

**Safer Jobs And A Sustainable Economy Through Green Chemistry
and Safer Alternatives to Toxic Chemicals In California:**

A Constituency Analysis

**A Project of Clean Water Fund and the
Lowell Center for Sustainable Production**

March 2007



**“There is nothing about green chemistry that is inconsistent with the industry.
It is an iterative discovery process.”**

John Ulrich, Executive Director, California Chemical Industries Council

“Green chemistry is one thing, while green production is 1000 different things.”

Jose Bravo, Executive Director, Just Transition Alliance

“It’s time is now.”

Sarah Diefendorf, Executive Director for the Environmental Finance Center, U.S. E.P.A Region IX, talking about green chemistry



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Executive Summary

Beginning with the premise that California would benefit from being a leader in safer chemicals use and manufacture, Clean Water Fund (CWF) interviewed 53 diverse stakeholders interested in chemical production and use during 2006. This analysis explores their thoughts on building a safer chemicals economy, on exploiting the drivers of change in industry, and on overcoming barriers. While CWF supports reforms to chemicals policy to provide greater information on chemical toxicity and use and incentives for implementing safer alternatives, this report specifically concentrates on how to promote the development and growth of industries that produce and use safer materials and processes, causing less harm to people and the environment. It is our hope that this narrower focus will be a step in furthering the discussion of creating an economic competitive advantage for California in the face of environmental pressures, the need for sustainable jobs, rising costs associated with public health and environmental degradation, and shifting international regulations. Our research has convinced us fully that it is possible for California to have a healthy economy, good, safe jobs, a clean environment, and safe products.

Safer chemicals practice is often denoted by the term “green chemistry.” Green chemistry is defined as the design of chemical products and processes that reduce or eliminate the use and generation of hazardous substances¹. Twelve principles define what green chemistry is in practice (see Appendix A). At its heart, green chemistry is about two things: (1) detoxification – design of products and production processes that are inherently less toxic and dangerous; and (2) resource efficiency – ensuring chemical products and processes are based on renewable feedstocks, create as little waste as possible, and use as little energy as possible. Consequently, the term green chemistry refers to the design of molecules based on the twelve principles. Our references to safer chemicals and processes, which refers to the substitutions of more dangerous chemicals and processes with less hazardous ones (including the support networks necessary to adopt green chemistry innovations) entails the incorporation of green chemistry. This report examines the opportunities and barriers to development and implementation of the products of green chemistry in the state of California.

As the leader of a chemical industry association told us, there is nothing about green chemistry that is incompatible with the chemical industry. And, as a leading investment advisor in the state noted, California’s tough stance on the environment has created growth by spurring innovation because California companies are always challenged to do better. We believe that greener is also economically healthier.

The key findings from our interviews point to several future directions for research, outreach, and policy direction, including:

:

- The key is the market. Many stakeholders believed that moving toward more sustainable models of production and reducing or eliminating dangerous chemicals provided companies with a clear competitive advantage in the face of shifting regulations, growing liability related to chemical use, and gaining market share in a world demanding reduced toxicity. However, developing the market for safer chemicals will be critical to realizing a similar competitive advantage for the California economy. Two distinct markets

emerged as key: the consumer market and the industrial or corporate market through which companies making products seek less toxic alternatives from their suppliers.

- Public and private investment is central. In order for California to take the lead in developing industries and an economy based on safer chemicals, there will need to be robust public and private investment in developing green chemistry expertise, encouraging sustainable start-up enterprises, and supporting reformulation of established products and processes. Other states and nations are already moving ahead with the development of research centers and public financial incentives for green chemistry and California risks losing its economic position if it does not follow suit.
- Developing new, sustainable production models must be compatible with social and environmental needs. Transitioning to an economy based on safer materials and production needs to be done in such a manner that protects jobs and responds to the environmental and economic well-being of local communities in which industries exist. In addition, farsighted policies or initiatives to promote development and use of safer chemical products must also address immediate problems workers and communities are struggling with as a result of current industrial practices.
- Business and public policy decisions should account for all costs Contrary to the notion that environmental and social protections are incompatible with economic success, accounting for the full costs of current polluting production methods and products is necessary to realize economic competitive advantage, provide an incentive to investment in safer alternatives, *and* protect the environmental and worker health of our communities. Fiduciaries and business managers need to factor in such traditionally unconsidered costs as environmental cleanup, liability, and worker health care when making investment and corporate decisions in order to protect shareholders. Policy makers need to ensure that economic impacts to communities, such as health costs resulting from workplace and environmental exposure, reduced property values, and lack of access to safe, sustainable jobs are taken into account when decisions are being made about such diverse issues as workplace and environmental standards, and investment in green chemistry initiatives. Ultimately, policy decisions that ensure that communities and workers are adequately protected from chemical risks as well as ensuring that green chemistry implementation leads to new, well-paying jobs is beneficial to our businesses as well.
- Regulation is one tool. While all interviewees concurred that regulation is a fundamental driver of change, it was also generally believed that increased regulations by themselves would not transition California to an economy based on safer chemicals and products. A range of stakeholders expressed concern that regulations only create “a floor that people sit on” and can stifle continuous improvement. Nor do regulations, by themselves, create the economic environment that will promote green chemistry initiatives or incorporate green chemistry principles into California’s industries. Consequently educational initiatives to build green chemistry expertise, building public awareness, investment strategies, and the development of financial and other incentives must accompany

regulations that set environmental or human safety standards, restrict chemical use, or promote safer alternatives.

Stakeholders held a variety of views about what types of regulations will be necessary to create economic and environmental change. Central themes included overcoming the endemic paucity of information about chemicals used in the state, setting appropriate environmental standards across media but avoiding the command and control regulations that stifle innovation, creating a level playing field for businesses, and harmonizing regulations within the state and nationally (and increasingly internationally). There was great debate over the efficacy of chemical bans, which is discussed in a separate box within the regulations section of this report.

Introduction: California's Opportunity to Lead a Safer Sustainable Economy:

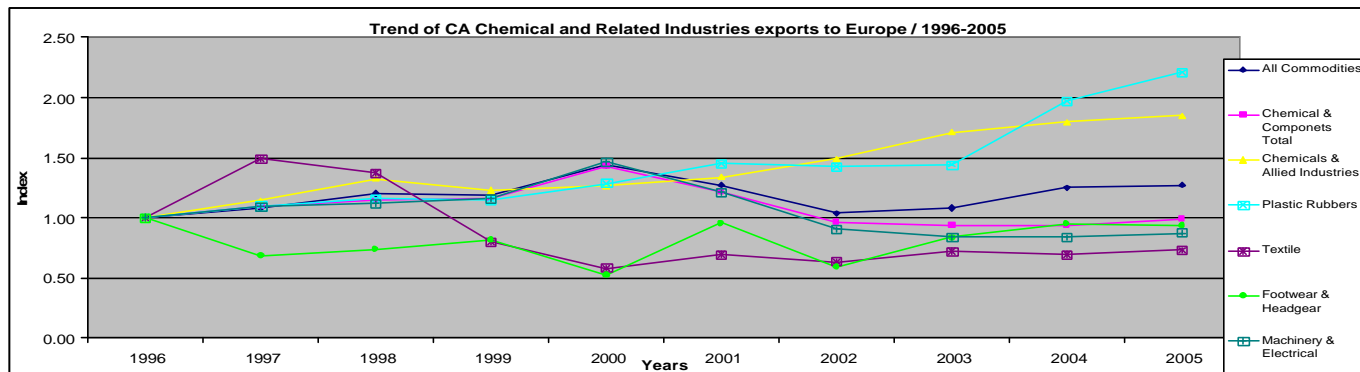
This report is a first step in what Clean Water Fund (CWF) hopes will be a long-term role in helping reorient the economy of California towards safer and sustainable chemicals, processes and jobs.

