



*Executive Summary*

# **California Green Chemistry Initiative**

**Phase 1: A Compilation of Options**

*January 2008*



CALIFORNIA ENVIRONMENTAL  
PROTECTION AGENCY





# Executive Summary

## Introduction

Every week, news headlines report on toxic substances discovered in consumer products. The public assumes that the government tests products for chemical safety, but that is not true for most items. We know little about how the thousands of industrial chemicals in use today affect people and the environment. Consumers do not always know when they are being exposed. Businesses lack information about their supply chains. These information gaps prevent the free market from working properly to stimulate the development of safer substitutes.

Green Chemistry can prevent toxic substances from contaminating the environment and our bodies. It is a sharp departure from managing industrial wastes by disposal or incineration. Green Chemistry is a way to make products using less toxic materials, less energy, and less waste. Renewable feedstocks, recycling, sustainability, and other life-cycle attributes are incorporated into the design of new products and processes. This “cradle-to-cradle” approach of Green Chemistry means fewer hazardous substances along with improved air quality, cleaner drinking water, and a safer workplace.

Meanwhile, global markets are increasing their demand for less toxic products, especially in Europe, Canada, and Japan. California has the opportunity to grow its economy and lead the nation by creating safer substitutes for export to new markets and creating new jobs and products.





In her April 20, 2007, memorandum, Linda S. Adams, Secretary for Environmental Protection, directed the California Department of Toxic Substances Control (DTSC) to launch the California Green Chemistry Initiative in collaboration with the other California Environmental Protection Agency (Cal/EPA) boards, departments, and offices and other state agencies. The Secretary requested a broad public process to generate ideas that could fill these information and safety gaps, develop overall policy goals, and identify an array of policy options. DTSC Director Maureen Gorsen organized teams for the initiative and hosted an extensive public process known as the “Conversation with California.”

The California Green Chemistry Initiative continues California’s pre-eminence as a global environmental leader. The Initiative is an opportunity to accelerate technological innovation in materials science. It will catalyze research at California universities. Consumers will gain additional protection from toxic products. Less floating rubbish will help marine life and make our beaches cleaner. Fewer landfills and hazardous waste sites will be passed to future generations. The California Green Chemistry Initiative is a far-reaching, market-driven strategy with ambitious aim—the launch of a new chemicals policy framework and a quantum shift in environmental protection.

### **What is Green Chemistry?**

Green Chemistry is a strategy to reduce the use of toxic substances so that they do not harm the public or contaminate the environment. It seeks to fundamentally remake the way we make things via the design and manufacture of products with little or no hazardous substances. It reduces the overall “footprint” of goods and processes.

Much like the Hippocratic code in medicine, Green Chemistry promotes chemicals and processes that do no harm or reduce harm to human health and the environment. Green Chemistry seeks to transform industrial activity to create a zero-waste society. It is a marked departure from past practices in which industrial wastes were dumped or burned. Rather than manage the risks, Green Chemistry seeks to reduce or eliminate them

## **12 Principles of Green Chemistry**

Paul T. Anastas and John C. Warner first published their 12 principles of Green Chemistry in their 1998 book, *Green Chemistry: Theory and Practice*. Both serve as members of the California Green Chemistry Science Advisory Panel. In summary, the 12 principles are:

1. Prevent waste rather than treating it or cleaning it up.
2. Incorporate all materials used in the manufacturing process in the final product.
3. Use synthetic methods that generate substances with little or no toxicity to people or the environment.
4. Design chemical products to be effective, but reduce toxicity.
5. Phase-out solvents and auxiliary substances when possible.
6. Use energy efficient processes, at ambient temperature and pressure, to reduce costs and environmental impacts.
7. Use renewable raw materials for feedstocks.
8. Reuse chemical intermediates and blocking agents to reduce or eliminate waste.
9. Select catalysts that carry out a single reaction many times instead of less efficient reagents.
10. Use chemicals that readily break down into innocuous substances in the environment.
11. Develop better analytical techniques for real-time monitoring to reduce hazardous substances.
12. Use chemicals with low risk for accidents, explosions, and fires.

by making products benign by design. Green Chemistry focuses on improving the building blocks of manufacturing—the molecules, feedstocks, and catalysts—so products can be engineered safer, be readily broken down in the environment, and be easily reused. This “cradle-to-cradle” philosophy stands in sharp contrast to the current “cradle-to-grave” model in which products are manufactured and pass briefly through the hands of a consumer en route to incineration, disposal, or otherwise being rendered useless. Existing laws and regulations clean up the chemical pollution; Green Chemistry avoids the generation of the pollution in the first place.

