CALIFORNIA GREEN CHEMISTRY INITIATIVE

Phase 1—A Compilation of Options

Table of Contents

Executive Summary i
Chapter 1—Data Collection and Use Options 3
Chapter 1—References 16
Chapter 2—Economic Incentives and Market Options 39
Chapter 2—References 48
Chapter 3—Statutory and Regulatory Requirements and Enforcement Options 63
Chapter 3—References 81
Chapter 4—Voluntary Measures Options 125
Chapter 4—References 129
Chapter 5—Education and Outreach Options 135
Chapter 5—References 139
Chapter 6—Research and Technology Options 155
Chapter 6—References 159
Chapter 7—Technical Assistance Options 163
Chapter 7—References 170
Chapter 8—Recognition, Awards, and Certification Options 181
Chapter 8—References 189
Endnotes 191

Glossary of Acronyms and Terms
Acknowledgements
Appendix A—Secretary Adams' memorandum
Appendix B—Emerging Options
Appendix C—Conversation with California Stakeholder Comments

Chapter 1—Data Collection and Use Options

Acquiring information needed to address the
health and environmental impacts of chemicals

SYNOPSIS

Many participants said that better data and information about chemicals is essential to address the four challenges presented by the Green Chemistry Initiative. Many others—while not explicitly calling for better data and information—recommended options that include improving how chemical data, risk or hazard information, and toxicity and other related information is collected, shared, and used. Data collection and use represented roughly 17% of the total number of comments received throughout the Conversation with California. More than 140 options involving chemical data and information were submitted.

The comments related to data collection and use addressed several common themes. These are compiled in this chapter into the following seven major options:

- Systematically collect data and information needed to categorize and prioritize chemicals; take actions to reduce toxics in products.
- Use the best elements of existing programs such as the Canadian Environmental Protection Act (CEPA) and the European Union's Registration, Evaluation and Authorisation of Chemicals (EU REACH) program as models for better data collection and use.
- Use the best elements of other programs in the United States as sources of data or as models for information collection and use.
- Establish mechanisms and tools to facilitate the sharing, use and analysis of data.
- Collect data for life-cycle assessments to inform actions.
- Build a toxicological and exposure potential database on chemicals used in California.
- Map chemicals that are produced in and imported to California and how these chemicals are transported, used, and managed through end-of-life.

Stakeholder comments included a range of data collection mechanisms, including: (i) collection of new data by the State and independent entities; (ii) compiling existing information from national, international, and state programs; and (iii) requesting additional data from chemical manufacturers, either making it mandatory or voluntary. However, this chapter focuses on compiling stakeholder comments regarding what data and information could be collected and how the data could be used, rather than on data collection mechanisms.

BACKGROUND

Although not an exhaustive list, State agencies administer several programs that collect certain chemical data and information. These include:

- Health-related chemical data: The California Department of Public Health (DPH) collects or monitors certain chemical data and human health information for various health-related programs, including childhood lead, occupational health, indoor air, and other programs.
- Pesticide data: The California Department of Pesticide Regulation (DPR) maintains the most extensive pesticide use reporting system in the United States. Recent data show a decline in the use of high-toxicity chemicals.
- Cancer and reproductive harm chemical data: The Office of Environmental Health Hazard Assessment (OEHHA) administers the Proposition 65 program and maintains data used in reviewing chemicals for possible listing as known to cause cancer or reproductive harm.
- Fish advisory chemical data: OEHHA collects and disseminates to consumers information on levels of chemicals in fish.
- Water and sediment quality chemical data: The State Water Resources Control Board (SWRCB) and the nine Regional Water Quality Control Boards collect discharger and receiving water data to assess water quality and sediment quality.
- Air quality and toxic air contaminants data: The State Air Resources Board (ARB), along with the local air districts, gathers chemical concentration data for ambient air and emissions for certain criteria air pollutant and toxic air contaminant chemicals.
- Biomonitoring chemical data: A new multi-agency program (DPH, DTSC, and OEHHA) will begin to identify and track data on chemicals of concern in biota, beginning this year.
- Hazardous waste data: Pursuant to the *Hazardous Waste Source Reduction and Management Review Act of 1989*,[1/] DTSC collects data on hazardous waste generation and source reduction from the State's largest waste generators every four years.
- Pollution prevention chemical data: Local governments are beginning to collect data on green business and pollution prevention programs. The data will measure the progress of small businesses in reducing waste.

DISCUSSION OF OPTIONS

OPTION DC-1: Systematically collect data and information needed to categorize and prioritize chemicals, and take actions to reduce toxics in products.

Many stakeholders recommended establishing a program to identify, assess, and manage priority chemicals based on an evaluation of hazard, including toxicity and potential for exposure. From the comments received in the Conversation with California, the concept of systematically collecting appropriate chemical data has broad-based support from industry, environmental organizations, and academia. The challenge of addressing the human and environmental impacts of the myriad of chemicals in use today in California and present in everyday products is formidable. To tackle this challenge, participants said a better understanding of the potential for human and ecosystem exposures to these chemicals, their toxicological and physicochemical properties, how long they can persist in the environment, and their tendency to bioaccumulate in living organisms is needed. Further, many stakeholders noted the need to reduce toxics in products, but to make sure the replacement technology or chemical is safer, while retaining

product effectiveness, and price competitiveness. Thus, other types of information would need to be collected on available alternative technology and chemical substitutes.

Many commenters also noted that data collection efforts could ensure that most of the information sources are tapped to the fullest extent possible, and that the collected data would then be used in a prioritization process to rank chemicals for further action.

To be most effective, participants said new and expanded data collection efforts could include the following elements:

1. **An Inventory**—The universe of chemicals used in commerce in California could be defined and captured in a registry which would include a summary of the physicochemical properties, toxicity, and use data for each chemical.

2. **Exposure Data**—In order to prioritize chemicals by hazard, there needs to be some measure of potential for exposure. The types of exposure information that could be collected include:

    a. ***Chemical production and use patterns***. Data on the production, distribution, and use—in industrial processes as well as in final products—could be collected, several participants said. They noted that this information could be used to develop a "Chemicals Map for California." In concept, this database would include information on the flow of chemicals in California; what the chemicals are, where they are produced, and how much is produced; how the chemicals are used, in what quantities, and by whom; and the fate or the wastes generated. Among other things, "the map" would identify which industry sectors generate or use the most toxic products. (See Option DC-8, below, for a more detailed discussion of the "chemicals map" topic.) Participants recommended evaluating what data are currently available from USEPA, Canada, and others that could be used in developing a "chemicals map" for California.

    b. ***Biomonitoring data***. Several commenters suggested making use of biomonitoring data, or doing more biomonitoring. Biomonitoring is the measurement of chemicals (or their metabolites) in wildlife or people (body fluids or tissues). Such data reflects total exposures to the measured chemical from all sources (for example, from air, soil, water, dust, and food) over the individual's life. Suggestions included collecting available biomonitoring data to evaluate exposures occurring within the State. National-level data are currently collected as part of the Center for Disease Control and Prevention's National Biomonitoring Program.[2/] European and Canadian biomonitoring efforts are also underway. Finally, recently enacted law[3/] established the California Environmental Contaminant Biomonitoring Program, which will generate valuable information to complement existing and future chemicals-related programs in the State.

    c. ***Data on persistence and bioaccumulation potential***. The environmental persistence and tendency of a chemical to bioaccumulate affect the potential for exposures to that chemical. Participants recommended using (or modifying as appropriate) existing criteria for identifying chemicals as persistent and/or bioaccumulative. They said this information could be used for classifying chemicals into tiers based on degree of persistence or bioaccumulation potential.

d. ***Exposure simulation models***. Some stakeholders suggested that, if appropriate, California could use physicochemical and use data in models simulating exposure scenarios to inform decisions involving common chemicals in commonly used products.

3. **Toxicity data—**Many commenters stated that California could gather information on the toxicity of chemicals used in commerce in California. They said this data would support a prioritization effort. Information collected on the toxicological properties of chemicals used in commerce could include available animal studies, epidemiological (human) studies, and ecological studies. Some suggested that the data be used to create lists of carcinogens, mutagens, reproductive toxicants, developmental toxicants, neurotoxicants, endocrine disruptors, and any other compound capable of causing serious or irreversible harm. Regarding toxicity information, several stakeholders from various sectors recommended:

   a. Devising strategies to ensure that data collection efforts will access all readily available sources. Sources include: primary scientific literature; Cal/EPA health assessments; USEPA assessments (as identified in sources such as the Integrated Risk Information System[4/]); publicly available chemical toxicity profiles developed by Health Canada and Environment Canada under CEPA; other states' evaluations; and assessments conducted by industry and submitted to U.S. EPA under voluntary programs, such as the High Production Volume (HPV) and Voluntary Children's Chemical Evaluation Program (VCCEP). Additionally, participants said California could evaluate the publicly available chemical dossiers developed under the EU REACH program as they become available (this program is not yet implemented).

      Several participants also noted California could enter into memoranda of understanding with the Canadian government and the European Chemicals Agency to access chemicals data in those programs. Under such agreements, governments might share data on chemical properties, toxicity, and information that is not publicly available or data claimed as confidential business information.

   b. Obtaining tiered sets of toxicity information according to usage, amounts produced or imported, or other indicators of exposure—starting with chemicals in the very high and high concern categories. This may involve requiring toxicity testing data from chemical manufacturers. Some noted that California could encourage the use of alternatives to animal testing where possible.

   c. Where data are not available, using Quantitative Structure-Activity Relationship (QSAR) models[5/] to predict and quantify the toxicity of untested or minimally tested chemicals. Founded on the principle that chemicals with sufficiently similar structures exert similar qualitative toxicities, these models infer the toxicological properties of a chemical based on known properties of a structurally and chemically related substance. Environmental persistence, bioaccumulation, and exposure potential may similarly be estimated based on a chemical's molecular structure. (The USEPA "PBT Profiler[6/]," for instance, is a web-based evaluation tool that predicts the environmental persistence, bioconcentration potential, and aquatic toxicity of discrete chemicals based on molecular structure.)

      Stakeholders across sectors recognized that in order to address chemicals of greatest concern first and use limited resources most efficiently, they said chemicals could be

prioritized by level of hazard**.** Commenters urged that criteria for prioritization be clearly defined, and that both exposure and toxicity (including ecological toxicity) be considered. Some participants recommended considering worker exposure, as workers tend to have the highest exposures. A number of commenters noted that the criteria used by Canada for its CEPA prioritization [see discussion under Option DC-2] could be evaluated for their applicability to California, and modified as appropriate to better suit the State's needs. Several noted that prioritization could emphasize protection of the most vulnerable populations and resources. For example, theses comments highlighted the potential for children to be exposed to chemical in toys and consumer products used by or on children. They pointed out that immature, developing organisms, such as children, are more sensitive to the effects of the chemical in question, could warrant assigning a higher priority to the chemical and/or product(s).

Many stakeholders noted that the prioritization process would classify chemicals into tiers according to levels of concern. Chemicals designated as being of highest concern could then be: (a) comprehensively evaluated, similar to the Canadian CEPA program's chemical-specific toxicity profiles and/or (b) used less according to pre-determined criteria defining the consequences of manufacturing or using chemicals in the various tiers. Finally, several stakeholders stressed that California could include the climate impacts and energy requirements of chemicals (that is, energy required to manufacture, transport, use, dispose, and remediate contamination, etc.) when evaluating need for use reduction and safer substitutes.

4. **Data on types of, efficacy, and cost of alternative technologies**—Following the prioritization process, many stakeholders recommended: (1) taking chemicals of top priority concern; (2) identifying the specific applications or industry uses posing the greatest risk from those chemicals; and (3) applying a collaborative process of agency, industry and third-party experts to identify or develop viable alternatives that can maintain efficacy, but reduce risk in those targeted applications. The comments also noted that partnerships (discussed in Chapter 7, Technical Assistance) are necessary to ensure that chemical substitution or process redesign (for example, to reduce or eliminate the need for a toxic chemical) incorporates product efficacy, and concepts of designing for the least environmental impact overall. Many comments noted that products could be designed with recyclability and re-use in mind. Different types of information—beyond chemical data—are needed to assess economic aspects, technical feasibility, and effectiveness of the substitute technology.

5. **Iterative Data Updates**—Several stakeholders stated that a Green Chemistry program depends upon current chemicals use information for California and must be capable of incorporating new information on use, toxicity, and exposure as it becomes available. Thus, they recommended an iterative process as part of data collection and use.

OPTION DC-2:	***Use the best elements of the Canadian Environmental Protection Act (CEPA) and the European Union's Registration, Evaluation and Authorisation of Chemicals (EU REACH) program as models for data collection and use.***

Many stakeholders recommended using elements from other governments that have developed chemicals policies, such as the Canadian Environmental Protection Act of 1999 (CEPA)[7/] and

the European Union's Registration, Evaluation and Authorisation of Chemicals (EU REACH).[8/] They noted that these programs rely on methodical collection and evaluation of data on a well-defined universe of substances. Several commenters recommended following the EU REACH approach—which shifts the burden of proof from government to industry for gathering chemical information, assesses chemical safety, and selects appropriate risk management measures.

Stakeholders said California could draw upon the regulatory framework created by CEPA and EU REACH. They pointed out the useful knowledge and experience gained by Canada and the European Union in implementing these programs. Rather than adopting international programs wholesale, several commenters recommended that California evaluate the best elements of each program and then incorporate or adapt those as part of a California Green Chemistry program. For example, participants said, California could move quickly by leveraging priorities identified in the Canadian Chemical Management Plan. Since the Canadian chemical inventory may not be exactly the same as California's, the state would need to include a means for adding and deleting priority chemicals based on unique California circumstances. Stakeholders noted that prioritization processes and criteria adopted under CEPA and EU REACH could similarly be considered as California develops its own process and criteria.

OPTION DC-3: Use the best elements of other programs in the United States as sources of data or as models for data collection and use.

Several stakeholders said California could act quickly where others have found a problem in terms of a chemical's persistence or toxicity. Other states have implemented programs aimed at reducing the use of toxic chemicals. A number of comments stated that California could evaluate those programs and adopt appropriate elements to reduce exposure to toxic chemicals in the state. Notable examples of other state programs include:

- **Massachusetts Toxic Use Reduction Act (TURA)**[9/] as amended in 2006. This law requires manufacturing companies using certain toxic materials above a threshold volume to file a report describing their use of the chemical and to develop a Toxics Use Reduction Plan for each chemical. The law has reduced toxic chemical usage, chemical waste, and chemical emissions. TURA has saved industry millions of dollars and provided Massachusetts significant health and environmental benefits. Several commenters suggested that California use TURA data on process-specific chemical usage.

- **Oregon Toxics Use and Hazardous Waste Reduction Act (TUHWR)**[10/] as amended in 2005. Under this Oregon law, users of toxic materials as well as large and small quantity hazardous waste generators are required to develop a reduction plan and report completion of the plan. Business must complete an Implementation Summary describing how the plan was implemented and their successes, challenges, and future opportunities for toxic waste reduction. Several comments noted that California could collect data submitted under TUHWR and use the information on process-specific chemical usage.

- **Oregon Executive Order—Elimination of Persistent, Bioaccumulative, and Toxic Pollutants**. The Executive Order (EO 99-13) requires identification of persistent, bioaccumulative, and toxic (PBT) pollutants; tracking the production and use of those chemicals; and eliminating them in the environment through education, technical assistance, pollution prevention, economic incentives, procurement policies, and compliance and permitting activities. Stakeholders commented that Oregon's identification

criteria, its PBT chemicals list, and its information on industries using or producing PBT chemicals could be useful for a California Green Chemistry effort.

- **USEPA Inventory Update Rule.** As part of the effort to use existing data, participants said California could leverage the recently assembled U.S. Inventory Update report. This report includes volume, use, and exposure information; it identifies uses and user industries for the high priority chemicals that raise the greatest concern. Stakeholders said California could request producers of priority chemicals and manufacturers with high concern uses to provide hazard and exposure information from this program.

OPTION DC-4: Establish mechanisms and tools to facilitate sharing, use, and analysis of data.

From the Conversation with California, stakeholders indicated broad support for filling California's data needs as much as possible by accessing data collected and compiled by other states, nations, researchers, industry, consumer groups, and other entities. Several stakeholders noted a need for new data generated by manufacturers voluntarily or pursuant to a State requirement. They recommended that such data to be compiled and made widely accessible. As noted by one participant:

> *"By leveraging its preeminence in data management and mining and information technologies, in partnership with the information technology sector (for example, Internet search firms), California could organize the world's chemical data and facilitate access to this information for consumers, businesses and regulators. Currently, the dossiers for the USEPA High Production Volume (HPV) Chemical Challenge program, and the related European program are often difficult to find, and the data difficult to extract. By partnering with the information technology sector (for example, Internet search firms), the State could expand access to chemical information, support its local industry and raise awareness of chemical safety information currently available."*

In devising strategies for promoting the exchange, use, and analysis of shared data, a number of Conversation with California participants stated that the State could consider options for the following:

- **Linking databases**. Stakeholders said existing databases containing chemical use, toxicity, and hazard information could be linked to encourage sharing and use of data. Further, linking databases on chemical production, use, and exposure, with spatial data (for example, through Geographic Information Systems) whenever possible can reveal geographic trends and patterns that could then be considered in decision-making.

  Databases created under existing regulatory programs provide discrete pieces of information on the hazardous substances used and handled by California businesses. Examples include: facility-specific airborne emissions data from the California Air Toxics Hot Spots Program; facility-specific releases to air, water, or land from the USEPA Toxic Release Inventory; and information from individual local businesses (not yet in a database) regulated under the California Accidental Release Prevention Program. Linking this information into a single database would make obtaining information considerably easier,

particularly where businesses already submit data under one program or another. Where not prohibited by their governing laws or regulations, reporting forms could also be modified to gather additional data on industrial chemicals manufactured and used in California.

- **Analytical tools**. Many stakeholders noted that availability of existing software designed to evaluate relative hazards of chemicals developed by a number of organizations for various purposes. The State could evaluate the utility, applicability, and validity of these tools and, where appropriate, promote their use by entities faced with the need to make determinations regarding chemical safety. Participants mentioned several examples in their comments, including Dolphin Software,[11/] the "Green Screen for Safer Chemicals,"[12/] Chemical Compliance Systems,[13/] and The Blue Angel.[14/]

- **Web-based information clearinghouse**. Several commenters stated that California could create a public website that presents a variety of information to a variety of users, including: chemical hazard and use data; toxic chemical ingredients in common consumer products; safer alternatives; and web-based assessment tools for identifying safer alternatives (for example, existing tools such as the Green Screen, Chemical Compliance Systems, Pfizer's Solvent Alternatives, as well as new or modified software specifically designed to meet California's needs). Further, to promote the safe use, handling, and disposal of chemicals in households, stakeholders said the State could develop an interactive web-based program describing a "Safe-Home" environment, with information geared towards children.

  In populating the information clearinghouse, several stakeholders noted that California could catalog and make easily available information regarding best practice screening processes, green chemical design, and existing collaborative efforts. These efforts include the American Chemical Society Green Chemistry Institute; Cleangredients; USEPA programs such as Design for Environment, Performance Track, eChemPortal, and EPEAT; the DTSC Technical Resource Center, and international efforts such as the Global Harmonization System. According to several commenters, many medium and small companies lack knowledge and resources; they will need assistance in taking advantage of Green Chemistry practices. Providing incentives for the sharing of data and best practices will help all companies.

  Since transparency is a key to any effective government program, stakeholders said the clearinghouse and its contents could be readily available to interested parties, understandable, and useful. Visitors to the site could have access not only data on chemical use, exposure, and toxicity, but also information on how these data were applied for various purposes, such as prioritizing chemicals into categories of concern, and assessing hazard.

- **Database of chemical or technological alternatives.** Several comments proposed that California develop a database of chemical or technological alternatives that compares a number of sustainability parameters. The parameters may include performance, price, human health and environmental factors (such as toxicity, bioaccumulation, persistence), carbon footprint, and source sustainability.

- **"Wiki" Approach to Data Collection**. To maximize its ability to collect information, participants said, California could employ a "wiki" approach in compiling a database on chemicals in commerce, their uses, and toxicity, and emerging green chemistry technologies. Wikipedia pioneered this approach as an open, collaborative process for

compiling a multilingual, web-based, free content encyclopedia. [See http://en.wikipedia.org/wiki/Wikipedia:About] Volunteers from all around the world can contribute content to Wikipedia which, since its creation in 2001, has grown rapidly into one of the largest reference websites. The wiki approach has likewise gained popularity in recent years as a way to obtain information and ideas from interested parties.

- **Develop a data audit system.** Some commenters noted that the State could have a system to evaluate the scientific validity of information gathered from external sources to ascertain whether the data the State uses to prioritize chemicals are appropriate, up-to-date, and inclusive of all toxicological endpoints. Others noted the importance of data validation and data quality in any information collection system.

- **Establish partnerships with states to create an interstate clearinghouse of environmental health and safety data.** A few stakeholders thought California could establish a clearinghouse of information related to green chemistry and reducing toxics in our environment by tapping into other states to establish an interstate clearinghouse of data on chemicals in commerce that provides environmental health and safety information. This could include information generated by other state's environmental and public health agencies on chemicals of common concern. Some commenters further suggested that other public and private sector entities could use a multi-state clearinghouse.

OPTION DC-5: Collect data needed to conduct life-cycle analysis of high-use products and develop a life-cycle analysis prototype.

Green Chemistry is part and parcel of sustainable development. Several stakeholders expressed the need to evaluate use of chemicals in products by looking at the product as a whole and analyzing every aspect of that product's life cycle—from the harvesting and processing of raw materials to that product's ultimate disposal or "end of life." Since efforts to use renewable resources and "clean" energy to support manufacturing are involved in sustainable development, life-cycle analysis (LCA) can be used to evaluate this aspect of a product's production. Several comments said life-cycle analysis would aid process and product re-design, substitution, and alternatives. Partnerships with industry, several participants stated, would be beneficial in developing a prototype life-cycle analysis methodology. Some recommended that California consider using LCA guidelines established by the Society of Environmental Toxicology and Chemistry. These guidelines include water, energy, and raw materials used in the product as well as the transportation and waste streams from those processes.

OPTION DC-6: Build a toxicological and exposure potential database on chemicals used in California.

Among the data to be collected, several stakeholders recommended including information on chemicals in use, where and how they are used, which companies produce them, chemical ingredients in products, toxicity data, physiochemical properties, and exposure-related data. They said that a well-constructed, well-managed database could be a critical tool for collecting, retrieving, and evaluating chemicals. They also noted that such a database would help identify data gaps.

As the comments indicated, a database could be initially populated with toxicity and exposure information identified from a baseline assessment of what is already available. To fill gaps, some stakeholders recommended certain measures. Many stakeholders wanted data to be publicly accessible, as much as possible, to allow a free flow of information among users, researchers, the public, and industry. Stakeholders from several sectors noted that California could develop measures to improve information flow along the supply chain from chemical manufacturers, through businesses using chemicals to make products, and ultimately to consumers.

OPTION DC-7: "Map" chemicals that flow into and out of the state and how they are used in California.

Participants in the Conversation with California identified a need for California to develop a full understanding of how chemicals flow into and out of the state. They recommended creating a "chemicals map" for the state. As proposed in the comments, the chemical map would be a database of information on:

- Chemicals that are produced in or imported into California;
- The location where the chemical is produced or enters the state and who manufactures or imports the chemical;
- Where and to whom the chemicals move in the state (that is, the downstream suppliers and users);
- Production or import volumes of the chemicals;
- How the chemicals are produced and processed;
- How the chemicals are used, in what applications, processes, or products, and in what physical forms and concentrations; and
- The fate of the chemicals (that is, whether they are discharged into the environment, exported out of the state for other uses or as waste, etc.).

Comments indicate that a "chemical map" database would allow the state to track geographically the identity, volume, the manner of production, uses and ultimate fate of chemicals flowing into and out of the California environment. The database could be searched and analyzed using traditional methods, but could also be represented and manipulated using geographic information systems (GIS). The chemical map could also be linked to toxicity information already available from state agencies (such as the Department of Toxic Substance Control [DTSC], Department of Pesticide Regulation [DPR], State Air Resources Board [ARB], Department of Public Health [DPH], and the Office of Environmental Health Hazard Assessment [OEHHA]) and federal agencies (such as the U. S. Environmental Protection Agency [USEPA]) to identify chemicals of particular concern in California.

During the Conversation with California, significant discussion occurred about a chemical map for the state. These lengthy discussions are summarized here in a short question and answer form.

How could a "chemical map" be developed?

A chemical map for California could be compiled using several approaches:

- Use information already available to the state, such as:
  - Certified Unified Program Agencies (CUPA) data, collected under the California Accidental Release Prevention Program, on use and handling of hazardous materials by businesses in California
  - Hazardous chemical substances data collected as part of the state's *Hazardous Waste Source Reduction and Management Review Act of 1989* ("SB 14" program) and Chapter 881, Statutes of 1998, ("SB 1916") which encourages hazardous waste generators to implement pollution prevention programs
  - California Air Toxics Hot Spots Program emissions inventory data
  - California Toxic Air Contaminant monitoring network data
  - California Pesticide Use Report data
  - California Public Drinking Water System monitoring data
  - USEPA Toxics Release Inventory data

- Use information already available to companies, by requiring companies that do business in California to submit any relevant information on the chemicals or chemical products they produce in, import, sell, distribute, or use in California that they have already submitted or are required to submit to other government agencies, including:
  - Federal agencies such as the USEPA under the TSCA Inventory Update Rule, including information designated confidential business information (CBI), or under the HPV Challenge Program
  - European Chemicals Agency under EU REACH
  - Health Canada and Environment Canada under *CEPA*
  - Foreign or other state governments for relevant chemical information, including CBI that they possess, pertaining to chemicals used in California

Several stakeholders noted that existing programs might serve as a model to collect relevant data and develop a chemical map. For example, the Hotspots Analysis and Reporting Program (HARP), currently used by many industrial facilities in California to report airborne emissions, could be adapted to collect additional required data. Comments also pointed out that the existing pesticide use reports include several data that may be useful in designing a comprehensive chemical map. Participants cautioned that evaluating these existing programs in terms of required resources, task-based costs, statutory requirements, state/federal cooperation, industry costs, stakeholder opinions, tracking requirements, and potential implementation pitfalls would be critical to the development of the comprehensive chemical map for California.

What are the benefits of a "chemical map" and how will it be used?

Stakeholders stated that reliable, current, and comprehensive information on what chemicals are produced and how they are used is an important element of any chemical prioritization scheme.

Generating a broad base of production, use, and fate information about most all chemicals would also aid efforts to identify chemicals that pose little or no risk to people or the environment.

- *Improve Worker and Consumer Safety*

As participants stated, information on production, use, and fate is directly relevant to assessing the potential for release of a chemical or exposure to it, whether to workers, consumers, the general public, or the environment. Release and exposure information can then be used in a number of ways. First, several comments noted, it can be used directly, as well as in conjunction with hazard information, to gauge the extent of risk posed by a chemical. Second, it can be used to screen chemicals in order to identify those of most concern or to prioritize among multiple chemicals, so that those with significant exposure can be targeted for toxicological studies, further assessment, or control. Stakeholders noted the benefits of not only identifying chemicals warranting further scrutiny (for example, those used in consumer products intended for children), but also those posing little or no concern (for example, chemical intermediates that are never removed from process equipment). Third, release and exposure information can be used to help determine the extent and types of hazard information that are needed for a chemical, and hence can be used to set and prioritize testing and risk assessment needs.

- *Improve Risk Management and Homeland Security*

Ready access to chemical production, use, and fate information is critical for protecting public safety in a natural disaster or other emergency, some commenters noted. A chemical map could aid emergency preparedness and planning efforts. It would also provide a baseline and a means of tracking the effectiveness of risk management plans. Most chemical production, use, and fate information is, by definition, geographically specific, so several stakeholders said it makes sense to collect it at the state level.

Where release or exposure to chemicals is already known, a chemical map database could be useful in identifying the range of and individual sources of potential exposure, their relative magnitude, and contribution to the total. With this information, commenters said chemical users and the state could direct emergency efforts more effectively.

