

The role of chemical policy in improving supply chain knowledge and product safety

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Abstract Although the US government has made important improvements in chemical management since the 1970s, these advances have not kept pace with scientific knowledge about chemical hazards. While US federal chemical policy reform is being debated for the first time since 1976, some US businesses have voluntarily sought to improve their knowledge of chemical hazards in their supply chains, and several US states, the European Union, China, and other countries have moved forward with chemical policy reforms. Until policy reforms occur in the USA, the US chemical market will continue to experience problems associated with poor information on hazardous chemicals in supply chains. These market conditions make it difficult for consumer product companies to identify hazards and create safer products. Results from interviews with consumer product company representatives demonstrate that challenges in obtaining chemical-related information exist across sectors, and information on chemical hazards and uses can be conflicting, protected by trade secrets, lost in supply chains, or nonexistent. Interview results illustrate how some consumer product companies are exceeding regulatory requirements by voluntarily restricting from their

products chemicals that could harm human health or the environment. Understanding the motivations behind—and barriers to—these actions could inform efforts to modernize US chemicals policies in ways that promote effective chemical management in supply chains. Using examples from the European Union and some US states, we introduce policy suggestions that would increase knowledge, market transparency, and information flows regarding hazardous chemicals and their uses; these would support the efforts of companies to develop and market safer products.

Keywords Chemicals · Consumer products · Supply chains · Information asymmetry · Market failure · Human and environmental health

Introduction

Industrial chemicals have become a central part of modern life, contributing to improvements in society's infrastructure and advances in medicine and technology. Since 1979, more than 84,000 chemicals have been registered for use in the USA (USEPA 2010), with over 700 newly registered chemicals entering commerce each year (USGAO 2005). Along with the significant increase in chemicals in commerce comes the need to better understand and prevent their potential adverse effects on human health and the environment.

The Toxic Substances Control Act (TSCA) of 1976, which governs the manufacture, importation, distribution, and use of industrial chemicals, was intended to give the US Environmental Protection Agency (EPA) the authority to (1) obtain hazard and exposure information from chemical manufacturers, and (2) regulate chemicals that pose an “unreasonable risk” to human health or the environment (USEPA 2010; USGAO 2005). In practice, however, shortcomings in the law have severely limited EPA's ability to meet these

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objectives; only four existing chemicals or chemical classes have been successfully restricted under TSCA's formal rule-making process since its passage, and EPA has been able to require chemical producers to conduct safety testing on an additional 200 out of the tens of thousands of chemicals in commerce (Denison 2009; Wilson and Schwarzman 2009). Thus, over 35 years after the passage of TSCA, substantial knowledge gaps exist about the health and environmental effects of the great majority of chemicals on the market.

As a consequence of TSCA's weaknesses, chemicals suspected of being hazardous have remained on the market and are found in numerous consumer and commercial products, including some to which children would likely be exposed (e.g., Shapiro 2007; Stapleton et al. 2011; Taylor 2010). Downstream businesses that purchase and use chemicals have been left on their own with the burden of identifying and managing potentially hazardous chemicals in their supply chains. Meanwhile, the Centers for Disease Control and Prevention have detected hundreds of industrial chemicals in a representative sample of American children and adults (Centers for Disease Control and Prevention 2009). Many of these chemicals have been linked to adverse health effects, but for the majority, there is too little information to understand their potential for long-term harm (e.g., Wilson and Schwarzman 2009; Woodruff et al. 2011). Despite the challenges in establishing a cause and effect relationship,¹ experts estimate that the environmental contribution to disease may explain a quarter to a third of the global disease burden (Bergman et al. 2013; WHO 2013). In addition to human health effects, environmental contamination continues to erode biodiversity and ecosystem health worldwide (e.g., Falconer et al. 2006; Schwarzman and Wilson 2009).

