutagens, and reproductive toxicants (CMRs).
Technical Rule for Hazardous Substances 600 (TRGS) (Germany) http://www.baua.de/nn_78960/en/Topics-from-A-to-Z/Hazardous-Substances/TRGS/TRGS-600.html?_nnn=true	The German Hazardous Substances Ordinance (GefStoffV) states that the employer has the duty to determine, test, and decide on substitution and to document it. TRGS 600 includes a framework for deciding on substitution that considers criteria for assessing technical suitability and health and physicochemical risks of alternatives.

legal demands and market demands. Other common ways include positive lists of preferred substances, requiring eco-labelled products, and including environmental criteria in green procurement.

A number of large companies across sectors have instituted chemicals management/safer chemicals programs that require information on chemical content of products and substitution of high-concern chemicals. These companies—in a variety of sectors, such as the electronics, manufacturing and consumer products industries—include ABB, Boots, Marks & Spencer, EUREAU, Scania, IKEA, Skanska, Heidelberger, Bosch Siemens, H&M, NCC, and Volvo Technologies.

In addition, large companies that cooperate with many other companies and the public sector on a regular basis (e.g., construction companies) have developed strategic approaches to avoid hazardous substances. The reasons for this are, on one hand, to protect their workers, and on the other, to avoid additional costs for compliance with extensive health and safety and environmental protection requirements and safe disposal.

Many large companies are driven to substitution in order to avoid incidents or public criticism that might affect their reputations. Companies producing consumer goods (e.g., sportswear and shoes, furniture, clothes) seem to be highly vulnerable to such attention and have introduced strict rules to eliminate or reduce hazardous chemicals.

The pressure of safety representatives and trade unions has also forced some companies to substitute hazardous substances that cause occupational health problems. Several examples can be found in Spain, where the intervention of health and safety representatives from the trade union Comisiones Obreras forced companies to substitute for carcinogens, reproductive toxicants, neurotoxicants and even endocrine disruptors [23]. Training programs on chemical substitution for health and safety representatives, combined with the development of detailed substitution assessment tools (such as RiscTox, which contains information on the health and environmental risks of more than 100,000 chemicals as well as information on alternatives) and case studies, provide important foundations for workers to advocate to employers for safer chemicals, processes, and products in an informed manner.

In addition, with the progress of REACH, more and more information on the hazardous effects of chemicals will become publicly accessible. This will influence companies and other stakeholders' behavior. Companies are now closely monitoring developments with regard to the classification and labeling of chemicals they use. In this respect REACH may become an important driver for future substitution processes, particularly for substances labelled as hazardous.

While there may be strong but often not very specific pressures to implement substitution from legislation, markets or the media, there are still many internal obstacles to substitution in enterprises. Such obstacles can be economic barriers, technological barriers, performance barriers, lack of knowledge both of chemical dangerous properties and of alternatives, lack of enforcement, or the lack of motivation and awareness.

For example, the CADimple project analyzed and evaluated the impact of the Chemical Agents Directive in EU Member States in terms of specific prevention approaches adopted by Member States, and by private and public sector employers, on protecting workers' health and safety from risks due to exposure to hazardous substances at work. As part of the project, Dutch, German, and Spanish occupational safety and health (OSH) practitioners and workers' representatives described their impressions of the barriers to substitution in enterprises [20, Chapter 7]:

> In theory it is a very good method. In practice it is hard. A lot of companies abandon this strategy because it costs too much (e.g., the whole production line should be adapted) or the appropriate products/substances are not available. (Netherlands, External OSH services, OSH practitioner)

> Substitution is without a doubt the best method for risk minimisation. However, substitution is rarely carried out in practice because economic reasons can always be found that stand in the way of an exchange or substitute for a hazardous material. So, for example, the material qualification measures are supposedly so time-consuming and cost-intensive that power stations cannot do without hydrazine use, although numerous alternatives are known; these, however, have only been certified up to now for other working materials than the one in question. (Germany, Representative of a Professional Association, OSH practitioner).

Findings in Spain mirror these, suggesting that the hierarchy of controls is often reversed because of cost considerations. As such, the use of personal protective equipment predominates and as a consequence, implementation of prevention is poor. Worker representatives interviewed in Spain as part of a Comisiones Obreras–led project on solvent substitution describe these barriers:

> The cheapest measure is chosen and which has the least consequence for the product and process. (Spain, Employee's representative)

> Companies tend to select the measure which is the easiest to implement and/or the cheapest. Recommendations from the risk assessment are ignored and personal protective equipment is (continued to be) applied. (Spain, OSH Practitioner)

> The hierarchy of measures does not normally play a role in the decision on which measures to implement. It is believed to be not well known. Mostly the cheaper options are selected. (Spain, Labour Inspector)

As a consequence, there is a great need for supporting tools and guidance to support substitution efforts.

CURRENT TOOLS AND GUIDANCE

Recognizing this need, tools, databases, and guidance documents to support substitution have been developed by a number of public authorities, industry associations, and related institutions, scientific bodies, and NGOs.

According to our experience, most of them are not specific to an industry sector, the type of chemical, or the type of process. Many substitution guidance documents are very general and do not go beyond the basic description of the substitution principle or simple steps—that is, replacing the hazardous by the less hazardous [24]. Process guidance that outlines a structured approach to substitution is scarce [25, 26]. There is a range of tools to support substitution, including tools that are designed to identify and screen out hazardous chemicals, tools that are designed to compare alternatives (e.g., decision criteria), and tools that are designed to identify safer chemicals. Some publicly available tools in Europe designed to partially or wholly support substitution include the Dutch

Stoffenmanager, the Swedish Kemiguiden, the German EMKG, and the Spanish RiscTox as well as software tools from private publishers (Table 1).

Several organizations have also developed databases with alternatives for different substances (Substitution-cmr database for alternatives to carcinogens), products (Clean Solutions Database for cleaners, Pesticide Action Network for pesticides) or applications (CLEANTOOL for metal parts cleaning). A number of databases include substitution case stories (CatSub, CLEANTOOL, Substitution-cmr and RiscTox) and some databases include general resources for pollution prevention (PPGems) or substitution (IFCSs) (see Table 1).

A number of methods to assess and compare alternatives have also been developed by different stakeholders (Table 2). Most of these methods consider intrinsic properties of chemicals and are used to assess and compare individual substances (Green Screen, Quick Scan); several compare products (Column Model, MAL Code); and some are also used to compare substances, products and processes (P2OASys).

While useful, these tools do not always lead to an unambiguous, easy decision as to substitutes because even in the absence of economic and technical considerations, conflicting targets and possible shifts in risks (e.g., from toxicological impacts to increased energy consumption or accident risks for workers) may occur and hence need to be evaluated and balanced. In many cases, information on alternatives (toxicity, performance) may not be available.

Further, due to lack of capacity and resources, smaller companies (but also enterprises without technical capacity or that are not manufacturers of particular products) often need to rely on easily accessible and visible tools when comparing alternative substances (i.e., many of the previously developed tools may be too sophisticated for many users), such as classification and labeling and also the information contained in safety data sheets. Some private software providers are beginning to develop tools that would allow non-experts to identify safer alternatives.

An analysis of the various tools, combined with our experience in training, research, and support of safer alternatives implementation, indicates that the most common approach for substitution assessment is to compare the current technology with one alternative (occasionally, with more than one) using a basic process model and a number of decision considerations. Typically the following are considered in the comparative assessment:

- risks of the alternatives (health and safety risks caused by chemicals, other health risks, environmental risks);
- technical suitability (compliance with product and process specifications, identification of necessary process or product adaptations);
- work organization (are changes needed—for example, use of different chemicals to achieve the function, changes in the workplace to accommodate the chemical change (e.g., in the cleaning sector));