- *Enhance Pollution Prevention (P2)*

Several participants noted that chemical map type information could also be used to identify economic priorities and opportunities. Chemicals in commerce in California are likely to be concentrated in certain sectors and associated products. Stakeholders stated that factors such as critical uses of chemicals, job and economic impacts, and other sector data is useful in setting priorities and considering various policies options.

Finally, several stakeholders mentioned that chemical information and data empowers people to make better decisions about chemicals they produce, sell, purchase, or use. Access to such information could improve the chemicals market, enhance market-based incentives to provide better information, and increase demand for safer chemicals, even without direct government intervention.

CHAPTER TEAM

The following Green Chemistry team staff members served as principal editors for this chapter, Data Collection and Use:

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The team compiled each of the comments relating to chemical information and chemical data collection and use. They organized the comments that stakeholders made during the Conversation with California. The chapter team worked closely with the overall team, whose members are given in the Acknowledgements. The references for each of the seven major options summarized in this chapter are presented in the next section of this report.

REFERENCES

The tables below cross-reference each option to Appendix B. The figures shown in the first column represent the "challenge area" and the option number.

OPTION DC-1:	***Systematically collect data and information needed to categorize and prioritize chemicals, and take actions to reduce toxics in products.***
1-4	Develop and establish mandatory criteria that must be addressed for all substances used in commerce. Take into account toxicity, effectiveness, volume used/reduction in use, long and short term health and environmental impacts (life cycle).
1-5	Develop and establish balancing criteria for all substances used in commerce. Take into account long and short term costs/economics, "alternative analysis," and public acceptance.
1-6	Prioritize and address chemicals by toxicity, risk, and volumes used and/or released into commerce and the environment.
1-10	Mandate full disclosure of substances contained in products. "Green labeling" should be used with restraint.
1-13	Realign and leverage with existing federal, state and local mandated reporting activities to avoid duplication and waste of resources.
1-17	Standardize terminology/definitions to promote the necessary and real change towards creating more sustainable, social, and environmental solutions.
1-18	Prioritize protection from chemical harm in decision-making. Use data on all toxicological end-points, including cancer, reproductive effects, developmental effects, etc.
1-20	Use EU REACH as model.
1-26	Support development of a chemical risk analysis process, such as that now being implemented in Canada.
1-27	Support mandatory reporting and enforcement of chemical use by manufacturers and distributors.
1-30	Rethink the processes for allowing chemicals into the market.
1-36	Establish mandatory requirements needed to fill gaps about chemicals. In addition to CMR data, other end-points—neurotoxicity, long-term toxicity, endocrine disruption, immunotoxicity, etc.—are needed. Industry should be responsible for developing these data, with the government as auditor/verifier.
1-93	Map the flow of chemicals in California by developing and sharing chemical production and use information.
1-94	Require California producers, importers, and users to submit and update information on production and processing (amounts, facility locations), uses (including in products), and post-use management.
1-110	Create lists of chemicals of concern at different levels of evidence or certainty. There may be chemicals that are of concern as possible toxic air contaminants or carcinogens but that do not make it onto the lists of the Toxic Air Contaminants or the Proposition 65 chemicals, for example. There could be "feeder" lists that would provide an early view on potential chemicals of concern.

OPTION DC-1:	***Systematically collect data and information needed to categorize and prioritize chemicals, and take actions to reduce toxics in products.***
1-115	Understand the information needed by businesses using chemicals to make informed choices and evaluate how to address these information needs throughout the supply chain (i.e., information transfer up and down the supply chain between manufacturers to chemical users).
1-204	Screen all chemicals (new and existing) to determine further information needs in a tiered, risk-based approach.
2-4	Base environmental regulation on thorough scientific data that has clear evidence of harm to human health and environment.
2-9	Compile a comprehensive list of all reports that must be filed with federal, state and local agencies, including the information and data submission requirements for each; determine whether current reports provide sufficient baseline information, and if additional information should be obtained.
2-11	Prioritize protection of the most vulnerable people (e.g., children) and resources (e.g., endangered species, critical resources). In other words, identify currently unaddressed ways children are exposed to potentially harmful substances.
2-27	Identify priority chemicals for toxics use reduction. Create a list as targets for toxics use reduction.
2-29	Require businesses that use large quantities of toxic chemicals to report annually on the quantities of toxic chemicals used, and prepare and biennially update toxics use reduction plans.
2-30	Survey California businesses regarding information about each facility it owns or operates in the state, the full-time equivalent number of employees at that facility, and whether a listed substance is manufactured, processed, or otherwise used in a facility. Establish the total quantity used statewide as a baseline against which toxics use reduction progress can be measured.
2-42	Ensure that chemical producers generate, distribute, and communicate information on chemical toxicity, ecotoxicity, uses, and other key data.
2-43	Strengthen government tools for identifying, prioritizing, and mitigating chemical hazards.
2-62	Require California producers, importers, and users to submit and update information on amounts, facility locations, and uses (including in products).
2-64	Require disclosure of chemicals in consumer products, perhaps initially on priority chemicals.
2-65	Prioritization is essential.
2-66	Leverage opportunities in other state-mandated activities (e.g., the Biomonitoring Program).
2-70	Ensure that information is transmitted through all consumers in the supply chain.
2-74	Focus research on impacts of chemicals on early childhood development.
2-86	Use the most sensitive receptors as the basis for acceptable risk.
2-87	Prioritize chemicals that should be restricted.
2-99	Incorporate biomonitoring as part of the Green Chemistry policy.
2-118	Prioritize based on exposure.
2-124	Do not reinvent the process, as a whole new process could have a negative effect. Study, instead, Canadian list, EU REACH, and others to determine their usefulness/validity.
2-141	Evaluate elements of EU REACH and CEPA; choose those elements most relevant to California.
2-148	Adopt a phased approach for existing / new chemicals, as with CEPA.

OPTION DC-1:	***Systematically collect data and information needed to categorize and prioritize chemicals, and take actions to reduce toxics in products.***
2-151	Identify less hazardous chemicals, as Canada did.
2-257	Develop an integrated state program that features the following actions: (a) Introduce a regulatory requirement that all existing chemicals undergo a tiered process of scrutiny for their environmental, social, health, and toxicity impacts. (b) Introduce a regulatory requirement that this information should be passed in a standard form along the supply chain. (c) Require manufacturers to label consumer products with all chemicals and materials (including nanotechnology) that the product contains. (d) Develop interactive consumer tools and technologies that assist consumers to interpret and use labeling data in their shopping. (e) Require industry to conduct green chemistry assessments for chemical products sold or used. (f) Expand greatly the investment of resources into green chemistry education and research at the UC system. And, (g) Introduce a modest toxicity tax on all intermediates and chemical products used or sold within the State of California.
3-1	Develop science-based criteria for determining whether a particular product is greener or safer than alternatives.
3-7	(a) Prioritize chemicals used in commerce in California based on exposure potential and toxicity; work to reduce exposure to the most hazardous substances. To do this, California should gather data regarding all chemicals manufactured in or used in commerce in California, including in what products, how, and in what volumes they are used. Additional data regarding available toxicity characteristics should also be gathered for each of those chemicals. Gaps in toxicity and exposure data should be identified. (b) Use the above data to prioritize or rank chemicals in terms of hazard as a function of toxicity and exposure. Tools for such ranking are available from other efforts such as Canada's CEPA program and USEPA, which should be evaluated for use in California. Subsequent efforts should then focus on working with industry to find viable, safer alternatives for the highest ranked chemicals (i.e., those that pose the biggest threat in terms of toxicity and exposure), while at the same time engaging industry and our University system to fill in important gaps regarding toxicity and exposure data. (c) Tap biomonitoring efforts to help fill exposure gaps. In evaluating and ranking chemicals, considerations should be given to the performance and feasibility of alternatives.
3-10	(a) Prioritize protection of most vulnerable people and resources. For example, get information on exposures of children to harmful substances through toxics in products and seek changes to reduce or eliminate these toxics chemicals. Focus on consumer products with lots of exposure potential. This needs a regulatory action. (b) Look for initial easy fixes by integrating existing programs that have identified actual sources of pollutants. (c) Drive the demand for cleaner products through state procurement practices. (d) Designate the Occupational and Environmental Health at UC Berkeley and UCLA as lead entities within the UC system to address research relevant to Green Chemistry and Chemicals Policy in California.

OPTION DC-1:	***Systematically collect data and information needed to categorize and prioritize chemicals, and take actions to reduce toxics in products.***
3-12	(a) Use the Green Chemistry principles in developing useful approaches to pollution prevention. (b) Leverage resources with USEPA programs, Canadian CEPA, etc. (e.g., information from the HPV program, VCCEP program, and ICCA Global Initiative on HPV chemicals). (c) Conduct a baseline assessment to determine needs. (d) Study available hazard and exposure data and how California can best use these data. (e) Identify "green approaches" that have worked as well as those that have not worked.
3-34	Require responsible parties to identify the individual constituents of their products or, if that information was considered to be confidential business information, to provide the appropriate health information on their products. Responsible parties should be required to report new factual information regarding adverse health effects of their products or of the individual constituents of their products. This information could be reported to a centralized, publicly addressable database. The adverse effects reporting requirements for pesticides, as set forth in Section 6 (a) (2) of the *Federal Insecticide, Rodenticide, and Fungicide Act*, could be used as a starting point.
3-35	Require chemical manufacturers, importers, and users to supply Cal/EPA with the structure of chemicals in use in California commerce, physicochemical properties, and all available toxicity and hazard data. California should use Quantitative Structure-Activity Models to evaluate exposure potential and predict toxicity where data are not yet available. This information should go into any prioritization scheme.
3-38	Use EU REACH program as a model and do the following: (a) Register all chemicals in commerce in California and require a summation of the chemical properties, toxicity, and hazard of each in order to be registered for use. (b) Develop a list of chemicals of concern based on usage and toxicity or hazard information. (c) Register products containing these hazardous materials including imported products and publish this information. (d) Require tiered sets of toxicity information according to usage, amounts produced/imported, or other indicators of exposure. (e) Eliminate the use and/or require strict regulation of use of highly persistent or bioaccumulative chemicals, carcinogens, mutagens, reproductive toxins developmental toxins, neurotoxicants, and any other compound capable of causing serious or irreversible harm. (f) Develop models to simulate exposure scenarios for common chemicals in common products to inform decisions on chemical management.
3-39	Evaluate best practices for chemical management schemes pointed out in the April 2007 report entitled "Not That Innocent: A comparative analysis of Canadian, European, and United States Policies on Industrial Chemicals by Richard Denison for application to a California Green Chemicals Policy.
3-44	Develop clear criteria for identifying chemicals as persistent or bioaccumulative.
3-45	Use Quantitative Structure Activity models to help identify toxicity potential and exposure potential of chemicals used in commerce in California.
3-52	Use data on toxicity and use; prioritize chemicals into low, medium, high, and very high concern categories. Develop clear criteria for manufacturers and users of chemicals prioritized into very high, high, medium, and low concern.
3-54	Use data from the Canadian CEPA program summaries of chemicals in their prioritization program, and any summaries that come from EU REACH program.

OPTION DC-1:	***Systematically collect data and information needed to categorize and prioritize chemicals, and take actions to reduce toxics in products.***
3-55	Look at available data sources to obtain information on chemical toxicity. These include USEPA's various programs (IRIS, HPV, and VCCEP); TSCA test submissions of unpublished technical reports, European Chemical Substance Information System, OECD member countries, and International Programme on Chemical Safety.
3-56	Ensure access to information and data gathered by others by: (a) Requiring companies submitting data under Canada's CEPA and EU REACH to submit it to California. (b) Negotiate for access to CBI data submitted under CEPA and EU REACH. (c) Enhance IT infrastructure to receive and share data.
3-57	Map the flow of chemicals in California, require submission of data from California producers/users on amounts of chemicals produced/used, and where, amount and use in products and post-use management.
3-59	Require disclosure of chemicals in consumer products, focusing initially on high concern chemicals.
3-106	Move toward a model in which hazard traits are prioritized. This will be essential in protecting and growing the California economy. While the EU may accept risk management as a premise, hazard trait analysis can provide our companies with a competitive advantage by enabling them to develop/choose safer alternative chemicals and to respond to shifts in international regulatory frameworks as they occur.
3-107	Develop a system that focuses on a chemical's rank relative to environmental performance and impacts on health, including worker health.
3-109	Focus on the 500 high priority substances identified in Canada's program. To address unique circumstances that might exist in California, the State could have a process to add substances to the high priority list, as necessary, based on hazards, uses and exposures to workers and consumers in California. Once the high priority chemicals are identified, use and exposure should be considered to determine whether there are impacts on human health and/or the environment. .
3-113	Map the flow of chemicals in California using information drawn from existing sources such as USEPA's Inventory Update Reporting (IUR), the data received by Canada during its data call-ins for high priority chemicals, and other contributions from the public.
3-118	Establish a program to identify, assess, and manage priority chemicals based on an evaluation of hazard and potential for exposure. Move quickly by leveraging priorities identified in the Canadian Chemical Management Plan. Create a collaborative effort between California and Canada to accelerate progress in both geographies. Include a means for adding and deleting priority chemicals based on unique California circumstances. Leverage the recently assembled U.S. Inventory Update report to provide initial volume, use and exposure information. Identify uses and user industries for the high priority chemicals that raise the greatest concern. Expect producers of priority chemicals and manufacturers with high concern uses to provide hazard and exposure information on those chemicals/uses to the program. Provide the agency with authority and a due process to establish restrictions for uses of priority chemicals that have unacceptable risks.
3-120	Encourage the use of alternatives to animal testing and require testing only as a last resort, in pursuing the objective of the Green Chemistry Initiative to expand toxicology information on chemicals. Cal/EPA and the UC system could work with other experts to provide assistance on alternative screening methodologies that can be utilized to provide adequate toxicology information for recommendations and decisions about priority chemical uses.

OPTION DC-1:	***Systematically collect data and information needed to categorize and prioritize chemicals, and take actions to reduce toxics in products.***
3-126	Consider existing data and information already available to California and the public before making judgments on additional chemical specific data and information needs. There are existing programs such as the High Production Volume (HPV) Challenge Program and the Extended HPV Program, which have provided valuable toxicology and exposure information that is publicly available. Hazard information from such sources can be used in light of exposure scenarios to evaluate potential risk and ensure appropriate risk management. In addition, the information from the recent evaluation and categorization of chemicals on the Canadian Domestic Substance List (DSL), Canada, should be considered by California.
3-141	Integrate GIS data with workplace use, health, ecological, and other data to identify patterns that affect chemical impacts. We need to understand, in particular, the distributional effects of chemical exposures.
3-146	Prioritize chemicals for screening, testing, and appropriate restrictions. We suggest building upon the model of Canada's analysis and prioritization as well as the Proposition 65 review process. Chemicals of high concern should be allowed for targeted, low-exposure uses as determined in an open process. The use of a transparent and rigorous process to evaluate risk factors as indicated by toxicological, epidemiological, and exposure data will allow us to compare the relative importance and safety of chemicals as well as determine whether any restrictions or substitutions are appropriate.
3-153	Build chemical data development efforts on existing statutory and regulatory structures, voluntary initiatives, and data development efforts, and collaboration by California in ongoing work by other government agencies to assess chemicals and consumer products. Leverage efforts by Health and Environment Canada in addressing priority chemicals in the Chemicals Management Plan. California could also participate in the e Security and Prosperity Partnership (SPP) under the Montebello Agreement involving trilateral cooperation among the governments of Canada, the United States and Mexico to share chemical information and safety assessments.
3-159	Conduct a detailed, comprehensive assessment of existing chemical toxicity reporting and data availability programs and ensure access to those data as applicable to California. Assurances of some measure of formulation confidentiality would encourage producers and manufacturers to make toxicity and use data available.
3-161	Avoid a static, required list of toxicity tests as check-the-box toxicology. Instead, tiered, thoughtful testing strategies should be pursued with flexibility and creativity. For example, bioaccumulation, biopersistence, solubility, and other physicochemical parameters should be determined prior to conducting dose-related evaluations such as percutaneous absorption testing; moving up from there would involve a full characterization of the chemical or material using in vitro cell and tissue assays. For the sake of flexibility as science advances a list of required tests promulgated legislatively should be avoided.
3-163	Keep pace of new methods to evaluate toxicity other than new animal testing. These include: OECD QSAR Toolbox and other International QSAR Foundation activities, OECD and NTP toxicogenomics initiatives, ILSI/HESI's Tiered Toxicology Testing Proposal for Pesticide Chemicals, OECD Integrated Approaches to Testing and Assessment workshop (taking place in December 2007), and others, such as those presented at the October 1-2, 2007, workshop.
3-164	Analyze the human health and environmental profile of the chemicals, and manage chemicals in an appropriate way in accordance with their profile. EU REACH is a good example of such responsibility. Such a system should give clear certainty to industry that a chemical can continued to be used once the assessment is completed and approved, and it should also not continuously be challenged on the basis of data which are not scientifically sound.

OPTION DC-1:	***Systematically collect data and information needed to categorize and prioritize chemicals, and take actions to reduce toxics in products.***
3-167	Establish a California-specific chemical evaluation process to identify uses of concern for priority chemicals that were not on the original CEPA categorization process or that will not be addressed under the Montebello Agreement in the timeframe required. The process should utilize a tiered approach, in which chemicals and their uses are prioritized for further evaluation. The process should also utilize risk-based screening and should focus on potential “data needs” versus “data gaps”. Producers and users of identified priorities should be engaged in a collaborative process to bring hazard, use and exposure information to improve decision-making. As California proceeds with its process, it should leverage information already generated or that will be generated under regulatory or voluntary chemical evaluation programs. California must be transparent in the processes used to make risk evaluation and risk management decisions.
3-171	Adopt a proactive approach to obtaining data needed to assess hazard traits. The current practice is for the state to consult various lists and data sources to try to track down whatever information is available to assess hazards of chemicals. The information available varies enormously, and little is available for many chemicals. The State needs to have the authority to obtain the information and test results needed to assess and characterize the hazards of chemicals.
3-172	Use methods that reflect current understanding of issues—including the importance of timing of exposure and how effects at different life stages can differ; differences in susceptibility including the particular susceptibility of children; the importance of multiple exposures to multiple chemicals; and the significance of biological perturbations in increasing likelihood of diseases or disorders. Cal/EPA should engage experts to work toward incorporating current science into better methods for assessing the hazards of chemicals. These would likely include use of genomics and related technologies and other high through put approaches. It would also include systematic validation. Such efforts should be guided by the policy goal to adopt the best currently available methods.
3-178	Find an acceptable way to prioritize chemicals for additional testing. Hazard traits are certainly one criterion, but it is only part of the story. Green Chemistry must not consider hazard at the exclusion of exposure. If so, there would be a misalignment of limited resources for marginal value.
3-179	Consider risk versus hazard. Admittedly too much emphasis has been placed in prior year on reducing exposure (risk) and too little emphasis on reducing toxicity (hazard). The transition movement within the chemical industry, however, has begun. Emphasis on a transition to hazard reduction (i.e. green chemistry) is and will continue to build. However, GCI needs to forthrightly acknowledge that elimination of all toxicity through chemical substitution is not possible. At best there will always be trade-offs, which will need to be evaluated via life-cycle analysis (LCA) methodologies.
4-1	Assess chemicals within the context of alternatives. Criteria for better or worse green products should be clear.
4-11	Use sound scientific information to define what is "toxic" and "non-toxic."
4-12	Identify specific industry sectors that generate the most toxic products and identify green production and processing for those sectors.
4-44	Require responsible parties to report new factual information regarding adverse health effects of their products or of the individual constituents of their products to a centralized, publicly accessible database. The adverse effects reporting requirements for pesticides as set forth in Section 6 (a) (2) of the *Federal Insecticide, Rodenticide, and Fungicide Act*, could be used as a starting point.
4-45	Require responsible parties to identify the individual constituents of their products or, if that information is considered to be confidential business information, to provide the appropriate health information on their products.
4-50	Require manufacturers to know what is going into products they produce.

OPTION DC-1:	***Systematically collect data and information needed to categorize and prioritize chemicals, and take actions to reduce toxics in products.***
4-54	Require EU REACH-like analysis, reporting, and removal of toxics in products.
4-63	Develop legislation that would require new chemicals to be tested for toxicity prior to marketing in California. Toxicity testing would also be required for existing chemicals already being used and marketed in California. The set of required toxicity tests would be developed by a group of scientists with input from California government agencies and the public. California government agencies would evaluate the results of the toxicity testing and decide whether the chemical would be marketed (new chemicals) or whether the chemical would have to be removed from the market (existing chemicals). The criteria for deciding on this "up or down" vote on a chemical would be predetermined by the group of scientists who designed the toxicity test battery, along with input from California government agencies and the public.
4-64	Expand the budget of OEHHA to speed the evaluation of toxicity test results and determination of whether particular chemicals pose an unacceptable risk.
4-66	Develop clear criteria for prioritizing chemicals by level of concern based on a range of factors including chemical production volume and uses, exposure criteria such as persistence and bioaccumulation, and toxicological characteristics. Follow through with safety assessment and appropriate action.
4-69	Create a map of chemical production and use in California. Show how chemicals flow into the state, who produces them, and how they are used.
4-74	Build technical capacity in state agencies such as OEHHA in the use of QSAR (quantitative structure activity relationship) models; review and consider how these methods can be applied in identifying chemicals of concern as well as safer alternatives.
4-88	Ensure data requirements, analyses, and decision-making processes: (a) Incorporate new science demonstrating the importance of low doses, as well as the significance of background exposures, synergistic effects, and the timing of exposures during the lifecycle. (b) Address the effects of cumulative exposures. (c) Provide comprehensive protection, including protecting the most vulnerable populations, endangered species, and water quality. (d) Consider environmental justice and worker impacts. And, (e) Are based on a full cost accounting including costs to communities.

OPTION DC-2:	***Use the best elements of the Canadian Environmental Protection Act (CEPA) and the European Union's Registration, Evaluation and Authorisation of Chemicals (EU REACH) program as models for data collection and use.***
1-4	Develop and establish mandatory criteria that must be addressed for all substances used in commerce. Take into account toxicity, effectiveness, volume used/reduction in use, long and short term health and environmental impacts (life cycle).
1-5	Develop and establish balancing criteria for all substances used in commerce. Take into account long and short term costs/economics, "alternative analysis" and public acceptance.
1-6	Prioritize and address chemicals by toxicity, risk and volumes used and/or released into commerce and the environment.
1-10	Mandate full disclosure of substances contained in products. "Green labeling" should be used with restraint.
1-13	Realign and leverage with existing federal, state and local mandated reporting activities to avoid duplication and waste of resources.
1-17	Standardize terminology/definitions to promote the necessary and real change towards creating more sustainable, social and environmental solutions.
1-18	Prioritize protection from chemical harm in decision making. Use data on all toxicological endpoints including cancer reproductive effects developmental effect etc.
1-20	Use EU REACH as model.
1-26	Support development of a chemical risk analysis process such as that being implemented in Canada.
1-27	Support mandatory reporting and enforcement of chemical use by manufacturers and distributors.
1-30	Rethink the processes for allowing chemicals into the market.
1-36	Establish mandatory requirements needed to fill gaps about chemicals. In addition to CMR data, we need other endpoints: neurotoxins, long-term toxicity, endocrine disruption, immunotoxicity. Industry should be responsible for developing these data, with government's role is to audit/verify.
1-90	Negotiate for access to confidential business information (CBI) submitted under the European Union's REACH Regulation and under the Canadian Environmental Protection Act.
1-91	Require companies making/importing chemicals in California that are subject to REACH or CEPA to submit the same information to California officials.
1-118	Implement the policy that "no data means no market," meaning that chemicals for which safety data are not available are to be banned from sale or use.
2-4	Base environmental regulation on thorough scientific data that has clear evidence of harm to human health and environment.
2-9	Compile a comprehensive list of all reports that must be filed with Federal, State and local agencies, including the information and data submission requirements for each; determine whether current reports provide sufficient baseline information, and if additional information should be obtained.
2-11	Prioritize protection of the most vulnerable people (e.g., children) and resources (e.g., endangered species, critical resources). In other words, identify currently unaddressed ways children are exposed to potentially harmful substances.

OPTION DC-2:	***Use the best elements of the Canadian Environmental Protection Act (CEPA) and the European Union's Registration, Evaluation and Authorisation of Chemicals (EU REACH) program as models for data collection and use.***
2-27	Identify priority chemicals for toxics use reduction and create a list as targets for toxics use reduction.
2-29	Require businesses that use large quantities of toxic chemicals to report annually on the quantities of toxic chemicals used, and prepare and biennially update toxics use reduction plans.
2-30	Survey California businesses regarding information on each facility it owns or operates in the state, the full-time equivalent number of employees at that facility, and whether a listed substance is manufactured, processed, or otherwise used in a facility. The total quantity used statewide should be established as a baseline against which toxics use reduction progress can be measured.
2-42	Ensure that chemical producers generate, distribute, and communicate information on chemical toxicity, ecotoxicity, uses, and other key data.
2-43	Strengthen government tools for identifying, prioritizing, and mitigating chemical hazards.
2-62	Require California producers, importers, and users to submit and update info on amounts, facility locations, and uses (including in products).
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2-66	Leverage other state-mandated activities (e.g., the Biomonitoring Program).
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2-124	Do not reinvent the process, as a whole new process could have a negative effect; instead study Canadian list, EU REACH and others to determine their usefulness and validity.
2-141	Evaluate elements of EU REACH and CEPA and choose those most relevant to California.
2-148	Adopt a phased approach for existing / new chemicals, as with CEPA.
2-151	Identify less hazardous chemicals, as Canada did.
3-1	Develop science-based criteria for determining whether a particular product is greener or safer than alternatives.

OPTION DC-2:	***Use the best elements of the Canadian Environmental Protection Act (CEPA) and the European Union's Registration, Evaluation and Authorisation of Chemicals (EU REACH) program as models for data collection and use.***
3-7	(a) Prioritize chemicals used in commerce in California based on exposure potential and toxicity; work to reduce exposure to the most hazardous substances. To do this, California should gather data regarding all chemicals manufactured in or used in commerce in California, including in what products, how, and in what volumes they are used. Additional data regarding available toxicity characteristics should also be gathered for each of those chemicals. Gaps in toxicity and exposure data should be identified. (b) Use the above data to prioritize or rank chemicals in terms of hazard as a function of toxicity and exposure. Tools for such ranking are available from other efforts such as Canada's CEPA program and USEPA, which should be evaluated for use in California. Subsequent efforts should then focus on working with industry to find viable, safer alternatives for the highest ranked chemicals (i.e., those that pose the biggest threat in terms of toxicity and exposure), while at the same time engaging industry and our University system to fill in important gaps regarding toxicity and exposure data. (c) Tap biomonitoring efforts to help fill exposure gaps. In evaluating and ranking chemicals, considerations should be given to the performance and feasibility of alternatives.
3-10	(a) Prioritize protection of most vulnerable people and resources. For example, get information on exposures of children to harmful substances through toxics in products and seek changes to reduce or eliminate these toxics chemicals. Focus on consumer products with lots of exposure potential. This needs a regulatory action. (b) Look for initial easy fixes by integrating existing programs that have identified actual sources of pollutants. (c) Drive the demand for cleaner products through state procurement practices. (d) Designate the Occupational and Environmental Health at UC Berkeley and UCLA as lead entities within the UC system to address research relevant to Green Chemistry and Chemicals Policy in California.
3-12	(a) Use the Green Chemistry principles in developing useful approaches to pollution prevention. (b) Leverage resources with USEPA programs, Canadian CEPA, etc. (e.g., information from the HPV program, VCCEP program, and ICCA Global Initiative on HPV chemicals). (c) Conduct a baseline assessment to determine needs. (d) Study available hazard and exposure data and how California can best use these data. (e) Identify "green approaches" that have worked as well as those that have not worked.
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3-35	Require that chemical manufacturers, importers, and users supply Cal/EPA with the structure of chemicals in use in California commerce, physicochemical properties, and all available toxicity and hazard data. California should use Quantitative Structure-Activity Models to evaluate exposure potential and predict toxicity where data are not yet available. This information should go into any prioritization scheme.