This paper presents a brief analysis of TSCA's weaknesses, followed by examples of governmental and voluntary initiatives that aim to improve chemical management. We then summarize recent research that demonstrates the impacts of weak chemicals policies on proactive businesses and the limitations of voluntary initiatives. The research results provide insights into the gaps that exist in current laws and how those laws might be strengthened. Based on these findings and analysis of different policy options, we offer suggestions on how policy improvements could help shift the chemical market in ways that would lead to investments by industry in the design of safer chemicals, and—over time—reductions in the health and environmental impacts of toxic substances.

¹ Linking specific chemicals used in consumer products to negative effects in humans or wildlife can be challenging because the effects may manifest years after exposure, or they may appear in the exposed organisms' offspring. Assessing exposure retrospectively is inherently inexact. In the context of human exposure, there may also be synergistic, additive, or antagonistic effects at play (Carpenter et al. 2002).

TSCA's limitations

Information on the hazards and uses of many chemicals has been difficult to collect because TSCA “grandfathered” the approximately 62,000 chemicals in use at the time of its enactment, exempting them from toxicity screening requirements. Even for chemicals introduced after TSCA's passage, producers are not routinely required to generate and disclose to EPA information about their potential hazards or risks (USGAO 2005, 2009; Wilson and Schwarzman 2009). Further, chemical producers can claim much of the data submitted to EPA under TSCA as confidential business information, thereby concealing it from consumers, workers, government officials, emergency responders, and consumer product manufacturers.

Chemical hazard assessment and risk management by EPA are hampered primarily because TSCA's legal and procedural requirements impede the Agency's ability to both control and require industry testing of chemicals suspected of presenting risks to health or the environment (USGAO 2009; Wilson and Schwarzman 2009). Instead of chemical producers, it is the EPA—at public expense—that is assigned responsibility under TSCA to gather data sufficient to assess chemical hazards (USGAO 2005; 2009). In assigning EPA the “burden of proof,” TSCA requires the agency to meet a high standard of evidence—one that is virtually unreachable using the tools of modern science. Thus, few of the approximately 84,000 chemicals in commerce have been tested or restricted since TSCA's enactment, and EPA has resorted to encouraging business participation in voluntary chemical management programs, in place of regulatory action (USGAO 2005; Wilson and Schwarzman 2009).

Organizations across the political spectrum, from health and environmental advocacy groups to the chemical industry, now agree that TSCA should be modernized, though exactly what form a new law should take is contested (Hogue and Erickson 2012). TSCA reform legislation has been introduced in both Houses of the US Congress during the past several years, though no legislative reforms have been passed.

Notable government responses to chemical policy gaps

New regulations in Europe have emerged as an example of what is possible for comprehensive chemical management. Individual US states have also taken the initiative to create their own chemicals policies, which range from individual chemical bans to more far-reaching programs.

Europe's REACH

In response to problems with weak chemicals policies that mirrored the problems of TSCA, the European Union passed

sweeping 2006 legislation on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH). The law applies to all chemicals (both new and existing), including those in mixtures and articles, produced in or imported into the European Union. Because REACH extends to imports, the law has received considerable international attention. Businesses around the world must comply as a condition of retaining access to the European market. Other countries, including China, India, and Japan, are using REACH as a model for their own chemicals policies, which is leading to a global shift in chemical management.

REACH requires information reporting by companies that produce or import chemicals in quantities greater than 1 t/producer/year; data and information reporting requirements are phased in through 2018 and tiered according to the volume and type of chemical that is produced or imported (REACH 2006). REACH differs from TSCA in important ways as follows: (1) chemical producers must provide basic information on the identity and chemical properties of their products as a condition of access to the European market; (2) producers of chemicals designated as “Substances of very high concern” are required to gain authorization from the European Chemicals Agency for continued use; (3) at minimum, basic information on chemicals must be communicated in supply chains to allow for safe use; and (4) substitution of chemicals of concern with less dangerous alternatives is encouraged, and in some cases required, when viable alternatives exist (REACH 2006; Schwarzman and Wilson 2009).