The ultimate goal of the Safer Sustainable Economy Through Green Chemistry Project is to help move California toward a new economic paradigm based on the sustainable production and use of products designed using green chemistry principles. We believe such a new economic model is necessary, not only to address the health and environmental impacts of toxic chemicals in products made or used in the state, but to respond to the fiscal implications of continuing on the current path. The costs of chemical management, health care related to chemical exposures, and environmental remediation are unsustainable. For example, researchers in Massachusetts have estimated that the preventable costs of childhood chemically related illness could be as much as \$1.1 billion per year. Perhaps more importantly, the current U.S. regulatory system discourages implementation of safer chemicals and products by limiting the collection of data on chemical toxicity and by implicitly endorsing the presumption that most chemicals in commerce are safe until proven dangerous². While the U.S. EPA has undertaken important initiatives focused on developing safer chemicals³, the vast majority of chemicals in commerce are unregulated.

The passage of the European Union's Registration, Evaluation, and Authorization of Chemicals (REACH) in December 2006 will raise the global bar in terms of chemical information and safety requirements, particularly for chemicals of high concern⁴. The Canadian government has also taken action, publishing a categorization of its chemicals in commerce in December 2006 and announcing restrictions on potentially more than 1000 chemicals of high concern.

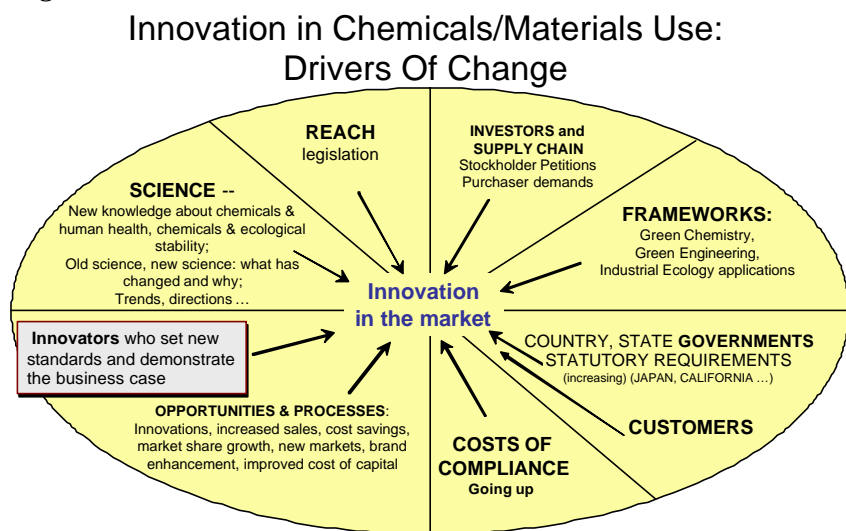
As Europe and other parts of the international marketplace move forward with far-reaching reforms to address major limitations of chemicals regulations, our industries face the real threat of losing their share of those markets by being unable or unready to comply. This is important to California, which is a major exporter to the European Union and other parts of the world that are increasing their scrutiny of toxic substances. California exports to the European Union amounted to \$23,206,474,550 in 2006. California exports of plastics and chemical products to the European Union increased by 1.97 and 1.79 times, respectively, between 1996 and 2005. Figure 1 shows the changes in California exports to Europe over this 10 year period. A more detailed summary of exports from key states and European Union is included in Appendix F.

Figure 1



The increasing demand for safer chemicals and products is not only coming from Europe; it is also coming from states, such as Maine, Michigan, Washington, and Massachusetts, as well as from industry itself (see overview of state chemicals policy activities in Appendix G). Major manufacturers such as Dell, Hewlett Packard, SC Johnson, and Interface have undertaken extensive initiatives toward using safer chemicals in their products. A large number of chemical producers have sought recognition for their innovations in green chemistry through the Presidential Green Chemistry Awards⁵. Large U.S. corporations that use or sell toxic chemicals as diverse as Kaiser Permanente⁶ and Wal-Mart⁷ are responding to increasing demands for safer chemicals and products by voluntarily shifting their purchasing practices to buying safer products and publicly committing to increasing this activity over time. Accompanying this analysis is a supplemental report which contains a series of case examples of leading firms committing to implementation of safer chemicals and products. These examples, among many others, demonstrate the economic potential of investing in safer chemicals and products. These trends demonstrate a convergence of factors that if left unaddressed, will leave California as a laggard rather than a leader in safer chemicals and products. Figure 2 shows the intersection of several of these factors.

Figure 2



Leaders in California must begin to recognize that if the state doesn't act soon, it will risk losing its competitive advantage in being a leader in environmental innovation. Thus, reorienting the economy toward safer chemicals and products and protection of human health and the natural environment are not only moral imperatives, but also strategies for creating and retaining good jobs and strong, sustainable businesses.

By developing expertise on green chemistry and safer product and process design and incentivizing the creation of products and processes based on green chemistry principles, California has the potential to not only expend less resources in addressing public and worker health issues and environmental problems, but to grow industries that will have an actual competitive edge in the international marketplace. **This presents a tremendous opportunity for California to become a global leader in a revitalized and safer economy.** As the world engages in a “third industrial revolution”⁸ oriented around products and processes that are

ecologically superior and vastly more efficient in terms of energy and resource use, the actors who take the lead in the revolution will be the first to reap the enormous economic and societal benefits.

Clearly, such an effort to reorient the California economy will require input from a diverse group of constituencies who are impacted by this economic shift, who will develop and implement safer chemicals and processes, or who will influence the changes that are to come.

Purpose of This Report

Open communication and clear presentation of diverse perspectives will be essential as this process of reorienting the economy towards safer chemicals and processes progresses. To facilitate such a process, CWF undertook this study to examine attitudes about re-orienting the California economy around safer chemicals. Our goals were to:

- Determine the level of awareness of or engagement in the development of chemical policy, green chemistry, and safer alternatives in California among specific key constituencies or stakeholder groups
- Assess possible areas of cooperation and disagreement in order to help move a process of change forward,
- Identify drivers and barriers for positive change, and
- Survey what actions or policies will be needed to sustain our environment, protect human health, and develop our economy around safer chemicals and processes.

Why California

A key motivator for undertaking the effort to promote a safer chemicals economy in California is the opportunity for the state to create new and sustainable jobs and increased revenue. For proactive businesses, the opportunity to gain a competitive advantage by being able to meet the changing demands of the market, differentiating their products, reducing risk, and capturing new markets is the motivation. And the public gets safer jobs, a cleaner environment, and products that are less harmful to human health.

There are, of course, barriers to developing products of green chemistry in California. The state has not traditionally been seen as hospitable to some industries, including chemical manufacturers. Chemical production and other manufacturing are therefore limited; the chemical companies in the state tend to be formulators who package the active ingredients for use or specialty chemical producers who trade in limited markets. California does, however, have end-user industries that buy and incorporate chemicals or chemical intensive components into their products and processes. These industries can be impacted by chemical policies and can help drive the market for safer chemicals.