Green Chemistry is a tool to help slow global warming. Warming threatens California’s economy and natural resources. About 98% of the organic chemicals synthesized in the United States are made of petroleum. Petroleum refining consumes about 15% of the energy produced in the country. Green Chemistry emphasizes energy conservation and renewable chemical feedstocks. Green Chemistry can help California meet the 30% reduction in emissions by 2020, which the *California Global Warming Solutions Act of 2006* requires.

Source: Green Chemistry: Theory and Practice

Green Chemistry is a philosophical and scientific approach to reinvent the economy through fundamental changes in science and engineering. It offers large-scale reductions in the use of toxic chemicals so California can achieve improved air quality, less greenhouse gas emissions, safer workplaces, cleaner beaches, and purer drinking water.

### **The California Connection**

California leaders have always met big challenges with bold ideas. Today, California is well positioned to develop the nation’s first comprehensive chemicals policy to cut pollution while strengthening the economy.

Environmental protection began in the 19<sup>th</sup> century with Henry David Thoreau and John Muir extolling nature’s grandeur. In the 20<sup>th</sup> century, Rachel Carson led a second wave focused on industrial pollution. In the 21<sup>st</sup> century, the third wave will focus human ingenuity and technological prowess on solving climate change, ocean degradation, and toxic build-up of the planet. California is uniquely situated to lead this new movement.

Governor Schwarzenegger joined this new wave with the signing of the *California Safe Cosmetics Act of 2005*<sup>1/</sup>—the first state in the nation to regulate toxic ingredients in cosmetics. He signed legislation,<sup>2/</sup> authored by Senator Don Perata, establishing the California Environmental Contaminant Biomonitoring Program to identify toxics

Extensive debris in the ocean and on our beaches harms wildlife and destroys the scenic beauty of our coastal resources. Most of the debris floating in the world's oceans is plastic and nearly all junk on beaches consists of plastic materials. In the north Pacific, floating plastic debris covers an area nearly twice the size of Texas. Californians generate about 21 million pounds of plastic waste daily, but only 3% gets recycled and much of it washes into the ocean. Plastic debris, which persists for centuries and is toxic to wildlife, has been found inside 43% of seabirds and 86% percent of marine animals studied.

Source: University of California Public Policy Research Center

accumulating in Californians. He also signed a new law,<sup>3/</sup> authored by Assemblywoman Fiona Ma, to ban phthalates from children's plastic products. And, he signed the landmark *California Global Warming Solutions Act of 2006*,<sup>4/</sup> by Assembly Speaker Fabian Núñez.

California was at the forefront when it adopted the nation's first air pollution and pesticide control laws 60 years ago. Californians launched the modern environmental movement after the 1969 Santa Barbara oil spill. Aggressive controls on tailpipe emissions revolutionized clean vehicle technology and led to substantial declines in smog. The State's ambitious solid waste reduction measures achieved recycling rates in excess of 50%. And, California will be a world leader in reducing emissions that contribute to climate change and global warming.

But today, toxic chemical threats

outstrip the government's response. Californians use more than 164 million pounds of chemical products daily from solvents to adhesives to personal care products. The United States produces or imports 42 billion pounds of chemicals daily and global production is expected to double every 25 years.<sup>5/</sup> Contaminants show up in the human fetus, workers, toys, clothing, low-income neighborhoods, furniture, jewelry, breast milk, and pet food. Recycling helps, but hazardous substances inexorably end up in landfills and



our environment. And the implementation of the principal federal hazardous chemicals reduction law, the *Toxic Substances Control Act* (TSCA), has failed to ban a single substance in over 20 years. The National Academy of Sciences and the U.S. Government Accountability Office concluded TSCA has been ineffective.

California lawmakers responded with more than 50 bills regarding



toxic chemicals last year. But, the piecemeal approach taken since TSCA has several shortcomings. Sometimes, regulations fix one problem, but cause another, such as when methyl tertiary butyl ether (MTBE), the smog-fighting fuel additive, polluted water supplies. More regulation adds significant red tape, costs, and uncertainty for business.