Prior to passage of REACH, the European Commission estimated that the regulation could yield potential long-term public health benefits that outweigh projected costs to industry tenfold (European Commission 2003). Five years after REACH’s enactment, the Commission conducted a review to ensure that the regulation was on track to achieving the expected benefits. In short, the Commission believes that REACH is functioning well and has made chemical use in the European Union safer due to increased availability of chemical-related data and improved risk management. However, it identified several areas needing adjustment. Chief among these were the need to improve the quality of data submitted by industry and better enforcement of the regulation by Member States (European Commission 2013).

US state activities

In reaction to perceived policy voids at the federal level, more than 900 chemical-related initiatives were proposed or enacted by state and local governments between 1990 and 2009 (Schifano et al. 2009). In 2012 alone, lawmakers in 28 states considered legislation to reduce their residents’ exposures to potentially hazardous chemicals in consumer products; the proposed legislation ranged from phasing out certain flame retardants and bisphenol A, to requirements that manufacturers

disclose product ingredients to consumers (Hogue 2012). Several states, including California, Maine, Massachusetts, and Washington, are moving toward more comprehensive chemical management policies that aim to increase information availability, identify chemicals of concern, promote green chemistry education, implement strategies for assessing alternatives, and expand pollution prevention.

State actions can affect federal regulations and industry operations alike. As illustrated by the federal Toxics Release Inventory, which was based on Maryland and New Jersey programs, successful state-based initiatives can provide models for federal programs (Rabe 2010). But while state-based programs can serve as important progenitors and are sometimes necessary in their own right (Denison 2009), states generally do not have the regulatory influence to reform an entire industry, and—from industry’s perspective—chemical regulations that vary dramatically among states can complicate interstate commerce and industry operations. As a consequence, business organizations historically have preferred uniform federal policies (Hoffman 2001).

Voluntary responses to chemical policy gaps

US federal government programs

EPA has launched some 50 voluntary programs since the mid-1980s that ask industry to provide information that the agency cannot access through regulatory channels (Press and Mazmanian 2010). Many of these programs have one of two general goals: collecting data on health and environmental hazards or encouraging pollution prevention. Programs in the first category have typically struggled for lack of participation and data disclosure. For example, the High Production Volume (HPV) Challenge program² “challenged” chemical companies that produced or imported the greatest quantities of chemicals to make publically available certain data on their products’ health and environmental effects (USEPA 2013a). However, the program has been criticized for poor data quality, significant delays in promised data, and hundreds of “unsponsored” chemicals (Denison 2007). Programs encouraging pollution prevention have arguably had more success, though their impact is harder to assess. For instance, Design for the Environment (DfE),³ which relies on EPA collaborations with industry, environmental groups, and academia to advance safer products and green chemistry, has engaged numerous partners since 1992. Over 2,500 products, mostly cleaners and detergents, carry EPA’s DfE logo (USEPA

² See <http://www.epa.gov/hpv/for> more information on EPA’s HPV Challenge program (EPA 2013a).

³ See <http://www.epa.gov/dfe/for> more information on EPA’s DfE partnership program (EPA 2013b).

2013b); while a laudable achievement, it is difficult to gauge its overall impact on health and the environment given the vast number of products on the market.

Private sector initiatives

The private sector has also responded to the aforementioned gaps in chemical regulations. Some chemical producers and chemical users (e.g., consumer product companies) have designed and adopted chemical management programs that suit their needs and interests.

While chemical producers and their trade associations have historically resisted chemical policy reforms (Hogue 2009; Press and Mazmanian 2010), the industry has also suffered from a negative public image (McCoy 2011). In an attempt to address both of these issues, the International Council of Chemical Associations launched the chemical industry's voluntary Responsible Care[®] program shortly following the 1984 Bhopal disaster. Responsible Care[®] requires member companies to take actions that would make their operations and products safer and more sustainable (International Council of Chemical Associations 2010). However, critics charge that the initiative was created for the sole purpose of repairing damage to the industry's reputation and avoiding or softening possible regulations (Hook 1996; King and Lenox 2000; Press and Mazmanian 2010). Researchers have found that Responsible Care[®] members do not have superior environmental performance compared to non-members, largely because—in the absence of sanctions and other penalties—opportunistic behavior appears to override institutional pressures for self-regulation (King and Lenox 2000). Further, since the program operates in tandem with industry lobbying to weaken public health and environmental legislation, it is not widely viewed as a credible force for improving health and environmental protections (Press and Mazmanian 2010).