The results of our interviews demonstrated a general sense that these barriers are largely outweighed by California's many assets that would allow it to take a leadership position in shifting away from hazardous chemicals. These include a culture that embraces technology and startups, an educated workforce, the presence of significant venture capital, and potential

business and research synergies with resident renewable energy and biotechnology industries. We heard from several business representatives that though their manufacturing was not located here, the fact that their corporate headquarters are California-based impacted their corporate decisions. One such stakeholder specifically cited California's "green" awareness among the reasons their company was moving to reduce toxic chemicals in its facilities and waste-stream. We also heard that California is ripe for green chemistry because this is where the investors are. One industry specialist suggested that the state may be able to bring in more manufacturing industries because of the availability of sustainable feedstocks. Another industry representative predicted that while the state is likely to see a further drop in actual chemical manufacturing and a rise in corporate divestment, there will be growth opportunities around distribution and formulation of safer chemicals in California.

That chemical policy in general, and the promotion of safer chemicals and processes specifically, are gaining attention in California can be born out by a number of activities that took place in the academic, policy, business, and non-profit arenas during the time we conducted our interviews. These formed an important backdrop to our conversations and may have influenced the interviewees' opinions. The most significant were:

- The release of a University of California report that urged the state to undertake comprehensive chemical policy reform and to specifically address what the authors called the "Data Gap", "Technology Gap", and "Safety Gap".⁹
- The California Chemical Policy Symposium in Oakland, California (March 16-17, 2006). The symposium, which brought together a broad group of stakeholders, was coordinated by the Environmental Finance Center of U.S. EPA Region 9 and the WELL Network¹⁰
- The passage of the European Union's Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) regulation that will regulate 30,000 chemicals in everyday products.
- Public hearings held by California State Senator Joseph Simitian (June 28, 2006 and October 10, 2006) focused on development of a state chemical policy and his announced intention to introduce related legislation in 2007¹¹.
- The creation of CHANGE (Californians for a Healthy and Green Economy), a coalition of California NGOs and labor advocates to promote chemical policy reform and green chemistry.
- An explosion of venture capital investment in California in "clean technology", with an emphasis on renewable energy. (See Appendix H for a bibliography of Clean Tech relevant reports and analyses that have recently been issued.)
- The passage of two California bills setting up state biomonitoring system with the intention to better understand the impacts of chemicals on public health.¹²

Methodology

CWF undertook this study to examine attitudes about re-orienting the California economy around safer chemicals. CWF identified individuals representing a broad range of constituencies engaged in some way with the issue of chemical manufacture and use in the state. The targets for the different industry sectors were companies that had implemented some aspect of green chemistry or safer products in their business or organization, or were engaged in the current public debate on chemical policy. Participants included both large established businesses and smaller innovators trying to break into the market.

CWF staff and a consultant, together with staff from the Center for Sustainable Production at the University of Massachusetts at Lowell, developed a target list of interviewees including at least 2 people from each of the following categories:

- Academia
- Business: Chemical producers
 - Consumer products
 - High-Tech
 - Health care
 - Paper and printing
 - Textiles and apparel
- Finance and Investment
- Labor
- Local government
- Non-governmental organizations:
 - Environmental and Environmental Health
 - Environmental Justice
 - Agricultural Worker Issues
- The political arena
- Water agencies

CWF then interviewed 53 individuals in person or over the phone between May and November 2006ⁱ. Each interview was conducted by either a CWF staff person, a CWF consultant, or both. While the interviews did follow a semi-structured format with an outline of discussion topics, they did not follow a standard instrument, thus allowing them the freedom to explore areas of relevance to each interviewee. The interviewers wrote up notes summarizing each interview, and the results were collated and analyzed to produce this report.

This research does not represent a comprehensive, statistically significant sampling of stakeholder interests. It is meant to provide a summary of issues identified by diverse interests that will need to be addressed in order to build a safer sustainable economy around products of green chemistry. We also present some potential next steps to advance the process of moving California towards safer chemicals and products.

Box 1: Sector Specific Comments: Summary of Perspectives

The interviewees expressed views on a range of issues associated with transforming California's economy to one based on safer chemicals and products. Although each person had a unique point of view, comments within sectors tended to have some common themes, including:

Business. There were several common business themes, including the recognition that regulations were necessary. There was a variety of views however, as to the form such regulations should take and the degree of regulation that was necessary. There was general agreement that regulations be constructed with the needs of business in mind, allowing them to innovate and easily comply. One concern repeatedly voiced was the difficulty of keeping track of all the chemicals in a businesses supply chain and the need for assistance with this issue.

Fiduciaries and financial analysts. These stakeholders expressed common ideas about risk, liability, and optimism about future opportunities. They noted that the current structure of the chemical economy does not adequately consider or reflect the risks and liabilities of toxic chemicals. These interviewees expressed excitement about the possibility of stimulating innovation and building a new economy around environmental technology.

Labor and Environmental Justice. Labor and environmental justice concerns were closely linked because of shared interest in exposure and impacts on economic development. Stakeholders noted that any economic transition needed to be just for workers and communities, so that those most affected by the chemical industry would be engaged in crafting the transition. Labor interviewees wanted to ensure a fair transition that does not cost workers and communities their health, environment, jobs, or economic assets, and fairly compensates any losses. They also expressed the need that current policies needed correction, including workplace safety and exposure standards that were less strict than general environmental standards and lack of surveillance of medical issues borne by workers as a result of exposure.

Local government. These stakeholders saw the benefits of building a new economic engine in the state and eliminating external costs that are currently shifted from business to local governments. Water agencies in particular saw green chemistry as a way to keep toxic contaminants out of drinking water sources and the waste stream, which eased costs for them. They wanted to ensure that the transition to a safer chemical economy would not harm local economies, which would in turn impact local government budgets on which utilities rely.

Non-governmental Organizations (NGOs). NGOs emphasized their perspective that the current regulatory system is broken. Common themes included health and environmental costs to society from the use of poorly regulated and untested chemicals. These stakeholders urged a precautionary approach to chemicals us when information is incomplete, and underscored the need to identify safer alternatives for the most hazardous chemicals. Environmental justice organizations in particular emphasized the importance of community quality of life, including safe jobs, cleaning up existing contamination and letting communities decide their own fates.

Transforming California to a Green Chemistry Economy: Drivers of Change

Stakeholders suggested many strategies and tactics for creating a thriving safer chemicals economy in the state. Three key drivers of change emerged:

- Setting regulations;
- Growing the market for green chemistry products (including providing incentives, facilitating information flow, investing in research, and creating market signals); and
- Educating people.

CWF asked stakeholders about drivers of change in the industry to develop an understanding of forces that could be mobilized to promote green chemistry. Many interviewees made specific suggestions for legislative and regulatory changes, and these ideas are listed in Appendix D.

Business stakeholders, consultants, and government personnel working with businesses had the most to say about what would lead them to move toward a green chemistry model of production. There were, not surprisingly, differences of opinion over how important individual drivers were or, in some cases, if they were drivers at all. For instance, three companies noted that their efforts in green chemistry were internally driven by the corporate leadership or the company's desire to "do the right thing". Some NGOs and other businesses suggested companies were motivated by the ability to differentiate their products, avoid risk, garner positive publicity, and other economic drivers.

Setting Regulations

It was almost universally held that regulations play an important role in creating change and could help California promote green chemistry. Interviewees varied greatly, however, on the degree to which regulations should be implemented and how effective they will actually be. Several interviewees from both business and non-governmental organizations asserted that regulations "set a floor that industry tends to sit on" and thus provide a disincentive for continual improvement. Other stakeholders (including an investment analyst and local government representative) stated that regulations were the most efficient way to drive change in chemical production and use.