California can leverage its natural advantages to build the nation's first far-reaching chemicals policy. The University of California system and other leading universities could become engines of technological innovation and scientific breakthrough. California's clout as the nation's biggest consumer market could be enhanced through partnerships with the European Union, Canada, and Pacific Rim economies. California is the leading state for venture capital investment; materials science projects captured about one-third of the \$3.6 billion cleantech investment last year. The California Public Employee Retirement System (CalPERS) and the California State Teachers Retirement System (CalSTRS) committed \$870 million for cleantech investments in energy, water, and material technologies to reduce carbon emissions, conserve natural resources and improve energy efficiency.

Following are examples of companies turning to Green Chemistry practices to cut waste, save energy, and reduce liability and costs:

- Dow Chemical Company reduced its solid waste by 1.6 billion pounds globally, wastewater by 183 billion pounds, and energy by 900 trillion BTUs—enough to heat 8 million U.S. homes—due in part to Green Chemistry practices. Dow's costs: \$1 billion; Dow's savings: \$5 billion.
- Kaiser Permanente created an entirely new market for reformulated carpet in 2002 by requiring its supplier to produce a product free of polyvinyl chloride (PVC) and made from post-consumer recycled materials. The initiative was part of the company's commitment to Green Chemistry.
- Dell Inc. identified 50 toxic chemicals for elimination in products and required suppliers not to use them. Dell has eliminated all halogenated flame retardants from its desktop, laptop and plastic computer chassis—one of the first Fortune 500 corporations to go beyond existing U.S. regulations and adhere to international chemicals polices.

California has demonstrated that prudent policy can spur economic growth. The State's quest for a lesser-polluting car in the 1990s revolutionized automotive technology. More recently, the *California Global Warming Solutions Act of 2006* signed by Governor Schwarzenegger, as well as other energy conservation measures, will reduce per capita electricity consumption and greenhouse gas emissions by 50%. An estimated 89,000 new jobs in clean energy technology will be created by 2020, according to the University of California. California's \$3 billion investment in stem-cell research under Proposition 71 is expected to lead to breakthroughs in disease prevention.

The Green Chemistry Initiative will promote innovation, create new jobs, and keep people safe from harmful substances. It will ensure that California's historic role as an environmental leader will continue into the new century.

### **Conversation With California**

Following the Secretary's directive, Director Gorsen and DTSC launched the Conversation with California, an innovative, interactive, and inclusive dialogue to explore Green Chemistry ideas. All of the policy options in this report flow from this dialogue. The Conversation with California engaged participants as problem-solvers; and DTSC compiled options suggested by the participants.

Over 600 participants joined the Conversation with California. They provided more than 400 pages of written comments. Among the participants were representatives from companies such as DuPont, Procter & Gamble, Panasonic, Dow Chemical Company, Rohm & Haas, and Pfizer Inc.; from trade organizations including the American Chemistry Council, the Consumer Specialty Products Association, the Chemical Industry



Council of California, the Cosmetic, Toiletry, and Fragrance Association, the Soap and Detergent Association, the Western States Petroleum Association, and the Silicon Valley Leadership Group; from environmental, labor, and community organizations, including the Sierra Club, Environmental Defense, Californians for a Healthy And Green Economy, California Association of Professional Scientists, and Environment California; from public health advocates,

including The Breast Cancer Fund; from foreign governments, including Japan and Canada; from the U.S. Environmental Protection Agency (USEPA); and from academic institutions, including the University of California, Berkeley, UCLA, and the University of Massachusetts.

The Conversation with California consisted of five major components: brainstorming sessions, Green Chemistry symposia, a web log, the Science Advisory Panel, and preparation of this report. Each is discussed below.

### **Brainstorming Sessions**

From June through December 2007, six brainstorming sessions were held in Los Angeles, Sacramento, San Jose, and San Diego. Director Gorsen opened each Green Chemistry session with a presentation. This was followed by a panel discussion on toxic chemicals management issues, including the efficacy of the *Toxic Substances Control Act*; the European Union's Registration, Evaluation, Authorization and Restriction of Chemical substances regulation (EU REACH); the Canadian "Domestic Substances List;" the evaluation of chemical alternatives; risk and hazard assessment; financial incentives; and timely, accurate information about chemicals. Next, a facilitator organized all participants into small groups and tasked them with developing solutions to these four major challenges:

- Cradle to Cradle—How do we build products so they become raw materials for new products or nutrients for nature at the end of their useful life?
- Toxics by Accident—How do we prevent hazardous substances from inadvertently being incorporated into products through supply chains, illegal activity or foreign manufacturers?
- Toxics by Design--How do we reduce or eliminate hazardous substances intentionally built into products to improve performance or reduce costs?
- The Green Chemistry leadership team, consisting of senior managers from Cal/EPA, the California Health and Human Services Agency, and the State and Consumer Services Agency and the Department of Public Health, helps guide the overall effort and participated in each part of the Conversation with California.