Some individual US chemical companies are voluntarily responding to the lack of available chemical-related information. For example, Dow and DuPont have made their products' Material Safety Data Sheets (MSDSs) available online (Dow 2010; DuPont 2010). While MSDSs may be useful in certain circumstances, they have been criticized for lacking substance and depth (Nicol et al. 2008), and many consumer product companies do not consider MSDSs to be a useful tool for informing the design of safer products (Scruggs and Ortolano 2011).

Consumer product companies, especially those with highly visible brands, have strong incentives to avoid or reduce hazardous chemicals associated with their products (Seuring and Müller 2008). Despite these incentives, even highly motivated consumer product companies face significant barriers to eliminating hazardous chemicals from their products and manufacturing processes. Most notably, the paucity of available data on chemical hazards and the lack of communication

on chemical use in supply chains hinder their ability to identify hazardous chemicals and select safer chemicals for substitution (Guth et al. 2007).

Learning from proactive consumer product companies' experiences

We conducted an interview-based study to examine: (1) the challenges that consumer product companies face in making safer products, and (2) the strategies to improve chemical management that some proactive companies have voluntarily adopted. We interviewed environmental managers from a diverse set of multinational companies that several non-governmental organizations and government agencies⁴ considered to be leaders in chemical management. Sampling was not representative since the interview set included only the willing participants from a small group of proactive companies identified by governmental and nonprofit entities. Twenty companies from the USA and Europe were included in the sample; data were gathered in 2009, before the European companies experienced any benefits of REACH, so their situation then was comparable to that of US companies today.

The sample included companies from a wide array of business sectors that we grouped into the following five categories: telecom and IT, apparel, retail, construction and home goods, and transportation. One or two environmental managers from each company were interviewed, depending on whom had the kinds of company-specific knowledge needed to participate. Each interviewee was personally involved in designing and/or implementing the chemical management program for his or her company, and most interviewees had science backgrounds.

Interviewees participated in in-depth, semi-structured interviews that were typically 60–80 min in length. Thirteen interviews were conducted in person and the remaining seven were conducted by telephone. Each interview was digitally recorded and transcribed. The transcriptions were systematically coded and analyzed using HyperRESEARCH[™] software.

The interviews provided insights into gaps in chemical regulations and the information and tools companies need to fill those gaps in order to produce goods that are safer for health and the environment. Findings relevant to the argument of this public policy research paper are summarized below.⁵

⁴ These non-governmental organizations and government agencies specialized in working to protect human and environmental health from hazardous chemicals. They worked with companies on chemical management issues, and had knowledge of companies' proactive chemical management strategies that was not publically available.

⁵ For extensive details on all research results, see Scruggs and Ortolano (2011) and Scruggs (2013).

Challenges in obtaining information

All of the companies we interviewed faced challenges in obtaining chemical-related information. Quite simply, they had difficulties identifying the chemicals in their materials and products because such information was not routinely communicated to them in useable forms in their supply chains. Companies tried to obtain this information from actors throughout their supply chains, and some tested random samples of materials and products to verify that certain undesirable chemicals were not present. Other companies resorted to requiring full material disclosure from their suppliers, sometimes enforcing penalties for noncompliance (e.g., not allowing suppliers to be paid until all necessary data had been provided).

Companies also had problems accessing complete and reliable information about hazards associated with chemicals they used or wanted to use in their products. Interviewees said that they searched for this information using numerous external resources: the internet; materials safety data sheets (though most companies did not find them to be very useful); proposed regulations around the world; government studies on the hazards associated with certain chemicals; industry associations; peer-reviewed literature; non-governmental organization (NGO) campaigns; media reports; consumer associations; databases (e.g., the Toxicology Data Network (TOXNET)); expert lists and classifications (e.g., the Substitute It Now List and California's Proposition 65 List of Chemicals); independent certification schemes (e.g., Oeko-tex® and GUT); and independent consulting scientists. This approach to finding chemical hazard information was complicated by the fact that information from different sources could be conflicting or confusing, and information regarding a chemical's safe use could be unknown or unclear for a given application. Interviewees also explained that the information they sought often could be unavailable, protected by trade secrets, or "lost" in supply chains.