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3-38	Use EU REACH program as a model and do the following: (a) Register all chemicals in commerce in California and require a summation of the chemical properties, toxicity, and hazard of each in order to be registered for use. (b) Develop a list of chemicals of concern based on usage and toxicity or hazard information. (c) Register products containing these hazardous materials including imported products and publish this information. (d) Require tiered sets of toxicity information according to usage, amounts produced/imported, or other indicators of exposure. (e) Eliminate the use and/or require strict regulation of use of highly persistent or bioaccumulative chemicals, carcinogens, mutagens, reproductive toxins developmental toxins, neurotoxicants, and any other compound capable of causing serious or irreversible harm. (f) Develop models to simulate exposure scenarios for common chemicals in common products to inform decisions on chemical management.
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3-45	Use Quantitative Structure Activity models to help identify toxicity potential and exposure potential of chemicals used in commerce in California.
3-52	Using data on toxicity and use, prioritize chemicals into low, medium, high, and very high concern categories. Develop clear criteria for manufacturers and users of chemicals prioritized into very high, high, medium, and low concern.
3-54	Use data from the Canadian CEPA program summaries of chemicals in their prioritization program, and any summaries that come from EU REACH program.
3-55	Look at available data sources to obtain information on chemical toxicity. These include USEPA's various programs (IRIS, HPV, and VCCEP); TSCA test submissions of unpublished technical reports, European Chemical Substance Information System, OECD member countries, and International Programme on Chemical Safety.
3-56	Ensure access to information gathered by others by: (a) Requiring companies submitting data under Canada's CEPA and EU REACH to submit it to California. (b) Negotiating for access to CBI data submitted under CEPA and EU REACH. (c) Enhancing IT infrastructure to receive and share data.
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3-106	Move toward a model in which hazard traits are prioritized. This will be essential in protecting and growing the California economy. While the EU may accept risk management as a premise, hazard trait analysis can provide our companies with a competitive advantage by enabling them to develop/choose safer alternative chemicals and to respond to shifts in international regulatory frameworks as they occur.
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3-113	Map the flow of chemicals in California using information drawn from existing sources such as EPA's Inventory Update Reporting (IUR), the data received by Canada during its data call-ins for high priority chemicals, and other contributions from the public.
3-118	Establish a program to identify, assess and manage priority chemicals based on an evaluation of hazard and potential for exposure. Move quickly by leveraging priorities identified in the Canadian Chemical Management Plan. Create a collaborative effort between California and Canada to accelerate progress in both geographies. Include a means for adding and deleting priority chemicals based on unique California circumstances. Leverage the recently assembled U.S. Inventory Update report to provide initial volume, use and exposure information. Identify uses and user industries for the high priority chemicals that raise the greatest concern. Expect producers of priority chemicals and manufacturers with high concern uses to provide hazard and exposure information on those chemicals/uses to the program. Provide the agency with authority and a due process to establish restrictions for uses of priority chemicals that have unacceptable risks.
3-120	In pursuing the objective of the Green Chemistry Initiative to expand toxicology information on chemicals, encourage the use of alternatives to animal testing and require testing only as a last resort. Cal/EPA and UC system could work with other experts to provide assistance on alternative screening methodologies that can be utilized to provide adequate toxicology information for recommendations and decisions about priority chemical uses.
3-126	Consider existing data and information already available to California and the public before making judgments on additional chemical specific data and information needs. There are existing programs such as the High Production Volume (HPV) Challenge Program and the Extended HPV Program, which have provided valuable toxicology and exposure information that is publicly available. Hazard information from such sources can be used in light of exposure scenarios to evaluate potential risk and ensure appropriate risk management. In addition, the information from the recent evaluation and categorization of chemicals on the Canadian Domestic Substance List (DSL) should be considered by California.
3-141	Integrate GIS data with workplace use, health, ecological, and other data to identify patterns that affect chemical impacts. We need to understand, in particular, the distributional effects of chemical exposures.

OPTION DC-2:	***Use the best elements of the Canadian Environmental Protection Act (CEPA) and the European Union's Registration, Evaluation and Authorisation of Chemicals (EU REACH) program as models for data collection and use.***
3-146	Prioritize chemicals for screening, testing and appropriate restrictions. We suggest building upon the model of Canada's analysis and prioritization as well as the Proposition 65 review process. Chemicals of high concern should be allowed for targeted, low-exposure uses as determined in an open process. The use of a transparent and rigorous process to evaluate risk factors as indicated by toxicological, epidemiological, and exposure data will allow us to compare the relative importance and safety of chemicals as well as determine whether any restrictions or substitutions are appropriate.
3-153	Build chemical data development efforts on existing statutory and regulatory structures, voluntary initiatives, and data development efforts, and collaboration by California in ongoing work by other government agencies to assess chemicals and consumer products. Leverage efforts by Health and Environment Canada in addressing priority chemicals in the Chemicals Management Plan. California could also participate in the Security and Prosperity Partnership (SPP) under the Montebello Agreement involving trilateral cooperation among the governments of Canada, the United States and Mexico to share chemical information and safety assessments.
3-159	Conduct a detailed, comprehensive assessment of existing chemical toxicity reporting and data availability programs and ensure access to those data as applicable to California. Assurances of some measure of formulation confidentiality would encourage producers and manufacturers to make toxicity and use data available.
3-161	Avoid a static, required list of toxicity tests as check-the-box toxicology; instead, tiered, thoughtful testing strategies should be pursued with flexibility and creativity. For example, bioaccumulation, biopersistence, solubility, and other physicochemical parameters should be determined prior to conducting dose-related evaluations such as percutaneous absorption testing; moving up from there would involve a full characterization of the chemical or material using in vitro cell and tissue assays. For the sake of flexibility as science advances a list of required tests promulgated legislatively should be avoided.
3-163	Keep pace of new methods to evaluate toxicity other than new animal testing. These include: (a) OECD QSAR Toolbox and other International QSAR Foundation activities. (b) OECD and NTP toxicogenomics initiatives. (c) ILSI/HESI's Tiered Toxicology Testing Proposal for Pesticide Chemicals. (d) OECD Integrated Approaches to Testing and Assessment workshop (December 2007) and others such as those presented during the Cal/EPA workshop October 1-2, 2007.
3-164	The responsibility to analyze the human health & environmental profile of the chemicals, and manage chemicals in an appropriate way in accordance with their profile. EU REACH is a good example of such responsibility. Such a system should give clear certainty to industry that a chemical can continued to be used once the assessment is completed and approved, & it should also not continuously be challenged on the basis of data which are not scientifically sound.
3-167	Establish a California-specific chemical evaluation process to identify uses of concern for priority chemicals that were not on the original CEPA categorization process or that will not be addressed under the Montebello Agreement in the timeframe required. The process should utilize a tiered approach, in which chemicals and their uses are prioritized for further evaluation. The process should also utilize risk-based screening and should focus on potential "data needs" versus "data gaps". Producers and users of identified priorities should be engaged in a collaborative process to bring hazard, use and exposure information to improve decision-making. As California proceeds with its process, it should leverage information already generated or that will be generated under regulatory or voluntary chemical evaluation programs. California must be transparent in the processes used to make risk evaluation and risk management decisions.

OPTION DC-2:	***Use the best elements of the Canadian Environmental Protection Act (CEPA) and the European Union's Registration, Evaluation and Authorisation of Chemicals (EU REACH) program as models for data collection and use.***
3-171	Adopt a proactive approach to obtaining data needed to assess hazard traits. The current practice is for the state to consult various lists and data sources to try to track down whatever information is available to assess hazards of chemicals. The information available varies enormously, and little is available for many chemicals. The State needs to have the authority to obtain the information and test results needed to assess and characterize the hazards of chemicals.
3-172	Develop methods that reflect current understanding of issues including the importance of timing of exposure and how effects at different life stages can differ; differences in susceptibility including the particular susceptibility of children; the importance of multiple exposures to multiple chemicals; and the significance of biological perturbations in increasing likelihood of diseases or disorders. Cal/EPA should engage experts to work toward incorporating current science into better methods for assessing the hazards of chemicals. These would likely include use of genomics and related technologies and other high through put approaches. It would also include systematic validation. Such efforts should be guided by the policy goal to adopt the best currently available methods.
3-178	Find an acceptable way to prioritize chemicals for additional testing. Hazard traits are certainly one criterion, but it is only part of the story. GCI must not consider hazard at the exclusion of exposure. If so, there would be a misalignment of limited resources for marginal value.
3-179	Consider risk versus hazard. Admittedly too much emphasis has been placed in prior year on reducing exposure (risk) and too little emphasis on reducing toxicity (hazard). The transition movement within the chemical industry, however, has begun. Emphasis on a transition to hazard reduction (i.e. green chemistry) is and will continue to build. However, GCI needs to forthrightly acknowledge that elimination of all toxicity through chemical substitution is not possible. At best there will always be tradeoffs which will need to be evaluated via Life Cycle Analysis (LCA) methodologies.
4-1	Assess chemicals within the context of alternatives. Criteria for better or worse green products should be clear.
4-11	Use sound scientific information to define what is "toxic" and "non-toxic."
4-12	Identify specific industry sectors that generate the most toxic products and identify green production and processing for those sectors.
4-44	Require responsible parties to report new factual information regarding adverse health effects of their products or of the individual constituents of their products to a centralized, publicly accessible database. The adverse effects reporting requirements for pesticides as set forth in Section 6 (a) (2) of the *Federal Insecticide, Rodenticide, and Fungicide Act,* could be used as a starting point.
4-45	Require responsible parties to identify the individual constituents of their products or, if that information is considered to be confidential business information, to provide the appropriate health information on their products.
4-50	Require manufacturers to know what is going into products they produce.
4-54	Require EU REACH-like analysis, reporting, and removal of toxics in products.

OPTION DC-2:	***Use the best elements of the Canadian Environmental Protection Act (CEPA) and the European Union's Registration, Evaluation and Authorisation of Chemicals (EU REACH) program as models for data collection and use.***
4-63	Develop legislation that would require new chemicals to be tested for toxicity prior to marketing in California. Toxicity testing would also be required for existing chemicals already being used and marketed in California. The set of required toxicity tests would be developed by a group of scientists with input from California government agencies and the public. California government agencies would evaluate the results of the toxicity testing and decide whether the chemical would be marketed (new chemicals) or whether the chemical would have to be removed from the market (existing chemicals). The criteria for deciding on this "up or down" vote on a chemical would be predetermined by the group of scientists who designed the toxicity test battery, along with input from California government agencies and the public.
4-64	Expand the budget of OEHHA to speed the evaluation of toxicity test results and determination of whether particular chemicals pose an unacceptable risk.
4-66	Develop clear criteria for prioritizing chemicals by level of concern based on a range of factors including chemical production volume and uses, exposure criteria such as persistence and bioaccumulation, and toxicological characteristics. Follow through with safety assessment and appropriate action.
4-69	Create a map of chemical production and use in California. Show how chemicals flow into the state, who produces them, and how they are used.

OPTION DC-3: Use the best elements of other programs in the United States as sources of data or as models for data collection and use.	
1-39	Legislate something similar to the State of Massachusetts (S-1268 & H-2275) *The Act for a Healthy Massachusetts: Safer Alternatives to Toxic Chemicals.*
3-10	(a) Prioritize protection of most vulnerable people and resources. For example, get information on exposures of children to harmful substances through toxics in products, and seek changes to reduce or eliminate these toxics. Focus on consumer products with lots of exposure potential. This needs a regulatory action. (b) Look for initial easy fixes by integrating existing programs that have identified actual sources of pollutants. (c) Drive the demand for cleaner products through state procurement practices. (d) Designate the Occupational and Environmental Health at UC Berkeley and UCLA as lead entities within the UC system to address research relevant to Green Chemistry and Chemicals Policy in California.
3-46	Evaluate what other states have done and utilize appropriate elements from those programs, including the Massachusetts Toxics Use Reduction Act, the Oregon Toxics Use and Hazardous Waste Reduction Act, , and Oregon's Executive Order to reduce persistent and bioaccumulative Toxicants.
4-12	Identify specific industry sectors that generate the most toxic products and identify green production and processing for those sectors.
4-69	Create a map of chemical production and use in California. Show how chemicals flow into the state, who produces them, and how they are used.
4-107	Use the recently assembled U.S. Inventory Update Rule report to provide initial volume, use, and exposure information. Identify uses and user industries for the high priority chemicals that raise the greatest concern. Expect producers of priority chemicals and manufacturers with high concern uses to provide hazard and exposure information on those chemicals/uses to the program.

OPTION DC-4: Establish mechanisms and tools to facilitate sharing, use, and analysis of data.	
1-35	Develop a database of ingredients used in consumer products similar to the Skin Deep database that is currently available for cosmetics. In order to ensure accuracy, California would need the regulatory authority to regulate consumer products and to require disclosure of ingredients in consumer products.
1-37	Develop an information clearinghouse on DTSC's website. This information would include hazard and use data as well as information about safe alternatives.
1-42	Develop an automated, web-based assessment of "green" chemicals, products and processes for product design and procurement.
1-43	Use web-based MACS emissions and health risk assessment modules.
1-44	Use an automated web-based system for identifying munition and non-munition chemicals of concern (Chemical Homeland Security System [C–HoSS]).
1-73	In 2000, the U.S. Army Defense Ammunition Center (DAC) began working with Chemical Compliance Systems, Inc. (CCS) to use CSS's extensive centralized Relational Chemical and Product Databases as the basis for a series of integrated, web-based modules within what has become the Munitions Analytical Compliance Suite (MACS). (The CCS centralized databases include over 650 regulatory lists.) MACS include eight modules. In a few months, the 9th and 10th automated modules the Emissions Risk Assessment and Human Health Risk Assessment–will be added. The most comprehensive of the MACS modules is the "Green" Munitions Analytical Compliance System (G-MACS).
1-155	Provide consumer education on what will be hazardous when product is thrown away, wake up consumers that there is no "away.
2-10	Develop a centralized database of chemicals and properties.
2-26	Develop a "Safe Home Environment" place for children to visit/learn.
2-69	Create a database of "safe" chemical alternatives.
2-71	Enable the public to drive green chemistry by providing them with information, such as through a database with green information
2-139	Certify products. The German environmental certification, "The Blue Angel," (www.blauer-engel.de/englisch/navigation/body_blauer_engel.htm), can be used as a model for the certification of products and services.
2-154	Employ wiki data and other new and emerging technologies for consumers, industry and others.

OPTION DC-4: Establish mechanisms and tools to facilitate sharing, use, and analysis of data.	
3-4	(a) Expand consumer education regarding product life cycle costs and impacts (e.g. appropriate selection, use, disposal, and alternative materials or practices) since well-informed consumers will not only handle and dispose of chemicals more safely, and will demand safer products. (b) Disseminate information through traditional media as well as outreach through community partners as well as the private sector. (c) Educate people how chemicals are created, screened for use, and managed through a process. Show people "a day in the life of a chemical." (d) Provide complete, transparent chemical risk information in a way the public can access, understand, and absorb. (e) Create convenient, credible chemical evaluation tools that businesses, schools or individuals can easily use when selecting chemical products. These could use prior art such as the Green Screen or Pfizer's Solvent Alternatives Chart. These tools could show examples of the risk as well as hazard, and define hazard/risk as high, medium and low and compare to products and services used by consumers everyday. If something is a hazard, show the alternatives or how the risk relates to the pathways for exposure. (Is it in a product, or solely for use in a process? If it is in a product, what entails safe use? Etc.)
3-7	(a) Prioritize chemicals used in commerce in California based on exposure potential and toxicity, and work to reduce exposure to the most hazardous substances. To do this, California should gather data regarding all chemicals manufactured in or used in commerce in California, including in what products, how and in what volumes they are used. Additional data regarding available toxicity characteristics should also be gathered for each of those chemicals. Gaps in toxicity and exposure data should be identified. (b) Use this data to prioritize or rank chemicals in terms of hazard as a function of toxicity and exposure. Tools for such ranking are available from other efforts such as Canada's CEPA program, and USEPA, and should be evaluated for use in California. Subsequent efforts should then focus on working with industry to find viable, safer alternatives for the highest ranked chemicals (i.e., those that pose the biggest threat in terms of toxicity and exposure), while at the same time engaging industry and our University system to fill in important gaps regarding toxicity and exposure data. (c) Tap biomonitoring efforts to help fill exposure gaps. In evaluating and ranking chemicals, considerations should be given to the performance, and feasibility of alternatives.
3-51	Evaluate products already available to screen chemicals in products including the Chemical Compliance Systems tool used by the DOD and US Army to evaluate munitions, paint, etc.
3-64	Require companies to generate comprehensive safety and health data based on the hazard traits of chemicals for all chemicals in their products by 2016.
3-115	Expand product-specific chemical ingredient disclosure for consumer products which currently do not have that requirement.
3-121	(a) Expect and encourage manufacturers of consumer products to communicate information about the ingredients in products, either on the package or on the internet at the manufacturer's discretion and with appropriate provisions for protection of Confidential Business Information. (b) Expect and encourage chemical and product manufacturers to update their MSDS document to the new 16-section ANSI standard and to reflect the latest hazard information from voluntary (e.g. HPV) and regulatory (e.g. Canada CMP) programs. (c) Encourage companies in important value chain sectors to work together to identify "beyond MSDS" information needs both upstream and downstream and to establish processes for communication to meet those needs. (d) Leverage California's capability and interest to assemble a chemical information system on hazard, use and exposure from global sources.

OPTION DC-4: Establish mechanisms and tools to facilitate sharing, use, and analysis of data.	
3-134	Work with affected industries to implement a means of ingredient communication that would provide consumers with the information they can use to make even better informed decisions regarding the products they use in their homes.
3-135	Work with scientific experts to examine best practices and to develop a toolkit for safety assessment programs and for safety assessments. Companies also could make a description of their safety assessment process available on the Internet. This could help provide context for product ingredient communication.
3-155	Work with industry to implement a means of ingredient communication that would provide consumers with the information they can use to make informed decisions regarding the products they use in their homes.
3-174	Provide clear and transparent characterization of chemical hazards to the public. Many entities can and are making decisions and take action that contribute to adoption of safer or lower hazard chemicals and products. To support such efforts, businesses, agencies, and the public need comprehensive, current, accurate, and reliable information about the relative hazard of different chemicals. The State of California should develop a matrix of information about the hazard traits of chemicals in use or considered for use, presented in ways that are useful and understandable to various audiences. This matrix should also make clear when gaps in data exist, so that businesses and individuals can choose to avoid chemicals with unknown hazards as well as those that are higher hazard.
4-12	Identify specific industry sectors that generate the most toxic products and identify green production and processing for those sectors.
4-14	Use tools that are already available for decision-makers (such as purchasing managers) which collect and analyze information on environmental hazards, health hazards and cost of chemical inventories and products (e.g., Dolphin Software, www.chemply.com).
4-69	Create a map of chemical production and use in California. Show how chemicals flow into the state, who produces them, and how they are used.
4-120	Catalog, and make easily available, information regarding best practice screening processes, green chemical design, collaborative efforts, international efforts, and examples of product development decisions and substitutions that have resulted in reduced waste produced and energy inputs.

OPTION DC-5: Collect data needed to conduct life-cycle analysis of high-use products and develop a life-cycle analysis prototype.	
1-122	Look at a product from all the various aspects of its life cycle. It is critical to ensure the total picture of benefits and impacts is understood. Failure to look across the entire life cycle when making decisions can lead to unintended consequences and often fail to solve the issue of concern. Dissecting a product into all the various processes that contribute to its production and disposal can help us better understand how our production and consumer habits affect the environment.
1-129	Alleviate concerns over the trend to use LCA as a marketing tool by using the Society of Environmental Toxicology and Chemistry (SETAC) guidelines. SETAC guidelines can be used by both governmental and private agencies; these include a code of ethics. Consider following this type of standard.
1-210	Use life-cycle assessments, which offer the greatest opportunity in establishing flexible approaches and more holistically evaluate the balance between societal needs, protection of public health and the environment, and sustainable production and consumption, rather than through traditional regulatory paradigms.
1-211	Base decisions of preference and substitution on the comparative life-cycle impacts of a chemical and its potential substitute. While a safety-based characterization scheme may focus on toxicity, persistence and bioaccumulation, there are a number of other parameters which are relevant to the sustainable use of a particular chemical in a formulation such as raw material sourcing and carbon footprint. All relevant aspects of sustainability should be taken into consideration for a potential substitution decision. Similarly, any plan to consider substitution of chemicals should require that the efficacy and benefits of that compound be considered as any diminution of efficacy may negatively impact public health and well-being through reduced hygiene and sanitation.
1-213	In order to facilitate informed substitution of high priority substances towards those with a more favorable environmental and human health profile, develop database of chemical alternatives that compares a number of sustainability parameters: performance, price, human health and environmental (e.g., toxicity, bioaccumulation, persistence) including carbon footprint and source sustainability.
3-76	Consider using life-cycle analysis guidelines established by the Society of Environmental Toxicology and Chemistry in using LCA to compare water, energy, raw material use to generate products, and the transportation and waste of same.
3-100	Use life-cycle assessment to more holistically balance between societal needs, protection of public health and the environment, sustainable production and consumption.
3-108	While a safety-based characterization scheme may focus on toxicity, persistence and bioaccumulation, consider a number of other parameters which are relevant to the sustainable use of a particular chemical in a formulation such as raw material sourcing and carbon footprint. All relevant aspects of sustainability should be taken into consideration for a potential substitution decision.
3-111	For alternatives identified, require a separate life-cycle assessment by an outside party, or state-funded Center for Excellence in order to confirm that there is no loss in performance with the alternative, to avoid unintended consequences, and to assist in commercialization. Develop a Cooperative Extension-type program to assist companies in cradle-to-cradle product design/formulation and assist in adoption of new alternative chemistries and processes.
3-143	Strengthen the recognition and pursuit of Green Chemistry processes and products by establishing clear criteria and voluntary certification based on comprehensive lifecycle considerations. Equally important, consumers need to be educated about responsible choices and practices.

OPTION DC-5: Collect data needed to conduct life-cycle analysis of high-use products and develop a life-cycle analysis prototype.	
3-149	While the focus of the Initiative has been on chemical safety, incorporate an accounting of embedded energy, C02 impact, water usage, packaging, recyclability, and so forth. Industry on the whole is already moving toward a greater consideration of these factors in our practices. The difficulty of quantifying and ascribing relative importance to these factors points to the need for commonly-held practices or industry standards.
3-189	Begin an immediate effort to ramp-up the state's life-cycle analysis capability. Unquestionably, one cannot envision competency in cradle-to-cradle techniques without enhanced in-house LCA capability.
4-100	In developing and implementing the use of life-cycle analysis, be sure to: (a) Understand that data reliability and quality will vary greatly and acknowledge this transparently (b) Clearly articulate the scale (e.g. global, local) (c) Understand that uncertainty is everywhere—LCA will be refined as more and better quality data is available (d) Understand that comparisons between life-cycle studies are difficult due to differing up front assumptions (e) Understand that no single, globally accepted method exists for LCA work (f) Consider guidelines developed by the Society of Environmental Toxicology and Chemistry (SETAC) for conducting life-cycle analyses by both governmental and private agencies.

OPTION DC-6: Build a toxicological and exposure potential database on chemicals used in California.	
1-35	Develop a database of ingredients used in consumer products similar to the Skin Deep database that is currently available for cosmetics. In order to ensure accuracy, California would need the regulatory authority to regulate consumer products and to require disclosure of ingredients in consumer products.
1-120	Create a unified database that includes data from sources around the world. This database would have to be designed to be accessible to different users (chemical products users; consumers, etc) and should be made public. (The "E-Chem" unified data portal newly introduced by OECD might be considered a "baby step" toward this.)
1-131	Provide consumers with accurate information upon which they can make informed decisions. This can be a very useful tool in driving changes. There are many programs that are predicated on consumer choice. Cars are labeled with expected fuel efficiency ratings. Major home appliances have energy labels which can be used for comparisons. Plumbing fixtures show the water use. The clear intent is that consumers will use these labels to make more informed purchasing decisions.
1-132	Polls have shown that consumers want to have the information they desire readily available to them so that they are able to make informed decisions about the products they purchase. This must be a shared responsibility of the value chain.
1-180	Create a clearinghouse of best green chemistry practices. There are numerous initiatives being conducted around the world with an existing and developing body of knowledge that can be leveraged to speed implementation.
3-112	Develop database of chemical alternatives that compares a number of sustainability parameters: performance, price, human health and environmental (e.g., toxicity, bioaccumulation, persistence) including carbon footprint and source sustainability.
4-16	Develop mechanisms for improving the flow of information through the manufacturing process.
4-22	Build toxicological and exposure database on chemicals in use in California.
4-62	Make a baseline assessment of chemical information that is already available to the State.
4-141	Create a database on alternatives that compares a number of sustainability parameters: performance, price, human health and environmental (e.g., toxicity, bioaccumulation, persistence) including carbon footprint and source sustainability.

Chapter 2—Economic Incentives and Market Options

Economic Incentives, Markets, and Funding
Capitalizing on market forces to advance Green Chemistry

SYNOPSIS

Participants in the California Green Chemistry Initiative suggested a number of options that include using economic incentives, market forces, and funding as possible drivers that can spur green chemistry innovation and technologies. They said economic tools could help overcome resistance to change and "level the playing field" between toxics and greener choices for chemicals, products, and technologies. Economic and market-related topics represented roughly 22% of the total number of comments received throughout the Conversation with California. More than 177 options involving economic and other incentives were submitted. Stakeholders also presented different funding options, creating a linkage in some instances to economic incentive options.

From the comments, the economic and market-related options include:

- Establishing incentives and disincentives;
- Using market drivers and correcting market failures;
- Encouraging corporate responsibility and accountability;
- Leveraging government procurement systems;
- Instituting awards and recognition; and,
- Developing funding sources for green chemistry activities.

Many comments suggested that government may have a role in influencing market forces toward more environmental preferable products through economic incentives. Commenters proposed many economic options, such as positive incentives—low interest loans, grants, or tax credits, to encourage the development of, demand for, and use of green products, processes, and technologies. Similarly, participants also suggested disincentives, such as fines or penalties, to discourage the continued use of hazardous substances in consumer goods, finished products, and the workplace.

Stakeholders also suggested the public sector, through its large volume of purchases, has the ability to drive an increased demand for safer alternatives. They said consumer preferences could be influenced by providing accurate, reliable information to consumers using a variety of means, including product certification and labels. (In addition to the market attributes of certification options, stakeholders submitted many options relating to recognition, awards, and certification. These are summarized in Chapter 8.) Participants also noted that product certification and labeling could also motivate manufacturers to modify their products in order to meet certification criteria.

A number of comments suggested that government could engage industry as a partner in green chemistry. For many different reasons, an increasing number of businesses are adopting corporate responsibility and product stewardship. Commenters suggested that this trend is an opportunity for green chemistry. Finally, several participants indicated awards and

recognition programs could provide indirect incentives that often translate into economic benefits, through increased sales.

BACKGROUND

Although not an exhaustive list, State agencies administer several programs that involve economic tools, such as incentives. These include:

- Environmentally Preferable Purchasing: This program identifies greener products that state agencies and departments can purchase; it encourages other businesses to buy environmentally preferable products. DTSC, OEHHA, CIWMB, SCSA, and the Environmentally Preferable Purchasing Task Force work together in guiding this program.
- Take It Back Partnership: DTSC, in collaboration with CIWMB, has established partnerships with retailers who take back universal wastes from consumers at their retail stores.
- Extended Producer Responsibility: CIMWB leads efforts to shift responsibility for end-of-life management of products from consumers to producers.
- Green Vehicles and Fleets: SCSA administers a statewide program for fuel-efficient and alternative fuel vehicles for state vehicle and fleet operations.
- Green Paints and Cleaning Products: OEHHA works Green Seal and other stakeholders in the development of national standards for green paints and cleaning products.
- State Pension Fund Investments: SCSA, along with CalPERS and CalSTRS, works to invest state pension funds in environmental technology and sustainability companies.
- State Buildings and Public Schools: SCSA, DPH, and CIWMB work on ways to improve the sustainability of new and existing state facilities. They are developing standard methods and certification practices for public buildings. In conjunction with the Collaborative for High Performance Schools, state agencies are developing and using incentives for greener school facilities.
- Financial Assistance (Loans and Grants): Many state agencies and departments (including CIWMB, SWRCB, DPR, DTSC, DPH, and ARB) manage various financial assistance programs that help reduce air and water pollution, solid waste, and energy usage. Several of these programs provide incentives for cleaner equipment, vehicles, wastewater and drinking water treatment technologies, runoff control, and recycling and reuse.