Table 2. Alternative Assessment Methods

Assessment method	Description
Column Model for Chemical Substitutes Assessment (Germany) http://www.dguv.de/ifa/pra/spaltenmodell/index.jsp	The Institute for Occupational Safety (IFA) of German accident insurance businesses developed the Column Model to provide industry with a practical tool for identification of alternative substances. This is a simplified method to make a preliminary comparison between the risks of the different substances and products and offer a quick judgment on the convenience of substitution.
Green Screen for Safer Chemicals (United States) http://www.cleanproduction.org/Greenscreen.php	The Green Screen for Safer Chemicals, developed by Clean Production Action, is a hazard-based screening method that is designed to inform decision-makers in businesses and governments, as well as individuals concerned with the risks posed by chemicals, and to advance the development of green chemistry. The Green Screen defines four benchmarks on the path to safer chemicals, with each benchmark defining a progressively safer chemical. Green Screen assesses chemicals on the basis of intrinsic hazards.
Determination and work with code numbered products (MAL Code) (Denmark) Executive Order on Work with Code Numbered Products http://www.at.dk/~/media/E6DCB04DD3264D0CB2AA8D80AA259028.ashx	The National Working Environment Authority in Denmark has developed a code number system to provide users with a practical tool for choosing less harmful products and determining working routines and prevention measures for products with different code numbers. Once a code number is designated to a product it is easy for a user to compare products. The higher number—the more hazardous.
Pollution Prevention Options Analysis System (P2OASys) (United States) http://www.turi.org/home/hot_topics/cleaner_production/p2oasys_tool_to_compare_materials	P2OASys was designed by the Toxic Use Reduction Institute (TURI) to provide companies with a framework for complete and systematic evaluation of potential hazards of processes and products in use, and also of alternatives.
PRIO—a tool for risk reduction of chemicals (Sweden) http://www.kemi.se/, the PRIO-Guide under http://www.kemi.se/templates/PRIOframes4045.aspx	Developed by the Chemicals Agency of Sweden (KEMI), PRIO facilitates the assessment of health and environmental risks of chemicals. PRIO includes: a database of 4472 substances with properties hazardous to the environment and health that should be prioritized in risk-reduction work; priority-setting guide; and guidance on how to reduce chemical risks in practical use.

Table 2. (Cont'd.)

Assessment method	Description
Quick Scan (Netherlands) http://www.rijksoverheid.nl/documenten-en-publicaties/publicaties-pb51/uitvoering-strategie-omgaan-met-stoffen.html	Quick Scan is a screening method developed by the Dutch Ministry of Housing, Spatial Planning and Environment as part of a new chemicals policy to ensure that the potential risks and hazards associated with the use of substances in each stage of their life cycles are sufficiently controlled so as to remove, or to reduce to a negligible level, any harmful effects caused by substances on man or the environment.

- costs (material costs, material consumption, equipment and investment costs, energy, labour costs, organisation costs, transport costs, insurance costs, storage costs, costs of different protective measures);
- generation of solid waste or sewage (treatment and/or disposal equipment and organisation, treatment and/or disposal costs);
- other influencing factors such as corporate image, employee satisfaction, sustainability / planning reliability; and
- shift of risks—for example, between environmental media (from air to water), from health risks of a toxic substance to safety risks of a flammable substance (halogenated solvents to flammable solvents).

These considerations also form part of the methodology undertaken in the Subsport project.

SUBSPORT APPROACH

In 2007, several organizations that work on substitution from different perspectives at both the national and international levels (Kooperationstelle Hamburg, ISTAS, Lowell Center for Sustainable Production, and Chemsec) began discussing how to help and support enterprises and other interested stakeholders to promote substitution and to put it into practice.

Specific identified needs included, among others, support to find alternatives to POPs regulated under the United Nations Stockholm Convention; support to facilitate substitution during REACH authorization procedures, including identification of alternatives and guidance on alternatives assessment implementation; structured and accessible information on alternatives, tools, practical examples and tutorials to facilitate substitution in workplaces; and the building of cooperation between different stakeholders.

The European Commission LIFE+ Programme, with the financial assistance of the Federal Institute for Occupational Safety and Health of Germany (BAuA)

and the Federal Ministry of Agriculture, Forestry, Environment and Water Management of Austria gave these organizations the opportunity to develop SUBSPORT. The goal of the project is to develop an internet portal, a comprehensive and innovative information resource on safer alternatives to the use of hazardous chemicals.

SUBSPORT seeks to overcome particular barriers to substitution. It is designed to help enterprises identify legal requirements for substitution quickly and easily. The portal includes criteria to identify substances of high concern to help companies prioritize chemicals to substitute. These criteria refer to acute toxicity and chronic toxicity (such as carcinogenicity, mutagenicity, reproductive toxicity, endocrine disruption, sensitization of the skin or respiratory system, neurotoxicity, and developmental toxicity) to environmental concerns (persistence and/or bioaccumulation, ozone depletion, environmental toxicity, aquatic toxicity) and to safety concerns (fire and explosion). It also includes a database of substances that have been identified as being of high concern by different governmental and nongovernmental organizations, including substances on restriction lists from large companies or industry associations.

SUBSPORT offers an overview of tools to help companies assess and compare alternatives in order to allow them to choose the most suitable tool for their substitution needs. For example, a simple substitution requirement at a specific workplace can be assessed via a less advanced and less complex tool; or specific sector information (with information on performance characteristics of a particular alternative) might be more useful for some companies than general information.

The experience of the SUBSPORT partners has shown that case studies play a core role in promoting substitution. Learning from colleagues in the same sector or at the same workplace is an effective means to motivate other actors in companies. Therefore SUBSPORT compiles substitution case stories, including "easy cases," where a simple exchange of a chemical substance or preparation was needed; examples of cases where adaptation of processes was required; and information on those complex cases which even required research and development.

In order to facilitate the identification and assessment of alternatives for the REACH authorization procedure, the Stockholm Convention, and other international legislative frameworks, the SUBSPORT project team and its network of experts will analyze in detail the substitution options for 10 substances of high concern.

These substances represent a broad range of sectors and applications in order to achieve the broadest impact:

1. chloroalkanes
2. chromium VI and compounds
3. bisphenol A
4. dialkylphthalate

5. lead and its inorganic compounds
6. octylphenol, nonylphenol
7. trichloroethylene, tetrachloroethylene
8. formaldehyde
9. brominated flame retardants: hexabromocyclododecane (HBCDD); tetrabromobisphenol A (TBBPA); decabromodiphenylether (deca-BDE); and pentabromodiphenylether (PBDE)
10. butylparaben

The project partners will offer the following information on SUBSPORT's internet portal and make it publicly available in four languages:

- a structured presentation of legal information on substitution in the EU and at international and national levels;
- a database of hazardous substances that are legally or voluntarily restricted or are subject to public debates;
- a compilation of prevailing criteria for the identification of hazardous substances;
- a description of existing substitution tools to compare and assess alternative substances and technologies;
- a database comprising general information on alternatives to the use of hazardous substances;
- a database containing detailed and evaluated case studies which document practical experiences in the substitution of 10 selected substances of very high concern in various essential applications;
- materials for substitution training programs; and
- interactive elements for discussion, networking, exchange of information and experience, as well as for updates.

In addition, the project aims at creating a network of experts and stakeholders who would become actively involved in substitution efforts. The network should assist in the development of content and the promotion of the portal as well as ensuring database updates and maintenance. Networking started with the creation of an expert committee made up of representatives of employers, unions, industry, government, and NGOs from all over Europe and also from the Lowell Center for Sustainable Production in the United States.

Finally, training is also part of SUBSPORT activities. The project will develop training guidance materials and carry out 15 training sessions on substitution for key stakeholders, including: environmental and health and safety technicians from companies, trade unions or governmental organizations; experts from NGOs, consultancies, industry, and consumer organizations; academics; and policymakers. Participants of these training seminars should learn a systematic approach towards effective substitution, and alternatives assessment methods. They can then become change agents in their own organizations.

CONCLUSION

It is interesting to see that substitution of chemicals is back on the public and research agenda, as in the last 10 years there has been very little financial or technical support for substitution from public authorities. Public and scientific concerns about health and environmental hazards, safety problems regarding the handling of chemicals in many companies, and the implementation of REACH and other legislation have contributed to this return.

Substitution is the preferred option in the prevention hierarchy as it eliminates risks at the source, avoiding the need for expensive environmental and health and safety control measures. The reduction of chemical risks by control solutions will continue to be important, but these can fail and are rarely a fully effective strategy. Substitution is a necessary complementary concept, not only in legislation, but also in practice.

The practical implementation of substitution has shown that it can be a complex process. Implementation is often disregarded and can be difficult in practice. Also, in order to avoid the shift of risks, all areas of potential risk have to be assessed and a comparison of levels and types of hazard factors is necessary. As such there is a need for a wide range of expertise and tools for assessment and decision-making. The rigorous work on the practical implementation of safe substitutes needs to be supported by specific and comprehensive information.

Case studies and practical information have been shown to play an important role in the implementation of substitution, in particular in small and medium-sized enterprises with fewer resources. Existing online databases receive thousands of visits per day from companies searching for safer products and processes.