Interviewees characterized their companies' supply chains as vast and complex, which exacerbated their information-gathering challenges. Most interviewees encountered communication problems in their supply chains and felt that transparency was lacking. Another frequent complaint was the lack of common systems to effectively manage and communicate chemical information in their supply chains. Interviewees found that regulations and tools that might simplify production of safer products, such as standardized data sheets and internationally recognized test methods, were either inadequate or nonexistent.

These findings document the types of chemical-related information deficits and needs experienced by consumer product companies across sectors that prevent them from making informed purchasing decisions based on complete information. Companies not only struggle to obtain information about

the identities of and hazards associated with the chemicals they want to use in their products, but, as a consequence, also have difficulty identifying safer substitutes for chemicals of concern. This hinders companies' abilities to innovate safer products.

Proactive chemical management practices

The 20 companies created their own chemical management strategies to improve their awareness and minimize their use of currently unregulated, but potentially hazardous, chemicals in their products. Each company's chemical management strategy was unique, tailored to suit its products and needs, and based on data the company collected for its own use.

The elements of the companies' chemical management strategies generally focused on either: (1) finding or generating data about chemical hazards and making those data more user friendly for internal use, or (2) enhancing communications with the many actors in their supply chains. Companies reported that many of the elements from the first category were useful in minimizing potentially hazardous chemicals in their products. Examples included: restricted substance lists, which comprised unregulated, but potentially hazardous, chemicals that were forbidden from use by suppliers; chemical phase-out programs and research on safer substitute chemicals; searchable databases including information about chemical hazards and uses to streamline chemical management; and risk management and assessment tools to help determine which chemicals were appropriate for different applications. The value of these strategies was limited by the quality of the data the companies were able to collect, which depended, in part, on the resources the company was willing and able to put toward data collection.

To improve the communication of chemical information in supply chains, companies used a variety of approaches, including the following: supplier training on chemical use and reporting; forms that asked suppliers for specific information (and in some cases full disclosure) about the chemical content of supplied materials and products; and product testing or supplier audits to verify that supply chain communication on chemical use worked as planned. Based on the interviewees' communications with suppliers and interactions with their competitors, they did not perceive such practices to be routine for most consumer product companies; these practices are therefore considered to be innovative here.

The interviews also revealed the broader supply chain challenges companies faced in implementing their voluntary chemical management programs. In order to create programs that produced both adequate communication in the supply chain and reliable data, companies with effective strategies devoted a continual stream of resources to training suppliers, staying abreast of new chemical data, and refining company strategies as new information surfaced.

Motivations for minimizing potentially hazardous chemicals in consumer products

The interviewees could not predict which chemicals would eventually be found to be dangerous or become the focus of NGO or media campaigns. Thus, they designed their chemical management strategies to restrict the use of, or find substitutes for, as many potentially hazardous chemicals as possible. Many interviewees described how their strategies helped them “stay ahead” of regulations, which allowed them to work at their own pace, maintain product quality, and ensure access to needed resources. Interviewees described watching their competitors react to new regulations: they struggled to find solutions and lost sales in the process, as it can sometimes take years to find safer substitute chemicals. Interviewees also said that avoiding negative publicity was critical to protecting their companies’ corporate reputations. Many of the companies had either: (1) suffered the consequences of negative publicity in the past, or (2) conducted surveys to learn that their customers expected them only to sell products that were safe and ethically sound and trusted the companies to deliver on this expectation. Companies used elements from their chemical management strategies (described in the previous subsections) to try to ensure that dangerous chemicals did not end up in their products, since this could lead to damaging media coverage, NGO actions, and loss of consumer confidence.