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### **Green Chemistry Symposia**

Three Green Chemistry symposia

were held in Sacramento between October 2006 and December 2007 and led by Director Gorsen. The symposia brought together experts from government, industry and academia. The first symposium featured Mike Wilson of UC Berkeley; Jeff Wong of DTSC; John Ulrich, acting general manager of the Chemical Industry Council of California; Leif Magnuson, USEPA pollution prevention coordinator; Tim Shestek, director of state and local affairs for the American Chemistry Council; John Warner of the University of Massachusetts; and Terry Applebury of Applied Process Technology, Inc., and many more.

The second symposium, titled “Chemicals Policy for a Sustainable California,” featured Assemblymember Jared Huffman; Cal/EPA Secretary Linda Adams; John Froines of UCLA; Mark Schapiro of the Center for Investigative Reporting; Richard Denison of Environmental Defense; Jo Ann Foley of the Silicon Valley Leadership Group; Bill Magavern of the Sierra Club; and Thomas Jacob of DuPont, and many others. The third symposium, “Synthesis of Success,” featured Catherine Hunt of the American Chemical Society; Bill Greggs of Procter & Gamble; Jill Reed of AMPAC Fine Chemicals; Katy Wolf of the Institute for Research and Technical Assistance; and Michelle Smith of Rohm and Haas, among others.

The Office of Environmental Health Hazard Assessment

(OEHHA) within Cal/EPA also convened a Green Chemistry Conference; OEHHA participated throughout the process and provided technical staff and support for the Nanotechnology Symposia and Biomonitoring Symposium.

The Green Chemistry Symposia provided vital expert testimony about business practices, scientific and engineering research, regulatory initiatives in other jurisdictions, international chemicals policies, economic investment opportunities and environmental and health impacts.

### ***Green Chemistry Web Log (“Blog”)***

To stimulate on-going dialogue about Green Chemistry ideas between the stakeholder meetings and symposia, Director Gorsen launched a web log (“blog”) site. It is the first time a California agency utilized an interactive web-based forum to solicit comments, stimulate discussion and build public policy. Similar to a “wiki” interactive approach, in which participants develop the content, California invited scientists, environmentalists, industry leaders, public interest groups, governments and the general public from around the world to join the California Green Chemistry Initiative. The result: a total of 611 participants joined the Conversation with California and provided 411 pages of written comments.

The department can report substantial state, national, and global interest in California’s Green Chemistry



Initiative. Participants welcomed the invitation to directly participate and help shape the program. DTSC staff promptly posted all comments to the blog site and collected all the recommendations for inclusion into the menu of policy options contained in this report.

### **Science Advisory Panel**

To engage the scientific community, Director Gorsen and Deputy Director Jeff Wong assembled a Green Chemistry Science Advisory Panel consisting of 23 of the nation's leading scientists and engineers. The panel is a major asset to the program as it will guide the department on scientific matters and provide the technical basis for the Green Chemistry Initiative.

Panel members include: John Warner, Ph.D., of the Warner Babcock Institute of Green Chemistry; John R. Balmes, M.D., of UCSF and UCB; Paul Anastas, Ph.D., of the Massachusetts Institute of Technology; Nicholas Ashford, J.D., Ph.D., of MIT; Eric J. Beckman, Ph.D., of the University of Pittsburgh; William Carroll, Ph.D., of Occidental Chemical Corporation; Gail Charnley, Ph.D., principal at Health Risk Strategies; Richard Denison, Ph.D., of Environmental Defense; Daryl Ditz, Ph.D., of the Center for International Environmental Law; Michael Dourson, Ph.D., director of Toxicology Excellence for Risk Assessment; Kenneth Geiser, Ph.D., University of Massachusetts; Lynn Goldman, M.D., M.P.H., of

Johns Hopkins; John D. Graham, Ph.D., of RAND Graduate School; Robert Grubbs, Ph.D., of Caltech; Neil C. Hawkins, Ph.D., of Dow Chemical Company; Lauren G. Heine, Ph.D., principal for the Lauren Heine Group and Senior Science Advisor with Clean Production Action; James Hutchinson, Ph.D., University of Oregon; Vistasp M. Karbhari, Ph.D., of UC San Diego; John Peterson Myers, Ph.D., of Environmental Health Services; Mary O'Brien, Ph.D., Grand Canyon Trust; Barry Trost, Ph.D., of Stanford; Michael P. Wilson, Ph.D., of UC Berkeley; and Katy Wolf, Ph.D., director of the Institute for Research and Technical Assistance.