It is notable that the work of SUBSPORT is based on individual initiatives from the sector of occupational safety and health, from trade unions, from environmental NGOs and from a small group of scientists. With the exception of the Substitution-cmr (carcinogen, mutagen, and reproductive toxicant) database from French Agency for Environmental and Occupational Health Safety, government agencies in Europe have not developed any substitution database.

However, many of the earlier substitution projects of the SUBSPORT project partners were moderately supported by European and national governments. SUBSPORT represents the first time that considerable funding from a European source is available to support substitution activities. The SUBSPORT project's approach is supported by many important stakeholders from national governments and also by the European Agency for Safety and Health at Work. There are good probabilities that major stakeholders, members of the scientific community, and the industrial sector will support the concept of SUBSPORT with their expertise and financial contributions. A gate is now open for a

"sustainable" database to support the practical implementation of substitution for hazardous chemicals.

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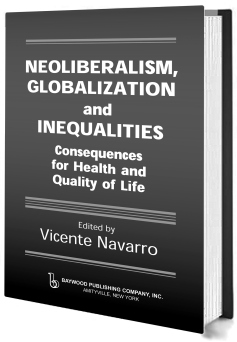

NEOLIBERALISM, GLOBALIZATION and INEQUALITIES

Consequences for Health and Quality of Life

Edited by Vicente Navarro

Policy, Politics, Health and Medicine Series • Series Editor, Vicente Navarro

Since U.S. President Reagan and U.K. Prime Minister Thatcher, a major ideology (under the name of economic science) has been expanded worldwide that claims that the best policies to stimulate human development are those that reduce the role of the state in economic and social lives: privatizing public services and public enterprises, deregulating the mobility of capital and labor, eliminating protectionism, and reducing public social protection. This ideology, called "neoliberalism," has guided the globalization of economic activity and become the conventional wisdom in international agencies and institutions (such as the IMF, World Bank, World Trade Organization, and the technical agencies of the United Nations, including the WHO). Reproduced in the "Washington consensus" in the United States and the "Brussels consensus" in the European Union, this ideology has guided policies widely accepted as the only ones possible and advisable.

This book assembles a series of articles that challenge that ideology. Written by well-known scholars, these articles question each of the tenets of neoliberal doctrine, showing how the policies guided by this ideology have adversely affected human development in the countries where they have been implemented.

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Scientific Solutions – Transforming Science

THE SCIENCE OF GREEN CHEMISTRY AND ITS ROLE IN CHEMICALS POLICY AND EDUCATIONAL REFORM

AMY S. CANNON
JOHN C. WARNER

ABSTRACT

Over the past 10 years, the science of green chemistry has continued to evolve and has been adopted in research labs in industry and academia. At the same time, new innovations in chemicals policy have widened opportunities for legislative action to protect human health and the environment. This article addresses the mechanisms by which the science of green chemistry and chemicals policy can work together to help attain a more sustainable future. It also speaks to the pitfalls of inappropriately merging these two, and explores how such a merger could inhibit the creation of sustainable technologies. Green chemistry's role in educational reform is discussed as a means for training students who are prepared to create truly sustainable technologies.

Keywords: green chemistry, chemicals policy

The field of green chemistry is entering its third decade. While there were certainly efforts to achieve goals similar to those of green chemistry through the 1960s, 1970s, and 1980s, the field of green chemistry dates back to the early 1990s, when it was first conceived at the US Environmental Protection Agency

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(US EPA) as an evolution of the agency's grants program "Alternative Synthetic Pathways for Pollution Prevention" [1]. In 1998 the 12 Principles of Green Chemistry were first published [2]. The articulation of these principles provided a direct link to the research laboratory, and provided a framework that would place the field of green chemistry in the hands of the materials scientists, chemists, and engineers as the *science* of sustainability.

Achieving a sustainable future is an aggressive goal that will require dozens of disciplines and hundreds if not thousands of new perspectives. The field of green chemistry is a small but important part of this greater overall effort. In order for all the various pieces of the sustainability puzzle to fit together and make progress, it is important to understand what green chemistry is, and what green chemistry is not. Based on this understanding, synergies between various related *and unrelated* efforts, including chemicals policy and educational reform, can be identified and mutual benefit optimized. This manuscript will present the science of green chemistry, describe how green chemistry fits into the theme of sustainability, and address how the science intersects with policy and can help to influence science education.

GREEN CHEMISTRY AS ACTIVE POLLUTION PREVENTION

Green chemistry is clearly defined in Anastas and Warner's book *Green Chemistry: Theory and Practice* [2]. This seminal book outlined the science of green chemistry, as well as the 12 principles of green chemistry. The principles are guidelines for practicing chemists, aimed at providing a framework for the bench chemist working towards greener chemistry. They detail how a researcher at the molecular level can improve the sustainability performance of a material or process. The 12 principles of green chemistry are referenced, cited, or listed in countless books and articles and on numerous websites. The principles are somewhat general, and a nontechnical audience can certainly appreciate the major points of each. But they are primarily geared to the bench scientist.

While the focus on the bench chemist may initially appear to be overly narrow, in fact it is urgently needed. As will be discussed later in this article, it is the bench scientist who has the greatest opportunity to improve the sustainability performance of any material or process. And yet the education of this bench scientist, at the undergraduate or graduate level, is essentially void of the training and skills necessary to identify or avoid the use or generation of hazardous materials. As will be discussed below, if we hope to make advances necessary to accomplishing a truly sustainable future we must provide skills where they are absent and needed. The 12 principles of green chemistry provide the missing information needed by the practicing bench scientist.

Tools have been developed to provide a direct measurement and graphical assessment across the 12 principles of green chemistry, such as the iSUSTAIN

Green Chemistry Index [3]. This tool is a web-based program designed to be used by bench scientists to assess the sustainability of their chemical processes using the 12 principles of green chemistry. This type of assessment is best used not as a marketing tool, but as a *research and development* tool. The iSUSTAIN Index for green chemistry is different from other "scorecard" evaluation tools in that it is not designed as a retrospective analysis, but rather is an evaluative tool for assessing process improvement at the research stage, from a molecular basis.

GREEN CHEMISTRY AND THE PRODUCT DEVELOPMENT PROCESS

The goal of green chemistry is to reduce or eliminate the use and/or generation of hazardous substances or processes [2]. It is important to keep in mind that the ultimate requirement of green chemistry is to physically reduce the quantities of chemicals that have a negative impact on human health and the environment. Science and technology are incremental processes that build over time on sequential and parallel advances in related fields. It is nearly impossible for "quantum leaps" of advancement to occur without the accumulation of countless supporting pieces of scientific understanding. Sometimes these foundational steps are recognized and celebrated, and sometimes they are not. In either case, the final technological achievement is often perceived as the "quantum leap" because the preceding steps and advances were of significance to a smaller technological audience and only the aggregate of achievements was of interest to a critical mass of individuals.

To accomplish green chemistry's ultimate goal of pollution prevention, a technology must not only be less toxic or have less environmental impact, but must also be successfully adopted. Thus, in order to truly be green chemistry, a technology must demonstrate appropriate performance and cost, so as to spur its success in the marketplace and increase the likelihood of adoption. Only if the three requirements are met will a new technology be successfully adopted and thus achieve the ultimate goal of pollution prevention (Figure 1).

To better understand how green chemistry fits into the bigger picture of product development, and to understand how it relates to chemicals policy, it is beneficial to reflect on the product development process. Understanding how scientists, engineers, and industrialists bring an invention at a research lab to a manufacturing floor in a factory, and into a shopping cart at a store or into our homes, and finally out in the trash and into a hole in the ground, can help us bring this subject into sharper perspective.