Several stakeholders commented that effective regulations needed to have certain qualities. One industry consultant captured the views of many other stakeholders when he said that California needs to "raise the bar and lower the burden," meaning that business would accept higher thresholds for chemical standards when paired with greater certainty about timelines and easier paperwork. Another consultant stressed that regulations should set up systems that provide yardsticks appropriate for business decision-making (metrics of progress) and can help overcome reactionary attitudes of industry. One person urged a standards-based approach instead of "command and control" regulations that dictate specific methods for dealing with the toxicity of chemicals. Another urged integrating standards across media (e.g. water, air, or land), instead of setting different standards for each. A financial analyst counseled that strong enforcement of regulations is critical for ensuring a level playing field for industries.

Numerous industry stakeholders urged harmonization of regulations across jurisdictions (local, state, federal), claiming that differing regulations stifled innovation. Two individuals felt regulation of the chemical sphere was more appropriate at the federal level than the state level to avoid disharmony.

Box 2: Banning Chemicals

There was a great deal of disagreement about the effectiveness of enacting bans on specific chemicals and it is difficult to say that any sector held a consistent viewpoint. We heard from some of the public advocates, local government stakeholders, and a number of businesses that bans are effective at eliminating harmful chemicals, help spur the creation of alternatives, and are part of creating a market for products and processes based on green chemistry. While some see bans as a tool to drive the development of alternatives, others see them as only useful if alternatives exist. In fact, there was concern across the constituencies that bans often meant swapping one toxic problem for another, less understood one since the alternatives might not be any safer. Consequently, bans need to be coupled with regulations that will require substitute chemicals to be less toxic to the environment and humans. Given these restrictions, one industry representative felt that bans would only shift the use of restricted chemicals to other markets, thus transferring their inherent problems to places with fewer environmental and worker protections and sending more of our economy out of the state or country.

Two industry specialists, one from the chemical industry itself and another representing an end-user industry trade association, believed that containment of toxic chemicals was a viable strategy to protect the environment and human health, and should be part of any state or national chemical policy. Public advocates saw containment as inconsistent with green chemistry initiatives in that it did not drive the need for non-toxic alternatives. Furthermore, there was the strong opinion that containment simply did not work. Exposures, they argued, occurred despite best efforts to curb them and there was still the problem of disposal at the end of life.

There was a degree of wariness about using bans as a central strategy to promote green chemistry since it placed advocates in the unsustainable position of having to implement chemical policy chemical by chemical. This has been the prevalent strategy to date, and has been largely unsuccessful in addressing the fundamental problems related to chemical use and in revitalizing the economy. Still, a ratcheting down on toxic chemical use appealed to a number of stakeholders. For instance, some end-user industry representatives and investment suggested a strategy of targeting specific chemicals for elimination—those considered having the worst impacts on human health and environment. It was also suggested by more than one stakeholder, including those from some companies, that end-user industries should create a wish list of 5 to 10 chemical alternatives needs so designers can focus on their creation. This would start the process of eliminating toxic chemicals from their supply chain and could expand from there.

Growing the Market

One of the most important points that came out of our interviews was the need to grow the market for safer chemical products. While most of this discussion came from business stakeholders, both from traditional companies and green innovators, their views were supported by some of the finance experts we spoke with, representatives from government (local and national) agencies working with businesses, and academics.

Overall, growing the market was seen as important because greater demand speeds up the rate of innovation and simultaneously lowers the costs of alternatives, creating even more opportunities. It must be understood, however, that when we talk about creating a market for products and processes of green chemistry, we are discussing two related, but distinct entities—businesses using chemicals and the everyday consumer market.

The End-user Market

The business or end-user market is made up of companies that use chemicals or components containing chemicals in their processes or products. These can include manufacturers or institutional consumers using chemical containing products, such as the medical industry, high tech industries, or apparel manufacturers.

Several of business interviewees noted that in their experience the end user market can be a powerful driver of change if companies are willing to take the lead on promoting safer alternatives. By pressuring their suppliers to create and provide safer chemicals and products, they can effectively push the burden of data collection and design upstream to the producers. We heard several examples from the health care industry, for example, where end-users identified key chemicals they wanted to eliminate from their facilities. Both incentives, such as offering exclusive contracts to producers who developed less-toxic alternatives, and deterrents, such as threatening to take business away from suppliers who do not, have shown to be effective tools in creating a market for and forcing the development of those alternatives.

Company representatives talked about the difficulty in manipulating the supply chain because of its complexity and the current lack of information about chemicals being used up and down the chain¹⁴. Several supported policy initiatives that would require greater information flow about chemicals being used or imported into California. Regardless, several stakeholders took the role of their industries to drive reductions in toxic chemicals very seriously. One representative from the high tech world stated that companies need to take on the role of educating their suppliers or else they will not have the materials they need. This can be daunting, he went on to say, if, like his company, they have thousands of suppliers.

The Consumer Market

The second type of market is the domestic consumer arena. This refers to members of the public buying retail products that contain chemicals and includes almost everything people use as part of their everyday lives from dish liquid to computers.

Consumers suffer from the same “data gap”¹⁵ as end-user companies. While many products are required to have labels indicating what is in them, many ingredients are unfamiliar to the reader, inactive ingredients are often not included (for example in pesticides), and there is no health or environmental information on which to base choices. There was a great difference of opinion, therefore, over the influence of consumers on developing a market for chemically less toxic products. For the most part, business stakeholders felt that there is little awareness among consumers in the United States about chemicals in the products they use, the limits of current regulatory structure in ensuring those products are safe, or of the health and environmental problems linked to their production, use, and disposal. As a result, green attributes, particularly the chemical make up of manufactured goods, do not generally serve as a compelling factor in consumers’ choices, despite growing interest in energy efficient or organic products. In fact, communicating the safe or less toxic features of a product was viewed as sometimes backfiring in that it implies that other products the manufacturer makes or previous formulations of the same product are not safe to use or that the new product offers lower performance. Some consumer product companies, such as SC Johnson, concerned about these issues, are beginning to create a corporate image of sustainability while continuing to market their products on the basis of performance.

A number of stakeholders, particularly in the apparel industry and small business sector, indicated that getting a greater share of the market was not a particularly important driver for improving environmental performance. Instead, a corporate desire to do the right thing or a desire to create a positive industry image took precedence. Despite this and the perceived apathy on the part of the public about chemicals in products, there was a sense among some of the financial experts that consumer pressure could be brought to bear in developing a growing market for safer products. Increased public education by any of the stakeholder groups, especially NGOs and companies themselves, will be an essential catalyst, as will more explicit information about health and safety issues related to product use.

Box 3: Driving Competitive Advantage

The bottom line of any business plan is to create a competitive advantage (created by either lower price or product differentiation), and several of the business interviewees identified ways in which green chemistry can provide such benefits for companies. According to one chemical industry consultant, companies will end up ahead of the pack by taking a stewardship approach and tracking the information about the chemicals they use throughout the supply chain. They will be able to be proactive in the face of changing regulations, take advantage of market trends and shifting preferences, and avoid liabilities and costs that result from toxic chemical use. Companies who do not rely on dwindling raw materials or feedstocks will also see a competitive advantage. As the rest of the world strives toward the United States’ standard of living, there will be growing strain on raw material supplies, which will drive the need to manage materials efficiently and identify alternative feedstocks. Companies that are moving to production based on sustainable feedstocks, a key green chemistry principle, will be able to effectively adapt to the pressures of global supply and demand, including increased scarcity and cost of petroleum based feedstocks. This may be particularly beneficial to California, according to one end-user expert. The state may be in a position to attract more manufacturing because of renewable resource

feedstock availability and proximity to the market place. This would lessen transportation costs for companies and ensure sustainable raw material supplies.