### **Report Preparation**

A Green Chemistry Working Group, consisting of senior managers within the Cal/EPA departments and the Department of Public Health, sorted the ideas, suggestions, and comments collected throughout the Conversation with California. The Working Group sorted the policy options at the close of the public comment period. They organized those options into eight categories, which are contained in this report and offered to inform policy discussions about next steps.

### **Options**

In her memo of April 20, 2007, Secretary Adams directed the department and other state agencies to prepare options for a California Green Chemistry Initiative. The

Conversation with California was launched, resulting in scores of letters, meetings, symposia, and blog comments. Those 818 ideas and comments, which have been grouped and distilled into 37 options and sorted into eight chapters, are offered to build the next steps for California Green Chemistry Initiative. The chapters, into which the comments were organized, are: data collection and use, economic incentives and markets, statutory and regulatory requirements and enforcement, voluntary measures, research and technology, technical assistance, and recognition, awards, and certification. Each is discussed below. These are options to be considered; none have been selected or are recommended.

**Data Collection and Use:** Numerous stakeholders commented on a lack of information about chemicals. Several noted that a functional marketplace requires access to timely information about goods and services, yet this is often missing when it comes to assessing toxic chemicals in products. The 2006 report, “Green Chemistry in California: A Framework for Leadership in Chemicals Policy and Innovation,” which was prepared by the U.C. Public Policy Center for the Legislature, identifies gaps in our understanding of toxic chemicals in products. These information gaps were a focal point for all sectors. A majority of commenters told DTSC that businesses do not always know substances in their products or supply chains; consumers do not

have access to information about chemical contents in products they buy; and regulators do not have the information to identify and prioritize chemical hazards.

To close the gaps, many participants said California could build a state-wide chemical inventory identifying chemical uses by type, industry sector and toxicity. This effort could be aided by data collected under memorandums of understanding with the European Union and Canada. The database could help create a chemical roadmap, showing hazardous substances flows, changes and endpoints. Several commenters suggested that California could create an on-line clearinghouse so the public, researchers, industry, non-governmental organizations and other governments could access the information with protections for certain types of information.

By collecting such information, commenters said, businesses and consumers could begin making informed decisions based on exposure, human toxicity, bioaccumulation and ecotoxicity. Currently, the Canadian Environmental Protection Act screens approximately 23,000 industrial chemicals for impacts on the environment and human health; high priority substances are targeted for risk-reduction measures, including life-cycle analysis and possible elimination. For more information about data collection and information options, see Chapter 1.

**Economic Incentives and Markets:**

Exposure to toxic chemicals in consumer products and the environment can be an example of failure in the free market, a number of participants pointed out. Third parties often bear the costs in illnesses and environmental degradation. If manufacturers do not pay these costs, they have little incentive to change manufacturing inputs and processes, so business as usual prevails. To correct this problem, several participants said California could create incentives and penalties to encourage corporate responsibility and accountability.

Among these comments, incentives may include low-interest loans, grants, and tax credits. Such measures may have the added benefit of attracting cleantech venture capital for Green Chemistry. Numerous participants remarked that California has extensive experience using economic incentives, including recyclable container deposits, rebates for energy efficient products and specific usage fees. Conversely, penalties, including fines and fees, shape markets by impacting a company's bottom line or its reputation in the industry or the community.

California could engage industry as partners, some suggested. Several commenters stated that government could develop codes of practice for design, manufacture, distribution and disposal of products. Participants also remarked that the State could promote product stewardship by requiring companies to take back harmful products at the end of their

useful life as auto batteries and some electronic wastes are handled now.

Finally, a number of stakeholders stated California government could use its procurement power to advance Green Chemistry. This would establish leadership and create marketplace demand for clean technologies. These measures could grow the economy, stimulate innovation and create jobs. For more information on economic and market options, see Chapter 2.