The first step in the process is that a molecule (chemical) is taken from somewhere in the earth—a mine, a plant, an animal, an oil deposit—and is converted to a material. This process is called "basic research" (Figure 2). The

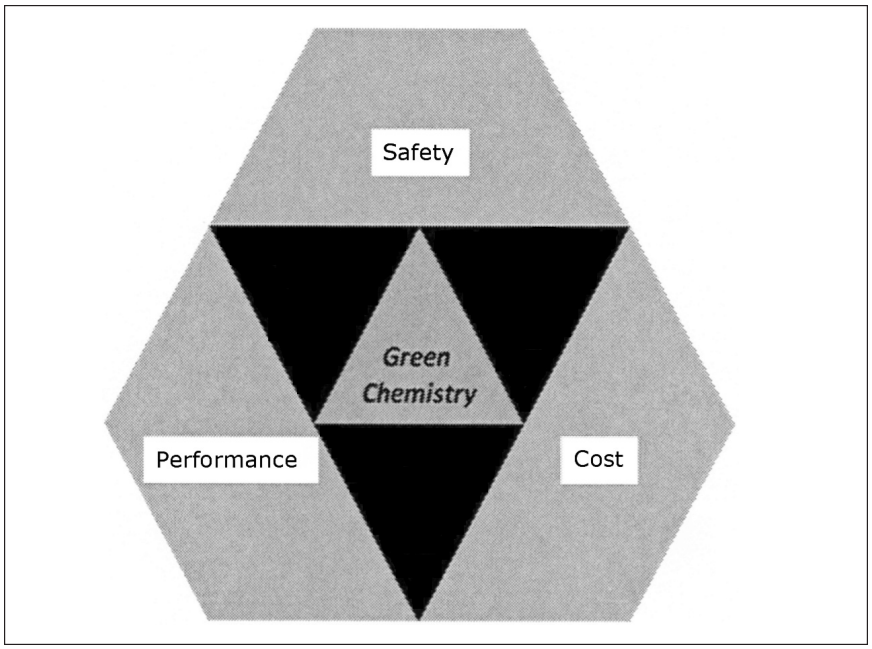

Figure 1. Three piers of green chemistry.

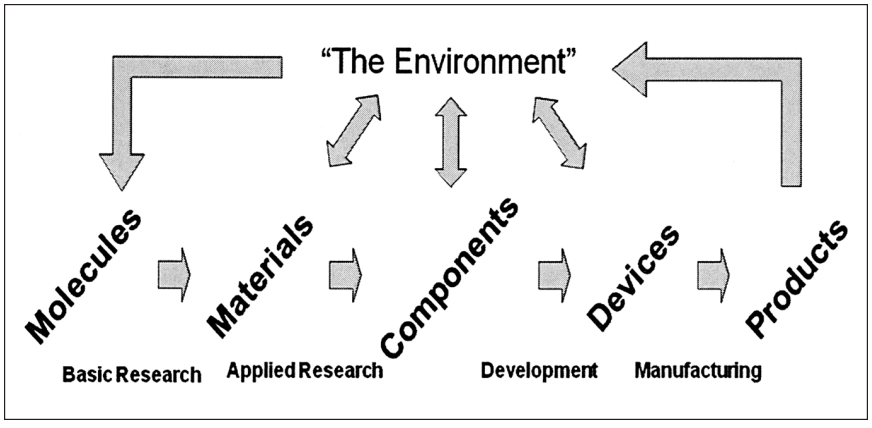

Figure 2. Product development schematic.

objective is to invent methods to make fundamental materials. The materials may or may not have any specific purpose; they reside at the frontier of research, as new and interesting "building blocks."

With these materials in hand, components are then developed. This is called "applied research" (Figure 2), and it is the heart of innovation. Components are materials that change when something happens to them. For example: when a material is heated it turns a different color; when a material is stretched, it changes the way it conducts electricity; when light is shined on a material, it changes the way it looks; when a material is smeared on a surface, it sticks. These components are not really useful for much of anything themselves, but they demonstrate a fundamental way in which the materials can be changed or manipulated in response to some input.

It is in applied research that most of the research happens within an industrial setting. And, it is within this realm where most of the environmental and human health impact decisions are made, whether consciously or not. For example, let us consider the design of an optical waveguide material for use in a touch-screen component, which will be used in a variety of devices, such as computers and cell phones. An optical waveguide is a material that guides light of a certain wavelength and functions similarly to a fiber optic material. The design criteria for developing a new waveguide material for use in a touch-screen computer (device) include many endpoints, such as solubility, mechanical properties, glass transition temperature, melting point, and refractive index. Each of these criteria ensures that a material is developed so that the performance is optimal in the end use of the device. For example, the glass transition temperature of the optical waveguide material is important in developing a touch-screen component that can withstand wide temperature ranges and that will not warp when in a hot room for long periods of time.

These types of criteria are very specific to ultimate product performance. However, throughout the history of product development, environmental and human health impacts have not typically been seen as attributes of product performance. Green chemistry is the science of pushing these into the criteria for molecular, materials, and product development. Adding toxicity and environmental impact to the list of criteria for the optical waveguide material ensures we are developing not only a high-functioning touch-screen component, but also one that has minimal impact on the environment and human health. And, just as we would go back to the research labs to redesign the component or device if it fails on one of the other criteria, we should do the same if it fails on the toxicity and environmental impact criteria.

The next stage of the product development process involves the creation of devices, in which a few, or several, components are put together. Cell phones, batteries, cars, paints, cosmetics, along with many more, are all assemblies of a few (or many) components. In the example of the touch-screen computer, the touch screen is just one component of many in the device. We call this step

"development"—when several components are assembled together to make something that consumers could actually use.

When thousands or millions of the devices have to be made in order to supply the demand, technologies must be created to do this quickly and efficiently, and to work within the constraints of regulations. Producing many things over and over—that is, making products—is what happens in the "manufacturing" stage of product development (Figure 2).

For successful product development, the final product must meet three criteria. The product must have good performance. The product must have appropriate economics, which includes consideration of all of the product development steps. And the product must be socially responsible (i.e., safe for use and in the production process). The latter has not always been part of the equation, but today is becoming more and more a focus within industry. Performance, cost, and safety are the criteria for successful product development in industry, and these are the same as the criteria for green chemistry (Figure 1). Green chemistry is not an exogenous concept, but is just good business practice. It is completely consistent with the way industry does business already. Industry may not have the tools in place or an appropriately trained workforce, but green chemistry fits in with traditional successful business models.

The environment is of course, in the middle of the road from molecules to products (Figure 2). Molecules are extracted from the environment, whether from renewable or depleting resources. When the product has finished its useful life and is discarded, it is either recycled, or persists and accumulates in the environment, or degrades into harmful or innocuous byproducts. When a product is made, sold, and used, it has impacts on human health and the environment around it. The scientist who invents the material or process is in the best position to understand and avoid the use of hazardous materials. Unfortunately, as we will discuss later in this article, that scientist, who did the basic and applied research, is unlikely to have had any education or training in toxicology or environmental impacts.

With this understanding of how green chemistry relates to product development by incorporating environmental and human health criteria throughout the product development phases, we can now consider how the science of green chemistry relates to the bigger picture of sustainability.

GREEN CHEMISTRY AND SUSTAINABILITY

"Green chemistry" has oftentimes been used interchangeably with "sustainable chemistry," a term that might be more relevant and understandable within the bigger picture of sustainability. The OECD defines sustainable chemistry as the design, manufacture, and use of environmentally benign chemicals, which is consistent with the definition of green chemistry [4]. Many organizations use the terms green chemistry and sustainable chemistry in referring to the same

intended end [5–7]. However, others use the term sustainable chemistry as a broader term applying to the use of chemistry within the realm of sustainability, applying it to other areas such as water use, conservation, recycling, public policy, among other sustainability-related concepts [8, 9]. This prompts a discussion on how green chemistry fits into the larger picture of sustainability and how it applies to areas such as sustainable technologies and sustainable development.

Sustainability is a nebulous concept that means something different for various groups of people. Sustainability cannot be a "one size fits all" concept. It must be a universal concept that everyone in society can participate in and contribute to. Derived from the document commonly known as the Brundtland Report, sustainability has been widely accepted as being defined as "meeting the needs of the present without compromising the ability of future generations to meet their own needs" [10]. One finds that the concept of sustainability applies across multiple disciplines, including economics, agriculture, education, business, chemistry, and many others.

Chemistry is applicable in many of these areas, including chemicals policy, remediation technology, exposure controls, water purification technologies, alternative energy technologies, sustainable production, green chemistry, and many other subjects. Green chemistry is but one of the many topics under the umbrella of sustainable technologies and sustainable products. However, it must be realized that green chemistry processes have not been typical within many of these "sustainable technologies." It is important to consider that one can create remediation technologies, water purification technologies [11–13], and alternative energy technologies that use high-energy processing, and use toxic and hazardous materials in the manufacture [14–19]. But these technologies are desperately needed, and these things are rightfully considered sustainable technologies. The *applications* of these technologies are sustainable, but the technologies themselves are not necessarily sustainable.