Companies must also consider the impact that investors will have on their environmental and public health profile. According to the fiduciary experts we spoke with, investment managers need to look at the liability that companies take on when using toxic chemicals in their products and processes.¹⁶ Those that reduce the amount of toxins they use, reduce risk for investors, and thus have a competitive advantage. The impact on investor interests is also being borne out in the press. For instance, a recent article on the use of nano-technology and non-tested chemicals in the cosmetic industry stated, “Things could get ugly for investors who ignore glaring health risks in the cosmetics industry, warns a new report from the Investor Environmental Health Network (IEHN), which represents 20 investment organizations with \$22 billion in assets under management. A powerful convergence of forces - including shareholder resolutions, improved health risk information, European and U.S. regulatory changes and growing consumer pressure -- could drive sweeping changes in the U.S. personal care and cosmetics industry, with significant implications for investors, according to IEHN.”¹⁷

The Issue of Price

Despite the differences of the corporate end-user and consumer markets, both are influenced by common factors. Most notable among them was price. Several interviewees noted that green products cost more. Alternative chemicals must not only perform to the same standards of those they are replacing, but must also be around the same price or cheaper or at least offer greater value/benefits, such as duration. In other words, as one stakeholder put it, we need to find cheaper ways to produce green materials.

While this was very much an issue in both the end-user and consumer markets, it was the companies focused on selling to the public that, by implementing creative marketing and product positioning strategies seemed better able to address the price issue. These tactics included creating products specifically for the high end market, spending less on marketing and creating word of mouth buzz for products, creating synergies with specific retailers to promote products, and negotiating the price for alternative materials. It was also pointed out that large corporate purchasers can buy large quantities of alternative products, and thereby help drive down the price.

The interviews indicated that there are economic barriers (cost issues) that inhibit the introduction of safer chemicals and products. However, some companies working actively to find safer alternatives noted they can actually be cheaper due to material efficiencies, improved image, and greater consideration of chemical management costs. In the end, these savings, including the health, safety and environmental benefits, should be key drivers for changes that propel California toward safer chemicals and products.

Box 4: Counting All of the Costs

Many stakeholders believed that an important driver for safer chemicals and products was accurately weighing true costs against cost/benefit tradeoffs and the perceived costs of implementing green chemistry. They noted that understanding these extended costs is integral to creating demand, taking advantage of economic benefits, making appropriate decisions, setting policies, and driving the market for green chemistry based production. While there was general agreement about this in principle however, different constituencies focused on different costs as being important.

Industry tends to focus on the short term costs of compliance and not these other full expenses, which may take a longer decision horizon for payback rather than the typical two and a half years. However, business and industry representatives talked about the need to internalize liability (understanding what can go wrong and the costs involved), along with the cost of managing toxic materials, pollution, and worker safety controls. Surprisingly, it was implied that many companies do not fully consider these factors when evaluating expenses, focusing instead on such things as the costs of research and development, the length of time it takes to bring products to market, the cost of safer alternatives¹⁸, or the cost of retrofitting a facility or process to accommodate new chemicals. Investment experts supported the need to consider all costs however, and suggested that fiduciaries had a responsibility to ensure that companies did so in order to protect the interests of their investors.

Public advocates, particularly those working on environmental justice issues, along with labor stakeholders and those from some businesses noted the external costs to communities and the state, such as the economic impacts of pollution (declining property values and tax base, treatment, clean-up, loss of resources), health expenses for chronic or acute illness, lost income due to work related injury or illness, family care when a parent is unable to take on that role, and increased need for social services. Such considerations are not usually taken into account when policy decisions are made about economic development, regulations and enforcement, or enforcement decisions.

Tools to Grow the Market

The various constituencies we interviewed agreed that a variety of policy and business tools were needed to increase demand, and thus grow the market for green chemistry. These included:

- artificially creating the market through regulation¹⁹,
- public investment in companies pioneering green chemistry based products or processes,
- government procurement policies,
- clear communication about chemical hazards and viable alternatives.

Government subsidies should be aligned with the goal of promoting green chemistry in California, recommended one stakeholder, and any existing subsidies that are not congruent with that goal should be discontinued. Many stakeholders expressed support for state government funding for basic research and development and state investment to incubate startups and/or efforts within existing companies to commercialize green chemistry products or processes.

Funding should be available to support both public and private research and to encourage collaboration among them.

Stakeholders across the constituency groups agreed that public policies that resulted in investment in green chemistry initiatives and incentives for companies to implement such initiatives were essential in shifting the state's economy towards safer chemicals and processes. Specific suggestions on how to support innovative companies came from as wide a spectrum of perspectives as Industry, Labor, and the NGO community. They included:

- providing tax rebates to consumers and companies for environmentally-preferable purchases,
- establishing policies for environmentally preferable purchasing by the state or local communities,
- taxing the production and use of toxic chemicals, and dedicating the revenues to the development of safer alternatives,
- establishing local and/or state government procurement policies that support less toxic products or that are produced through less toxic processes²⁰ and
- adding green chemistry to the CalPERS Green Wave Initiative²¹ and including checks on safe chemical products to the building audits required by pension funds.

Improving the Information Flow: A Critical Tool to Grow the Market

Stakeholders across the spectrum emphasized the need to improve the quality of information flowing in multiple channels within the value chain as a part of growing the market for safer chemicals and products. Without such information flow, companies could not respond to changing markets and consumers could not make informed choices. They identified business to business (vendor/supplier relationship), business to consumer, business to regulator, and regulator to business information channels, as well as channels internal to a business. Many stakeholders commented that they often did not know what chemicals were in the inputs or products they purchased from suppliers, and that concerns about proprietary information precluded them from obtaining this information. One stakeholder commented that businesses do not have easily accessible and accurate sources of information about the safety of chemicals and non-toxic alternatives and they sometimes rely on inaccurate sources. Another interviewee indicated that companies do not adequately track or consider the true costs of chemicals (particularly regarding disposal, which can be the most expensive part of the lifecycle), which excludes externalities and distorts decision-making. Businesses also lack information about liability associated with chemical use.

While stakeholders agreed on the need to improve the quality of information, they disagreed on what type of information was appropriate for decision-making in the chemical industry to support safer chemistry. Several stakeholders suggested a public disclosure framework could address the information needs of multiple channels. The framework could take many forms, from standardized corporate responsibility frameworks such as the Global Reporting Initiative or Ceres to material disclosure rules from the Securities Exchange Commission.²²

Other concrete ideas suggested by stakeholders across the constituencies included:

- creating and disseminating a “wish list” of clean products and processes that companies would like to have as inputs or in their supply chain, so that entrepreneurs can create them.
- sharing information among businesses about opportunities in green chemistry (best practices, state of the art, available alternatives) and provide training to businesses.
- creating a statewide clearinghouse or research institute to generate, gather, and distribute information about safer alternatives for multiple audiences.
- employing existing media such as trade journals and general population magazines to influence design specifications and industry leaders.
- ensuring that the primary disseminators of information are objective and are not the vendors of chemical products²³.
- developing databases of chemical hazard and exposure information and alternatives.