While proactive consumer product companies worked to build trust with informed stakeholders, such as NGOs and government entities, most of the companies handled relationships with consumers differently. Companies generally did *not* aggressively advertise their chemical management strategies directly to consumers, largely because they did not want to awaken scrutiny about product safety by disrupting the “taken-for-granted” consumer belief that consumer products are safe.⁶ Several interviewees said that most of their customers did not think about the fact that consumer products are composed of chemicals. Some companies also wanted to avoid alarming customers with older model products about chemical eliminations from newer models. Other interviewees described watching their competitors advertise and launch “green” products: the products were harshly criticized by NGOs for not being “green enough,” prompting withdrawal of the products from the market. This is not to say that the interviewed companies lacked transparency around their chemical management activities—they included information about chemicals and product safety on their websites and provided multiple avenues for customers to ask questions and make comments. But in general, in an effort to avoid an association between chemical-related problems and their products, companies kept their chemical management work

in the background. This is an unusual strategy for brand differentiation, reputation protection, or gaining a competitive advantage, in that it derives from a desire to avoid negative attention. These findings illustrate the ways in which current chemicals policies disincentivize an open dialogue around improving product safety.

Looking to the future of US chemicals policy

Traditional risk assessment approach to regulation

Agencies such as the US EPA have historically used a probabilistic risk assessment approach to make regulatory decisions. The approach includes three sequential steps: (1) *research*—collect available scientific data on a chemical’s adverse health and environmental effects; (2) *risk assessment*—gather information regarding exposure levels and likely consequences; and (3) *risk management*—consider regulatory alternatives and propose a plan (Rosenbaum 2014).

There is uncertainty inherent in the information underlying each step of this approach. Not surprisingly, in light of the shortcomings of TSCA, data are usually missing, incomplete, or extrapolated from animal models; long-term adverse health and environmental effects are often unknown (since many chemicals have come onto the market only recently) and chronic effects can be difficult to study. At the same time, the risk assessment approach to decision-making requires high levels of scientific evidence to justify regulation and allows for delayed action based on scientific uncertainty. For these reasons, Ashford (2007) argues that the approach benefits industrial and producer interests while undermining public health and the environment. In the context of an often-contentious political process that typically includes the prospect of judicial review, sorting out the science can take years, if not decades (Rosenbaum 2014). In the meantime, hazardous chemicals remain on the market.

Limitations of voluntary approaches

Reliance on voluntary approaches to chemical management perpetuates a classic source of market failure: information asymmetry.⁷ In this case, chemical producers have more information about the chemicals they sell than they are required to disclose to the downstream manufacturers of consumer products that use those chemicals. In a well-functioning market, chemical producers would respond to downstream companies’ needs and preferences for additional information, which would enable those companies to make more informed decisions and, potentially, use that information to manufacture

⁶ See Suchman (1995) for more on the notion of taken-for-granted beliefs.

⁷ See Reinhardt (1999) and Rosen and Gayer (2008) for more on information asymmetries and market failure.

safer consumer products and identify safer substitutes (Guth et al. 2007).

Furthermore, while voluntary approaches may reduce hazardous chemicals in some companies' products, they are *inefficient* from a societal perspective. Voluntary schemes require each company to individually research and assess (sometimes confusing and conflicting) information about each chemical they use and make individual determinations regarding the chemical's safety under a range of possible exposure scenarios. Companies duplicate each other's work and, because of gaps in both chemical hazard information and technical knowledge at the company level, may come to different conclusions about the risks to health and the environment from chemicals in their products. Relying on voluntary approaches is also *incomplete*; despite the actions of some industry leaders, the great majority of consumer product companies are not investing resources in voluntarily gathering the additional information they need to improve product safety.

In brief, absent requirements that chemical producers and other upstream actors in supply chains communicate adequate information about chemical hazards to their buyers, consumer product companies are left with two choices: do nothing, or pay the costs of developing ad hoc approaches to chemical management. Only a handful of proactive companies appear to be taking the latter approach.