For example, solar energy devices on the market today consist mainly of silicon-based cells [14]. Silicon, while maintaining highly valuable semiconductor properties, has a melting point of 1414°C. The crystalline silicon is grown from molten, high-purity silicon in order to produce high-quality semiconductor material that is then doped with impurities to create a photovoltaic. The process uses immense amounts of energy, as well as reactive and toxic materials for purification [14], leading to high cost and the need for government subsidies for implementation [15]. Other advances in solar energy devices use hazardous elements and heavy metals such as cadmium [16], copper [17, 18], indium [14–18], gallium [19], and arsenic [19]. Each of these new devices is being developed because the end goal is to create a highly functional solar energy device capable of converting sunlight to energy in the most efficient manner possible, a noble goal indeed. The very act of converting the sun's light to electricity using these devices is a non-polluting, non-wasteful way of generating usable energy. There are no wasted inputs, no generated byproducts—and the

feedstock of light from the sun is essentially never-ending. However, it must be noted that these alternative energy devices are grounded on unsustainable manufacturing principles, typically using hazardous and toxic materials, high energy, and generating much waste in the process.

The role of green chemistry is not to focus solely on the application, but to focus on the fundamental building blocks. If the basic building blocks of a technology are sustainable, then there is a good chance that the technology itself will be sustainable. Therefore, in the case of the solar energy devices, an ideal device would use less hazardous materials in the manufacture, as well as use low-energy processes in order to create devices that are truly sustainable from the building blocks through the end product. Newer solar energy devices based on dye-sensitized solar cell technology first developed in the early 1990s [20] have promise to achieve the goal of having a sustainable end product that also has a sustainable production process.

GREEN CHEMISTRY IS NOT A "BIRTH OF ETHICS"

It is incorrect to think that green chemistry somehow represents a birth of ethics in the field of chemistry. One must understand that it has been generally accepted that chemistry *must* be dangerous. Toxicity and hazard are just part of the business of doing chemistry. Chemists have traditionally relied on scientists and engineers who have developed technologies to allow the safe use of hazardous materials. When using dangerous materials, scientists wear gloves to protect their skin, wear masks to protect their lungs, wear goggles to protect their eyes, or use specialized equipment that limits their exposure to the chemicals, or to other environmental conditions (air, light, heat, etc.). Engineers have created remarkable technologies to mitigate and limit exposure of chemicals to the air, land, and aquatic environments, including scrubbers and filters, as well as other waste mitigation technologies. Accepting that chemistry *had* to be dangerous, the historical approach has been to protect human health and the environment by *limiting exposure.*

The problem with depending on technologies that mitigate exposure, of course, is that they can fail. Whenever one hears of some chemical disaster, an oil spill in the gulf, a tanker truck tipping over, an explosion at some factory, it is typically a result of some exposure control failing, or of human error. The National Response Center reports that an estimated 33,000 accidents involving oil or chemicals happened each year between 2000 and 2010. Of the 33,000 accidents, the most often reported cause is equipment failure, and human error is one of the top four causes [21]. Chemical systems are designed with the assumption that everything will happen the way it is supposed to happen. Of course, things do not always go as planned. Green chemistry asks scientists to design, not with the expectation that everything will go correctly in the future, but with the expectation that things could go wrong.

CHEMICALS POLICY AND GREEN CHEMISTRY

Green chemistry has an opportunity to transform the way that chemistry is performed and applied throughout the chemical and materials industries. The field has been held up as a model of a non-regulatory approach to pollution prevention [22]. However, chemicals policy has the opportunity to add stresses and externalities in order to define toxicological and environmental impact as product performance attributes. Market forces and regulatory pressures can influence the cost equation so as to render safer materials more valuable in the marketplace, or hazardous materials more costly. The external forces of the marketplace, chemicals policy, and regulations are inextricably linked to the field of green chemistry. But it is critical to understand that the *science* of green chemistry necessarily operates independently of these forces. Many scholarly studies have discussed the intersection of chemicals policy and green chemistry [23–26]. While we value these works, we recognize the need for further explanation on how these two important fields can work jointly, yet in separate ways, towards the same goals.

Green chemistry and chemicals policy go hand in hand. But they are not the same thing. Chemicals policy drives the demand for safer alternatives; the science of green chemistry provides the solutions. It is really an issue of semantics: if one combines the science of green chemistry with chemicals policy, the confusion that results can have negative impacts on everyone's goals. We *must* find ways to help industry develop a workforce capable of using the science of green chemistry. We need industry to be the loudest and largest supporter of changing academic institutions so that when they teach chemistry, they teach future generations about how to identify and prevent hazards. If the science of green chemistry is semantically combined with chemicals policy, we pull the rug out from under the feet of green chemistry and make it difficult for industry to support the direly needed changes in academic curricula. We will address a key point in the chemicals policy and green chemistry debate: that of chemicals policy driving demand for safer alternatives versus driving innovation.

DRIVING DEMAND FOR SAFER ALTERNATIVES

To understand how to approach green chemistry and chemicals policy, it is useful again to reflect on the product development process. We are completely surrounded by molecules (chemicals). Some are completely natural and would be there whether or not humans had ever evolved on the earth. And some of them are present solely because humans invented them, and started making them. All things being equal, there is no scientific difference between a molecule that is "natural" and an "industrial" molecule, other than the processes for obtaining the molecule (through extraction processes or synthetic procedures). It is not impossible to invent and manufacture molecules sustainably. We cannot do such

things today very often, but there is no fundamental law that says it cannot be done. At the same time, just because a molecule is "natural" does not necessarily mean it is sustainable. For example, if one takes a certain species of plant, uses hazardous chemicals to promote its growth and suppress its predators, harvests it with large amounts of energy, and in the end uses a toxic solvent to extract a molecule of interest, it is clear that this is not a sustainable process. On the other hand, it might be possible to synthesize the same molecule in a chemical factory in a more sustainable way, using the 12 principles of green chemistry.

With this in mind, we can take a closer look at the products available to society: the ceiling tiles and flooring in a room, the clothes that we wear, the electronic gadgets that we work and play with, the cars we drive, the pens we write with, the soaps and cosmetics we use, the prescription drugs we take. It is reasonable to assume that most every product that we have available to us today has something "unsustainable" in its manufacture; the way it is synthesized might use a hazardous reagent, it could be derived from a non-renewable feedstock, or it might not degrade in the environment after its useful lifetime. If any one of the 12 principles of green chemistry is not being met, there is room for improvement.

To address this need for improvement, one can do an "alternatives assessment" to seek out replacement technologies. One can search to find companies offering safer alternatives. For moral, ethical, and economic reasons, this must be done, and it is highly valuable for organizations to perform alternatives assessments to ensure that they are using the best available technologies. Unfortunately, such an assessment will often come up empty because the safer technology *has not been invented yet*.

This absence of safer technologies changes the discussion. Protecting human health and the environment is not at odds with industry; rather, through green chemistry the two are aligned. There is a big difference between identifying alternatives and inventing solutions. Because of this reality, we must realize that alternatives assessment alone will not solve our problems of wasteful, hazardous processes and products. We require chemical regulation to help channel these alternatives to the marketplace. However, chemical regulation directing the use of safer, non-toxic alternatives will not succeed in solving the problems if new, innovative solutions are not being invented. The fact remains that most alternative technologies do not yet exist.

An example of this is the state of Washington's ban on the use of brominated flame retardants. Polybrominated diphenyl ethers (PBDEs) have been widely used as flame retardants in a number of consumer products. The heavy use of these materials has resulted in their being found in high concentrations in the human body, breast milk, and other biological systems [27]. PBDEs are bio-accumulative and pose a potential threat to humans and the environment [27, 28]. The state of Washington proactively approached this issue and successfully

passed a law[1] that phased out the use of PBDEs in a number of consumer products, with a focus on products used in the home [29]. However, the successful passing of a ban was not enough to effectively phase out the use of PBDEs. At the time the bill was passed, in April 2007, no alternatives had been identified for deca-BDE (one form of PBDEs) in upholstered furniture and in plastic used in televisions and computers; therefore, the legislature postponed the implementation of the ban on these uses until less toxic alternatives were available [30]. It was not until 2009 that safer alternatives were approved by the legislature, triggering the ban to take effect and phasing out the use of PBDEs in upholstered furniture and computers and televisions by January of 2011 [30]. Despite the successful reduction in the use of PBDEs in many consumer products in the state of Washington, the use of PBDEs continues in many products where suitable, effective alternatives do not yet exist. By focusing on green chemistry to help to invent safer, non-hazardous alternatives, we can ensure that the alternatives that are developed are indeed more benign than the traditional counterparts. As in the case of brominated flame retardants, it has been found that many times industry welcomes the ban of one form of PBDEs, and substitutes that banned form with another form of PBDE, therefore not actually removing PBDEs from the product, but instead changing the form (e.g., moving from deca-BDE to octa-BDE).