Many stakeholders across the various constituencies we spoke with mentioned the idea of a “green chemistry label”, similar to the Energy Star²⁴, the Design for Environment, or GreenSeal labels as a means of improving information flow, providing clear signals in the market, and combating “outrageous” claims that can confuse consumers. Such labels were also perceived as a way companies could gain positive recognition for green chemistry initiatives, which was considered a potent driver for change. On the other hand, there were those, including a political strategist, a media consultant, and an investment expert who downplayed the efficacy of labels and predicted strong industry resistance. They argued that creating a meaningful label based on clearly defined standards would be a daunting task given the ubiquitous nature of chemicals in the economy and the complexity of the supply chain.

Ironically, stakeholders on both sides of the green label debate pointed to the organic food labeling system to support their view. Most saw these labels as successful in defining what organic means for the consumer, but it was also pointed out that establishing the standards for organic produce has been a difficult, lengthy, and controversial process. All agreed, however, that setting well-defined standards²⁵, along with a high quality marketing design and plan was essential in both promoting products of green chemistry and creating a labeling tool.

The Role of Education in Growing the Market

A number of stakeholders also suggested a variety of educational efforts targeted at specific audiences as a means to grow the market for products of green chemistry. Their reasons were two-fold. First, while demand may be growing for non-toxic, sustainable alternative chemicals and products, there are few green chemists to meet the demand. Instituting programs at the university level will be essential to ensure that California creates the necessary foundation of professional expertise to support a new economic model. Secondly, demand will be directly tied to both public and corporate awareness of the need to build a safer chemicals paradigm in the state, for environmental reasons, to protect public health, and to ensure that California is able to take advantage of the economic opportunities that will result.

Specific educational goals that stakeholders across the spectrum suggested included:

- Integrating environmental and public health toxicity education into college level chemistry programs equip the next generation of graduates to deliver the needs of an industry of products of green chemistry.
- Employing cross-sector engagement (business, policy, nonprofit) to develop solutions to on-the-ground practical issues.
- Shifting the consciousness of employees or suppliers through quality education programs so they understand the importance of green chemistry and can achieve change within businesses.
- Educating the general public in order to capitalize of the power of investor pressure on corporate behavior.
- Educating fiduciaries about the risks and liabilities of the traditional chemical economy so investors' decisions reflect true costs and they can create pressure on businesses to adopt safer chemical use.
- Raising public awareness of the link between hazardous substances and health and environmental issues.
- Issuing reports examining successes in reformulating products and promoting sustainable processes.

Box 5: Agricultural Chemicals: A Unique Market

Given the immensity of agriculture in California, its importance to the state economy, and health impacts of pesticides on workers and local communities situated near agricultural enterprises, it can be argued that pesticides are industrial chemicals and should therefore be considered as efforts get underway to reform California's chemical policies or consider green chemistry based alternatives. In fact, at the chemical policy symposium that corresponded with the release of Wilson, et. al.'s report, environmental and environmental health advocates were vocal about the need to include this class of chemical in such discussions. This will involve overcoming the regulatory morass and territorialism so typical in this state. We approached agricultural worker advocates to gauge their awareness of the current movement to reform state policy and promote green chemistry (it was limited), explore opportunities and barriers, and begin outreach to engage organizations with roots in the farm worker community in this work down the line.

As far as green chemistry is concerned, it should be noted that less toxic pest control includes both chemical and non-chemical methods, such as soil management. Perhaps even more than with other industries, the issue of acceptable alternatives is complicated, since pesticides are intentionally toxic to specific living organisms. Consequently, this sector has been especially plagued by the issue of replacing banned chemicals with equally as toxic alternatives.* There is still room for chemical innovation however, In fact, one California company won a green chemistry award for developing a less toxic, biologically based pesticide.

There are two targets for green chemistry within the agricultural community; the farmers and the pesticide manufacturers. For farmers adopting new technologies or alternative chemicals is a financial risk. Older "dirtier" chemicals are off patent and are therefore cheaper. In addition,

until they see others using a method and getting the same or better yields before farmers are reluctant to employ a less toxic alternative. In some cases, they are actually required to use known chemicals as a means to reduce financial risk in order to receive bank loans. Air and water regulations can be drivers for farmers to change practices, but these are not as strict or as enforced as with other industries.

According to our interviewees, there are few drivers for pesticide manufactures to change the chemicals they use or sell. For one thing, there is no split between the growers and manufacturers in Sacramento, so no pressure being applied by farmers for less toxic alternatives. Consequently, there is little market incentive to reduce toxicity. While liability issues can have an impact, it is either difficult to say which chemical caused a specific health or environmental problem or the manufacturers try to pin such problems on improper use. We were told that initiatives that would help drive the development of green chemicals or other less toxic methods of pest control may not be politically feasible. They include:

- Higher mill fees on the most toxic chemicals, with revenues going toward developing alternatives;
- Crop insurance, which would provide farmers with a financial safety net to try new things and cause banks to drop their pesticide requirements;
- Streamlined regulations with need tighter green standards;
- More oversight of chemical fertilizers;
- Reformed pest control advice system that is independent of industry and the pest control advice system

**See Box 2*

Barriers to a New Economic Paradigm around Safer Chemicals and Products

In discussing the drivers to change and various perspectives of our diverse array of constituencies, we have already discussed some of the barriers to change that must be overcome to promote an economy around products of green chemistry. This section provides a more focused discussion on those and other barriers, followed by some of the incentives stakeholders identified to help foster and nurture this new model. The barriers to transforming California's economy to a green chemistry economy, as identified by the interviewees, clustered around the following topics:

- structure of the industry, including the supply chain;
- time and cost to change; and
- fear of change.

It is worth noting that a few stakeholders identified the term “green chemistry” itself as a barrier. Beyond a relatively small core of people, the term “green chemistry” is not known. Several interviewees had not heard of the term prior to the interview, even some who were practicing aspects of green chemistry. Among those who did know it, several reported reluctance to use it because of a lack of common understanding of the term.

Structural Issues of the Chemical Industry

Several aspects of the structure of the chemical industry could hamper efforts to make California a leader in green chemistry, including a limited number production based industries, insufficient research and development, a paucity of viable start-up businesses focused on safer products, and the complexity of the supply chain.

As already discussed, is the fact that there is not a lot of manufacturing currently located in California, and very limited chemical production²⁶. Stiff competition from off-shore areas (especially Asia) has moved production of chemicals, product components and parts, and products themselves out of California and out of the United States. The off-shoring is occurring across the board, in industries ranging from electronics to textiles to paper.

Insufficient research and development of less toxic chemicals, products, and processes is another barrier mentioned by several stakeholders. Product competition from Asia has led to a decrease in corporate investment in green technologies in the state, stated one businessman, and a trade association representative claimed there was almost no activity in research and development or commercialization of discoveries made in Universities in the state.²⁷ An investment analyst concurred that there was not a concerted or coordinated effort to spark green chemistry innovation nationwide, and that what little did exist was buried in research and development departments of large companies or isolated in smaller spin-off corporations. Another noted disincentive to R&D was the traditionally low payback in commoditized markets, such as paper.

These barriers most likely feed a third barrier identified by several interviewees: the lack of good start-ups in the green chemistry and safer materials arena²⁸. One investment analyst noted that companies producing products of green chemistry had not developed good business plans,

nor had they attracted high talent management teams. An investment analyst suggested that a lack of good startups was hampering the development of a safer chemistry economy in the state, because successful startups help secure policy and regulatory changes to support the new economy. We heard similar comments from companies that were struggling to launch themselves and alternative products in a traditional marketplace. One commentator at the second Senate hearing on chemical policy told of negative campaigns from their competitors that were hampering their attempts to break into the market. However, one businesses stakeholder did not see the difficult environment for startups as a particular problem. He was of the opinion that change would have to come from the big industrial end-users who had the market, the money and development capability, and the ability to pressure their suppliers once they perceived a demand, either due to regulation or other factors, for green chemistry products and processes.