A regulatory approach grounded in the precautionary principle

The limitations associated with managing chemicals using a risk assessment approach have led some to advocate use of the precautionary principle. Since obtaining scientific certainty regarding a chemical's harmful effects is difficult, if not impossible, to establish in a timely manner, a precautionary approach to regulation opts for preventive action based on the best available data, before exhaustive studies have been completed and widespread harm has occurred (Ashford and Miller 1998). This approach also shifts the burden of proof to chemical producers to demonstrate that their products are reasonably safe, and facilitates the movement toward safer chemicals and processes through improved transparency (Rosenbaum 2014). Such improvements in information flows would enable consumer product companies to: (1) understand hazards associated with the chemicals in their products, (2) determine chemicals' suitability for different product applications, and (3) identify or develop safer alternatives.

Scholars have demonstrated that the precautionary principle can guide decision-making in the face of uncertainty to spur innovation and economic growth. By using all available evidence to encourage full consideration of uncertainties and thorough assessment of alternatives, the focus shifts from problem characterization to solution identification (Tickner et al. 2003; Tickner and Geiser 2004). For example, this

approach challenges chemical users to fully understand their use of chemicals and materials in order to analyze options that exclude potential hazards. New chemical substances or technologies may be identified, which accomplish the same objectives as those they are replacing, but without the hazards (Tickner et al. 2003). Further, alternatives assessment has proven to lead to outcomes that are both economically advantageous and beneficial to public health and the environment (Tickner and Geiser 2004; Zwetsloot and Ashford 2003).

Improving the quality and transparency of information on chemicals is prerequisite to stimulating market demand for, and innovation of, safer substances. It also helps governments identify, prioritize, and take action on chemicals that pose risks to health and the environment. The European Union's REACH regulation illustrates how producers of chemicals and materials can help close data gaps about the hazards and risks of tens of thousands of chemicals on the market for which there is currently little publicly available information.⁸ REACH also demonstrates approaches to improving communication of information about chemical identities, properties, and uses through supply chains so that exposures and risks can be better understood. Policymakers in the USA would benefit by examining REACH's potential for addressing the deficits in US chemical policy and evaluating its ability to support consumer product companies in making safer products.

In brief, the interviews conducted with consumer product companies demonstrated a need for chemical hazard information in useable forms, as well as tools to improve communication of chemical information in supply chains. These are needs to which US policy makers can respond; improving the quality and transparency of chemical information would help reduce persistent information asymmetries and thereby improve the economic efficiency of resource allocations.

Based on the interview results described above and previously developed theoretical arguments for chemical policy reform (Schwarzman and Wilson 2009; Wilson and Schwarzman 2009), Table 1 summarizes elements of TSCA reform that—if enacted—would support the efforts of consumer product companies to develop safer products.

Precautionary approaches in action

In the European Union and in some US states, new chemicals policies are increasingly informed by precautionary approaches. In both contexts, governments are taking steps to improve information transparency, promote safer alternatives, and shift the burden of proof to chemical producers. The results of our interview-based study, discussed above, suggest that these actions would improve the ability of proactive

⁸ See Denison (2009) for recommendations on ensuring credibility of industry-generated data.

Table 1 TSCA reform features that would support creation of safer consumer products

	Current US chemicals policy	Goals for reformed US chemicals policy
Information on chemical hazards	Not required of companies, tightly controlled, centralized, redacted, incomplete, non-standardized	Required, transparent, distributed throughout markets, comprehensive, standardized
Generator of hazard information	Government, at public expense	Producers, at industry expense
Burden of proof	Assigned to government to prove a risk	Assigned to producers to demonstrate reasonable safety
Default marketing assumption	Producer places products on the market, awaits government to find and prove risk	Producer demonstrates safety of products to government as a condition of market access
Key drivers of the chemical and product market	Function, price, performance	Function, price, performance, safety
Trigger for government to take action	Demonstrable damage to health or environment, clear evidence of cause and effect	Best available data, balance of evidence, early warnings of harm, action despite uncertainties
Overall objective	Government to identify, target, document, legally defend, and eventually reduce the production and sale of the most toxic chemicals on the market.	Government to improve transparency and accountability in the market to reduce the competitive advantage of toxic chemicals and open opportunities for the design of new classes of chemicals and products that are safer for health and the environment

downstream companies to assess the safety of chemicals and chemical products in their supply chains.