DISCUSSION OF OPTIONS

OPTION EI-1:	***Establish incentives and disincentives to encourage or discourage specific actions.***

In concept, monetary incentives provide an inducement for businesses and consumers to select an intended alternative or course of action that may not be the most economically sensible choice. Direct economic incentives are designed to tip the scales in favor of more environmentally preferable choices by easing the cost burden or reducing the perceived economic risk associated with these choices.

Many stakeholders suggested a range of economic incentives, including low-interest loans, grants, tax credits, capital investments, subsidies, and venture capital. California's experience with economic incentives that have been effectively used in the past to influence manufacturers or consumers to make more environmentally desirable choices, stakeholders told us, includes product-specific usage fees, recyclable container deposits, and rebates for energy efficient products. They pointed out state financial assistance programs for innovative technologies in specific sectors, such as lower-emission equipment and vehicles, pollution prevention, water and wastewater treatment or recycling, power generation, etc. CIWMB, for example, offers loans to businesses that use post-consumer or secondary waste materials to manufacture new products or that reduce waste from manufacturing. Several commenters also noted that federal agencies sponsor—through grants and contracts—research and development in environmental, energy, science, chemistry, and related sectors.

Stakeholders proposed several specific options as economic incentives:

- **Loans and grants.** Many participants suggested grants or low-interest loans to encourage business investment in a safer alternative process without the need to increase product price. Options for state-issued financial assistance also included grants to third-party entities, such as educational institutions, to research, investigate, design and develop safer alternatives, as well as to demonstrate and implement these. Stakeholders indicated these research and development grants would accelerate technology implementation, yield new knowledge that would benefit all businesses, especially smaller and medium-sized ones, and, in some cases, overcome industry's reluctance to adopt new processes in the face of uncertainty. Another option suggested research grants to fund studies to develop chemical toxicity data.

- **Tax incentives**. In many instances, safer alternatives are not well known or have yet to be developed. Larger companies with the technical expertise to develop such alternatives may have little incentive to do so if the high cost of research results in a short-term competitive disadvantage. To counteract this, a number of comments proposed tax incentives for private sector investment in new research, new processes, new technologies, and new products and formulations. Some stakeholders indicated that tax incentives could also be offered to businesses that have replaced hazardous chemicals and processes with safer alternatives.

- **Reporting incentives**. The effectiveness of any chemical management policy is closely connected to type and amount of information collected. Commenters pointed out that companies have little incentive to provide or share such information, especially if it is to

be made publicly available. Compiling and submitting this information can be time-consuming and costly. And, it may be perceived as revealing information that can compromise a competitive advantage. Some participants thought a monetary incentive may help offset reporting costs and promote sharing of data and best practices information.

- **Product rebates**. A commenter suggested rebates to persuade consumers to select a greener option by reducing the cost of that option relative to other choices.

In addition to economic incentives, some comments suggested disincentives, such as eliminating subsidies or direct monetary penalties assessed for undesired activities. Some participants indicated that disincentives can effectively steer businesses and individuals toward environmentally preferable choices by increasing the costs associated with less optimal choices, making these less economically attractive. Some stakeholders suggested that positive and negative incentives work best in tandem.

Some of the economic disincentive options which participants submitted include:

- **Usage fees**. Some commenters suggested usage fees as one way to reflect all costs, including external costs, in a product's price. Some participants thought these fees could capture costs resulting from the impacts of the use of hazardous substances in a product throughout its life cycle. Some participants suggested that in addition to generating revenue that could support relevant government programs, a usage fee would make a product less appealing to consumers, thus reducing market demand. A number of comments suggested a sliding scale for fees, where the amount of the fee is based on the amount of hazardous chemical present, or degree of hazard associated with the chemical. In this way, commenters said, a usage fee could serve both as disincentives and incentives. According to the commenters, largest fees might be assessed on products that pose the greatest degree of concern. At the opposite end of the scale, products containing green chemicals (representing lesser or no hazard) could qualify for payments or subsidies.

- **Deposit and refund schemes.** In several comments, some participants favored a deposit and refund scheme, which represents a disincentive when a fee is charged at the time of purchase and an incentive when the fee is refunded upon returning the containers for recycling. Stakeholders referenced the California Redemption Value (CRV) scheme for recyclable beverage containers as a possible model for this option.

- **Taxes**. Some commenters suggested considering taxes known as "sin taxes," which are imposed on undesirable products or activities, such as cigarettes and alcohol. Stakeholders stated that taxes could be assessed on products that are not defined as "green" or for using virgin materials. Another option, a few stakeholders said, would be imposing a tax on toxic chemicals used in chemical products or intermediates in California. Several participants said another approach would be to impose an excise tax on chemical sales to provide a large fund that could be used to upgrade manufacturing processes and equipment.

- **Fines**. A few participants suggested imposing monetary penalties for violating regulatory requirements. They pointed out that jewelry products that exceed allowable lead

concentrations are subject to fines under current law.[15/] (Other regulatory and statutory options are summarized in Chapter 3.)

OPTION EI-2:	***Use market drivers to accelerate the demand for safer products in the marketplace.***

Many stakeholders suggested options to increase demand for greener products, reduce uncertainty about those products, and make them more affordable. One commenter proposed devising a method to provide exclusivity within the marketplace for a reformulated product for a given time period. Other participants suggested options for promoting greener products and processes.

Several commenters said government could use its procurement process to increase demand for greener products and make them more affordable for the market as a whole. They pointed out that the State is a major consumer in California. And, they noted that the state procurement process includes preferences for disabled veteran business enterprises and for certain products, such as recycled paper products. Some commenters suggested expanding the State's procurement preferences to add criteria for green products. Several participants said that government purchasing could be based on a product's life cycle. One suggested option included a public-private partnership to develop a "green product" purchasing standard that can be applied statewide. Another option is a "green chemistry scorecard" that the government publicizes to recognize innovative vendors. Other participants pointed out that government procurement decisions are often viewed as endorsements of the quality and desirability of products. They said government purchases of reformulated or safer products could encourage other public agencies and private entities to buy greener goods and products.

Some participants suggested that government could pay a premium for promising greener products. One commenter gave an example—glass beads used for roadway markings. The imported product now used contains lead and arsenic but the domestically produced glass beads typically do not. The commenter stated that a state purchasing preference for green products would likely result in procurement of beads that do not contain heavy metals.

Some stakeholders recommended that government engage consumers as allies in moving green chemistry forward by providing them with ready access to information. They stated a well-informed public would recognize the need to select and buy greener products. Several comments suggested easily understandable, well-publicized information about chemicals, their toxicity, environmental fate, and other relevant properties, as well as safer substitutes for common household products, could be disseminated through a variety of means. Additional options for public education are further discussed in Chapter 5, Education and Outreach.

Participants also thought labeling and certification programs that identify "green" products through an easily recognizable logo can supply consumers with the information they need for purchasing decisions. Additionally, stakeholders suggested these product labels have the added benefit of motivating manufacturers to produce products that meet certification criteria. Many commenters pointed out that a number of green certification programs are currently in use, but no single green standard has yet been established. Chapter 8, Recognition, Awards, and Certification, includes more discussion about certification options presented during the Conversation with California.

OPTION EI-3:	***Encourage corporate responsibility and accountability by helping businesses make informed, green choices.***

Participants talked extensively about their perspectives regarding the role of manufacturers and companies in green chemistry. "Corporate responsibility" (also referred to as "corporate social responsibility") is a concept whereby companies integrate environmental and social concerns in the business operations and in their interaction with stakeholders on a voluntary basis.[16/] Stakeholders noted that the concept frequently overlaps with similar approaches such as corporate sustainability, corporate sustainable development, and corporate citizenship.[17/] Fundamentally, commenters said during the dialogue, corporate responsibility presumes that businesses can be expected to consider the social and environmental impacts of their business activities, and take measures to mitigate or prevent potential harm. Several stakeholders said many corporations have adopted corporate responsibility as an operating principle. In terms of environmental responsibility, in particular, corporations seek ways to go "beyond compliance" (that is, beyond what is required by statute or regulation) and take more proactive steps in minimizing their ecological footprint.

A number of commenters suggested government could engage businesses as partners in green chemistry, and where possible, assist and build upon their efforts to be more environmentally responsible citizens. Some stakeholders recommended developing jointly codes of practice governing the design, manufacture, distribution, use, disposal, or recycling of products through these partnerships. Several participants added that partnerships could also promote related concepts, such as product stewardship. They described "product stewardship," which involves all entities associated with a product—the manufacturer, retailers, users, and disposers—sharing responsibility for reducing the environmental impacts of the product. The "Take It Back Partnership" is a current example of a partnership between DTSC and retailers, wherein the retailers agree to take back universal waste (e.g., batteries, lamps, and electronic devices) from consumers at retail stores. Some participants indicated that responsible business entities could adopt systems to manage their products at the end of their useful lives. If the costs associated with end-of-life management are high, they said, a company would be motivated to design a more benign product with lower end-of-life costs and impacts.

To help businesses to take a more active role in applying green chemistry principles, some commenters recommended clarifying and communicating the definitions of green chemistry and associated criteria. In addition, participants suggested government could support greener products and practices by re-evaluating existing requirements and specifications to add a priority for greener approaches. One participant gave an example where outdated military specifications hamper switching from an old process to cyanide-free electroplating solutions.

Some stakeholders suggested governmental entities could allow regulatory tradeoffs to industries that employ green practices. Some participants pointed out that tradeoffs, in an ideal situation, would occur naturally since an industry that reduces its use of toxic substances would likely have fewer reporting and permitting requirements if emissions or discharges are reduced. Stakeholders suggested public-private partnerships to develop and enhance such opportunities would benefit everyone.

OPTION EI-4: Institute awards and recognition that provides a market advantage to their recipients.

Many participants stated awards and recognition could play an important role in stimulating green chemistry and green engineering. They said government-sponsored programs could encourage product and process designers, manufacturers, and researchers to find new environmentally friendly solutions. Stakeholders noted that a number of programs already exist to do this. The examples they gave include: the DTSC Chemical Industry Challenge partnership, the USEPA Presidential Green Chemistry Challenge Awards, and various eco-labeling schemes, such as Green Seal, EnergyStar, the Germany "Blue Angel" program, and Leadership in Energy and Environmental Design (better known as "LEED") certification for green buildings. Some stakeholders indicated monetary awards could help stimulate innovation, particularly to encourage research and development of innovative products and process. Other commenters suggested even recognition could be a strong motivator, driving business decisions, and providing assurance to consumers wanting to make green buying decisions. See Chapter 8, Recognition, Awards, and Certification, which summarizes these options.

OPTION EI-5: Develop funding sources for green chemistry activities.

A number of stakeholders included suggestions for funding green chemistry activities, both for state government and within industry. As mentioned earlier, in some of the fee and tax options suggested, participants thought the collected funds could be used in a variety of ways:

- Fund government programs, such as technical assistance, public outreach and education, or data collection;
- Offset subsidies or other positive financial incentives;
- Provide technical assistance or capital funding to industry for projects such as retrofitting equipment or processes; and
- Address long-term environmental impacts.

Stakeholders also suggested ensuring adequate funding or increasing funding in general. Some commenters referenced specific programs to facilitate green chemistry, research, technical assistance, and data. Chapter 3, Statutory/Regulatory Requirements and Enforcement, also discusses some options suggested for funding approaches.

CHAPTER TEAM

The following Green Chemistry team staff members served as principal editors for this chapter, Economic Incentives:

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The team compiled each of the comments relating to economic and market-related options. They organized the comments which stakeholders made during the Conversation with California. The chapter team worked closely with the overall team, whose members are given in the Acknowledgements. The references for each of the five major options summarized in this chapter are presented in the next section of this report.

REFERENCES

The tables below cross-reference each option to Appendix B. The figures shown in the first column represent the "challenge area" and the option number.

Option EI-1: Establish direct incentives and disincentives to encourage or discourage specific actions.	
1-3	Foster participation in development of innovative alternatives through incentives for stakeholders. Do not regulate.
1-11	Mandate a surcharge on chemicals and products to support a fund which would address long-term environmental impacts.
1-22	Foster on-going and continual progress rather than one-time improvements.
1-45	Change policy to change materials flow (i.e. eliminate special tax treatment for extraction of virgin materials and subsidies for agriculture).
1-46	Tax the use of virgin materials.
1-47	Regulate mining, oil, gas, and nonhazardous solid wastes under RCRA. Eliminate special tax treatment for extraction of virgin materials and subsidies.
1-48	Establish depletion quotas on extraction and import of virgin materials. Tax the production of virgin materials.
1-50	Mandate consumer separation of materials for recycling. Establish weight or volume-based fees.
1-51	Tax hard to dispose products. Establish deposit fund for packaging hazardous products.
1-52	Establish a fee rebate based on energy efficiency.
1-56	Change how we use taxes and charges; make the individual actor pay for the full cost. For example, pro-rate charges based on emissions, pounds of waste disposed, etc. to encourage reuse and recycling. Include everyone, from household wastes all the way up to the big chemical companies and corporations. "Pay by the bag" approach.
1-68	Introduce government subsidies as temporary measures, being phased-out when wider policy goals are achieved.
1-69	Consider the importance of timing for incentives. A recession is a bad time to introduce a new tax.
1-70	Consider a "feebate" scheme to reward or penalize consumers of specified chemicals.
1-71	Link fiscal instruments (tax changes) and regulations (emissions standards); these work best in parallel.
1-72	Tax exemptions seem to have a psychological effect on taxpayers that is out of proportion to the benefits received.
1-109	Lower the barrier to obtaining access to data and create incentives for the production of data, rather than maintaining the current framework, which actually provides incentives to avoid producing data.

Option EI-1: Establish direct incentives and disincentives to encourage or discourage specific actions.	
1-142	Ensure that a solution is economically viable in the long run. Unending subsidies and credits are not appropriate and can disrupt markets. However, these tools can be very powerful to initiate, develop and commercialize new technologies and products. Rewarding early adopters should be the objective. These risk sharing mechanisms between the private and public sectors should have a finite limit.
1-143	Remember that not all incentives require revenue or an exchange of money. Expedited permitting or regulatory relief can be very important to companies and cost governments little to implement and can even streamline the government processes in some cases.
2-16	Remove known chemical hazards from the market immediately via Proposition 65, Silent Spring/Harvard study, tax incentives etc.
2-17	Establish regulatory framework that drives green chemistry through prohibitions, cost structures, etc. (i.e. disincentives for using practices that are not in agreement with green chemistry principles).
2-18	Provide government incentives for the implementation of sustainable technologies.
2-31	Establish fees for businesses that use toxic chemicals. Such fees should be used to fund agency toxics use reduction activities, including data analysis, and the provision of technical assistance.
2-39	Pursue legislation for a Cleantech Advantage Act. Create a tax credit for cleantech research.
2-50	Increase grants to accelerate commercialization.
2-51	Add criteria to State Revolving Fund allocations to encourage use of green technologies.
2-52	Provide matching fund offsets to water providers who choose new green technologies.
2-54	Consider tax credits for developers and users developers of green technologies.
2-58	Support research and development through various initiatives (e.g., university-based center, government funding, cooperative state research, etc.).
2-80	Offer research and development tax credits as an incentive for industry.
2-81	Offer tax credits for green chemistry capital investments as an incentive for industry.
2-82	Offer low interest loans as an incentive for industry.
2-83	Offer a grants program as an incentive for green chemistry.
2-98	Recognize the value and role of industry stewardship programs (e.g., American Chemistry Council's Responsible Care, which includes evaluations of chemical products and their uses to assure that they deliver their intended benefits while protecting public health and the environment, and a management system certified by third-party auditors) and create incentives for others to take similar steps.
2-105	Provide more research and demonstration (R&D) for private/government, including R&D prior to using chemicals in products.
2-112	Offer incentives or awards for good ideas on products or project; establish a "green inventor" or "imagineer" award.
2-113	Provide venture capital to business or manufacturers that design green chemistry products or processes.
2-120	Provide funding for re-tooling manufacturing.
2-130	Consider tax incentives, phase tax/penalty approach.

Option EI-1: Establish direct incentives and disincentives to encourage or discourage specific actions.	
2-133	Invest in green chemistry research and development, develop leading university centers; invest in EDC (endocrine disrupting chemicals) research, encourage collaborative work between green chemists and EDC researchers to foster strategies for avoiding EDCs in new products; promote public education into the dangers of EDCs and the need for alternatives.
2-153	Provide incentives or public funding for research and development of alternatives.
2-165	Conduct a feasibility review for the following economic and tax incentive ideas, investment tax credits, public private partnership grants, low interest revolving fund loan, personal property tax exemption for laboratory equipment, preferred tax treatment for equity fund investment in California's Green Chemistry movement.
2-166	Host a Green Chemistry Symposium IV dedicated entirely to technology transfer, start-up funds, equity funding, and possible pension fund (CalPERS) investment in California companies with homegrown technology that solve California environmental problems.
2-167	Re-establish funding for technology development staff to review and validate the green chemistry/green engineering performance claims made by companies seeking economic incentives in the form of grants, low interest revolving loans, and preferred equity funding—without the certification component. Look at USEPA Design for the Environment program.
2-191	Make capital available to companies on preferential terms to encourage Green Chemistry and Green Engineering manufacturing process development.
2-210	Place fees on products and processes for which there is inadequate health and safety information.
2-217	Create economic penalties as part of a regulatory program for companies using toxic chemicals followed by a ban after a period of time.
2-222	Provide grants funded from revenue from fees imposed on companies using toxic chemicals to groups engaged in grassroots outreach and education on green chemistry issues.
2-255	Enact a strong environmental law that produces strict regulations and, at the same time, financial incentives for promoting and facilitating reclamation. Incentives can come in the form of financial awards; tax incentives; favorable terms by state procurement departments; R&D tax credits; tax credits given for green chemistry capital investments; and low interest loans.
2-257	Develop an integrated program that features the following actions: … 7) Introduce a modest toxicity tax on all intermediates and chemical products used or sold within the State of California.
2-258	Include the following policy elements to further Green Chemistry in California: … 5) Greater investment in pollution prevention in the short term as well as extension of the current CA Pollution Prevention model to downstream chemical users.
2-260	. . . Institute incentives that encourage the production and use of products that do not contain toxic chemicals.
2-283	Provide a positive incentive for introduction of best practices.
2-292	. . . Put incentives into place for chemical manufacturers and testing laboratories to develop and validate human-relevant methods.
2-306	Incorporate full cost accounting, including "externalities," in chemical policy decisions.
2-307	Encourage the growth of green chemistry investment and real world enterprises.
3-86	Make capital available to companies at preferential terms, whether via grant or lower interest loans, to encourage Green Chemistry and Green Engineering manufacturing process development.

Option EI-1: Establish direct incentives and disincentives to encourage or discourage specific actions.	
3-122	(a) Prime the pump to initiate early and significant advancements in Green Chemistry and to recognize and reward success. (b) Provide economic incentives for business innovation in green chemistry. (c) Provide economic support and incentives for innovation at California's university system: scholarships, research funds, technology licenses, etc. (d) Focus the above programs on development and commercialization of alternatives for restricted priority chemicals, including for small business application and on innovations that create breakthroughs in performance, value and environmental quality. (e) Establish an annual Green Chemistry recognition program for new chemicals, products and processes and for advances in research, analytical and toxicological methods that best exemplify the objectives of Green Chemistry.
3-135	Close the "technology gap" through market-based incentives to support green chemistry. This could include funding for university research grants, scholarships, and similar programs, as well as awards for innovation, tax credits, low-interest loans, and other incentives. These positive incentives should be open to all companies that are innovators and sell products in California – not simply be limited to companies located in California.
3-3	Evaluate things that have worked in the past to reduce toxics in products and the environment, including gaps and opportunities; consider legislating toxic reduction efforts, such as: (a) Legislation has helped on numerous toxic reduction efforts. (b) Mandatory emissions standards for automobiles in California. This has had a tremendous impact by mandating a shift in demand allowing the auto manufactures to voluntarily comply if they want to participate in the California market. (c) Usage fees (taxes) can help to move a product's sales price closer to the total product life cycle costs (inclusive of decommissioning, disposal, clean up, associated human health care cost, and environmental rectification costs that are now born by tax payers). (d) Bottle tax gives an incentive to be environmental conscious to reduce the toxins in the waste we consumers create. (e) Cigarette tax provides a disincentive for consumption. (f) Rebates for use of preferred product purchases; for example, rebates for hybrid automobile purchases.
3-11	(a) Include human health and environmental considerations, performance, cost, and feasibility in evaluating alternatives materials and processes. (b) Provide positive incentives for green chemistry. Use the Green Chemistry principles (articulated by Anastas) in evaluating alternatives.
4-8	Provide funding for adequate research on toxins using modern methods.
4-31	Scrutinize who is liable for a toxic product in the chain from manufacturing to sale and ensure there are consequences for the responsible party.
4-36	Encourage media publicity and engagement on toxics in products.
4-46	Strengthen relevant liability law to provide greater incentive for consumer protection from toxics in products.
4-56	Develop a process for rapid removal of products found to be toxic by new studies that is fair to industry—State subsidized transformations.
4-60	Establish green chemistry scholarships and international exchange programs for students and/or scientists (sponsored by California government and/or industry).

Option EI-1: Establish direct incentives and disincentives to encourage or discourage specific actions.	
4-86	Impose fees on companies that either directly use toxics in their products and processes or use inputs or processes that result in toxics in products. Apply these fees over a specified period of time; at the end of that time take action to phase-out or restrict particular chemicals/processes.
4-98	Consider a wide range of incentives to motivate changes in the behavior of industry and/or consumers: production tax credits; rebates to consumers or business; investment tax credits; R&D tax credits; R&D grants; equipment grants; loans or loan guarantees; public infrastructure development; government support to deploy environmentally preferred products or technologies; public/private partnerships; employee training and workforce development; CEQA exemption on qualified projects or other regulatory relief and special status once qualified (fast track permits; environmental leaders programs) or other expedited permitting programs; government preferred purchasing or government sponsored preferences; government specified product standards; use of consensus standards; use of third party standards and certification; product labeling programs; web-based consumer information.
4-99	Construct incentives that: (a) Foster innovation in the private sector and academia. (b) Create markets. (c) Facilitate increasing demand for the desired products and solutions. (d) Periodically are reviewed to assess the ongoing need of the incentives change. (e) Are as comprehensive and equitable as possible. (f) Provide transparent and user friendly information to consumers.

OPTION EI-2: Use market drivers to accelerate the demand for safer products in the marketplace.	
1-4	Develop and establish mandatory criteria that must be addressed for all substances used in commerce. Take into account toxicity, effectiveness, volume used/reduction in use, long- and short-term health and environmental impacts (life cycle).
1-23	Advertise green businesses.
1-37	Develop an information clearinghouse on DTSC's website. This information would include hazard and use data as well as information about safe alternatives.
1-58	Recognize that a dominant position in markets for an advanced technology can lock in control of a long stream of follow-on product and process innovations, making market entry much harder for technology "followers."
1-59	Note that it might actually be to the economic advantage of manufacturers to be second rather than first – to absorb the spillovers from investments made initially by competitors (foreign or domestic) and thus start production further along the technological learning curve.
1-61	Note that the government is a significant consumer of technology in its own right as it goes about providing for our common needs. In areas ranging from national defense to infrastructure, like any other large customer, the government must open our wallet to get the technology it needs. Very often that means sponsoring research and procurement that launch new industrial capabilities.
1-131	Provide consumers with accurate information upon which they can make informed decisions can be a very useful tool in driving changes. There are many programs that are predicated on consumer choice. Cars are labeled with expected fuel efficiency ratings. Major home appliances have energy labels, which can be used for comparisons. Plumbing fixtures show the water use. The clear intent is that consumers will use these labels to make more informed purchasing decisions.
1-132	Polls have shown that consumers want to have the information they desire readily available to them so that they are able to make informed decisions about the products they purchase. This must be a shared responsibility of the value chain.
1-135	Use Environmentally Preferred Purchasing (EPP) as an effective approach to drive change by assigning an advantage in the purchasing process for products and services that meet a pre-determined set of "green" or "sustainable" attributes. Using this approach, brand owners, retailers and government regulations set the marketplace expectations and develop market demand for new technologies. It is up to manufacturers, and their suppliers, to deliver products and services that meet the market demand, or risk being left behind.
1-136	Develop and market materials to meet rising consumer demand for "green" or sustainable products.
1-138	Apply science-based EPP definitions so that measurable environmental improvements can be delivered.
1-139	Use government preferred purchasing or government-sponsored preferences.
1-141	Avoid unintended consequences from "signals" sent to markets. For example, specifying increased recycle content will significantly raise barriers to entry and delay introduction of new, innovative materials since recycling infrastructure and markets take time to develop. A flexible, performance based approach avoids the government picking technological winners and losers, but it must be done using a holistic, long-term view.
1-183	Avoid picking "winning" or "losing" products. Instead, remove barriers and create objective tools to allow companies to create new products and enable consumers to recognize and choose them.
1-186	Design a green chemistry program which promotes products which are technologically and commercially feasible to produce.

OPTION EI-2: Use market drivers to accelerate the demand for safer products in the marketplace.	
1-231	Note that speed to market of products is most important to companies than any other incentive.
1-239	Level the playing field and strive for consistency across the board.
1-240	Recognize that time-to-market is critical in any new product launch. Delays and uncertainties increase the financial risks and reduce the initiative.
2-19	Lead the way to driving demand for cleaner products through government procurement processes.
2-69	Create a database of "safe" chemical alternatives.
2-70	Ensure that information is transmitted through all consumers in the supply chain.
2-71	Enable the public to drive green chemistry by providing them with information, such as through a database with green information.
2-79	Develop labeling process for identifying and comparing green products and/or green product certification.
2-85	Develop a system for public contracting, such as preference points, that takes lifecycle costs analysis into account.
2-88	Develop a credible and effective third-party labeling system for green products.
2-94	Educate consumers. Provide green information to consumers to change the marketplace and consumer attitudes, enable informed choices, and drive green chemistry. Create a database for the public to get green information.
2-106	Make green products affordable.
2-108	Classify or rank existing chemicals (green, light green, yellow, red).
2-128	Provide a way to ensure exclusivity of a reformulated product in a market without competitors for a given period.
2-138	Include information—on websites—geared towards the general public, particularly related to the purchase and use of certain products, including: lists of manufacturers and products that have received "green" awards to motivate submission of information to state regulators for review; information on the environmental impacts of plastics; greener alternatives to household chemicals; disposal options for universal waste; information on green chemistry; a page called "What can I do to help the environment?" (which also should be posted broadly on government web pages). Increased awareness will enable the general public to put greater pressure on manufacturers and legislatures to make green chemistry and environmental protection a priority.
2-190	Pay a modest premium for a set period of time for new “green materials” that show promise in state procurement.
2-199	Support policies designed to overcome barriers to commercial applications of green chemistry research and development efforts.
2-204	Develop a marketing program to promote companies that are actively engaged in Green Chemistry and Green Engineering, and products that are the result of Green Chemistry and Green Engineering.
2-257	Develop an integrated program that features the following actions: . . . 4) Develop interactive consumer tools and technologies that assist consumers to interpret and use labeling data in their shopping.
2-286	Create a “green chemistry scorecard” for suppliers which would allow specific materials and their applications to be rewarded through favored purchasing policies.