The complexity of the supply chains involving chemical products and processes was another often mentioned barrier to promoting green chemistry in the state. Because of this complexity, businesses do not know what chemicals their inputs contain. Substituting cleaner chemicals or instituting cleaner processes in one part of a product can often require changes throughout the supply chain, rippling through multiple layers of transactions and hundreds of suppliers and sub-suppliers. For example, stakeholders with experience incorporating green chemistry principles into their apparel and electronics products explained that their companies devoted a lot of resources to educating and then assisting their suppliers with making the changes. In addition, when there are complex supply chains, there is no “one-size-fits-all” solution and significant differences across geographic regions result. Finally, the larger companies tend to have established and inflexible supply chains which makes them unable to adopt safer chemical products quickly. In particular, larger companies tend to lock in long-term contracts in their supply chain, thus hampering innovation.

Time and Cost

Long time-frames for change were considered to increase costs and hamper innovation. Changing a product or process to use safer chemicals often requires sourcing new materials, educating suppliers, creating new processes, retrofitting facilities, and phasing in alternatives. Developing entirely new products is even more time and resource intensive. Another stakeholder explained that the traditional constraints of scalability, profitability and regulatory compliance were difficult enough to factor into product development. Designers perceive additional considerations, such as adhering to green chemistry principles as adding cost and time to the product development process.

Making newly designed or reformulated products requires large capital investments, meaning renovations or changes to the facility or project will reduce the payback or increase the time needed for a return on the investment. In addition, as one government official noted, certain pots of state funding require equity capital, which may preclude start ups in the green chemistry field from this funding source.

Lack of a Market

As mentioned in *Growing the Market* section of this report, companies did find ways to overcome the issue of cost through a variety of innovative business plans and marketing strategies. It was also pointed out by one NGO that sustainable companies must always be innovative and reinvent themselves to remain competitive. However, there are challenges to ensuring that there is a market for such innovations. While recognizing the very real financial implications of shifting to less toxic forms of production, this stakeholder argued that this was the price of doing business. That said, it was clear that various policies and incentives needed to be developed to ensure that growth along green chemistry principles was a viable avenue for California industries.

Box 6: Capturing Investment for Green Chemistry

Attracting investment for green chemistry ventures will be essential in reformulating the California economy around safer products and industrial processes. Traditionally, environmental technology has not enjoyed much attention from venture capitalists for a variety of reasons, including a lack of financing for commercialization, varying regulations and inconsistent enforcement, convoluted permitting processes, and little impetus to try new technology when older options meet regulatory standards²⁹.

It is possible that less toxic chemical technologies that improve existing products for which markets already exist would fare better in attracting venture capital. In order to do so however, such initiatives will have to meet certain market criteria. They must:

- Fit into an emerging market with potential to expand;
- Represent an early entry into the market;
- Be able to command a large share of the chemical market;
- Experience rapid growth;
- Fit into a market where there are barriers to entry, so that the product or process won't be quickly overwhelmed by competition;
- Enjoy global application, to take advantage of international opportunities;
- Be ready for immediate application;
- Have the ability to generate recurring revenue; and
- Provide enormous potential by being broadly applicable in the manufacturing sector³⁰.

Clearly, development of less toxic chemicals for use in products and processes is an emerging area with growing interest worldwide and the potential recurring revenue. What is less certain is the size of the market any one initiative can capture and if rapid growth is viable given the need to develop “green chemists”, less toxic formulations, and public/corporate awareness.

Government was seen by numerous stakeholders as playing an important role, both in terms of public investment and in helping to create an environment in which business initiatives can meet investment criteria. Suggestions included the creation of a research center and informational clearing house along the lines of Massachusetts' Toxics Use Reduction Institute, the development of university green chemistry programs, tax schemes that support less toxic

initiatives and penalize the use of toxic chemicals, and public investment strategies similar to 2004's Proposition 71, which implemented \$3 billion in bond sales to support stem cell research. In that instance, the public's investment is expected to generate thousands of jobs and "stimulate economic growth in areas around the universities as private organizations are expected open offices and provide matching funds and other support for stem cell research"³¹.

Transitioning to Green Chemistry Based Production: Creating Sustainable Jobs and Communities

While the previous sections focused on drivers and barriers for change in California toward a sustainable production model, it is important to understand the social impacts that both the status quo and any fundamental transitions will have on communities. While worker safety and community social issues did not emerge as primary drivers for change within the industrial or business community, partly because of a view that containment and other protective practices or technologies made fundamental change in materials and design unnecessary. However, advocacy efforts from labor and environmental justice interests can provide compelling impetus to move toward safer alternative products and processes. Nonetheless, in speaking with advocates, it became clear that transitioning to an economy based on safer materials and production needs to be done in such a manner that protects jobs and responds to the environmental and economic well-being of local communities in which industries exist. In addition, farsighted policies or initiatives to promote development and use of safer chemical products must also address immediate problems workers and communities are struggling with as a result of current industrial practices.

While labor advocates recognize the value of reducing the use of toxic materials in the workplace, they began by pointing out that environmental protections are sometimes thousands of times stronger than those prescribed for the workplace by that state or federal Occupational Safety and Health Administration³². In addition, laborers have far fewer legal avenues of redress than do advocates and local communities when there has been environmental contamination and worker exposure. Consequently, we were told that immediate changes in chemical policy or regulation were needed that create “toxic parity” to “even the playing field” for workers. In addition, they called for the creation of a system of medical surveillance for workers who have been exposed to toxic chemicals to date. This, it was argued, would ultimately be much cheaper than treating cancer and other serious health problems, and thus economically feasible.

While the promotion of green chemistry in industry was viewed as ultimately important in protecting workers, there was concern that changes in technologies, including green chemistry, can lead to the eradication of jobs tied to traditional chemical use. Consequently, in addition to protecting worker safety and health, was the expressed issue of protecting jobs and creating high wage positions in the future. Chemical policies or initiatives that promote green chemistry and economic change must therefore include provisions for interim economic relief and retraining for workers who are thus impacted.

As with labor interests, green chemistry was seen as one tool to help environmental justice communities³³, but that specific issues need to be addressed to ensure equitable benefits of safer products and processes for all communities. While the building of more environmentally sustainable businesses was ultimately important, we were reminded of the need to address the environmental impacts that are the legacy of current industrial practices. It was further expressed that local communities should not only benefit from less detrimental environmental impacts, but should share in the economic benefits of green businesses and industries situated in their neighborhoods. Advocates consequently stressed the need to include community voices in decisions about the types of industries that develop in their backyards so that they ensure access

to safe workplaces and sustainable jobs. Most importantly, we heard that communities and workers should not be held hostage by health vs. jobs, or what was called “economic extortion”. We heard the desire to actually close “dirty” businesses or move away from the use of toxic chemicals because they impose greater health and social costs on local communities, without always any other compelling economic advantages. The health vs. jobs argument is not credible in the end; greener safer jobs and communities have proven to be economically preferable. Thus community interests provide a potent driver for the promotion of environmentally sound practices, including those based on green chemistry principles.