**Statutory and Regulatory Requirements, Enforcement:**

The majority of stakeholders said new laws and regulations should be among the options that decision-makers consider for the California Green Chemistry Initiative. The options they presented include requirements for data collection, reporting, and disclosure; prohibitions on uses of or bans for harmful chemicals; product labeling; programs that require manufacturers take back certain products at the end of use; and other regulatory options. A voluntary Green Chemistry program could be augmented with enforceable measures. Commenters also suggested a broad range of risk or hazard assessment strategies along with metrics to evaluate those strategies. For more information about statutory and regulatory requirements and enforcement options, see Chapter 3.

**Voluntary Measures:** Voluntary measures to develop chemical information and data, reduce toxics

use, and find safer substitutes can be an important tool to advance Green Chemistry, several participants said. They noted that many voluntary measures—including existing public-private partnerships and programs—could be expanded to encourage companies to design and sell less toxic products. For more information on voluntary measures, see Chapter 4.

**Education and Outreach:** While some in business, government, and the environmental community are well acquainted with Green Chemistry, most participants noted that the general public is not familiar with Green Chemistry. They said political will, public support, and informed consumer choice will be necessary for a successful Green Chemistry program. Participants also said California must train a new generation of scientists and engineers who conceive of molecules in a societal context. Some commenters also recommended augmenting the present Education and the Environment curriculum for K-12 students to include Green Chemistry principles. Participants recognized that today's students will be tomorrow's consumers, workforce, and leaders. They suggested that higher education and research institutions train young scientists and engineers in Green Chemistry principles. The University of California Extension could offer courses for mid-career professionals. The community colleges could design and implement certificate programs for a new Green Chemistry workforce, several commented.

Smart and simple messages could be developed to engage consumers, news media, and non-governmental organizations and leveraged across various media, according to participants. Messages could include



information about toxicity and chemicals in products, alternatives and safe use and disposal of products. For more information on education and outreach options, see Chapter 5.

**Research and Technology:** As in earlier eras, research and discovery will be key drivers for the third wave of change, participants noted. New chemical designs can replace processes where life-cycle factors are included before production and use. Several participants called for research in Green Chemistry, noting that considerable and much needed scientific information could be generated. Laboratories and research institutions could conduct research in new screening methods, production methodologies, and safer



substitutes and alternatives. From raw materials to a final product's end-of-useful life, several commenters said additional scientific research and technological innovation is needed for a Green Chemistry transformation. For more information about research and technology, see Chapter 6.

**Technical Assistance:** Not all businesses—several commented—have the resources or expertise to explore alternatives to the chemicals and processes they use. Participants said the State can help these companies by providing expertise, best management practices, and other information. Collaborations with trade groups, professional societies, consumer groups and academia could also help businesses, participants suggested.

Some participants proposed that the State establish a Green Chemistry business program to promote access to information for businesses. Such a program might include demonstration projects, workshops, training and education, mentoring and curriculum development. For more information, see Chapter 7.

**Recognition, Awards, and Certification:** Public acknowledgment for a job well done can be a powerful

inducement for high performance, according to participants. Awards are also marketplace signals, guiding consumers to products from companies of distinction. California can amplify these market signals, some suggested, by certifying exemplary products and services. Participants highlighted similar programs include the Presidential Green Chemistry Awards administered by the USEPA, Green Seal, and the German Blue Angel awards. For more information, see Chapter 8.

### **Key Elements**

Like molecules, several elemental parts or building blocks will be essential for a successful California Green Chemistry program. From the multitude of options shared by all commenters, the following components recur throughout the array of possible options:

***Collect accurate and comprehensive chemical information.*** Businesses, consumers and regulators often lack complete and standardized information on chemical toxicity and uses. Businesses find it difficult to identify hazardous chemicals in their supply chains; consumers do not know what is in the products they buy; government agencies lack information needed

to identify and prioritize chemical hazards. These information gaps prevent the free market from working properly to stimulate innovation of safer substitutes. Protection of certain types of information needs to be provided.

***Disseminate information on toxic chemicals.*** California's leadership position in information technology should be leveraged to develop new ways to communicate chemicals and toxicity to the public.

***Empower consumers to make informed choices.*** Information about toxicity in products should appear proximate to the products as an information label or notice. Public awareness campaigns similar to the Flex Your Power program could also help close information gaps.