OPTION EI-2: Use market drivers to accelerate the demand for safer products in the marketplace.	
3-5	(a) Create a labeling system that is accessible, and accurate. (b) Enable and streamline disposal of household hazardous waste (curbside pick-up or more local collection centers.), and improve the publicity of and accessibility to this disposal, and ensure safety of the collection sites. (c) Include manufacturers public disclosure of product selection and chemicals used in those products as part of public education and outreach. Define or identify toxic and non-toxic chemicals in specific products, proper use, dangers of inappropriate use, and include information about disposal. Include life-cycle analysis and impacts thereof.
3-10	(a) Prioritize protection of most vulnerable people and resources. For example, get information on exposures of children to harmful substances through toxics in products, and seek changes to reduce or eliminate these toxics. Focus on consumer products with lots of exposure potential. This needs a regulatory action. (b) Look for initial easy fixes by integrating existing programs that have identified actual sources of pollutants. (c) Drive the demand for cleaner products through state procurement practices. (d) Designate the Occupational and Environmental Health at UC Berkeley and UCLA as lead entities within the UC system to address research relevant to green chemistry and chemicals policy in California.
3-33	Work with other state agencies, including DGS, to develop information on green purchasing, and disseminate this information to counties and cities and to private sector businesses for their use.
3-85	Pay a modest premium—for a set period of time for new "green" materials—when the state purchases chemicals for state contracts. The goal of this subsidy would be to help a new material achieve greater economies of scale, but avoid locking in an inefficient permanent subsidy.
3-87	Consider a marketing program (perhaps akin to the "California cows" and dairy advertisements currently on television) whereby the state would promote companies that are actively engaged in green chemistry and green engineering, and products that are the result of green chemistry and green engineering.
3-93	Promote green chemistry. A glass-bead product for highway markings from China may be cheaper, but has significant levels of lead and arsenic in the product. Another glass-bead product that is domestically produced and does not contain dangerous levels of these heavy metals is available.
3-168	Require manufacturers to label consumer products with all the chemicals and materials (including nanotechnology) that these contain. Consumers currently lack the information required to discriminate between products based on their toxicity impacts, so industry has few incentives to develop new green chemistry products. In parallel, develop interactive consumer tools and technologies that assist consumers to interpret and use labeling data in their shopping. The Toxics Release Inventory succeeded because information tools made its data highly accessible.
4-1	Assess chemicals within the context of alternatives. Criteria for "better" or "worse" green products should be clear.
4-21	Require manufacturers and suppliers to certify the safety of the products they sell to retailers.
4-23	Develop a "green" rating system for products with agreed upon criteria.
4-38	Develop a fact sheet on chemicals policy in the U.S. and post it on the Cal/EPA Green Chemistry Initiative website to educate the general public.
4-41	Develop guidance on what citizens of California could do to move toward greener, sustainable living.

OPTION EI-2: Use market drivers to accelerate the demand for safer products in the marketplace.	
4-43	Work with other state agencies, including DGS, to develop information on green purchasing and disseminate this information to other government agencies, including county and city level, as well as private businesses.
4-71	Create a list to be posted on the Internet of "bad actor" chemicals that have been found in products and the associated suppliers/manufacturers.
4-75	Implement the policy that "no data means no market" meaning that chemicals for which safety data are not available are banned from sale or use.
4-113	Avoid programs that require pre-market approval of chemicals or consumer products (i.e., modeled on programs used for pesticides and drugs) because these would be far too expensive.

OPTION EI-3: Encourage corporate responsibility and accountability by helping businesses make informed, green choices.	
1-34	Design with intent of end-of-life: (a) Manufacturer take back (b) Producer responsibility with idea of economic change of design (c) Facilitate COUGE recycling (d) Design to be biodegradable (e) Design to last
1-116	Encourage greater collaboration and partnership across disciplines and institutions to increase overall knowledge. For example, consider the model of how pharmaceutical companies make decisions on which chemicals are too hazardous to pursue.
1-151	Use incentives for Extended Product Responsibility (EPR), which encourage manufacturers to minimize product costs of products, spur reuse, and decrease waste disposal costs.
1-236	Ensure that producers assume responsibility for the safe stewardship of their materials in order to promote environmental sustainability. Producers should be responsible for collection through processing/disposal, financially and operationally, with no cost to local government.
1-237	Shift the responsibility for the end-of-life management of discarded materials from local government to private industry producers, through Extended producer responsibility (EPR). Incorporate the costs of product collection, recycling, and disposal into product price, and thereby encourage product design that has a reduced impact on the environment and human health. The end results are products and product chains that have a reduced impact on the environment and that costs associated with a product's impact are paid by those manufacturing or using the product, rather than general taxpayers.
2-3	Use life-cycle perspective that includes social values.
2-14	Survey a statistically significant sample of California businesses to determine if they have adopted strategies or programs to implement environmental management systems; convene a business/industry stakeholder-advisory panel.
2-41	Implement a "Pollution Prevention (P2): Design for the Environment Program."
2-68	Promote the exchange of information about best management practices, incentives, and barriers among industries and corporations, and between industry and customers. One way to do this is through a mentoring program (e.g., large corporations mentoring small ones or via the American Chemical Council).
2-78	Develop definitions for identifying green chemistry.
2-98	Recognize the value and role of industry stewardship programs (e.g., American Chemistry Council's Responsible Care, which includes evaluations of chemical products and their uses to assure that they deliver their intended benefits while protecting public health and the environment, and a management system certified by third-party auditors) and create incentives for others to take similar steps.
2-156	Promote product stewardship and manufacturer responsibility which will lead to green products and production.
2-197	Support collaborative efforts to encourage public and private partnerships to develop "greener" products and "environmentally responsible" ingredients.

OPTION EI-3:	***Encourage corporate responsibility and accountability by helping businesses make informed, green choices.***
2-213	Make companies that make or sell products in CA containing hazardous chemicals take them back at the end of their life cycle and ensure their proper disposal.
2-251	Integrate the concepts of extended producer responsibility (EPR) and Green Chemistry. Promulgate product stewardship as the manufacturer's responsibility.
2-252	Factor end-of-life into the risk equation. Promulgate total lifecycle cost for industry. Industry should price their products to incorporate the true environmental/societal costs. The concept of an end-of-life label should be introduced.
2-265	Review and identify carefully with stakeholders those barriers that impede investment in, and adoption of, sustainable technologies.
2-308	Extend producer responsibility to placing the burden of end-of-life disposal, including sustainable practices such as recycling.
3-2	(a) Develop criteria for appropriate use of cosmetic pesticides and consider banning inappropriate use. (b) Ban the most toxic cosmetic pesticides via legislation/regulation; possibly create monetary incentives for new home builders to substitute non-toxic chemicals in landscaping or create more sustainable landscaping designs (i.e., drought tolerant landscaping, water conservation, plants indigenous to the region, etc.).
3-9	Work with the military and aerospace industry as well as the plating industry, to evaluate and revise outdated mill specifications to allow for more "environmentally friendly" plating chemistries. Technological advances have generated more environmentally friendly electroplating technologies (e.g., cyanide-free plating solutions). However, a wide-spread switch to more "green" plating practices has been hampered by outdated "milspecs" (i.e., the military specifications for most plating done for military and aerospace applications).
3-27	Utilize any useful information developed by USEPA Design for the Environment program and work with industry and businesses to implement elements. These include: (a) Evaluate the human health and environmental impacts of its processes and products. (b) Identify what information is needed to make human health and environmental decisions (e.g., hazard characteristics data and identification of "safer" alternatives). (c) Consider cross-media impacts and the benefits of substituting chemicals. (d) Reduce the use and release of toxic chemicals through the innovation of cleaner technologies that use safer chemicals. (e) Reduce the use and release of toxic chemicals through the innovation of cleaner technologies that use safer chemicals. (f) Make products that can be more readily reused, refurbished, remanufactured, or recycled. (g) Monitor the environmental impacts and costs associated with each product or process. (h) Recognize that although change can be rapid, in many cases a cycle of evaluation and continuous improvement is needed. Partnerships with UC and CSUS could help implement these objectives. Incentives for applying these as core business practices might also help.
3-37	Generate environmental codes of practices and procedures in the development and design of products that encompass the manufacture, distribution, use, and end-disposal or recycling of the product that all manufacturers, importers, distributors, and users of products must follow. These practices could include bans of specific chemicals from consumer products.
3-40	Work with industry to reduce toxics in products, and where that proves difficult because no safe alternative exists, require product take-back at no cost to the consumer. This shifts the physical and financial responsibility away from local governments and consumers back to the product manufacturer.

OPTION EI-3:	***Encourage corporate responsibility and accountability by helping businesses make informed, green choices.***
3-105	Consider the problem and cost of disposal at the end of the life of the products or processes in which they are used. Impose rules on manufacturers, requiring take back and recycling, but also remember that those processes in themselves are expensive and have their own environmental or health impacts.
3-127	Rather than imposing regulatory burdens, innovation through green chemistry can be promoted with positive incentives and partnerships. Encourage Green Chemistry through the sharing of expertise, financial support for research, information exchange, and public education. Offer incentives for companies to pursue and foster Green Chemistry and Green Engineering.
3-130	Push collaborative efforts to encourage public and private partnerships, with a goal of developing greener products and environmentally responsible ingredients based on life cycle considerations. Avoid mandatory and voluntary state labeling programs that endorse green products or programs that stipulate a single third-party certification of green products or numerical ranking.
3-139	Give incentives to develop products with improved characteristics, e.g. non-PBT or polymeric chemical additives. Similarly, improved stewardship, such as driven by the BFR industry's Voluntary Emission Control Action Program (VECAP) should be encouraged and rewarded.
3-165	Recognize and encourage product stewardship programs, designed to better management throughout the supply chain of the substance and continued minimization of the impact of the substance.
3-183	Conduct a baseline review of physical and intellectual capabilities to support and nurture the green chemistry research and development initiative. Encourage public-private arrangements between universities and private industry, particularly as it relates to green chemistry solutions.
4-3	Establish corporate and manufacturing codes of conduct.
4-4	Develop best practices for supply chain management.
4-33	Require company accountability for out sourcing
4-104	Promote private business sector sponsorship of training/education programs at all levels (including elementary, high school and university). Conflict of interest concerns could be avoided by using an independent third party to manage the funding.

OPTION EI-4: Institute awards and recognition that provides a market advantage to their recipients.	
2-53	Encourage a certification program for green technology similar to USEPA ETV program.
2-56	Disseminate information on accomplishments, best practices, costs and benefits.
2-84	Develop a program to recognize green chemistry achievement, such as awards.
2-96	Create a green business program to educate and encourage companies and recognize companies incorporating green chemistry practices.
2-98	Recognize the value and role of industry stewardship programs (e.g., American Chemistry Council's Responsible Care, which includes evaluations of chemical products and their uses to assure that they deliver their intended benefits while protecting public health and the environment and a management system certified by third-party auditors). Create incentives for others to take similar steps.
2-112	Offer incentives or awards for good ideas on products or project; establish a "green inventor" or "imagineer" award.
2-131	Establish a "green seal," reflecting a specified level of greenness, or certification of approval.
2-134	Use Green Buildings/LEED Certification as a model for green labeling/product certification; include the following as criteria—use of green energy during manufacturing, waste generation, use of recyclable materials, use of non-toxic ingredients.
2-136	Establish recognition and award incentives for green products. These would be a strong motivator because they can lead to greater sales and preferential purchase by environmentally conscious consumers. Recognition with the use of a logo would be most effective; see German Blue Angel award, www.Blauer-Engel.de.
2-137	Develop a grading/award system for products that meet certain green criteria as a joint effort within Cal/EPA. Consider both green energy and green chemistry technologies. A standard, easily recognizable green logo could be used, reflecting different levels of "greenness" (bronze, silver, gold and platinum); this would enable consumers to choose green products and motivate manufacturers to invest research and energy into the development of green products.
2-138	Include information on government website(s) that is geared to the general public, particularly related to the purchase and use of certain products. Include: (a) lists of manufacturers and products that have received "green" awards which would motivate submission of information to regulators for review; (b) information on the environmental impacts of plastics; (c) greener alternatives to household chemicals; (d) disposal options for universal waste; (e) information on green chemistry; and, (f) "What can I do to help the environment?" (which should be posted on other websites). Increased awareness will enable the general public to put greater pressure on manufacturers and legislatures to make green chemistry and environmental protection a priority.
2-139	Use environmental certification in Germany, "The Blue Angel," (www.blauer-engel.de/englisch/navigation/body_blauer_engel.htm) as a model for the certification of products and services.
2-185	Encourage voluntary industry efforts to create better alternatives to high hazard substances, to mitigate risk and to make full use of market-based incentives. Give recognition for early adaptors and/or outstanding achievements in green chemistry. These would then be complemented by regulatory compliance to meet public expectations for safe chemical management.

OPTION EI-4: Institute awards and recognition that provides a market advantage to their recipients.	
2-200	Recognize companies that develop sustainable business operations, processes and/or products.
2-258	Include the following policy elements to further Green Chemistry in California: . . . 1) Strengthen the recognition and pursuit of Green Chemistry processes and products by establishing clear criteria and voluntary certification based on comprehensive lifecycle considerations.
2-272	Establish an awards program to provide financial incentive and recognition for innovations.
3-84	To further stimulate Green Chemistry and Green Engineering, consider the following incentives: (a) awards like USEPA Green Chemistry Challenge (see http://www.epa.gov/greenchemistry/pubs/pgcc/presgcc.html for more information); (b) tax incentives/subsidies/grants/low interest loans for research and development; and (c) marketing exposure for Green Chemistry processes and products.
3-122	(a) Prime the pump to initiate early and significant advancements in Green Chemistry and to recognize and reward success. (b) Provide economic incentives for business innovation in green chemistry. (c) Provide economic support and incentives for innovation at California's university system: scholarships, research funds, technology licenses, etc. (d) Focus the above programs on development and commercialization of alternatives for restricted priority chemicals, including for small business application and on innovations that create breakthroughs in performance, value and environmental quality. (e) Establish an annual Green Chemistry recognition program for new chemicals, products and processes and for advances in research, analytical and toxicological methods that best exemplify the objectives of Green Chemistry.

OPTION EI-5: Develop funding sources for green chemistry activities.	
1-11	Mandate a surcharge on chemicals/products to support fund to address long-term environmental impacts.
1-119	Increase the budget for state agencies responsible for evaluating human and ecological risk, i.e. OEHHA.
1-224	Add resources. Criticisms of TSCA to protect human health and the environment often overlook the real need for resources to properly administer the statute. Without the proper staffing and financial resources, any regulatory program will have limited effectiveness.
1-230	The Green Chemistry report argues that there is a need to close the "technology gap" through market-based incentives to support green chemistry. This could include funding for university research grants, scholarships, and similar programs, as well as awards for innovation, tax credits, low-interest loans, and other incentives. These positive incentives should be open to all companies that are innovators and sell products in California -- not simply be limited to companies located in California.
1-236	Note that it is important for producers to assume responsibility for the safe stewardship of their materials in order to promote environmental sustainability. Producers should be responsible for collection through processing/disposal, financially and operationally, with no cost to local government.
1-237	Shift the responsibility for the end-of-life management of discarded materials from local government to private industry producers through extended producer responsibility (EPR). This will incorporate the costs of product collection, recycling, or disposal into product price, and encouraging product design that has a reduced impact on the environment and human health. The end results are products and product chains that have a reduced impact on the environment and that costs associated with a product's impact are paid by those manufacturing or using the product, rather than general taxpayers.
1-243	Re-establish funding within DTSC Science Pollution Prevention and Technology Development for the technology staff to review and validate the GCI performance claims made by companies.
1-244	Encourage sufficient funding is available to conduct the necessary process steps that lie ahead.
2-31	Establish fees on businesses that use toxic chemicals. Such fees should be used to fund agency toxics use reduction activities, including data analysis, and the provision of technical assistance.
2-51	Add criteria to State revolving fund allocations to encourage use of green technologies.
2-52	Provide matching fund offsets to water providers who choose new green technologies.
2-120	Provide funding for re-tooling manufacturing.
2-122	Consider a bond act to provide funding.
2-135	Enact a "California Toxic Substances Control Act (CAL TSCA)." This would require all new chemicals to be tested for toxicity before they are marketed, as would all existing chemicals sold in the state. DTSC with assistance from OEHHA would evaluate the results. OEHHA should be given more resources to speed up its current evaluation process and to implement CAL TSCA. ARB authority should be expanded to forbid the use of aerosol products where there are greener alternatives, and of certain toxics determined under CAL TSCA as a threat.
2-153	Provide incentives or public funding for R&D on alternatives.
2-191	Make capital available to companies on preferential terms to encourage Green Chemistry and Green Engineering manufacturing process development.
2-206	Push for the investment in improved methods to allow for the detection of early evidence of effects and to allow for better ways to look at the potential for cumulative effects of mixtures.

OPTION EI-5: Develop funding sources for green chemistry activities.	
2-222	Provide grants funded from revenue from fees imposed on companies using toxic chemicals to groups engaged in grassroots outreach and education on green chemistry issues.
2-257	Develop an integrated program that features the following actions: . . . 6) Expand greatly the investment of resources into green chemistry education and research at California State-supported universities, including the UC system.
2-258	Include the following policy elements to further Green Chemistry in California: . . . 5) Greater investment in pollution prevention in the short term as well as extension of the current CA Pollution Prevention model to downstream chemical users.
2-288	Fund development of the ingredient database.
2-290	Fund the replacement of outmoded plant and equipment. Worldwide detoxification of the industry will cost something on the order of $10 trillion, perhaps $500 billion in California alone. There is only one reliable source for such funding: an excise tax on chemical sales to create a Chemical Trust Fund.
2-298	Note that industry should bear the costs associated with their chemical production or use.
3-79	Increase funding for OEHHA to evaluate alternative chemicals to determine whether alternatives pose an unacceptable risk.
4-8	Provide funding for adequate research on toxins using modern methods.

Chapter 3—Statutory and Regulatory Requirements and Enforcement Options

Creating a regulatory framework to reduce adverse health and environmental impacts of chemicals

SYNOPSIS

Approximately 382 options presented during the Conversation with California included ideas for the enactment of laws and the promulgation of regulations to address adverse human health and environmental effects of hazardous chemicals. Many of the regulatory sub-options are inter-related with one another and with other options found in other chapters. These are organized here as twelve options, which stakeholders have suggested. Collectively, options for statutory and regulatory requirements and for compliance and enforcement measures represented roughly 47% of the total number of comments submitted.

Participants suggested enacting laws and adopting regulations that might require:

- Businesses to develop and report chemical information;
- Suppliers and manufacturers to disclose information and label products;
- Producers to certify safety or life cycle attributes of a chemical commodity or consumer good;
- Government to collect data, assess chemicals, and take steps to reduce hazardous chemical use or exposure;
- Producers to extend their responsibilities;
- Government to create economic incentives to drive green chemistry changes;
- Chemical users to reduce or eliminate hazardous chemicals; and,
- Government to expand laws and regulations as well as harmonize those with other states, the federal government, and other countries.

Stakeholders stated that options discussed in this chapter may offer several benefits. The benefits of the suggested laws and rules, commenters said, could include:

- Providing a “level playing field” for all companies doing business in California;
- Clarifying regulatory expectations so the market can respond;
- Build on existing State authority (that may need to be adjusted or expanded) to implement green chemistry policies;
- Serving as regulatory backstop for voluntary measures; and
- Ensuring uniform application of requirements and penalties for failure to comply.

Many of the options discussed in other chapters of this report, particularly *Data Collection and Use*, *Economic Incentives*, *Education and Outreach*, and *Recognition, Awards and Certification*, also include options about the use or control of harmful chemicals. Many of these options may involve enabling law or work in tandem with changes in laws or rules.

BACKGROUND

Most environmental protection programs are based on legal requirements set forth in laws and regulations. Statutes authorize governmental agencies or officials to carry out specified actions, and direct government, individuals, businesses, and other entities to abide by specified directives. Since statutory provisions are often broad, regulatory agencies promulgate regulations to clarify and implement these provisions.

Many stakeholders noted that statutory and regulatory requirements can be effective in changing practices. They pointed out numerous examples, including: fuel efficiency standards resulting in cars with improved gas mileage; pesticide residue testing improving food safety; and seat belts in cars reducing injuries and deaths. Many participants also said that effective enforcement is needed to ensure compliance. Fair and predictable enforcement, they noted, creates a level playing field for businesses, and can reward businesses that are acting responsibly, while penalizing those that violate the law.

A detailed inventory of existing federal, state, and local regulatory systems was not conducted as part of the Conversation with California. For this initiative, participants focused on those existing laws and rules relating to hazardous chemicals and ways of preventing such chemicals from harming people or our environment. Participants discussed strengths and weaknesses of the existing legal framework in their detailed comments and the sub-options included as references here.

DISCUSSION OF OPTIONS

OPTION SR-1: Establish statutory/regulatory requirements for the development and reporting of toxicity and exposure data, safety assessments, and follow-up actions on chemicals, products, and processes.

Many stakeholders recommended establishing a program to identify, assess, and address priority chemicals based on risk or hazard, including toxicity and potential for exposure. As discussed in Chapter 1, collecting data about chemicals is a key theme from the Conversation with California. Participants referred to the lack of information as the "data gap." Several commenters said the federal *Toxic Substances Control Act* (TSCA) contributes to this data gap; they point out that TSCA does not require chemical producers to generate or report toxicity information. Commenters also noted that pesticides, food additives, and pharmaceuticals are regulated under separate federal statutes.

Some stakeholders asserted that TSCA could work but just has not been implemented in the way it was originally intended. However, extensive discussion countered this comment; participants presented numerous comments they said show TSCA could be improved. Stakeholders pointed out that there is actually an incentive to avoid producing data under the current system of chemical regulation. Because of the data gap, the chemical market operates generally on the function, price, and performance of chemicals since the market has little information on their hazardous properties. Participants said the data gap has made it very difficult for governments, businesses, and the public to identify, prioritize, and mitigate chemical hazards, including those found in products. Some stakeholders pointed out the existence of voluntary measures to fill the

data gap, such as the USEPA High Production Volume (HPV) Challenge Program. Other stakeholders noted that voluntary programs have been useful in generating some data, but have not been sufficient to cover the scope of the current data gap.

A number of comments called for establishing legal requirements for businesses to generate and submit toxicity, exposure, production or import volume, and use data for chemicals as one means of closing the "data gap." They said this would restructure the current system that requires government to prove harm before action is taken and, instead, put more responsibility on industry to demonstrate that the chemicals they use and the products they manufacture are safe. This information would also be useful in making the "chemical map of California" (which is summarized in Chapter 1.) Several commenters recommended harmonizing legal requirements for data with other systems—such as the EU REACH program and *CEPA*—with which many businesses must already comply.

Some stakeholders suggested imposing a reporting requirement on chemical manufacturers and chemical importers. In this scheme, they said, the responsible party would be subject to legal penalties for non-compliance and could be prevented from manufacturing, importing, or using a chemical without data (i.e., a "no data, no market" approach). Participants content that requiring businesses to provide toxicity and exposure data proactively would help prevent situations where chemicals have caused harm after having been used extensively. They said liability, cleanup, and litigation costs could be avoided under their suggested approach. Other stakeholders asserted that requiring "pre-market" data submissions for industrial chemicals would be too costly, would be impractical, and would stifle innovation. Additionally, some stakeholders noted the importance of weighing all costs in considering any new regulatory scheme. They included, for example, costs to communities in terms of lost wages from sick leave, health care costs, environmental degradation and the economic impacts that brings, expensive cleanup actions, higher education costs due to higher rates of behavioral and developmental problems in highly exposed populations, etc.

A number of stakeholders noted that data development and subsequent regulatory action (e.g., use restrictions) could be targeted toward high priority chemicals, as determined using a risk-based approach. They recommended taking into account both chemical toxicity and the extent of exposure to that chemical. The risk-based approach was strongly advocated as sound science. Other participants felt strongly that an intrinsic hazard approach could be mandated for identifying and regulating chemicals of concern. Some stakeholders emphasized taking a precautionary approach, which would essentially involve assuming a toxic chemical is "guilty" until proven "innocent." Another group of stakeholders suggested that the state could be required to evaluate the submitted data and carry out appropriate safety assessments.

In evaluating chemicals, products, and processes, many stakeholders emphasized the need for life cycle analyses and risk assessments that take into account the full range of toxicological and environmental effects, chemical interaction and synergistic effects, social factors, environmental justice, chemical/product effectiveness, long and short term economics, and alternatives analysis. Some commenters also suggested requiring the state to take follow-up actions on chemicals meeting specific criteria (e.g., phase-out of highly toxic and persistent chemicals).

From the extensive stakeholder comments, a green chemistry policy—which could be set forth in laws and regulations—could include the following elements:

- **Registration and data submittal requirements**. Chemical manufacturers, importers, and users would be required to:
  - Register chemicals (both existing and new) that they use;
  - Submit information on:
    - overall use and use in specific products and processes,
    - amounts imported and produced in California, and
    - any information (e.g., toxicity, use, volume, exposure potential) that they are required to submit to other jurisdictions (e.g., to the European Union pursuant to EU REACH, to Canadian authorities under CEPA);
  - Develop and submit a baseline set of data for chemicals prior to marketing and use in California (i.e., a "no data, no market" policy may be implemented).

    California would need to evaluate and determine the appropriate set of baseline data that would be required. Stakeholders recommended that traditional toxicology tests be considered along with alternative approaches such as quantitative structure activity relationships ("QSAR) and innovative short term assays that address "upstream" effects (i.e., early indications of toxic concerns). A number of stakeholders also raised the issue of animal welfare. They recommended that animal testing be used only as a last resort. Some commenters further suggested that a data audit system could be established and could evaluate the scientific validity of information gathered from external sources (e.g., industry submissions).

    Data submission requirements for existing chemicals, commenters suggested, could be triggered in a tiered fashion, based on level of concern or on usage, production or import volume, or other indicators of potential exposure. Some stakeholders advocated that California start with the high priority chemicals already identified by Canada. Several participants said the Hotspots Analysis and Reporting Program (HARP),[18/] currently used by many industrial facilities in California to report air emissions, could be adapted for this purpose.

- **Timelines**. Stakeholders suggested that clear and realistic timelines be set for submittal of information. Further, time-to-market was noted as a critical factor that must be considered in imposing regulatory controls. Any government delay increases uncertainty for businesses.

- **Public Access to Data**. A number of stakeholders indicated the need for toxicological and exposure data to be made publicly available. Some stakeholders emphasized that CBI will need to be respected; other stakeholders believed that health and environmental data could not be classified as confidential. Issues related to CBI could be addressed, for example, by requiring up-front justification for, and government review of, any CBI claims, and a requirement that business reassert CBI claims after a predetermined period of time.

- **Safety assessments.**

- **Life cycle assessments**. Many stakeholders indicated the importance of using life cycle analyses to evaluate chemicals, products, and processes. These analyses, they said, could consider the full range of recognized and emerging toxicological and environmental effects, chemical interaction and synergistic effects, social factors, environmental justice, chemical/product effectiveness, long and short term economics, and alternatives analysis. Several participants cautioned that life cycle analyses must be applied carefully, with the

awareness of possible pitfalls (e.g., one life cycle analysis using a regional scale and another using a global scale, so they cannot be compared.)

- **Risk, hazard, or alternatives assessments.** "Risk" versus "hazard" elicited lengthy debate during the Conversation with California. In addition to the "data gap," how chemicals are assessed is another key theme.[19/] Many participants proposed abandoning traditional risk assessment in favor of a new hazard focus. Equally strongly held, many other stakeholders advocated the continued use of risk assessments. Across the spectrum of approaches, some form of systematic assessment would be used to assess chemicals. Risk, hazard, and exposure assessment generally includes:

  - Characterizing exposure potential in the general population and sub-populations (e.g., children, the elderly, and workers);
  - Characterizing hazard potential of chemicals of concern;
  - Considering interactions between chemicals both in terms of toxicity and exposure (e.g., use of products containing multiple chemicals) and cumulative effects; and
  - Determining whether to reduce or eliminate exposures to the chemical based on specific criteria. For example, if the state obtains new information that an existing chemical is highly toxic and persistent, the state could be required to develop a plan to phase out or restrict that chemical.

  Several participants pointed out that alternatives assessment could be more effective. Alternatives assessment includes: identifying a full range of alternatives; considering the potential adverse effects of each alternative; and considering the potential benefits of each alternative. Throughout the comments, stakeholders exchanged numerous ideas and perspectives regarding methodologies to assess chemicals and alternative courses of action. Some stakeholders wanted the state to be responsible for carrying out safety assessments, while others advocated that the responsible parties (e.g., manufacturer of a chemical) do the assessments.

- **Follow-up actions.** Commenters suggested that government develop a list of priority chemicals targeted for use restrictions, reductions or phase-outs. (See option SR-2 below for suggested options on bans). Several stakeholders recommended that California could consider action on the high priority chemicals already identified by Canada. For chemicals of high concern, businesses could be required to develop toxics use reduction plans. A number of stakeholders emphasized the need for careful substitution planning to ensure that safer and greener alternatives (chemical, product, or process) are used in place of chemicals or processes that will be phased out, and that possible unintended consequences of the substitutions be evaluated and addressed. Additionally, stakeholders pointed out that a range of risk management options could be considered that could range from process controls all the way to substitution. Others noted that to call a chemical "safer" could require the same high standards that were applied in identifying a chemical as "toxic" and needing phase out. If a toxic chemical is targeted for phase out and no substitute is available, it was suggested that there be a requirement to develop such a substitute. Additionally, if a safer substitute did exist, its use could be mandated. Stakeholders emphasized that non-chemical alternatives could be considered in choosing substitutes. Stakeholders also recommended that in the absence of data that demonstrates the safety of a chemical, the use of that chemical could be restricted until safety is demonstrated.