Conclusion

California has the opportunity to build a new economic engine in the state around clean chemical use and at the same time become a worldwide leader in this emerging field. CWF's conversations with 53 stakeholders indicate that there is not yet wide acknowledgement of this opportunity and not enough agreement that current chemical use is a problem. These and other fundamental drivers need to be in place for California to take advantage of this opportunity

As an organization oriented toward public education and policy development, CWF can play a key role within the NGO community in developing programs to put the right drivers in place to help move green chemistry forward in California. Some first steps could include:

- Convening organizations interested in the issue to brainstorm plans and timelines;
- Researching green chemistry solutions for problems within CWF's various areas of particular expertise (these would include but not be limited to drinking water and wastewater issues);
- Designing public education campaigns to motivate support for policy changes and influence consumer behavior;
- Research regulatory and other policy (including state investment) that can drive innovation and improve market conditions

Positioning California to gain economic competitive advantage by developing technological innovations that meet the needs of consumers, labor, business, public health, and the environment will take bold action. All sectors – public, private, and non-profit – have a positive role to play in getting California on the successful path to an economy oriented around safer chemicals.

Endnotes

¹ <http://www.chemistry.org/portal/a/c/s/l/acsdisplay.html?DOC=education%5Cgreenchem%5Cindex.html>. Accessed 11/28/06.

² Wilson, et. al., *Green Chemistry in California: A Framework for Leadership in Chemicals Policy and Innovation*. The California Policy Research Center. University of California, Berkeley, CA. 2006

³ Examples are U.S. EPA's Design for the Environment Program (<http://www.epa.gov/opptintr/dfc>) Green Chemistry Program (<http://www.epa.gov/opptintr/greenchemistry>), Green Engineering Program (<http://www.epa.gov/opptintr/greenengineering>) and the Environmentally Preferable Purchasing Program (<http://www.epa.gov/opptintr/epp>).

⁴ The European Union's Parliament and the EU's Environment Council adopted Registration, Evaluation and Authorisation of Chemicals (REACH) on December 13 and 18, 2006 respectively. Enterprise and Industry website, http://ec.europa.eu/enterprise/reach/index_en.htm, accessed 1/5/07. More information on REACH and other policies is available at www.chemicalspolicy.org.

⁵ See <http://www.epa.gov/greenchemistry/pubs/pgcc/presgcc.html>

⁶ <http://www.efc9.org/projects/symposium/Garske.ppt#465,8,ComprehensiveStatewide> Policy –Impact on KP. Accessed 11/28/06.

⁷ http://www.greenbiz.com/news/news_third.cfm?NewsID=34194. “WalMart to Use Preferred Substances in Chemical Intensive Products”. Accessed 11/28/06.

⁸ Greenwood, Jeremy, *The Third Industrial Revolution: Technology, Productivity, and Income Inequality*. American Enterprise Institute, 1977.

⁹ Wilson, et. al., *Green Chemistry in California: A Framework for Leadership in Chemicals Policy and Innovation*. The California Policy Research Center. University of California, Berkeley, CA. 2006

¹⁰ The symposium was also sponsored by the Fred Gellert Family Foundation, the Marisla Foundation, the Women's Foundation of California, and the Delegation of the European Commission to the United States.

¹¹ See http://www.senate.ca.gov/ftp/sen/committee/STANDING_ENV_QUAL/home1/PROFILE.htm.

¹² S.B. 1379, Saldana

¹³ See Appendix B for list of interviewees by category.

¹⁴ Also discussed in Wilson, et. al., *Green Chemistry in California: A Framework for Leadership in Chemicals Policy and Innovation*. The California Policy Research Center. University of California, Berkeley, CA. 2006

¹⁵ *Ibid.*

¹⁶ Goodman, B., S. Jonas Kron, and T. Little, *The Environmental Fiduciary: The Case for Incorporating Environmental Factors into Investment Management Policies*, Rose Foundation.

<http://www.rosefdn.org/images/EFreport.pdf>. Accessed 11/28/06. Also, Liroff, R., *Protecting Public Health, Increasing Profits, and Promoting Innovation by Benchmarking Corporate Governance of Chemicals in Products*, 2005. <http://www.resourcesaver.org/file/toolmanager/CustomO16C45F64352.pdf>.

¹⁷ *New report slams nanotechnology in cosmetics*, Nanowerk News, February 22, 2007.

<http://www.nanowerk.com/news/newsid=1505.php>. Accessed 2/24/07.

¹⁸ See the section entitled *The Issue of Price*, under Growing the Market.

¹⁹ An example of artificially creating the market through regulation was presented by one of the NGO stakeholders. Regulation requiring gas pipes that prevent excess flow (especially during earthquakes to reduce risk of catastrophic fires) created a market for a special kind of valve that did not exist before the regulation.

²⁰ While government procurement policies were seen as a potent tool for change, there was disagreement as to the degree. One business stakeholder suggested that products should not be blacklisted, but that procurement programs should simply prioritize those complying with green chemistry principles. Others suggested more stringent guidelines. For instance, one academic interviewee suggested that government not subsidize industries or companies that do not comply with such principles.

²¹ <http://www.treasurer.ca.gov/greenwave/>. "...a landmark environmental Green Wave initiative to bolster financial returns, create jobs and clean up the environment. The four-pronged initiative calls on the State's two large public pension funds – the California Public Employees' Retirement System (CalPERS) and the California State Teachers' Retirement System (CalSTRS) – to marry the jet stream of finance and capital markets with public purpose by committing \$1.5 billion to investments in cutting-edge technologies and environmentally responsible companies. The goal of the initiative is to improve long-term financial returns for pensioners and taxpayers through investments

in the burgeoning environmental technology sector, while also reducing the risks to the pension funds posed by corporate environmental liabilities.” Accessed 12/12/06.

²² For more information on public disclosure and fiduciaries, see the following two reports: Goodman, B., S. Jonas Kron, and T. Little, *The Environmental Fiduciary: The Case for Incorporating Environmental Factors into Investment Management Policies*, Rose Foundation. <http://www.rosefdn.org/images/EFreport.pdf>. Accessed 11/28/06. Also, Liroff, R., *Protecting Public Health, Increasing Profits, and Promoting Innovation by Benchmarking Corporate Governance of Chemicals in Products*, 2005. <http://www.resourcesaver.org/file/toolmanager/CustomO16C45F64352.pdf>.

²³ See Box 5

²⁴ The Energy Star label was developed with industry consensus as to standards. It should be noted that some companies, including two of our business interviewees, have instituted their own labeling to promote their products.

²⁵ A potential starting point for the standards of a safer chemical label could be the standards of the U.S. EPA’s Design for the Environment program (<http://www.epa.gov/dfe/>).

²⁶ See section entitled *Why California*.

²⁷ The interviewee pointed out that California did have strong research and development in biotech and pharmaceuticals, but that specific policies had jumpstarted the investment in both of these industries.

²⁸ One venture capitalist stated on a public panel that basic research at the university level is very important because venture capital does not support basic research and only comes in once a discovery is ready to be commercialized (the four panelists concurred). Women’s Technology Cluster Clean Tech Breakfast Series, 9/12/06.

²⁹ Diefendorf, S., *Venture Capital & the Environmental Industry*. Corporate Environmental Strategy, Vol. 7, No. 4, 2000, pp. 388-399.

³⁰ Ibid.

³¹ May, T., *Stem cell research supported by California voters*. Silicon Valley/San Jose Business Journal, Nov. 3, 2004.

³² One example of this phenomenon is benzene. For this known carcinogen, the exposure standard in the environment is 1 part per billion, while the exposure standard in workplace is 1 part per million, a thousand times less protective.

³³ In this context, environmental justice communities refers to low income communities and communities of color that are disproportionately impacted environmentally and economically by pollution due to their location near industrial facilities agricultural enterprises, transportation corridors, and other environmentally harmful human enterprises.