Another example of the need for viable alternatives in regulation is the case of asbestos; the regulation of asbestos has been debated for over 20 years, and a full ban has still not been implemented in the United States. In 1989 the EPA issued a ban and phase-out of asbestos, which was vacated and remanded by the US Fifth Circuit Court of Appeals in 1991. The Court determined that the EPA "failed to sustain its burden under TSCA section 6(a) of showing that the products banned by the rule present an unreasonable risk and that a less burdensome regulation would not adequately protect against that risk" [31]. The ban remained in effect only for new uses of asbestos and for products containing asbestos that were no longer being manufactured in the United States in 1989. There has been no further reversal on this decision, and any product that contained asbestos, and was being manufactured in the United States in 1989, can still legally contain asbestos, provided there is disclosure of the use.

These examples certainly are filled with controversy and there are many different views on the validity of statements on each side. And, the debate over the ban of asbestos still continues today [32, 33]. However, essentially we feel that if a viable alternative had been invented for asbestos then the discussion would end and the use of these materials would drop significantly. The Court of Appeals' decision clearly recognized the health impacts and the risks of asbestos

[1] The law bans the manufacture, sale, and distribution of three types of PBDEs in the following products only: televisions, computers, and residential upholstered furniture.

[31]. What was disputed was the "application of the least burdensome means of adequately protecting against the unreasonable risk" [34]. In this case, as in many other cases, if an efficacious, cost-effective, safe alternative material existed that could replace asbestos in each product where it is found, then this would lower the burden associated with banning a problematic substance and would allow for easier implementation of the safer alternative.

The revolution that is green chemistry proposes that instead of turning to lawyers and lobbyists to debate regulations and bans, we can instead turn to chemists and scientists to invent safer alternatives. Packaging traditional chemicals policies and calling them "green chemistry regulations" must be avoided. For example, a ban for phasing out asbestos or PBDEs should be called exactly that: a ban. Describing a ban and phase-out as a "regulation implementing green chemistry" is incorrect. For example, in California there has been a push for increased regulation of hazardous chemicals with the goal of safer products for consumers. This is a noble goal and certainly important. Many people have worked tirelessly to create regulatory language around a new initiative being called the "Green Chemistry Proposed Regulation for Safer Consumer Products" [35]. However, a close look at the proposed regulation and conceptual flowchart shows that the regulation would provide a structure for identifying chemicals of concern, understanding their hazards, and following up with an alternatives assessment, which would then provide a framework for a regulatory response. This is a wonderful and much-needed regulatory approach that will help to ensure the safest alternatives are available to consumers. Yet, it is not green chemistry. As stated previously, green chemistry is the *science* of inventing alternatives that reduce or eliminate the use or generation of hazardous substances. Therefore, it would be suitable to propose an alternative name to the California "green chemistry" regulation.

This is not to say that chemicals policy is not necessary and important; it is extremely important and very necessary. It is certainly a mistake to come to the conclusion that green chemistry is somehow an alternative to chemicals regulation. This is not the case. Society unequivocally needs stronger chemicals policies and regulations to protect human health and the environment. This fact allows no doubt or compromise. The point is that it will be much more difficult—or even impossible—for chemicals policy to be successful without having safer alternatives available first.

We find that when viable alternative technologies are available, chemicals policy is very effective in driving the adoption of these alternative technologies—for example, in the case of the catalytic converter. The 1988 California Clean Air Act is often cited as an example where chemicals policy "forced" industry to invent a technology. People point to this example with great (and justifiable) pride as the mechanism to bring about safer products. And in fact the chemicals policy was absolutely critical for the adoption of the catalytic converter by the auto industry. This mandated adoption of the technology enabled the reduction of

air pollution by staggering amounts [36]. This is an excellent example of how things can work. The mistake people make is in the timeline. The regulation did not cause the invention of the catalytic converter; it caused the adoption of the catalytic converter by the auto industry. The patent for the catalytic converter was filed in 1950 and issued in 1954 [37]. Invention and adoption are not the same. The technology to enable the catalytic converter had already been invented before the policy was enacted. The chemicals policy accelerated its use throughout the industry, along with implementing other methods for reducing smog and air pollution [36]. However, the policy did not accelerate its invention, but only mandated its adoption. When chemicals policy precedes invention of an alternative technology, it could in fact delay the invention, and certainly delay the passage of the regulation, as in the previously stated examples of asbestos and PBDEs. This is the reality of most cases that claim that policy drives innovation: when taking a closer look at the alternative technologies and the innovative timeline, we find that policy actually drives the *adoption of alternative technologies* and not the invention itself.

Chemicals policies and green chemistry research together can help to ensure the creation and adoption of green chemistry alternative technologies, but also they can help in identifying areas where no safer alternative exist. These policies also have the potential to influence much-needed educational reform, as will be discussed further.

EDUCATIONAL REFORM

In this article we have delved into the science of green chemistry and how it relates to chemicals policy. A key piece of successful implementation of green chemistry within industry and in our society is education. Sustainability as a theme is being introduced throughout educational systems. However, as was mentioned previously, our current educational systems lack training in fundamental environmental and toxicological concepts for chemists and scientists.

Thanks to the herculean works of people like Tony Cortese from Second Nature, and others, there has been a growing awareness of the need to introduce the concepts of sustainability on college campuses. Cortese's American College and University Presidents' Climate Commitment is a testament to catalyzing change [38]. At last count more than 670 college presidents had signed on to a pledge to review the infrastructure of their institutions, and commit to a path toward carbon neutrality. After years and years of hard work, Cortese's vision is becoming a reality.

When one visits most college campuses, one really gets a sense that they take sustainability very seriously. People working in the administration and facilities review utilities and services to minimize impacts. Recycling and waste reduction efforts are visible everywhere. It is spectacular to see this change happening. Some of the academic departments are even getting involved, with more and more

courses being offered in the realm of sustainability [39]. And as a result, more students today are taking these courses.

But in a way, the fact that many students are taking introductory courses in sustainability is a double-edged sword. While faculty from the humanities, social sciences, political sciences, business, environmental health, and perhaps biology and physics participate in the teaching of these courses, the chemistry faculty are, for the most part, absent. And the absence of these faculty members has serious implications. We need chemists at the table discussing these issues. It is one thing to identify the problems and consider social and political solutions. But at the end of the day, we need new materials and technologies to be *invented* to replace the existing technologies. If the conversation occurs without the inventors of the next generation of materials at the table, then we are missing the biggest part of the solution.

University dynamics are tricky. The work and effort of faculty, including eligibility for tenure, are typically calculated and rewarded within one department, making interdisciplinary efforts challenging. There is plenty of literature and discussion about this issue [40, 41] that does not need to be repeated here, but we do need to identify better mechanisms to break down the compartmentalization of education.

The focus on bringing sustainability into courses must include the practitioners of chemistry. In the academic year 2008–2009, U.S. colleges and universities that offer a chemistry degree approved by the American Chemical Society (ACS) granted 14,577 bachelor's degrees in chemistry, 1,986 master's degrees, and 2,543 doctoral degrees. Thus more than 19,000 students were trained in chemistry in the United States in just one year. More than 600 colleges and universities offer ACS-approved degree programs in chemistry [42]. Only one of these programs requires classes in toxicology or environmental impacts: the University of Massachusetts Boston's Ph.D. program [43, 44], from which two Ph.D. students graduated in the academic year of 2008–2009 [42]. Learning about how to identify and avoid using or making toxic materials is essentially absent from the education of chemists.

If a student is intending to have a career in environmental sciences or toxicology, he or she may have some coursework related to the mechanisms of toxicity. However, if a student wants to be an industrial chemist and get a job working at a company inventing new products, it is highly unlikely that he or she will *ever* have had a course about how to identify or avoid using hazardous materials.

There is a great need for an organized effort to bring green chemistry and sustainability into the education of a chemist. The ACS accredits chemistry programs for over 600 colleges and universities that offer chemistry degrees through the Committee on Professional Training (CPT). This accreditation is based on ACS guidelines developed by the Committee, which include the following requirements: curriculum coursework, undergraduate research, and

student skills development. The curriculum coursework includes introductory chemistry, analytical chemistry, biochemistry, inorganic chemistry, organic chemistry, and physical chemistry, along with in-depth coursework in these main areas and laboratory experience. The ACS CPT mentions green chemistry as an option for a degree track or concentration, recommending it as one option of several for an area of focused study [45]. However, the very nature of green chemistry is not to be a sidebar in a textbook, or a mere recommended course for a focus of study, but to be integrated into existing coursework and change the very nature of how we teach and study chemistry. By integrating green chemistry into each chemistry course and placing it at the center of a chemistry student's study, we can begin to change how students are trained, making them better prepared to enter the workforce with skills that will enable them to truly make more benign chemical products.