- **Stakeholder involvement**. Throughout the comments, numerous commenters recommended that stakeholders be involved early in the process of developing new statutory and regulatory requirements.

- **Progress metrics and continual regulatory improvement**. Stakeholders also raised the issue of how to evaluate the success of regulatory measures on green chemistry and chemicals policy. They suggested that government could review regulatory approaches on an on-going basis and make improvements as needed. Stakeholders urged the state to seek continuous improvement to achieve the "greenest" or "safest" possible results, and to link regulatory standards could be linked to the best, safest available technology or chemical.

OPTION SR-2:	***Establish statutory/regulatory requirements for disclosure, labeling, and certification.***

Many stakeholders stated that significant strides could be made by requiring disclosure of already available information on toxicity, mandating labeling of product contents, and holding responsible parties liable for certifying the accuracy of information and the safety of their chemicals and products. They noted a lack of transparency in the supply chain from manufacturers to users of chemicals and, ultimately, to consumers of products. A regulatory system of disclosure and accountability could enable quick identification of the party responsible for a toxic product or intermediate, and assignment of liability. Stakeholders suggested that suppliers and manufacturers could be required to know and disclose—to all interested parties—the identity of the constituents in their products. Forcing disclosure of ingredients raises the issue of CBI. However, several commenters noted, disclosure of financial information was initially resisted in the past but is now a key factor in the operation of financial markets. They said these examples could be used as a model for evaluating the benefits of information disclosure related to toxic chemicals.

A number of stakeholders pointed out the importance of Material Safety Data Sheets (MSDS), which are widely used as a means to comply with hazard communication requirements under worker safety laws. They emphasized the need to ensure that MSDS documents are accurate, up-to-date, and informative.

One comment suggested making public the name of any manufacturer or supplier that has provided off-specification chemicals or products, which could deter illegal or negligent behavior and tap into the power of peer pressure. This negative publicity could result in lost business for these entities—a market-delivered penalty for unacceptable practices.

Stakeholders suggested that all products, including consumer products, carry mandatory labeling of their contents (ingredients). Mandatory labeling of products could harness the power of the market to force change. Many participants discussed problems and limitations regarding nomenclature. For instance, they gave dozens of examples of inaccurate, confusing, or meaningless “green” claims about products. Several comments recommended regulating the use of “green” labeling **t**o ensure accuracy of claims. Stakeholders also noted that government must consider enforcement issues, in order to deter false claims of “greenness.”

Participants suggested that manufacturers and suppliers could be required to certify the safety of the products they sell, both to retailers and other manufacturers. Another suggestion involved a requirement for chief executive officers of chemical manufacturers or importers to certify personally the veracity of information provided under any regulatory requirements.

OPTION SR-3:	***Adopt regulatory standards for industrial processes, products, and supply chain management and establish authority for monitoring, testing, and enforcement.***

A number of stakeholders advocated that businesses establish and voluntarily follow standards for industrial processes, products, supply chain management—including control of imported raw materials, testing for toxics in products, and rapid response to control and remove toxics in products. Although there are many responsible companies taking such measures, other stakeholders pointed out that regulatory requirements could ensure that standards are being followed, and adherence to these standards is verified by an objective third party.

Credible, rigorous regulatory standards provide certainty to business entities. Many commenters emphasized that these standards could be established for industrial processes and products, both domestic and imported. They said such standards could include manufacturing process controls, quality assurance programs, raw materials, and best practices for supply chain management. In developing these standards, participants recommended working with trade or marketing associations.

Several stakeholders noted many companies and organizations have implemented environmental management systems (e.g., using the International Organization for Standardization's model in its ISO 14001 standard), with third party certification of these systems. Stakeholders also pointed out that risk management measures, identified as part of environmental management, could address many green chemistry concerns. They listed green chemistry elements—such as substituting alternative input materials, making process changes during manufacturing, installing technological controls, and requiring use of personal protective equipment—frequently found in such systems.

Stakeholders pointed out the need for monitoring and testing of products to ascertain compliance with regulatory standards. They recommended expanding state programs to monitor and test food and other products for both contaminants and unsafe constituents. Other commenters suggested a product safety organization to review new products using clear criteria. A number of participants called for centralized laboratory testing where the public could request testing of suspicious products. Increased investment in new testing and monitoring methods was a common comment also. New test methods, which could be used as a basis for proactive enforcement of safety requirements for both manufacturers and retailers and as the basis for product recalls, were suggested. Several stakeholder said such new methods are needed so harmful chemicals in products are detected and recalled in a timely manner.

When violations are discovered, stakeholders pointed out the need to pursue appropriate enforcement actions, including penalties and product recalls. To effectively do this, the State could scrutinize who in the supply chain is liable for a toxic product and have a means for holding that party responsible. They said identifying responsible parties and holding them liable would facilitate the removal of toxics in products. Stakeholders suggested that liability laws be

strengthened to assist enforcement and to encourage greater responsibility for parties at various steps in the supply chain. Commenters also said accountability for out-sourcing could be better defined. A few participants suggested that chief executives could be held personally liable if toxic chemicals manufactured or imported by their companies harm people or the environment.

Others suggested that "safe harbor" or some legal indemnity be offered to companies that test for toxic chemicals in their products and replace them with safer substitutes.

In today's global economy, a number of stakeholders said that the state needs to address toxics in imported products as well as exports of toxics from the state. Government, they stated, could strengthen trade agreements with other nations and improve import/export requirements and testing. Well-defined standards would facilitate a level playing field for companies competing on a global basis.

To facilitate the removal of a chemical in a product discovered to be toxic, a state regulatory program to support industry in making such changes was suggested. This idea could ensure that requirements for chemical removal would be fair and reasonable, without compromising safety. Establishing subsidies or technical consultation by government to industry was suggested also, particularly to smaller manufacturers in situations that call for quick retooling of industrial processes.

New standards could create potential economic impacts for business. However, economic impacts could be weighed against the potential costs of not acting. Participants discussed the possibility that California could become a dumping ground for products prohibited in Europe, if California fails to regulate toxic chemicals in consumer products.

OPTION SR-4:	***Establish statutory/regulatory measures to create economic incentives to drive green chemistry.***

Incentives. As discussed in Chapter 2, economic incentives can play a significant role in advancing green chemistry. A mix of positive and negative incentives could influence trends in the market, consumer preferences, and product innovation. In some cases, however, these incentives cannot be established—or would not be effective—without a statutory or regulatory basis.

Government procurement. A number of stakeholders advocated imposing requirements on State agencies to consider green chemistry in its operations, particularly in procuring services or products. Stakeholders noted that such action by State agencies would reflect California's commitment to take a leadership role in green chemistry and would provide a model for other businesses and consumers to follow. In addition to government procurement, participants suggested that green chemistry requirements govern all aspects of state business, including green building, green manufacturing or production, recycling, composting, and other environmentally sustainable practices. Given the large volume of products purchased by the state, mandating green purchasing by the state could have the added benefit of influencing the market toward safer alternatives.

Fees and taxes. Stakeholders pointed out that the impositions of surcharges, taxes or fees, assessed according to clear criteria, on hazardous chemicals and products, could serve the dual

purpose of discouraging the use of these materials and generating funds for green chemistry programs. Stakeholders also advocated that taxes be assessed on the use of virgin materials and hard to dispose of products. Additional suggestions included volume or weight-based fees for waste disposal, depletion quotas on the extraction and import of virgin materials, elimination of any special tax treatment for the extraction of virgin materials, and modification of agricultural subsidies to foster sustainable practices.

Many stakeholders said positive incentives, such as tax credits for green products and technologies, could encourage movement toward safer alternatives. Rebates for energy efficient, safe, and other environmentally preferable products were also suggested to make these products more economically attractive to buyers.

Third-party certification. A number of comments proposed a state-run or third party (i.e., other than the manufacturer) program to certify green products (and issue a "green seal") based on specific criteria. This idea could include review of current approaches for green product certification. Some of the proposed criteria for green products were energy usage, waste generation, use of recyclable materials, and use of less toxic ingredients. Any certification program—several participants noted—may be hampered by significant data gaps on toxic substances and safer alternatives (as discussed under Option SR-1 above). [More options are summarized in Chapter 8.]

OPTION SR-5:	***Mandate extended producer responsibility and other measures to control the waste stream.***

The environmental and public health costs associated with a chemical or product during its life and at end-of-life are generally not accounted for by manufacturers when they evaluate the economics of a product, participants told us. Certain products are designed to be discarded at the end of their useful life. Stakeholders proposed that producers be required to conduct full life cycle analyses of their products and take responsibility for managing the full life cycle, including end-of-life. Life cycle analyses could incorporate specific standards and be third party certified. For example, a few stakeholders suggested the Green Dot program in Europe as a model for developing this type of program. By mandating extended producer responsibility, including take-back programs, the environmental costs of unsustainable and toxic products would be borne by those responsible for designing and producing them, rather than by society as a whole. Stakeholders cautioned, however, that mandatory take-back programs be structured so costs are passed on to the consumer or borne by local government.

Until extended producer responsibility programs are fully implemented, stakeholders suggested that government address known issues in the waste stream that are causing immediate harm. Regulatory provisions to minimize the adverse health and environmental impacts of the waste stream were suggested; these could, among other things, require product reuse, recyclability, or biodegradability. Some participants asked that separation of materials for recycling and composting be required as part of a program. Several commenters recommended that regulation of waste management at RCRA facilities be tightened. Conversely, one comment suggested more flexible regulations, which could allow waste generators to reclaim waste streams onsite.

Additional regulatory or statutory options included requirements for: lighting waste, electronic waste ("E-waste"), and other products known to contain hazardous substances; mandatory take-back programs for unused pharmaceuticals; ozonation for wastewater disinfection (sewage

treatment); and a grant program to allow upgrades of facilities and regular monitoring of sludge and effluent.

Stakeholders further advocated that the State manage the California waste stream responsibly, and ensure that hazardous waste not be exported to developing countries.

OPTION SR-6:	***Consider a broad range of sustainability, social, economic, and other factors associated with the life cycle of a product, in addition to human and environmental impacts, in chemical management decisions.***

Most environmental regulatory programs decide on a course of action on the basis of an assessment of human or ecological health impacts on the one hand, and a range of non-health-based considerations, including technical feasibility and costs, on the other.

Multi-media factors. Many commenters urged the State to seek solutions that recognize all of society's needs. They recommended approaches that also consider and weigh environmental, social, environmental justice, and economic factors in addition to risk or hazard. In particular, they noted, all relevant aspects of sustainability could be taken into account besides health and environmental effects. These could include: energy costs, greenhouse gas emissions, water use, natural resource consumption, extent of packaging, and recyclability, for example. A number of comments also recommended that these impacts be examined for all stages of the life cycle of the product, including trade-offs. Other suggestions called for risk-benefit analyses that incorporate "externalities." That is, costs associated with potential consequences of chemical use—such as lost wages from illness, health care, environmental degradation and cleanup, and the burden on the educational system due to behavioral and developmental problems—would be incorporated. In some cases, it might be useful to investigate the reason behind the use of certain chemicals; for example, long-established manufacturing processes, purchasing practices, or product specifications might specify the use of certain chemicals. Or, regulatory standards (such as flammability standards for furniture) can drive the use of a particular chemical.

Hazard versus risk. Another aspect of the decision-making process, participants stated, is "hazard" versus "risk." As above, hazard refers to the inherent toxicity of a chemical, while risk involves both toxicity and extent of exposure to the chemical. One view advocated that hazardous substances, if properly managed, do not produce adverse impacts. The opposing view maintained that the current risk-based approach has put people in harm's way and have only benefited chemical suppliers. Where exposures are considered, a number of stakeholders pointed to the need to reduce impacts on the most highly impacted or disproportionately exposed communities, on workplaces (where the highest exposures tend to occur), and on the most sensitive individuals (such as children), natural resources, and ecosystems or species.

Precautionary principle. Several stakeholders endorsed the use of the precautionary principle in order to ensure that the public and the environment are protected when data are incomplete or uncertain. A related suggestion, some commenters noted, would be shifting the burden of proving safety to the product manufacturers. A few comments argued that a product could be assumed unsafe unless the manufacturer can demonstrate otherwise. One comment recommended requiring take-backs, at no cost to the consumer, for those products that cannot be shown as safe, hence shifting the physical and financial burden to the manufacturer.

Sound science. Finally, many of the comments emphasized the need to ensure that decisions are based on sound scientific considerations. One comment recommended that chemical management decisions be carefully documented, conclusions be explicitly qualified, and the type of information assessed, including any uncertainties, be characterized. This could help prevent instances where analyses and conclusions on a specific set of information are applied inappropriately to other, often dissimilar, situations.

OPTION SR-7:	***Eliminate the use of hazardous chemicals by prohibiting their use, replacing them with alternatives found to be preferable, or establishing pre-market approval requirements.***

Many of the comments addressed considerations relating to eliminating or reducing the use of hazardous chemicals. Stakeholders' suggestions ranged from immediate prohibitions (bans) on the use of these chemicals, to phase-outs, and finally to admonitions against banning chemicals in the absence of alternatives that have been adequately evaluated.

Several stakeholders called for immediate action to eliminate known chemical hazards, although there were varying opinions on the degree of evidence needed to trigger action (i.e., how much evidence would be considered adequate), as well as the hazardous characteristics that would warrant action. Chemicals that are toxic, bioaccumulative and persistent were often identified as targets for immediate prohibitions, and specific mention was often made of chemicals that have been classified as carcinogens, mutagens, reproductive toxicants, developmental toxicants, neurotoxicants, or otherwise capable of serious or irreversible harm. Other comments referred more broadly to eliminating chemicals found to be harmful to people or wildlife, chemicals with adequate data demonstrating "serious harm" or "severe hazard," chemicals "suspected of toxicity," or chemicals known to be "unsafe." The State was urged to be protective, such that when impacts are unknown or safety data are inadequate, use of the chemical could be phased-out.

A number of comments proposed banning specific chemicals, groups of chemicals, or products. Various stakeholders recommended bans on: diacetyl, single-use polystyrene containers and other plastic/non-biodegradable polymer materials, incandescent lamps, toilet additives containing formaldehyde for recreational vehicles, commercial cleaning products, the most toxic "cosmetics and pesticides," brominated and chlorinated fire retardants, hazardous substances in electronic devices, and phthalates in children's products.

In contrast to the suggestions for immediate action, some comments recommended that chemicals be prohibited only when an unacceptable level of risk—not offset by the benefits of continued use—has been associated with the chemical and that risk cannot be adequately mitigated. Other comments proposed that if risk levels are judged too high, industry could have an opportunity to introduce appropriate measures to reduce risk within a given time span, or face phase-out of the material. Other viewpoints advocated that bans be avoided in the absence of safer alternatives. They said the State could consider options other than bans and required substitutions—including process changes and technological controls, the use of personal protective equipment, and requirements governing storage, transportation and disposal.

Various options relating to the use of substitutes were frequently discussed in conjunction with many of the options that discussed chemical bans. Several comments proposed a requirement for

substitution planning to ensure movement toward greener and safer alternatives -- that is, that hazardous chemicals be replaced with safer substitutes when the latter are available; when not available, businesses could be required to develop non-toxic and/or cost effective alternatives. One proposal is to prioritize toxic hazards in products for evaluation and mitigation based on use and availability of known safer substitutes (it was noted that commercial cleaning products would be a priority if this was implemented).

While substitution was viewed by many as a solution, some stakeholders warned about the potential for the creation of a different set of issues or unintended adverse consequences unless care was taken to ensure "informed substitution." For example, a series of chemicals have been used as refrigerants: ammonia (which is toxic), which was replaced by chlorofluorocarbons (which are non-toxic, but are ozone depleting), later replaced by hydrochlorofluorocarbons (which do not impact ozone, are nonflammable, have low toxicity, but can contribute to global warming). Several participants noted that since substitution must ultimately reduce risks to health and the environment, decisions could be based on a comparative evaluation of the cross-media life cycle impacts of a given chemical and its potential substitutes. Hence, the stakeholders emphasized that this evaluation consider: raw material sourcing, carbon footprint, performance, efficacy, costs, benefits, and technical feasibility, in addition to human health and environmental impacts. Some stakeholders stressed that data requirements could be the same for both existing chemicals and potential substitutes; thus, substitution with materials for which there are limited data could not be acceptable.

Lastly, several options proposed the adoption of measures involving safety evaluations addressing all phases of a product's life cycle, data submission requirements, and approvals prior to allowing chemicals or products into the market, or as conditions to continued use of these materials. One concept proposed a "no data, no market" policy, in which chemicals for which safety data are not available would be banned from sale or use; opposing viewpoints noted that this policy would be incredibly burdensome, too costly, and unworkable for California.

OPTION SR-8:	***Take immediate actions to prohibit or restrict the use of known hazardous substances.***

Many stakeholders pointed out that those toxic chemical hazards, which are already documented, could be quickly addressed by the state, under clearly set out timelines. Regulatory actions to prohibit or restrict known hazards—for example, highly toxic, bioaccumulative or persistent substances, environmentally damaging products or unsustainable practices that are known to be harmful to human health and/or the environment—could move the market toward safer alternatives. Several stakeholders identified immediate actions as recommended options. Some chemicals are considered to be of such great concern that an immediate phase-out could be considered, either entirely or for specific uses, especially where their use provides no significant overriding social benefit (e.g., lead in children's jewelry).

Options that were suggested for immediate action included:

- Ban or restrict the use of chemicals or chemical classes that are known hazards, or products with these chemical, including:

- very persistent or bioaccumulative chemicals;
- carcinogens, mutagens, and reproductive/ and developmental toxicants, or other very high hazard chemicals;
- certain substances in personal care products that are harmful to humans and ecological systems (the state could consider partnerships with European entities that have been working on this problem);
- brominated and chlorinated flame retardants;
- diacetyl;
- plastic packaging used for commercial purposes containing styrene, bisphenol A, perfluorooctanoic acid, vinyl chloride, nonylphenol or alkylphenol (to reduce the amount of these substances entering the waste stream, storm drains, coastal environment, and oceans);
- hazardous substances in electronic devices;
- phthalates in children's products;
- lead in drinking water pipes and fittings; and,
- formaldehyde in toilet additives.

- Implement bans with clear timelines.
- Require regulatory authorization from the state for continued use of substances of very high concern.
- Prohibit the export of toxic products and waste to developing countries.

Other product-specific actions that participants suggested include:

- Develop criteria for appropriate use of pesticides applied for cosmetic purposes only (e.g., used on crops for appearances) and ban inappropriate uses of pesticides.
- Prohibit the sale of incandescent light bulbs, and mandating toxics reduction in lighting.
- Establish emission limits for composition wood treated with formaldehyde.
- Mandate use of CO_2 systems in place of toxic chemicals.
- Ban non-refillable refrigerant cylinders to service air conditioning systems

OPTION SR-9:	***Reduce or restrict the use of hazardous substances through use reduction measures, standards setting, process or engineering changes, and product stewardship initiatives.***

As an alternative to banning the use of hazardous substances, several commenters recommended reducing the use of these chemicals. They suggested that both reductions and restrictions be guided by a prioritized list of chemicals. Use reductions could occur within specified timeframes. Businesses could be surveyed regarding their manufacturing, processing, or use of chemicals in order to establish a baseline against which progress would be measured. Businesses could also be required to annually report quantities of toxic chemicals used, and biennially

prepare toxics use reduction plans. A number of comments identified marine debris and toxic substances in lighting as specific targets for reduction.

Some of the comments recommended that California create a system based on the successful management of identified risks. Risk management can be accomplished through appropriate use restrictions, or through the adoption of standards. The appropriate State agency could be provided with the regulatory authority to establish restrictions for uses of priority chemicals, along with due process for doing so. To ensure adherence to use restrictions for consumer products, some participants pointed out the need to make consumers aware of the importance of reading and following label instructions for safe product use, storage, and disposal. Use restrictions could also be imposed on a chemical until its safety has been comprehensively demonstrated. In addition, limits could be established on the amounts of hazardous chemicals that can be released over the life of a product. Such limits could be linked to the best, safest available technology or chemical. One suggestion for addressing toxic chemicals present in products by accident involved working with the industries responsible for selected key product areas to promote existing standards or to develop new ones.

Reductions in the use and release of hazardous substances could also be achieved through "green engineering," that is, manufacturing and production process changes and cleaner technologies. Technological controls (e.g., pollution control equipment), requirements for the use of personal protective equipment, the use of enclosed systems, and instituting a range of pollution prevention options could effectively address health and safety concerns in the workplace and the community. Government could consider identifying industry sectors that generate the most toxic products, and identifying green engineering solutions specifically for these sectors.

Many stakeholders encouraged the State to rely on product stewardship and risk management programs that many businesses already have in place. Commenters urged government to expect and encourage manufacturers of products sold in California to employ comprehensive product safety management systems. Such systems could include, among other things: assessments to ensure the safety of products prior to marketing; rigorous control of production (from raw material specifications, to formulation management and process and quality control); safe operations that protect employees and the surrounding community; compliance with all applicable product safety, labeling and regulatory requirements; constant vigilance in post-market surveillance with rapid response to identified concerns; and innovation that improves product performance, value and environmental quality based on life cycle considerations. Companies could be required to post information on their safety assessment process on the Internet. Finally, government can work with scientific experts to examine best practices and develop a toolkit for safety assessment programs, participants noted.

OPTION SR-10: Expand the regulatory authority and funding for state programs.

Cal/EPA and its boards and departments, the Department of Public Health, and other agencies are already actively engaged in the area of green chemistry. Several options proposed by stakeholders suggested that the regulatory authority and funding of existing state agencies be expanded to meet the challenge of advancing green chemistry in California.

Stakeholders advocated that Cal/EPA be given the statutory authority to establish restrictions on uses of priority chemicals. They cited the State Air Resources Board's (ARB) authority to

regulate and adopt requirements for consumer products. In this regulatory program, ARB establishes regulations based on the characteristics of the best available alternatives and technologies. In this example, ARB has set limits on volatile organic compounds (VOCs) in aerosol deodorant and antiperspirant products based on the low or no VOC content of existing roll-on substitutes. That has effectively reduced the use of aerosol products when a roll-on alternative is available. Commenters said this program could be expanded to consider other chemicals, beyond air pollutants.

A few stakeholders advocated that funding for OEHHA be increased. Similarly, a few commenters proposed re-establishing funding for DTSC staff to review and validate the green chemistry and green engineering performance claims made by companies. Participants also touted economic incentives in the form of grants, low interest revolving loans, and preferred equity funding for pollution prevention and process changes.

Stakeholders suggested immediate efforts to expand state capabilities in analytical approaches such as life cycle analyses and quantitative structure activity relationships. Increased funding and more field inspectors for retail products and food was proposed.

If certain requirements were more flexible, several commenters stated, state agencies could act now to address many important issues that were raised in the Conversation with California. Many acknowledged that additional funding would be required to broaden the responsibilities of existing agencies or to support new activities and programs. Potential sources of funding that were suggested included a bond act (modeled after the stem cell research initiative, for example), and fees on businesses that manufacture or sell toxic chemicals.

OPTION SR-11:	***Coordinate and harmonize laws and regulatory requirements with those of the federal government, other states, and other countries.***

Another key theme in the Conversation with California is coordination and harmonization with others. Many stakeholders urged that California draw upon the wisdom and experience gained from existing green chemistry and chemicals policy initiatives at the federal level and internationally. They cautioned not “re-invent the wheel.” Stakeholders noted that a key component of developing any new statutory or regulatory requirements is an understanding of what is already being done. Several stakeholders recommended that the state conduct a comprehensive baseline assessment of existing laws and regulatory requirements at the state and local level relating green chemistry issues. This could involve a critical analysis of both the desirable features and deficiencies of those programs in order to help guide California.

In considering harmonization, varying levels of protections and requirements could be reviewed, with stakeholders suggesting that the most protective standards be considered the benchmark. There was wide agreement, to the extent possible, that the state coordinate and harmonize with other initiatives to avoid duplicative and possibly contradictory regulatory requirements. Comments urged avoiding unnecessary regulations, which may impede green chemistry discoveries.

A number of stakeholders advocated that California consider adopting and implementing the approach taken by Canada under CEPA. Others proposed that California take advantage of efforts under the Montebello Agreement between the U.S., Canada, and Mexico. Stakeholders suggested that the state negotiate data sharing agreements with other countries to take advantage

of the information already being collected. A recommendation to develop partnerships with other states in developing environmental health and safety data was made.

To immediately take advantage of work being done in other countries, it was suggested that the state evaluate whether the agencies that implement EU REACH and CEPA could be identified as authoritative bodies under Proposition 65. In this way, the information generated under those programs could be directly used by California to identify chemicals as known to cause cancer or reproductive/developmental toxicity.

During the Conversation with California, the State forged relationships with experts in other jurisdictions. Collaboration with these other experts was encouraged for the formulation of effective policies and strategies. Stakeholders also emphasized the need for the State to ensure that the process of constructing a regulatory framework for green chemistry would actively involve all stakeholders at all stages.

Finally, within the State, stakeholders observed that it is essential that collaborations occur across programs to ensure the development and implementation of a comprehensive, stream-lined and well-coordinated chemicals policy in California.

OPTION SR-12:	***Establish metrics to assess the effectiveness of chemical management strategies implemented.***

Performance metrics are valuable tools for evaluating the effectiveness of a program. A small number of comments recommended that the State use metrics to assess the performance of its Green Chemistry Initiative, and to measure the impacts of its reforms. According to these comments, the adoption of green chemistry performance indicators would reflect a commitment to transparency and proactive responses to new information, and would provide a signal when changes are needed. Suggested metrics include those that track chemical releases to the environment, human exposures, health impacts, long-term benefits, cost-effectiveness,

CHAPTER TEAM

The following Green Chemistry team staff members served as principal editors for this chapter, Statutory and Regulatory Requirements, Enforcement:

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The team compiled each of the comments relating to laws and regulations as well as compliance and enforcement options for green chemistry. They organized the comments that stakeholders made during the Conversation with California. The chapter team worked closely with the overall team, whose members are given in the Acknowledgements. The references for each of the twelve options summarized in this chapter are presented in the next section of this report.

Chapter 3—Statutory and Regulatory Requirements and Enforcement Options

REFERENCES

The tables below cross-reference each option to Appendix B. The figures shown in the first column represent the "challenge area" and the option number.

OPTION SR-1:	***Establish statutory/regulatory requirements for the development and reporting of toxicity and exposure data, safety assessments, and follow-up actions on chemicals, products, and processes.***
1-4	Develop and establish mandatory criteria that must be addressed for all substances used in commerce. Take into account toxicity, effectiveness, volume used, volume reduce, long and short-term health and environmental impacts (life cycle).
1-5	Develop and establish balancing criteria for all substances used in commerce. Consider short and long-term costs and economics, "alternative analysis," and public acceptance.
1-8	Factor environmental, societal, environmental justice, and economics into decisions.
1-15	Use "precautionary principle" to shift burden to industry.
1-20	Use EU REACH as a model.
1-24	Avoid focusing exclusively on chemicals in products and chemical inputs. Manufacturing and production processes using chemicals should also receive attention in order to address health and safety concerns of workers and to address community concerns for inherent safety of chemical facilities.
1-26	Support development of a chemical risk analysis process, such as that being implemented in Canada.
1-27	Support mandatory reporting and enforcement of chemical use by manufacturers and distributors.
1-30	Rethink the processes for allowing chemicals into the market.
1-36	Establish mandatory requirements needed to fill gaps about chemicals. In addition to CMR data, we need other endpoints: neurotoxicity, long-term toxicity, endocrine disruption, immunotoxicity, etc. Industry should be responsible for developing these data, with government as auditor or verifier.
1-39	Legislate something similar to the State of Massachusetts (S-1268 & H-2275), *The Act for a Healthy Massachusetts: Safer Alternatives to Toxic Chemicals.*
1-40	Change state MSDS document requirements to be similar to the State of Pennsylvania requirements, which are more informative than federal MSDS criteria.
1-78	Adopt laws and regulations that: (a) are science-based; (b) balance potential risks with benefits; (c) factor in existing scientific knowledge as well as reasonable uncertainties; and (d) consider the degree of risk to people and the environment.
1-79	Find a way to successfully manage both toxicity and exposure (i.e., risk) while providing the solutions California needs.
1-109	Lower the barrier to obtaining access to data and create incentives for the production of data, rather than maintaining the current framework which actually provides incentives to avoid producing data.