***Account for chemical toxicity and impacts in state procurement decisions.*** California must lead by example and adhere to the same standards it proposes for the private sector. State agencies can leverage their influence in the marketplace by including cradle-to-cradle and life-cycle cost analyses in purchasing decisions.

***Train a new generation of scientists and engineers.*** California needs experts trained to think holistically about chemicals. California universities should offer scholarships, promote research and development, issue technology licenses and train students in ecotoxicity, life-cycle analysis and Green Chemistry principles.

***Include Green Chemistry principles in an Environmental Education Initiative.*** Students from kindergarten through 12<sup>th</sup> grade will be tomorrow's workforce and consumers. Environmental education curriculum should be expanded to include understanding of toxic chemicals, risk, consumer choice and sustainability.

***Forge strategic international partnerships.*** California can leverage its position as the United States' biggest consumer market by entering into memorandums of understanding with the European Union and Canada to share information about toxic chemicals. Such information is already being collected under the 2007 Registration, Evaluation and Authorization of Chemicals initiative (EU REACH) in Europe and the "domestic substances list" generated under the *Canadian Environmental Protection Act* (CEPA) of 1999. California participation would help harmonize these international efforts.

***Strengthen consumer protection laws.*** Laws to protect consumers are scattershot. Some lack standards, others lack enforcement mechanisms. An effective system is needed to protect consumers from hazardous substances in products.

***Expand California's pollution prevention program.*** California can prime the pump for Green Chemistry by growing existing pollution prevention programs. The program, called P2, helps businesses reduce toxic chemicals while increasing

profits. But the investment has been modest and limited. Green Chemistry is a long-term solution, but expanding pollution prevention to include more companies and spread technology across industrial sectors would achieve short-term gains.

DTSC will conduct the next phase of the California Green Chemistry Initiative this year and will gather detailed input on how some of the



options presented in this report might be implemented, by whom, over what timescale, in what manner, etc. While the process is still being formulated, it will be transparent, open, and inclusive. The Department will seek public input as well as expert advice and will evaluate different frameworks to select the appropriate portfolio of options and effective enforcement and compliance provisions. The Department will present potential integrated policy solutions, including voluntary, regulatory and incentive-based measures, in

recommendations to the Secretary for Environmental Protection by July 1, 2008.

## Going Forward

Chemistry has fueled remarkable advances in medicine, pharmaceuticals, agriculture, and industry over the past century. It has revolutionized electronics, transportation, energy, and manufacturing and improved every facet of life. But industrial chemicals and waste have exacted a high price on the environment and human health.

Green Chemistry seeks to build on scientific advances while challenging science to perform at its noblest. It seeks to make products better without making the planet worse. It is a call to leadership and imagination.

In the book, *Cradle to Cradle: Remaking the Way We Make Things*, author Bill McDonough asks, if we could restart the industrial revolution, knowing what we know now, would we create a system that:

- Releases billions of pounds of toxic material into the air, water and soil every year?
- Makes materials so dangerous they will require constant vigilance by future generations?
- Produces gigantic quantities of waste?
- Buries valuable materials in holes where they cannot be retrieved?

- Demands thousands of complex regulations – not to keep people and natural systems safe, but to keep them from being poisoned too quickly?

A California Green Chemistry Initiative would chart a new course to a better world. It would engage academia, business and government in partnership to stimulate economic growth using clean new technologies. It would cut toxic waste while increasing markets and global competitiveness working together with nations. It could replace

the current piecemeal approach with a market-driven strategy that favors innovation. Green Chemistry is an opportunity to get it right, a chance to reinvent invention and lead the nation in the 21<sup>st</sup> century.

## **(Endnotes)**

- 1 Chapter 729, Statutes of 2005, adding article 3.5 (commencing with section 111791, chapter 7, part 5, division 104) of the Health and Safety Code (Senate Bill 484, Migden).
- 2 Chapter 599, Statutes of 2006, adding chapter 8 (commencing with section 105440, part 5, division 103) of the Health and Safety Code (Senate Bill 1379, Perata).
- 3 Chapter 672, Statutes of 2007, adding chapter 11 (commencing with section 108935, part 3, division 104) of the Health and Safety Code (Assembly Bill 1108, Ma).
- 4 Chapter 488, Statutes of 2006, adding division 25.5 (commencing with section 38500) of the Health and Safety Code (Assembly Bill 32, Nunez).
- 5 University of California Public Policy Research Center