The good news is that chemistry education is changing, though it comes from a grassroots level. A growing network of green chemistry educators are sharing experiences and best practices through the Green Chemistry Education Network (GCEdNet) [46], an initiative led by Dr. Julie Haack from the University of Oregon, who is a leader in current thinking about green chemistry education. Through this network, informal regional networks have been formed based on a foundation of educators already implementing green chemistry in their courses and laboratories. Much of this work has been led by four-year academic institutions with forward-thinking faculty, such as Professor Irv Levy at Gordon College (Wenham, MA) and Dr. Rich Gurney at Simmons College (Boston, MA). Professor Levy has been teaching his organic chemistry course with green chemistry infused throughout the course for the past several years. He even integrates a student project, which he named GOLum for Green Organic Literacy Forum, where students take on a year-long project in the area of green chemistry. At Simmons College, Dr. Gurney teaches green chemistry throughout his organic chemistry course. He is also leading the effort to create a mechanistic toxicology course, which will be required of undergraduate chemistry majors at Simmons. To our knowledge, Simmons is the first college to require this of undergraduate students.

CONCLUSION

Green chemistry continues to grow and is being implemented in many laboratories around the globe. People often look for "success stories" and want to document examples of the use and implementation of green chemistry. The EPA's Presidential Green Chemistry Challenge Award has been in existence for 15 years, and more than 75 awards have been given out [47]. These case studies document some of the visible and public advances being made. But it is important to recognize that this is just the tip of the iceberg. There are significantly more success stories that are *not* being told, and for marketing reasons

an organization may choose to not broadcast its sustainability innovations (because in so doing it also broadcasts what it did before implementing greener, safer alternatives). In the end, for sustainability and green chemistry to be successfully integrated into all aspects of research, development, and manufacturing, the words themselves must vanish. Growing and nurturing a field is important in the early days. Green chemistry must mature to a point where its integration becomes seamless and unsurprising. There is still much to do with respect to academic adoption and curriculum development. The business case for green chemistry has been made. As time passes, markets change and technologies evolve. Some businesses and organizations adapt to change and thus thrive and grow, but others are incapable of such change and will require more support to transition to safer technologies and more sustainable science. The science of green chemistry is similar to many earlier innovations in technology and business: external incentives can help stimulate dissemination and education, but in the end it is up to the business or organization to embrace the change.

But there is still much to do. New materials and processes must be invented. To find solutions, we need new eyes and ideas focused on the problems. The collaboration between green chemistry and chemicals policy leaders can be powerful and effective if done through well thought out planning and strategy. And, by strengthening and reforming our educational systems to reflect the true needs of industry and our global society, we can ensure that the next generation of scientists in the workplace will be much better equipped to create materials and products that are truly sustainable.

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Documents

Editors Note: On May 5, 2011, the US Department of Health and Human Services held an Environmental Justice (EJ) Listening Session in Mobile, Alabama. The listening session was part of a government-wide Interagency Working Group on Environmental Justice to reinvigorate Federal government activities on EJ. This session sought input from communities in the Gulf Coast region of the United States. *New Solutions* was there and met representatives of the Gulf Restoration Network. We received permission to publish the following documents from the Gulf Future Campaign. A brief explanation precedes the documents.

The Gulf Future Campaign was created shortly after the BP Deepwater Horizon oil disaster of 2010 with a mission of providing the long-term support needed to protect the environment and the distinct culture of the Gulf Coast for future generations.

On October 4–6, 2010, ninety-five people representing forty-six communities, local, regional, national and international environmental, social justice, and fishermen groups met at the Beckwith Camp and Conference Center on Weeks Bay, Alabama. Together, we drafted the following set of goals and principles that we believe must guide the recovery and restoration of the Gulf of Mexico, our coast and our communities in the wake of the BP drilling disaster.

This March 2011, these organizations, joined this time by several more, reconvened to develop a plan for action. Building on the Weeks Bay Principles, we set out specific goals for making these principles a reality. These organizations continue to work together in a coordinated effort to bring about meaningful and effective restoration and recovery of our Gulf and our communities. The Gulf Future Unified Action Plan for a Healthy Gulf was released on April 20, 2011—on the one year memorial of the Deepwater Horizon explosion.

Visit www.gulffuture.org for more information.

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GULF FUTURE — UNIFIED ACTION PLAN FOR A HEALTHY GULF

One year after it began, BP's oil drilling disaster is not over. America's Gulf Coast is still suffering, and we need the support of the nation for a full and fair recovery. This is an on-going environmental and humanitarian crisis. BP's crude and toxic dispersants continue to impact the Gulf of Mexico and the Gulf Coast, poisoning people, killing wildlife, threatening ecosystems, and putting fishermen and tourism workers out of jobs. After a full year, Congress and the federal government have yet to adequately act to restore and protect the Gulf, and BP is working to minimize their liability and the perception of the severity of their disaster's impacts.

All along the Gulf Coast, however, communities, citizens, and non-profit organizations are coming together to address the crisis and restore our Gulf. We are a diverse group, representing fishermen, faith leaders, environmentalists, clean-up workers, and residents who live, work, and play on the Gulf Coast. We come from all five Gulf Coast states, and represent culturally and racially diverse communities.

We've all been impacted by the BP oil disaster, and together, we have come up with a way forward. The "Gulf Future: Unified Action Plan for a Healthy Gulf" addresses four areas of concern, marine restoration and resiliency, coastal restoration and resiliency, community recovery and resiliency, and public health. This plan represents our immediate goals—including specific demands of Congress, federal agencies, and the Obama administration—for a healthy and whole Gulf Coast. In the coming weeks and months, we will work together to realize these goals.

Marine Restoration and Resiliency: To provide that injury to the marine environment of the Gulf is fully assessed, we must ensure that (1) the Ecosystem Restoration Task Force is comprehensive (e.g., includes marine considerations), thorough, transparent, and participatory; (2) that the National Resource Damage Assessment (NRDA) process fully assess damage to the marine environment; (3) that there is funding for independent scientific research, and that there is ongoing monitoring and assessment of damage and restoration progress.

When future spills occur, local residents must be provided with access to impacted areas, allowing citizens and local officials' oversight of the response by responsible parties and the government.

The administration and Congress must take action now to implement the Oil Spill Commission recommendations, including the creation of a Regional Citizens Advisory Council to oversee future oil and gas activity in the Gulf, and prohibit the use of dispersant until found to be safe to the marine environment.

Gulf Coast leaders and residents who contributed to the Unified Action Plan gather near the water.

COASTAL RESTORATION AND RESILIENCY

1. 80% of Clean Water Act fines resulting from the BP drilling disaster must be directed to ecosystem restoration in the Gulf coast.
2. Federal and state restoration plans must support ecosystem and science-based strategies to increase ecological and community resiliency and sustainability.
   *These strategies must:
   a) Have measurable objectives that address root causes of degradation and injury
   b) Include a set of priorities on how to implement restoration projects, a timeline for implementation, and a process to evaluate their ecological effectiveness following implementation
   c) Incorporate stakeholder input in the decision-making process
3. All Gulf restoration efforts must have a governing structure to direct restoration efforts across agencies
4. Congress must act now to ensure the NRDA process is fully funded

Community Recovery and Resiliency: State and Federal government must build a shared resilience strategy for all communities to self-determine and engage in a meaningful way in the recovery of the Gulf Coast.

- Create a formal Community Advisory Mechanism that will contribute toward building resilient Gulf communities and a sustainable economy.
- Create and sustain community-based capacity to mitigate and respond to incidents.

State and federal government must create a sustainable and diverse economy by Gulf States leading the nation in incentives and investment in renewable energy industries.

- Ensure local communities can compete for jobs in this new economy by providing education, training and workforce development and giving preference to utilizing and benefiting local workers, businesses and institutions
- Restoration legislation must foster innovative collaborations for economic diversification, equitable and sustainable economic growth and new career pathways connected to Gulf Coast restoration, science and monitoring.

Public Health: Affordable, accessible health care must be made available at the county/parish level provided by well trained medical professionals who understand chemical exposure issues.