OPTION SR-1:	***Establish statutory/regulatory requirements for the development and reporting of toxicity and exposure data, safety assessments, and follow-up actions on chemicals, products, and processes.***
1-117	Reduce the differences in the ways that pharmaceuticals and environmental chemicals are regulated. The workshop identified several areas where information and methods developed in the pharmaceutical industry could be useful for environmental chemicals, and these should be addressed.
1-118	Implement the policy that "no data means no market," meaning that chemicals for which safety data are not available are banned from sale or use.
1-148	Recognize that substitution is not the only viable way to control risk.
1-152	Implement a "California Toxic Substances Control Act (CAL TSCA)." Require all new chemicals sold in California be tested for toxicity before they are marketed.
1-178	Develop and adopt green chemistry progress metrics with a commitment to transparency and proactive response to new information on any risk or benefit posed by chemicals.
1-184	Ensure the safety of consumer products by using sound science in the decision-making process.
1-189	Build on existing statutory and regulatory structures, voluntary initiatives, and data development efforts.
1-198	Require appropriate use-restrictions for chemical ingredients when scientific safety-based assessments indicate that they cannot be used safely in a consumer product or use application.
1-202	Put prohibitions in place only when an unacceptable level of risk is identified that cannot be adequately mitigated or that is not offset by the aggregate benefits of continued use. This approach is science-based, and relies on data generated through experimentation or by means of modeling (structure-activity relationships).
1-203	Base any chemical management system on risk.
1-204	Screen all chemicals (new and existing) to determine further information needs in a tiered, risk-based approach.
1-206	Recognize shared responsibilities of each party in the value chain.
1-211	Base decisions of preference and substitution on the comparative life cycle impacts of a chemical and its potential substitute. While a safety-based characterization scheme may focus on toxicity, persistence, and bioaccumulation, there are a number of other parameters, which are relevant to the sustainable use of a particular chemical in a formulation, such as raw material sourcing and carbon footprint. All relevant aspects of sustainability should be taken into consideration for a potential substitution decision. Similarly, any plan to consider substitution of chemicals should require that the efficacy and benefits of that compound be considered as any diminution of efficacy may negatively impact public health and well being through reduced hygiene and sanitation.
1-224	Recognize that criticisms of the TSCA to protect human health and the environment often overlook the real need for resources to properly administer the statute. Without the proper staffing and financial resources, any regulatory program will have limited effectiveness
1-225	Retain the pharmaceutical industry exemption from TSCA. The EU Reach program currently exempts pharmaceuticals, since they recognize that the pharmaceutical industry is heavily regulated by FDA-like government agencies and there may be product quality concerns if there are modifications to the registered formulations.
1-238	Hold substitute chemicals to the same standards as the chemical they are intended to replace.
2-4	Base environmental regulation on thorough scientific data that has clear evidence of harm to human health and environment.

OPTION SR-1:	***Establish statutory/regulatory requirements for the development and reporting of toxicity and exposure data, safety assessments, and follow-up actions on chemicals, products, and processes.***
2-7	Require chemical manufacturers to report information about the long-term health effects of chemicals in use by 2016.
2-12	Require real world information about how chemicals interact with each other.
2-27	Identify priority chemicals for toxics use reduction and create a list as targets for toxics use reduction.
2-29	Require businesses that use large quantities of toxic chemicals to report annually on the quantities of toxic chemicals used and to prepare and biennially update toxics use reduction plans.
2-42	Ensure that chemical producers generate, distribute, and communicate information on chemical toxicity, ecotoxicity, uses, and other key data.
2-43	Strengthen government tools for identifying, prioritizing, and mitigating chemical hazards.
2-45	Protect proprietary technology and intellectual property.
2-62	Require chemical producers, importers, and users to submit and update information on amounts, facility locations, and uses (including in products).
2-76	Fill data gaps and gain a better understanding [about chemicals].
2-89	Ensure that life cycle assessments have a key role.
2-109	Require new chemical registration, including information on fate, transport, and health effects.
2-119	Focus on upstream processes.
2-135	Enact a California Toxic Substances Control Act (CAL TSCA), which would require all new chemicals to be tested for toxicity before they are marketed, as would all existing chemicals sold in the state. DTSC with assistance from OEHHA would evaluate the results. OEHHA should be given more resources to speed up its current evaluation process and to implement CAL TSCA. ARB authority should be expanded to forbid the use of aerosol products where there are greener alternatives and ban certain toxics determined under CAL TSCA as a threat.
2-140	Leverage, not duplicate, the Security and Prosperity Agreement between US-Mexico-Canada.
2-141	Evaluate elements of EU REACH and CEPA; choose those most relevant to California.
2-143	Share data (from Canada's DSL to EU REACH) with other programs; avoid duplication; use equivalent testing systems.
2-144	Require “No data, no market idea.” Require a level playing field for all chemicals, both new and old.
2-146	Note that an available method for providing substitutions, as in EU REACH, will be important.
2-148	Adopt a phased approach for existing and new chemicals, as with CEPA.
2-150	Provide an effective stakeholder process, as Canada did.
2-151	Identify less hazardous chemicals, as Canada did.
2-180	Recognize that pre-market approval of chemicals or consumer products would be an incredibly burdensome and expensive process for the State of California and would unnecessarily slow the development of products.
2-193	Encourage company performed safety-based assessments of consumer products prior to the marketing of a product. Take into consideration the product’s life cycle.

OPTION SR-1:	***Establish statutory/regulatory requirements for the development and reporting of toxicity and exposure data, safety assessments, and follow-up actions on chemicals, products, and processes.***
2-195	Require appropriate use restrictions for chemical ingredients when scientific safety-based assessments indicate that they cannot be used safely in a consumer product or use application.
2-205	Develop requirements to obtain hazardous traits data to support a comprehensive assessment of chemical hazards for chemicals currently in use and those proposed for use.
2-207	Require companies to generate comprehensive safety and health data for all chemicals in their products by 2016. Require information for the following hazardous traits: mutagenicity and genetic toxicity; reproductive effects; developmental toxicity; cancer; immunological effects; neurological affects; organ effects, such as liver, kidney, eye, blood, and heart; respiratory effects; endocrine disruption; other disruptions of signaling and hormone systems; impacts on water and air quality and ecosystem health.
2-215	Require the use of safer substitutes for toxic chemicals when available. Require the development of non-toxic alternatives when safer substitutes are not available.
2-257	Develop an integrated program that features the following: (a) require all existing chemicals undergo a tiered process of scrutiny for their environmental, social, and health/toxicity impacts; (b) require that this information should be passed in a standard form along the supply chain; (c) require manufacturers to label consumer products with all the chemicals and materials (including nanotechnology) that these contain; (d) develop interactive consumer tools and technologies that assist consumers to interpret and use labeling data in their shopping; (e) require industry to conduct green chemistry assessments for chemical products sold or used within California; (f) expand greatly the investment of resources into green chemistry education and research at California State-supported universities, including the UC system (g) adopt a modest toxicity tax on all intermediates and chemical products used or sold within the State of California.
2-260	Place the burden of proof, when deciding if chemicals should be banned or not, on the chemical producing companies to fully disclose the chemicals in their products and to adequately demonstrate that the chemicals and products are safe. California should not fail to act in the face of uncertainty to ban chemicals suspected of toxicity. Chemical companies should be required to fund independent research of the impacts of their products, not just research conducted by their own scientists. The research should address the effects of multiple chemicals—only testing chemicals in isolation will fail to address the real world impacts. Chemicals found to be harmful to people or wildlife should be banned or phased out. Research efforts should also include the monitoring of various species, especially amphibians and upper trophic level predators, to better understand what chemicals are already present in the environment and what their impacts are. Incentives should be instituted that encourage the production and use of products that do not contain toxic chemicals.
2-285	Inform substitution decisions in terms of the characteristics and risks presented by potential alternatives.
2-291	Include measures that insure the development and incorporation of relevant, reliable, and predictive non-animal methods if toxicity testing policies or procedures are developed. These must not be limited to ICCVAM-validated methods.
2-293	Do not attempt pre-market approval of chemicals or consumer products because this would be an incredibly burdensome and unworkable process for California.

OPTION SR-1:	***Establish statutory/regulatory requirements for the development and reporting of toxicity and exposure data, safety assessments, and follow-up actions on chemicals, products, and processes.***
2-295	Base decisions affecting human health and the environment on the intrinsic hazards of a chemical and a new approach to toxicity testing.
2-296	Require that chemical manufacturers prove their products are safe.
2-298	Require that industry bear the costs associated with their chemical production or use.
2-299	Require safer alternatives to hazardous chemicals.
2-304	Create requirements to obtain scientifically defensible, full life cycle analysis data from producers to support complete chemical hazard assessment.
3-1	Develop science-based criteria for determining whether a particular product is greener or safer than alternatives.
3-7	(a) Prioritize chemicals used in commerce in California based on exposure potential and toxicity, and work to reduce exposure to the most hazardous substances. To do this, gather data regarding all chemicals manufactured in or used in commerce in California, including in what products, how and in what volumes they are used. Additional data regarding available toxicity characteristics should also be gathered for each of those chemicals. Identify gaps in toxicity and exposure data. (b) Use this data to prioritize or rank chemicals in terms of hazard as a function of toxicity and exposure. Tools for such ranking are available from other efforts such as Canada's CEPA program and USEPA. Evaluate these for use in California. Focus subsequent efforts on working with industry to find viable, safer alternatives for the highest ranked chemicals (i.e., those that pose the biggest threat in terms of toxicity and exposure). At the same time, engage industry and our university system to fill in important gaps regarding toxicity and exposure data. (c) Tap biomonitoring efforts to help fill exposure gaps. In evaluating and ranking chemicals, considerations should be given to the performance and feasibility of alternatives.
3-11	(a) Include human health and environmental considerations, performance, cost, and feasibility in evaluating alternatives materials and processes. (b) Provide positive incentives for green chemistry. (c) Use the Green Chemistry principles articulated by Anastas in evaluating alternatives.
3-34	Require responsible parties to identify the individual constituents of their products or, if that information was considered to be confidential business information, to provide the appropriate health information on their products. Require responsible parties to report new factual information regarding adverse health effects of their products or of the individual constituents of their products. Require that this information be reported to a centralized, publicly addressable database. Use the adverse effects reporting requirements for pesticides, as set forth in Section 6 (a) (2) of *the Federal Insecticide, Rodenticide, and Fungicide Act*, as a starting point.
3-35	Require chemical manufacturers, importers, and users to provide government with the structure of chemicals in use in California commerce, physicochemical properties, and all available toxicity and hazard data. Use Quantitative Structure Activity Models to evaluate exposure potential and predict toxicity where data are not yet available. Use this information in any prioritization scheme.

OPTION SR-1:	***Establish statutory/regulatory requirements for the development and reporting of toxicity and exposure data, safety assessments, and follow-up actions on chemicals, products, and processes.***
3-38	Use EU REACH program as a model and do the following: (a) Register all chemicals in commerce in California and require a summation of the chemical properties, toxicity and hazard of each in order to be registered for use. (b) Develop a list of chemicals of concern based on usage and toxicity or hazard information. (c) Register products containing these hazardous materials including imported products and publish this information. (d) Require tiered sets of toxicity information according to usage, amounts produced/imported, or other indicators of exposure. (e) Eliminate the use and/or require strict regulation of use of highly persistent or bioaccumulative chemicals, carcinogens, mutagens, reproductive toxins developmental toxins, neurotoxicants, and any other compound capable of causing serious or irreversible harm. (f) Develop models to simulate exposure scenarios for common chemicals in common products to inform decisions on chemical management.
3-39	Evaluate the best practices for chemical management schemes pointed out in the April 2007 report entitled "Not That Innocent: A comparative analysis of Canadian, European, and United States Policies on Industrial Chemicals" by Richard Denison for application to a California Green Chemicals Policy.
3-43	Develop clear criteria for prioritizing chemicals by toxicity, including aquatic toxicity. Evaluate Canada's criteria and those in EU REACH for applicability to California.
3-44	Develop clear criteria for identifying chemicals as persistent or bioaccumulative.
3-46	Evaluate what other states have done and use appropriate elements from those programs, including the Massachusetts Toxics Use Reduction Act, the Oregon Toxics Use and Hazardous Waste Reduction Act, and the Oregon Executive Order to reduce persistent and bioaccumulative toxicants.
3-52	Using data on toxicity and use, prioritize chemicals into low, medium, high, and very high concern categories. Develop clear criteria for manufacturers and users of chemicals prioritized into very high, high, medium, and low concern.
3-54	Use data from the Canadian CEPA program summaries of chemicals in their prioritization program, and any summaries that come from EU REACH program.
3-61	Consider environmental justice in setting green chemistry policy and initiatives for data requirements and analyses. Include consideration of communities bearing a disproportionate exposure to toxic chemicals in their communities and on the job.
3-66	Consider environmental justice in setting green chemistry policy and initiatives for data requirements and analyses. Include consideration of communities bearing a disproportionate exposure to toxic chemicals in their communities and on the job.
3-71	Require safer substitutes where available; use regulatory authority to require safer substitutes, including non-chemical solutions; and seek additional legal authority if necessary to do so.
3-73	Where no evidence exists for the safety of a chemical, restrict its use until safety can be comprehensively demonstrated.
3-78	Enact a California Toxic Substances Control Act, which would require all new chemicals to be tested for toxicity before they are marketed in California, and would established requirements for toxicity testing of existing chemicals.

OPTION SR-1:	***Establish statutory/regulatory requirements for the development and reporting of toxicity and exposure data, safety assessments, and follow-up actions on chemicals, products, and processes.***
3-83	Implement a modern, comprehensive chemicals policy in line with current scientific knowledge on human health, and which requires a full evaluation of the health impacts of both newly developed and existing industrial chemicals now in use.
3-95	Subject materials classified as persistent bioaccumulative toxicants, very persistent or bioaccumulative, carcinogens, mutagens, or reproductive toxicants to an environmental and human health risk assessment conducted by the producer or importer and reviewed by OEHHA.
3-99	In obtaining data to understand chemical risks, retain certain business information as confidential in order to protect intellectual capital. Health and environmental data should not be considered confidential. .
3-103	Focus assessment of chemicals on their intrinsic hazards and move away from reliance on time-consuming risk assessment methods that can be readily manipulated. Integrate the concepts of "cradle to cradle" and alternatives assessment to look for the least hazardous options in all cases. Furthermore, base these on the most sensitive criteria, such as the need to protect vulnerable human populations, endangered species, or water quality.
3-104	In weighing benefits and in analyses, consider the "externalities." These externalities include costs to communities in terms of lost wages from sick leave, health care costs, environmental degradation and the economic impacts that brings, expensive clean up actions, higher education costs due to higher rates of behavioral and developmental problems in highly exposed populations, etc.
3-129	Impose appropriate use restrictions for chemical ingredients when scientific safety-based assessments indicate they cannot be used safely in consumer product or use application..
3-138	Subject materials classified as PBT, vPvB, or CMR category 2 to risk analysis. If risk levels are judged too high, then industry should have the opportunity to introduce appropriate measures to reduce risk within a given time span, or face phase out of the material. Within a phase out strategy, the potential use of alternatives must address any risks associated with such substitution. It should not be acceptable to propose substitution by a material for which there is little data on its characteristics. Fundamentally, lack of data should not be rewarded.
3-152	Address the problem of chemicals being used in our daily lives that have not been tested for neurotoxicity in children. Include restrictions and bans on chemicals that demonstrate a hazard to our health and/or environment.
3-169	Require industry to conduct green chemistry assessments for chemical products sold or used within California. These assessments would consider whether there are green chemistry design options available and use options analysis to justify how products are designed. These assessments can be modeled on the Massachusetts TURA law but be updated greatly to reflect the combination of both products and processes. Companies currently do not generate enough decision-making information within their businesses. Registration of chemicals for marketing could be linked to the use of green chemistry design tools. If these tools have been used, then approval of the chemicals could be expedited.
3-171	Adopt a proactive approach to obtaining data needed to assess hazard traits. The current practice is for the state to consult various lists and data sources to try to track down whatever information is available to assess hazards of chemicals. The information available varies enormously, and little is available for many chemicals. The state needs to have the authority to obtain the information and test results needed to assess and characterize the hazards of chemicals.
3-181	Hold substitute chemicals to the same data requirements as the chemical(s) they are intended to replace.
3-182	Level the playing field in the green chemistry initiative and strive or consistency across-the-board.

OPTION SR-1:	***Establish statutory/regulatory requirements for the development and reporting of toxicity and exposure data, safety assessments, and follow-up actions on chemicals, products, and processes.***
3-184	Recognize, in a command and control regulatory environment, that private industry can only proceed as quickly as regulators can regulate. Time-to-market is critical in any new product launch. Delays and uncertainties increase the financial risks and reduce the initiative. California must ascertain its capability to manage whatever regulatory structure might be envisioned and begin making adjustments accordingly.
4-22	Build toxicological and exposure database on chemicals in use in California.
4-24	Ensure qualified experts develop data and identify toxics.
4-26	Prioritize chemicals of concern based both on risk and exposure.
4-27	Require testing, or submission of equivalent level of information, on materials prior to use.
4-28	Incorporate emerging toxicological issues such as endocrine disruption in the definition of toxic.
4-29	Evaluate the synergistic effects of chemicals in products.
4-44	Require responsible parties to report new factual information regarding adverse health effects of their products or of the individual constituents of their products to a centralized, publicly accessible database. The adverse effects reporting requirements for pesticides as set forth in Section 6 (a) (2) of the *Federal Insecticide, Rodenticide, and Fungicide Act*, could be used as a starting point.
4-45	Require responsible parties to identify the individual constituents of their products or, if that information is considered to be confidential business information, to provide the appropriate health information on their products.
4-49	Require multi-layered assessment of products including human and environmental impact, alternatives analysis, life cycle analysis, and multi-media impact.
4-54	Require EU REACH-like analysis, reporting, and removal of toxics in products.
4-63	Develop legislation that would require new chemicals to be tested for toxicity prior to marketing in California. Toxicity testing would also be required for existing chemicals already being used and marketed in California. The set of required toxicity tests would be developed by a group of scientists with input from California government agencies and the public. California government agencies would evaluate the results of the toxicity testing and decide whether the chemical would be marketed (new chemicals) or whether the chemical would have to be removed from the market (existing chemicals). The criteria for deciding on this "up or down" vote on a chemical would be predetermined by the group of scientists who designed the toxicity test battery, along with input from California government agencies and the public.
4-66	Develop clear criteria for prioritizing chemicals by level of concern based on a range of factors including chemical production volume and uses, exposure criteria such as persistence and bioaccumulation, and toxicological characteristics. Follow through with safety assessment and appropriate action.
4-67	Require the submission of safety data from chemical producers to address both hazard and use knowledge gaps. Start with lists already available to the state (e.g., Proposition 65 list) and set deadlines for data submission. Take action on substances of very high concern, including requiring permission for continued use of such chemicals. Include substitution planning to ensure movement toward safer and greener alternatives.
4-69	Create a map of chemical production and use in California. Show how chemicals flow into the state, who produces them, and how they are used.

OPTION SR-1:	***Establish statutory/regulatory requirements for the development and reporting of toxicity and exposure data, safety assessments, and follow-up actions on chemicals, products, and processes.***
4-75	Implement the policy that "no data means no market" meaning that chemicals for which safety data are not available are banned from sale or use.
4-78	Seek continuous improvement to achieve the "greenest" or "safest" possible results; link standards to the best, safest available technology/chemical.
4-79	Require companies operating in California to submit copies of the data and information that they submit to other jurisdictions, such as Canada pursuant to CEPA and the European Union pursuant to EU REACH.
4-80	Setup a third party (could be a government agency) that could facilitate the sharing of technologies and data among industries while guaranteeing the confidentiality of that information.
4-88	Require data requirements, analyses, and decision-making processes that: (a) Incorporate new science demonstrating the importance of low doses, as well as the significance of background exposures, synergistic effects, and the timing of exposures during the lifecycle; (b) Address the effects of cumulative exposures; (c) Provide comprehensive protection, including protecting the most vulnerable populations, endangered species, and water quality; (d) Consider environmental justice and worker impacts; and (e) Include a full cost accounting including costs to communities.
4-91	Incorporate a precautionary approach in decisions about chemical use to protect the public and environment when data are incomplete or uncertain, and therefore be based on the assumption that chemicals are unsafe unless reasonably demonstrated otherwise.
4-92	Where safer alternatives exist for hazardous chemicals, use of these alternatives should be mandated.
4-96	Carefully research and evaluate the possible unintended consequences of substituting one chemical for another.
4-102	Amend TSCA to correct the deficiencies that impede the timely and effective regulation of toxic chemicals.
4-105	When considering toxics in products, examine the entire environmental sustainability of the products, including health and environmental effects, transportation, use, disposal, efficacy, and potential benefits of use.
4-106	Focus initial regulatory efforts on the 500 high priority substances identified in Canada's program; require producers of these priority chemicals to provide hazard and exposure information. Chemicals of high concern should be allowed for targeted, low-exposure uses as determined in an open process. Include a means for adding and deleting priority chemicals based on unique California circumstances.
4-113	Avoid programs that require pre-market approval of chemicals or consumer products (i.e., modeled on programs used for pesticides and drugs) because these would be far too expensive.
4-134	If a significant risk is identified, consider a wide range of acceptable risk management options, including improving personal protective equipment and enhancing process technology controls to elimination of specific substances in favor of alternatives.

OPTION SR-1:	***Establish statutory/regulatory requirements for the development and reporting of toxicity and exposure data, safety assessments, and follow-up actions on chemicals, products, and processes.***
4-139	In pursuing the objective of the Green Chemistry Initiative to expand toxicology information on chemicals, encourage the use of alternatives to animal testing and require testing only as a last resort. Cal/EPA and the UC university system could work with other experts to provide assistance on alternative screening methodologies that can be utilized to provide adequate toxicology information for recommendations and decisions about priority chemical uses.
4-144	In assessing toxics in products, consider cumulative risks associated with multiple exposures (through using or being in proximity to multiple products).

OPTION SR-2: Establish statutory/regulatory requirements for disclosure, labeling, and certification.	
1-10	Mandate full disclosure of substances contained in products. "Green labeling" should be used with restraint.
1-38	Hold CEOs personally liable for adverse environmental and public health harm from toxic chemicals. They should also be held responsible for the veracity of information provided to the department under any new regulatory requirements.
1-40	Change state MSDS document requirements to be similar to the State of Pennsylvania MSDS requirements which are more informative than federal MSDS criteria.
1-167	The "emerging options" document contains several recommendations aimed at compliance and enforcement issues. In general, it will be difficult to enforce broad concepts of "green chemistry," largely because what constitutes "green chemistry" (or green engineering) will differ depending on the product, process, company, or industry involved. To the extent that regulatory actions are recommended by DTSC, appropriate enforcement measures will likely need to be considered. It is critical that those enforcement measures be capable of uniform application. In addition, California should address what steps might be necessary to deter false claims of "greenness" that mislead consumers and distort the market.
2-5	Require mandatory labeling and product disclosure indicating the presence and hazards of chemicals even if health data is unavailable.
2-6	Emphasize strict labeling of contents.
2-60	Develop and share production/use information (data on amounts, facility locations, and uses of chemicals; MSDS updated to include all data; consumer product contents disclosure, etc.).
2-63	Require updating of MSDS to reflect all available data (HPV, REACH, Canada).
2-64	Require disclosure of chemicals in consumer products, perhaps initially on priority chemicals.
2-70	Ensure that information is transmitted through all consumers in the supply chain.
2-212	Create labeling requirements to inform consumers of the potential health and environmental impacts of the chemicals contained in products.
2-223	Make information about chemicals to which the public and workers may be exposed more accessible, including mandatory labeling, indicating the presence of chemicals that may be hazardous.
3-5	(a) Create a labeling system that is accessible, and accurate. (b) Enable and streamline disposal of household hazardous waste (curbside pick-up or more local collection centers.), and improve the publicity of and accessibility to this disposal, and ensure safety of the collection sites. (c) Include—in education/outreach—manufacturers public disclosure of product selection and chemicals used in those products. Define and identify toxic and non-toxic chemicals in specific products, proper use, dangers of inappropriate use, and include information re; disposal. Include life cycle analysis, and impacts thereof.
3-34	Require responsible parties to identify the individual constituents of their products or, if that information was considered to be confidential business information, to provide the appropriate health information on their products. Require responsible parties to report new factual information regarding adverse health effects of their products or of the individual constituents of their products. Require that this information be reported to a centralized, publicly addressable database. Use the adverse effects reporting requirements for pesticides, as set forth in Section 6 (a) (2) of *the Federal Insecticide, Rodenticide, and Fungicide Act*, as a starting point.

OPTION SR-2: Establish statutory/regulatory requirements for disclosure, labeling, and certification.	
3-37	Generate environmental codes of practices and procedures in the development and design of products that encompass the manufacture, distribution, use, and end-disposal or recycling of the product that all manufacturers, importers, distributors, and users of products must follow. These practices could include bans of specific chemicals from consumer products.
3-69	Create labeling requirements that will inform consumers of potential health and environmental impacts of the chemicals contained in products.
4-5	Require full disclosure from suppliers.
4-7	Help establish a product safety/product liability organization to create a safety checklist and review products according to the checklist.
4-16	Develop mechanisms for improving the flow of information through the manufacturing process.
4-21	Require manufacturers/suppliers to certify the safety of the products they sell to retailers.
4-31	Scrutinize who is liable for a toxic product in the chain from manufacturing to sale and ensure there are consequences for the responsible party.
4-33	Require company accountability for out-sourcing.
4-44	Require responsible parties to report new factual information regarding adverse health effects of their products or of the individual constituents of their products to a centralized, publicly accessible database. The adverse effects reporting requirements for pesticides as set forth in Section 6 (a) (2) of the *Federal Insecticide, Rodenticide, and Fungicide Act*, could be used as a starting point.
4-45	Require responsible parties to identify the individual constituents of their products or, if that information is considered to be confidential business information, to provide the appropriate health information on their products.
4-47	Require a certificate of analysis to ensure purity.
4-48	Communicate information on suppliers providing off-specification chemicals.
4-49	Require multi-layered assessment of products including: human and environmental impact, alternatives analysis, lifecycle analysis, multimedia impact.
4-50	Require manufacturers to know what is going into products they produce.
4-101	In developing and implementing “eco-labeling,” ensure that: the analysis of the product is credible and based on scientific study; products meet agreed upon criteria and the eco-labels are not reliant on unsubstantiated claims by the producer; and an independent third party audits the eco-label.
4-111	Encourage or require manufacturers of products to communicate information about the ingredients in products, either on the package or on the Internet. Partner with the information technology sector (e.g., Internet search firms) to expand access to chemical information, support its local industry and raise awareness of chemical safety information currently available.