Closing data gaps and addressing information transparency

REACH's registration provision makes the reporting of basic chemical identity and hazardous properties a condition of entry to the European Union market for tens of thousands of chemicals. The data emerging from REACH registrations, including expanded data for higher volume and higher hazard chemicals, and the communication of information in supply chains, stand to significantly increase the amount of chemical hazard information available to companies, and—potentially—to the public.

Information transparency is also promoted by Washington State's 2008 Children's Safe Products Act. It created an online database in which manufacturers report on the presence of 66 "chemicals of concern" in products made or marketed for children. Washington expects that the availability of information on hazards in children's products could lead to a "virtuous cycle" of disclosure, assessment, and product improvement (Washington State Legislature 2013).

Promoting substitution with safer alternatives

Under California's Safer Consumer Products (SCP) Regulations, the state's Department of Toxic Substances Control is in the process of:

- Establishing a set of chemicals of concern,
- Identifying consumer products that contain those chemicals, and
- Requiring producers or retailers of those products to analyze alternatives to chemicals of concern so that safer processes or chemicals can be used.

The SCP regulations establish criteria for comparing impacts of potential alternatives and ask companies to investigate solutions, including the possibility of completely eliminating chemicals of concern from their products (California Department of Toxic Substances Control 2013). While the SCP regulations do not produce new chemical hazard information, and the scope will likely be limited to 3–5 chemical-product combinations per year, the new regulations are notable in that they require companies to seek safer substitutes to chemical hazards in consumer products. The regulations aim to avoid the history of unintended consequences that result from chemical bans made in the absence of guidance on the selection of appropriate substitutes (Massey 2008).

Consumer product companies generally seek to continuously improve their products, usually by maximizing performance features; the SCP regulations require that they also undertake continuous improvement aimed at improving the safety of their chemical constituents. For companies that have been asking these questions of their supply chains for years, the California law will help to level the playing field with their competitors who have not previously been required to seek safer alternatives for hazardous chemicals in their products.

Protecting future generations and shifting the burden of proof

In its most explicitly precautionary element, REACH gives government the ability to restrict a chemical irrespective of its toxicity if it is designated as a "very persistent, very bioaccumulative" substance, or "vPvB." This designation is based on the notion that a substance that resists degradation will remain in the environment for decades and accumulate in biota. Because concentrations in organisms rise as a substance accumulates up the food chain, a vPvB chemical has the potential to cause damage for many years. In its approach to vPvBs,

REACH is the first regulation with an explicitly precautionary approach to a category of chemicals whose risks are not yet fully understood, but whose impact could last for generations (Schwarzman and Wilson 2009).

Under REACH, authorization for continued use of chemicals designated as substances of very high concern (which includes vPvBs) will hinge on producers demonstrating the safety of each intended use, or in the absence of suitable alternatives, that the socioeconomic benefits outweigh the health and environmental risks (Schwarzman and Wilson 2009). In this respect, REACH shifts the burden of proof of safety to chemical manufacturers.

Conclusion

Chemical policy has been described as a classically “wicked problem” for which no easy solutions exist (Allen 2013). On the other hand, a comprehensive approach to chemical policy could potentially improve the safety of thousands of consumer and commercial products, as well as the workplaces where they are manufactured and used. This would deliver substantial benefits to health and the environment. New policies could create market conditions that would respond more efficiently to preferences of both consumer product companies and members of the public who make decisions based on chemical safety as well as performance, price, and function. Given the widely acknowledged shortcomings of TSCA, US legislators should consider introducing modernized chemicals policies that: (1) eliminate barriers to chemical-related information flows to ensure that chemical users have access to adequate information, and (2) provide EPA with the necessary legal and procedural tools to efficiently identify and take action on hazardous chemicals. Meeting these policy objectives would reduce market failures associated with information asymmetries, help shift the chemical market toward improved transparency and accountability, and reduce the competitive advantage linked to use of toxic substances.

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