- Educate healthcare providers and the public on oil-spill related illnesses addressing both physical and mental health impacts.
- Track health impacts and illnesses through government studies and community efforts.

- Secure affordable, accessible and quality healthcare by opening community clinics, holding health fairs, requesting emergency clinics.

We must have an integrated environmental assessment program that monitors health and ecosystem risks on the Gulf coast for 10 years.

- Long-term monitoring of water, soil, air, and biota for oil-spill related contaminants by relevant state and federal agencies that addresses current gaps and is informed by community concerns.
- Public clearinghouse of environmental data that includes, agency monitoring and studies, academic research, community testing, and NRDA studies/results.
- Training and certification of Gulf Coast residents to conduct environmental monitoring.
- Independent review of the safety of dispersant chemicals and other oil treatments.

We must establish new comprehensive federal monitoring standards that guarantee safety of seafood eaten in quantities typical of Gulf Coast populations.

- Independent scientific review of Food and Drug Administration (FDA) Gulf seafood safety assessment methods.
- Revised standards for contaminant levels in Gulf seafood that protect vulnerable populations and reflect the full spectrum of oil-spill related contaminants (including metals and oil-range-organics).
- Long-term seafood monitoring program of state and federal waters.
- Revised education and outreach materials that identify and inform vulnerable populations.

WE SUPPORT THIS ACTION PLAN

Advocates for Environmental Human Rights
Alabama Rivers Alliance
Apalachicola Riverkeeper
Asian Americans for Change
Bayou Healers
Bayou Interfaith Shared Community Organizing
Boat People SOS
Bridge the Gulf Project
Citizens League for Environmental Action Now
Clean Water Network of Florida
Emerald Coastkeeper
Equity and Inclusion Campaign
Galveston Baykeeper
Guardians of the Gulf
Gulf Coast Fund

Gulf Islands Conservancy
Gulf Restoration Network
Immaculate Heart Community Development Corporation
Louisiana Bucket Brigade
Louisiana Environmental Action Network
Lower Mississippi Riverkeeper
Mary Queen of Vietnam Community Development Corporation
Mercy Housing & Human Development
Mississippi Center for Justice
Mississippi Coalition for Vietnamese-American Fisherfolks and Families
Mobile Baykeeper
On Wings of Care
Oxfam America
Robert F. Kennedy Center for Justice and Human Rights
Sierra Club
South Bay Communities Alliance
Southern Mutual Help Association
Southwings
South Walton Community Council
Steps Coalition
Surfrider Foundation
TEJAS
Turkey Creek Community Initiative

THE WEEKS BAY PRINCIPLES FOR GULF RECOVERY

On October 4–6, 2010, ninety-five people representing forty-six community, local, regional, national and international environmental, social justice, and fishermen's groups met at the Beckwith Camp and Conference Center on Weeks Bay, Alabama. Together, we drafted the following set of goals and principles that we believe must guide the recovery and restoration of the Gulf of Mexico, our coast and our communities in the wake of the BP drilling disaster.

Our Collective Goal: Six months after the BP oil disaster began, the diverse communities that live, work, and derive benefit from the Gulf call on government to take responsibility to:

- Make coastal communities whole again;
- Commit to cleaning up and restoring the Gulf;
- Hold BP accountable;
- Ensure local participation in decision-making;
- Conduct short and long-term monitoring; and

- Invest in economic opportunities to support locally-driven, sustainable recovery that restores and enhances America's Gulf coast.

The oil is still here and so are we: Fundamental Guidelines In all of our work together we will be guided by the following axioms:

- Build confidence and trust
- Be inclusive
- Act and communicate with full transparency
- Ground decisions in science

COMMUNITY RECOVERY

1. Growing and diverse constituencies of Gulf residents and organizations recognize that the future of their livelihoods depends on Gulf restoration. Seventy-three percent of voters in Gulf coast states support comprehensive coastal restoration*.
2. The people of the Gulf coast whose way of life and livelihood has been most affected by the BP disaster must have a seat at the decision-making table.
3. Recovery and restoration efforts must create tens of thousands of new jobs and provide economic opportunities to local communities, particularly disadvantaged and distressed communities.
4. Recovery must put our communities to work restoring the Gulf and building a healthy economy—leading America into a renewable energy future.

PUBLIC HEALTH

1. Tens of thousands of response workers, community members and tourists have been exposed to oil and dispersants. There is a lack of health care providers who are trained to identify and treat chemical illnesses. We need the Center for Disease Control and National Institute of Health to provide our local health care departments with the training and resources to provide the needed health care.
2. There are still millions of gallons of oil and dispersants in the environment – while officials tell us that the water and air are fine, people continue to be concerned and report health symptoms. We need federal funding for independent, ongoing and long-term monitoring of our water, soil and air across all affected areas so we can be assured if and when the environment is clean.
3. The Gulf Coast provides 86% of the U.S. shrimp harvest, and 56% of the U.S. oyster harvest* – and we need better evidence that it's safe. Current monitoring is inadequate and does not test for toxic heavy metals or dispersants. It does not protect our children or our most vulnerable populations. We need the Food and Drug Administration to set monitoring standards that can guarantee the safety of the food we harvest and eat.

COASTAL RESTORATION

1. The BP disaster is only the latest, most visible evidence of environmental destruction that has been ongoing in the Gulf for decades.
2. The government must act now to restore our coastal wetlands. A healthy Gulf is a prosperous Gulf crucial to storm protection, fishing, recreation, seafood and tourism – the cornerstones of the Gulf culture and economy.
3. Eighty percent of the coastal wetlands lost in our country are lost in the Gulf coast*. For example, Louisiana loses a football field of wetlands every 45 minutes**, and 40% to 60% of that is attributed to oil and gas activity***. BP and the oil and gas industry must pay their fair share for coastal restoration.

*Turner, R.E. 1997. Wetland loss in the Northern Gulf of Mexico: Multiple working hypotheses. Estuaries. 20:1–13.

**Dahl, T.E. 2006. Status and trends of wetlands in the conterminous United States 1998 to 2004. U.S. Fish and Wildlife Service. p 54, Table 4.

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MARINE RECOVERY AND RESILIENCY

1. The first step to recovery of the Gulf marine ecosystem is to identify all sources of past, present and future environmental degradation, including fully understanding the long-term impacts of the BP oil disaster. Specific restoration initiatives, both short and long-term, must be implemented to address all sources of marine injury.
2. Robust monitoring programs that fully disclose process and results, as well as access to impacted areas, are critical for ensuring effective restoration.
3. In order to restore the entire Gulf ecosystem, it is essential that the off-shore environment receive its fair share of attention and funding for recovery. Specific funding sources for this work must be provided immediately.
4. Everything possible must be done to prevent offshore drilling disasters. Reforms in policy, regulations, oversight, and enforcement are urgently needed to prevent more drilling disasters and to guarantee rapid, non-toxic and non-destructive response and clean-up when accidents do occur. Policies must be implemented that transition the Gulf region to a clean, renewable energy economy.

CONCLUSION

The Weeks Bay Principles for Gulf Recovery present a unified vision that will guide our work towards restored and healthy natural resources in the

Gulf of Mexico region that support Gulf communities and wildlife, the region's unique cultures, and the nation.

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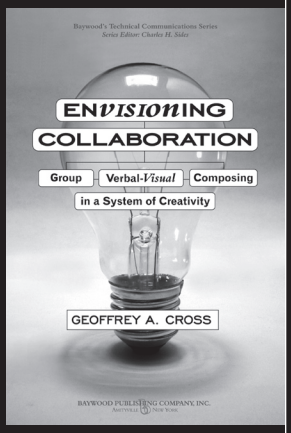

EN*VISION*ING COLLABORATION

Group Verbal-*Visual* Composing in a System of Creativity

GEOFFREY A. CROSS

The dissemination of desktop publishing and web authoring software has allowed nearly everyone in industrialized countries to combine verbal and visual symbols into text. Serious multi-modal projects often demand extensive teamwork, especially in the workplace. But how can collaboration engaging such different traditions of expression be conducted effectively? To address this question, En*vision*ing Collaboration traces the composing processes of expert graphic artists and writers preparing advertising campaigns to retain a vital national account. It examines the influences on individual and dyadic composing processes of what Csikszentmihalyi terms "the domain," in this case the disciplinary knowledge of advertising, and "the field," in this case the surrounding economic conditions and client, vendor, customer, and agency executive gatekeepers.

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— Charles Kostelnick, Professor and Chair
English Department, Iowa State University

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