OPTION SR-3:	***Adopt regulatory standards for industrial processes, products, and supply chain management; establish authority for monitoring, testing, and enforcement.***
1-7	Develop and use "global approach." Work with other states, countries and multiple organizations to ensure restrictions applicable to products are applicable to imports.
1-14	Establish product safety organization or partnership with University of California to develop checklist and review new products.
1-77	Product stewardship and risk management programs that establish mechanisms to assure exposures remain in the safe region for typical uses and foreseeable misuses.
1-153	Require American Society for Testing and Materials (ASTM) Standards.
1-160	Consider whether there should be industry specific cradle to cradle standards?
1-195	Adhere to the ISO standards, so that no LCA results carried out by companies can be published unless critically reviewed by third party or published in a peer reviewed journal.
1-233	Provide safe harbors similar to medical profession for companies taking initiative in substituting ingredients.
2-20	Invest in new testing methods since many of the current testing methods are out of date or do not exist.
2-21	Provide technical expertise to organizations lacking internal resources.
2-75	Develop testing methods.
2-80	Offer R&D tax credits as an incentive for industry.
2-81	Offer tax credits for green chemistry capital investments as an incentive for industry.
2-120	Provide funding for re-tooling manufacturing.
2-156	Promote product stewardship and manufacturer responsibility, which will lead to greener products and production.
2-194	Require that companies have a chemicals management programs based on sound scientific risk assessment to protect human health and the environment.
2-269	Require that companies manufacturing in or importing chemicals to California have a management system that includes process and product safety elements and be subject to third party certification by representatives of a nationally recognized auditing board. They should affirm to the state that the management systems are in place and that third party certification has occurred.
3-102	In California's Green Chemistry Initiative, risk management efforts can involve a variety of approaches such as: substituting alternative input materials, making process changes during manufacturing, installing technological controls (e.g., pollution control equipment), requiring use of personal protective equipment, instituting a range of pollution prevention options, training, labeling, imposing various storage, transport and disposal requirements.
3-136	Require that the chemical industry or chemical importers take the responsibility to describe the environmental characteristics of their products. The financial burden of testing chemical products appropriately lies with the producer or importer. Such testing should be carried out at independent test facilities, and it may be beneficial to California to encourage the creation of such test centers within the state—either as independent entities or as part of the university system.
4-2	Improve import standards for products manufactured offshore.
4-3	Establish corporate and manufacturing codes of conduct.

OPTION SR-3:	***Adopt regulatory standards for industrial processes, products, and supply chain management; establish authority for monitoring, testing, and enforcement.***
4-4	Develop best practices for supply chain management.
4-6	Establish process and product benchmarks. Distinguish between process chemicals and product chemicals.
4-7	Help establish a product safety/product liability organization to create a safety checklist and review products according to the checklist.
4-10	Educate companies on greener alternatives and penalize companies for selling toxic items.
4-15	Government responsibility for international cooperation on imports and exports of products.
4-17	Expand and randomize government testing of food and products.
4-18	Improve enforcement for retailers and upstream.
4-19	Address the issue of how to find out what's in products from abroad.
4-20	Establish rigorous manufacturing process controls.
4-25	Review current and next generation technologies to help with product recalls.
4-30	Establish a quality assurance/quality control program for precursors and raw materials.
4-31	Scrutinize who is liable for a toxic product in the chain from manufacturing to sale and ensure there are consequences for the responsible party.
4-32	Provide assistance to small manufacturers and encourage pooling of resources to improve safeguards and quality control on inputs.
4-33	Require company accountability for out-sourcing.
4-34	Strengthen trade agreements between the state and other countries.
4-46	Strengthen relevant liability law to provide greater incentive for consumer protection from toxics in products.
4-55	Expand state testing of products to detect hidden toxics in all products and to produce a level playing field internationally—police your laws.
4-56	Develop a process for rapid removal of products found to be toxic by new studies that is fair to industry—State subsidized transformations.
4-57	Encourage the use of existing environmental management systems (e.g., ISO 14000) and work with international standards setting organizations (e.g., International Organization for Standardization) to develop green chemistry technical standards.
4-61	Establish a centralized testing laboratory for toxics in products that would accept testing requests from the public.
4-72	Increase the number of inspectors in the field for retail products and food.

OPTION SR-3:	***Adopt regulatory standards for industrial processes, products, and supply chain management; establish authority for monitoring, testing, and enforcement.***
4-110	California should expect and encourage manufacturers of consumer and commercial products sold in California to employ comprehensive product safety management systems that include: (a) Assessments to ensure the safety of products prior to marketing; (b) Rigorous control of production from raw material specifications, to formulation management, to process and quality control; (c) Safe operations that protect the health and environment of employees and the surrounding community; (d) Compliance with all applicable product safety, labeling and regulatory requirements including transportation, waste management and product disposal; (e) Constant vigilance in post market surveillance with rapid response to identified concerns; (f) Innovation that improves product performance, value and environmental quality based on life-cycle considerations; (g) Transparency in communicating information about safety management systems and products; and, (h) Ongoing evaluation and improvement of systems performance.
4-125	Establish an indemnity or hold harmless provision to enable responsible parties to test and recover products without the threat of punitive regulatory action.

OPTION SR-4: Establish statutory/regulatory measures to create economic incentives to drive green chemistry.	
1-11	Mandate a surcharge on chemicals and products to support fund to address long term environmental impacts.
1-45	Change policy to change materials flow (i.e. eliminate special tax treatment for extraction of virgin materials and subsidies for agriculture).
1-46	Tax the use of virgin materials.
1-47	Regulate mining, oil, and gas non-hazardous solid wastes under RCRA. Eliminate special tax treatment for extraction of virgin materials and subsidies.
1-48	Establish depletion quotas on extraction and import of virgin materials. Tax the production using virgin materials.
1-49	Establish requirements for product reuse, recyclability, or biodegradability.
1-50	Mandate consumer separation of materials for recycling. Establish weight or volume-based disposal fees.
1-51	Tax hard to dispose products. Establish deposit fund for packaging hazardous products.
1-52	Establish a fee rebate based on energy efficiency.
1-56	Change how we use taxes and charges. Make the individual actor pay for the full cost. For example, pro-rate based on emissions, pounds of waste disposed to encourage reuse and recycling. Include everyone, from household wastes all the way up to the big chemical companies and corporations. Establish a “Pay by the Bag" approach.
1-63	Overhaul environmental regulation to promote long-term innovation and pollution prevention. More effective economic incentives for investments in clean technologies are long overdue. Current measures of industrial productivity need to be re-conceptualized so they recognize environmental costs. And, altogether more attention needs to be paid to how clean technologies can be transferred successfully from country to country.
1-70	‘Feebate’ scheme to reward or penalize consumers of specified chemicals.
2-17	Establish regulatory framework that drives green chemistry through prohibitions, cost structures, etc. (i.e. disincentives for using practices that are not in agreement with green chemistry principles).
2-19	Lead the way with government driving demand for cleaner products through its own procurement processes.
2-54	Consider tax credits for developers and users developers of green technologies.
2-88	Develop a credible and effective third party labeling system for green products.
2-123	Include a regulatory component.
2-130	Consider tax incentives. Use a phased tax or penalty approach.
2-131	Establish a "green seal," reflecting a specified level of greenness, or certification of approval.
2-134	Use Green Buildings/LEED Certification as a model for green labeling/product certification; include the following as criteria—use of green energy during manufacturing, waste generation, use of recyclable materials, use of non-toxic ingredients.
2-139	Use environmental certification in Germany, "The Blue Angel," as a model for the certification of products and services.

OPTION SR-4: Establish statutory/regulatory measures to create economic incentives to drive green chemistry.	
3-3	Evaluate things that have worked in the past to reduce toxics in products and the environment, including gaps and opportunities; consider legislating toxic reduction efforts, such as: (a) Legislation has helped on numerous toxic reduction efforts. (b) Mandatory emissions standards for automobiles in California. This has had a tremendous impact by mandating a shift in demand allowing the auto manufactures to voluntarily comply if they want to participate in the California market. (c) Usage fees (taxes) can help to move a product's sales price closer to the total product life cycle costs (inclusive of decommissioning, disposal, clean up, associated human health care cost, and environmental rectification costs that are now born by tax payers). (d) Bottle tax gives an incentive to be environmental conscious to reduce the toxins in the waste we consumers create. (e) Cigarette tax provides a disincentive for consumption. (f) Rebates for use of preferred product purchases; for example, rebates for hybrid automobile purchases.
4-23	Develop a "green" rating system for products with agreed upon criteria.
4-94	Develop a robust framework for regulating chemicals to accompany incentives for the development of greener chemicals and technologies; voluntary programs alone are not sufficient.

OPTION SR-5: Mandate extended producer responsibility and other regulatory measures to control the waste stream.	
1-21	Foster "Reduce Energy/ Resource Consumption" through take back programs.
1-29	Need responsible producer management at end-of-life.
1-34	Design with intent of end-of-life: (a) Manufacturer take back (b) Producer responsibility with idea of economic change of design (c) Facilitate COUGE recycling (d) Design to be biodegradable (e) Design to last
1-53	Tighten regulation of waste management at RCRA facilities.
1-236	Make producers assume responsibility for the safe stewardship of their materials in order to promote environmental sustainability. Producers should be responsible for collection through processing/disposal, financially and operationally, with no cost to local government.
1-237	Shift the responsibility for the end-of-life management of discarded materials from local government to private industry producers, through extended producer responsibility (EPR). Incorporate the costs of product collection, recycling, and disposal into product price, and thereby encourage product design that has a reduced impact on the environment and human health. The results are products and product chains that have a reduced impact on the environment and that costs associated with a product's impact are paid by those manufacturing or using the product, rather than general taxpayers.
2-35	Donate reusable computers to reduce e-waste.
2-38	Collect mercury added thermostats.
2-40	Water quality: sewage sludge.
1-195	Adhere to ISO standards, so that no LCA results carried out by companies can be published unless critically reviewed by third party or published in a peer-reviewed journal.
2-211	Require chemical producers to complete a full life-cycle analysis of products to foster cradle to cradle management.
2-213	Make companies that make or sell products in the state containing hazardous chemicals take them back at the end of their life cycle and ensure their proper disposal.
2-298	Require that industry bear the costs associated with their chemical production or use.
2-308	Extend producer responsibility to placing the burden of end of life disposal, including sustainable practices such as recycling.
3-37	Generate environmental codes of practices and procedures in the development and design of products that encompass the manufacture, distribution, use, and end-disposal or recycling of the product that all manufacturers, importers, distributors, and users of products must follow. These practices could include bans of specific chemicals from consumer products.
3-17	Mandate toxics reduction in lighting waste.
3-22	E-waste: personal computers.
3-40	Work with industry to reduce toxics in products, and where that proves difficult because no safe alternative exists, California should require product take-back at no cost to the consumer. This shifts the physical and financial responsibility away from local governments and consumers back to the product manufacturer.

OPTION SR-5: Mandate extended producer responsibility and other regulatory measures to control the waste stream.	
3-41	Ban the export of toxic products and waste to developing countries as they lack the infrastructure to handle these materials.
3-47	Promote chemical reclamation and recycling technology to reduce chemical waste, which in turn reduces chemical manufacture.
3-48	Require mandatory take-back for unused pharmaceuticals.
3-49	Ban the export of hazardous waste to developing countries.
3-74	Develop regulations to require extended producer responsibility including take-back of hazardous materials, recycling of materials and use of less toxic materials. California can look at the Green Dot program in Europe as a model.
3-117	Do not allow exporting waste that is causing great harm overseas. Develop closed-loop, safe, and just ways of handling our waste, including recyclable plastics. The current model of exporting plastic to countries such as China needs to be stopped if California is serious about its Green Chemistry Initiative.
3-185	Note that there are numerous opportunities to reclaim process streams that may require refining (i.e. distillation, filtration, etc) prior to recycling the material back into the same process. The Chemical Industry Council of California and DTSC have embarked on a partnership to promote voluntary pollution prevention and reduce waste. CICC is eager to work with DTSC to implement regulations allowing more flexibility for generators to reclaim streams onsite without having to go through tiered permitting or Part B Permit. CICC recommends that we work collaboratively with DTSC to fix this problem and reduce waste generation.
4-140	Acknowledge that plastic is "downcyclable" not "recyclable." Plastic needs to be looked at with a cradle-to-cradle perspective, which requires a close look at what is happening overseas. California needs to develop closed-loop safe and just ways of handling our waste. The current model of exporting plastic to countries such as China needs to be stopped if California is serious about its Green Chemistry Initiative.

OPTION SR-6:	***Consider a broad range of sustainability, social, economic, and other factors associated with the life cycle of a product, in addition to human and environmental impacts, in chemical management decisions.***
1-8	Factor environmental, societal, environmental justice, and economics into decisions.
1-15	Use "precautionary principle" shift burden to industry.
1-17	Standardize terminology and definitions to promote the necessary and real change towards creating more sustainable, social and environmental solutions.
1-75	Recognize that the question is not just, "How do we control toxic substances?", but also how do we successfully manage both toxicity and exposure—risk—while providing the solutions society needs?
1-78	Ensure that laws and regulations: (a) Are science-based; (b) Balance potential risks with benefits; (c) Factor in existing scientific knowledge as well as reasonable uncertainties; and (d) Consider the degree of risk to people and the environment.
1-79	Find a way to successfully manage both toxicity and exposure (i.e., risk) while providing the solutions California needs.
1-88	Require that conclusions or recommendations in policies be carefully written and explicitly qualified to limit their perceived and actual applicability to those settings for which information has been provided and deemed sufficient to warrant the conclusion or recommendation. Furthermore, the degree of uncertainty associated with a conclusion or recommendation should be stated and should reflect the extent of exposure information available. Lastly, policies should ensure that in the absence of good exposure information, exposure should be assumed possible or likely.
1-111	Focus more on what people are exposed to in the real world.
1-112	Focus more on products and the chemicals in products, which get little attention.
1-165	Note that "Green Chemistry" is not just about substitution of one hazard for another; it is ultimately about the reduction of risks to health and the environment that are otherwise unmanaged. A risk reduction policy seems to be a much better approach to accounting for the economic, social, health, and environmental dimensions of green chemistry, particularly because by definition it will address not only inherent toxicity (hazard), but potential exposures as well. Perhaps most importantly, a risk reduction policy (one that addresses both hazard and exposure) correlates very well with the pollution prevention policies that have been at the heart of many existing DTSC programs, and can serve as a meaningful focal point in encouraging the development of sustainable chemistry, green engineering, and products that improve the lives of Californians and the State environment
1-166	Establish a process by which statewide priorities can be identified, where existing and new risk reduction measures—spanning the entire spectrum from research and financial incentives to regulation—can be appropriately assessed, and where the relative benefits and impacts of the approach can be evaluated. In short, a risk reduction policy provides an important and appropriate organizing principle for DTSC's "Green Chemistry" recommendations.
1-175	Prioritize toxic chemicals according to risk in a practical, objective, and transparent manner using sound science.

OPTION SR-6:	***Consider a broad range of sustainability, social, economic, and other factors associated with the life cycle of a product, in addition to human and environmental impacts, in chemical management decisions.***
1-201	Note that successful management of chemicals already in the marketplace according to their characteristics and actual uses, rather than simply banning substances. This focus recognizes the important difference between risk and hazard, i.e., that hazardous substances properly managed may not pose actual risks, and would create a system that is based on successful management of identified risks, as opposed to establishing prohibitions based on potential hazard.
1-202	Use prohibitions only when an unacceptable level of risk is identified that cannot be adequately mitigated or that is not offset by the aggregate benefits of continued use. This approach is science-based, and relies on data generated through experimentation or by means of modeling (structure-activity relationships).
1-203	Ensure that any chemicals management system is risk-based.
1-211	Base decisions of preference and substitution on the comparative life cycle impacts of a chemical and its potential substitute. While a safety-based characterization scheme may focus on toxicity, persistence, and bioaccumulation, there are a number of other parameters that are relevant to the sustainable use of a particular chemical in a formulation such as raw material sourcing and carbon footprint. All relevant aspects of sustainability should be taken into consideration for a potential substitution decision. Similarly, any plan to consider substitution of chemicals should require that the efficacy and benefits of that compound be considered as any diminution of efficacy may negatively impact public health and well being through reduced hygiene and sanitation.
1-212	Ensure that product efficacy, performance, and usability are not undermined, and that the ability to innovate is not compromised.
2-158	Note that all toxicity in chemicals cannot be eliminated. Trade-offs must be identified through life cycle analysis.
2-219	Reduce impacts of chemical exposure on the most highly impacted communities, e.g., developmentally vulnerable; communities bearing a disproportionate exposure to toxic chemicals; and workers exposed to toxic chemicals on the job
2-220	Use full cost accounting when making decisions regarding chemical use and management including not only research and development but also the cost to communities of a degraded environment, health care, economic decline, education for developmentally impacted children, environmental clean-up, disposal of toxic materials, worker exposures and lost work days, and even premature death
2-233	Shift the burden of proof of safety to the manufacturer, which overturns the presumption of innocence for any chemical.

OPTION SR-6:	***Consider a broad range of sustainability, social, economic, and other factors associated with the life cycle of a product, in addition to human and environmental impacts, in chemical management decisions.***
2-257	Develop an integrated program that features the following: (a) require all existing chemicals undergo a tiered process of scrutiny for their environmental, social, and health/toxicity impacts; (b) require that this information should be passed in a standard form along the supply chain; (c) require manufacturers to label consumer products with all the chemicals and materials (including nanotechnology) that these contain; (d) develop interactive consumer tools and technologies that assist consumers to interpret and use labeling data in their shopping; (e) require industry to conduct green chemistry assessments for chemical products sold or used within California; (f) expand greatly the investment of resources into green chemistry education and research at California State-supported universities, including the UC system (g) adopt a modest toxicity tax on all intermediates and chemical products used or sold within the State of California.
2-260	Place the burden of proof, when deciding if chemicals should be banned or not, on the chemical producing companies to fully disclose the chemicals in their products and to adequately demonstrate that the chemicals and products are safe. California should not fail to act in the face of uncertainty to ban chemicals suspected of toxicity. Chemical companies should be required to fund independent research of the impacts of their products, not just research conducted by their own scientists. The research should address the effects of multiple chemicals—only testing chemicals in isolation will fail to address the real world impacts. Chemicals found to be harmful to people or wildlife should be banned or phased out. Research efforts should also include the monitoring of various species, especially amphibians and upper trophic level predators, to better understand what chemicals are already present in the environment and what their impacts are. Incentives should be instituted that encourage the production and use of products that do not contain toxic chemicals.
2-266	When evaluating alternatives to existing flame retardant chemicals, address affordability issues also.
2-280	Weigh risk against benefit, not just hazard, in the decision making process on any chemical.
2-296	Require that chemical manufacturers prove their products are safe.
3-10	(e) Prioritize protection of most vulnerable people and resources. For example, get information on exposures of children to harmful substances through toxics in products, and seek changes to reduce or eliminate these toxics. Focus on consumer products with lots of exposure potential. This needs a regulatory action. (f) Look for initial easy fixes by integrating existing programs that have identified actual sources of pollutants. (g) Drive the demand for cleaner products through state procurement practices. (h) Designate the Occupational and Environmental Health at UC Berkeley and UCLA as lead entities within the UC system to address research relevant to green chemistry and chemicals policy in California.
3-40	Work with industry to reduce toxics in products, and where that proves difficult because no safe alternative exists, California should require product take-back at no cost to the consumer. This shifts the physical and financial responsibility away from local governments and consumers back to the product manufacturer.
3-70	Take early action on bad actor chemicals directed toward eliminating impacts to the most sensitive populations including vulnerable humans and ecosystems/species.

OPTION SR-6:	***Consider a broad range of sustainability, social, economic, and other factors associated with the life cycle of a product, in addition to human and environmental impacts, in chemical management decisions.***
3-73	Where no evidence exists for the safety of a chemical, restrict its use until safety can be comprehensively demonstrated.
3-104	Consider “externalities” when weighing benefits. Externalities include: costs to communities in terms of lost wages from sick leave, health care costs, environmental degradation and the economic impacts that brings, expensive clean up actions, higher education costs due to higher rates of behavioral and developmental problems in highly exposed populations, etc.
3-108	While a safety-based characterization scheme may focus on toxicity, persistence, and bioaccumulation, there are a number of other parameters that are relevant to the sustainable use of a particular chemical in a formulation such as raw material sourcing and carbon footprint. All relevant aspects of sustainability should be taken into consideration for a potential substitution decision.
3-112	Develop database of chemical alternatives that compares a number of sustainability parameters: performance, price, human health and environmental (e.g., toxicity, bioaccumulation, persistence) including carbon footprint and source sustainability.
3-140	Conduct studies of why specific chemistries are being used in terms of industrial structures and histories. Regulatory standards or established industry practices can actually exacerbate the creation of risks. Flammability standards have encouraged the use of brominated flame retardants; companies often simply use specific chemicals in manufacturing because they are accustomed to doing so and their technologies and ordering systems are built on the chemicals.
3-149	While the focus has been on chemical safety, incorporate an accounting of embedded energy, carbon dioxide impact, water usage, packaging, recyclability and so forth. Industry on the whole is already moving toward a greater consideration of these factors in our practices. The difficulty of quantifying and ascribing relative importance to these factors points to the need for commonly held practices or industry standards.
3-152	Address the problem of chemicals being used in our daily lives that have not been tested for neurotoxicity in children. Include restrictions and bans on chemicals that demonstrate a hazard to our health and/or environment.
3-157	Change our current, risk-based method of policy making, which limits the scope of chemical evaluation and puts people in harm’s way before allowing the government to make chemical regulations. The only groups who benefit from "risk management" are chemical suppliers—they don’t have to run toxicity tests or report their findings, they don’t have to report quantities or end uses of potentially toxic substances, and they have no incentive to update manufacturing methods or reformulate, as that always comes with some monetary cost. They need markets and incentives to design better products, but will not comply without preventative regulation in place.
3-179	Note that too much emphasis has been placed in prior year on reducing exposure (risk) and too little emphasis on reducing toxicity (hazard). The transition movement within the chemical in industry, however, has begun. Emphasis on a transition to hazard reduction (i.e. green chemistry)is and will continue to build. However, GCI needs to forthrightly acknowledge that elimination of all toxicity through chemical substitution is not possible. At best there will always be tradeoffs, which will need to be evaluated via life cycle analysis (LCA) methodologies.
4-91	Incorporate a precautionary approach in decisions about chemical use to protect the public and environment when data are incomplete or uncertain, and therefore be based on the assumption that chemicals are unsafe unless reasonably demonstrated otherwise.

OPTION SR-6:	***Consider a broad range of sustainability, social, economic, and other factors associated with the life cycle of a product, in addition to human and environmental impacts, in chemical management decisions.***
4-105	For toxics in products, examine the entire environmental sustainability of the products, including health and environmental effects, transportation, use, disposal, efficacy, and potential benefits of use.
4-126	Reconsider the proposed bedding standard (TB 604), which may result in a large increase in the use of toxic flame retardants, in light of green chemistry principles. Evaluate the public health and environmental impacts of the increased use of toxic flame retardants.
4-137	In implementing the green chemistry initiative, look at the chemical information that is already available. Make it clear that the Green Chemistry Initiative process will be governed by a risk-based science approach. Support an understanding of both the benefits and the burdens of new regulatory proposals. Consider process technology as part of a green chemistry program.

OPTION SR-7:	***Eliminate the use of hazardous chemicals by prohibiting their use, replacing them with alternatives found to be preferable, or establishing pre-market approval requirements.***
1-30	Rethink the processes for allowing chemicals into the market.
1-54	Rethink the processes for allowing chemicals into the market.
1-202	Use prohibitions only when an unacceptable level of risk is identified that cannot be adequately mitigated or that is not offset by the aggregate benefits of continued use. This approach is science-based, and relies on data generated through experimentation or by means of modeling (structure-activity relationships).
1-144	Recognize that substitutions may change the nature of the problem rather than solve it.
1-145	Mandatory bans and forced substitutions often are not a complete solution because, as one issue is addressed, another set of concerns may arise. This is the difference between "informed substitution" and "regrettable substitution," with the goal of "informed substitution" being to avoid "regrettable substitution." For example, the health and convenience of our lives has been greatly enhanced by modern refrigeration. Refrigerators originally used ammonia, a toxic chemical, as a coolant. As scientific discoveries were made, chlorofluorocarbons (CFCs) replaced ammonia. While CFCs are practically non-toxic, they were later implicated in depleting the ozone layer and eventually banned. CFCs were then replaced with hydrochlorofluorocarbons (HFCs), which have no impact on the ozone layer, are non-flammable, have low toxicity, and high energy efficiencies. Scientists have now learned that HFCs could contribute to global warming if released into the air. Alternative coolants such as hydrocarbons and carbon dioxide have been considered, but both need to be carefully examined because of the potential for emissions and the possible dangers from higher operating pressures.
1-147	Note that substitutions may result in unintended adverse consequences.
1-148	Recognize that substitution is not the only viable approach to control risk.
1-165	"Green Chemistry" is not just about substitution of one hazard for another; it is ultimately about the reduction of risks to health and the environment that are otherwise unmanaged. A risk reduction policy seems to be a much better approach to accounting for the economic, social, health, and environmental dimensions of green chemistry, particularly because by definition it will address not only inherent toxicity (hazard), but potential exposures as well. Perhaps most importantly, a risk reduction policy (one that addresses both hazard and exposure) correlates very well with the pollution prevention policies that have been at the heart of many existing DTSC programs, and can serve as a meaningful focal point in encouraging the development of sustainable chemistry, green engineering, and products that improve the lives of Californians and the State environment
1-211	Base decisions of preference and substitution on the comparative life cycle impacts of a chemical and its potential substitute. While a safety-based characterization scheme may focus on toxicity, persistence, and bioaccumulation, there are a number of other parameters that are relevant to the sustainable use of a particular chemical in a formulation such as raw material sourcing and carbon footprint. All relevant aspects of sustainability should be taken into consideration for a potential substitution decision. Similarly, any plan to consider substitution of chemicals should require that the efficacy and benefits of that compound be considered as any diminution of efficacy may negatively impact public health and well-being through reduced hygiene and sanitation.
1-213	Develop a database of chemical alternatives that compares a number of sustainability parameters: performance, price, human health and environmental (e.g., toxicity, bioaccumulation, persistence) including carbon footprint and source sustainability.
2-16	Remove known chemical hazards from the market immediately via Proposition 65, Silent Spring/Harvard study, tax incentives, etc.

OPTION SR-7:	***Eliminate the use of hazardous chemicals by prohibiting their use, replacing them with alternatives found to be preferable, or establishing pre-market approval requirements.***
2-32	Prohibit diacetyl.
2-34	Ban incandescent lamps.
2-36	Prohibit polystyrene containers.
2-117	Develop criteria for determining safe alternatives, including multi-media considerations; identify and publicize safe alternatives.
2-144	Adopt "No data, no market" idea, which will level the playing field for all chemicals, both new and old.
2-146	Find an available method for providing substitutions, as in EU REACH.
2-151	Identify less hazardous chemicals, as Canada did.
2-157	Note that data and the lack or unavailability of data is a major issue: (a) Data represents great value to the developer, in terms of resources, time, and opportunity for market advantage; (b) Data is intellectual property, confidential business property that must be protected; (c) Data gap will always exist; (d) Must prioritize chemicals for additional testing and must consider exposure, as well as hazard and how chemical will be used, in characterizing data needed; (e) Substitute chemicals must meet same data requirements as the chemicals that they are replacing.
2-158	Note that all toxicity in chemicals cannot be eliminated. Trade-offs must be identified through life cycle analysis.
2-193	Encourage company performed safety-based assessments of consumer products prior to the marketing of a product, that take into consideration all of the phases of a product's life-cycle.
2-214	Take immediate action to reduce or eliminate the use of chemicals that are toxic, bioaccumulative, and persistent.
2-215	Require the use of safer substitutes for toxic chemicals when available. Require the development of non-toxic alternatives when safer substitutes are not available.
2-216	Phase-out chemicals that harm the health of humans or the environment or whose impacts are unknown.
2-234	Require that, without data, you cannot market the product. This levels the playing field for all chemicals both new and old.
2-259	Prohibit the import, sale, or use of certain recreational vehicle toilet additives containing formaldehyde and derivatives of formaldehyde.

OPTION SR-7:	***Eliminate the use of hazardous chemicals by prohibiting their use, replacing them with alternatives found to be preferable, or establishing pre-market approval requirements.***
2-260	Place the burden of proof, when deciding if chemicals should be banned or not, on the chemical producing companies to fully disclose the chemicals in their products and to adequately demonstrate that the chemicals and products are safe. California should not fail to act in the face of uncertainty to ban chemicals suspected of toxicity. Chemical companies should be required to fund independent research of the impacts of their products, not just research conducted by their own scientists. The research should address the effects of multiple chemicals—only testing chemicals in isolation will fail to address the real world impacts. Chemicals found to be harmful to people or wildlife should be banned or phased out. Research efforts should also include the monitoring of various species, especially amphibians and upper trophic level predators, to better understand what chemicals are already present in the environment and what their impacts are. Incentives should be instituted that encourage the production and use of products that do not contain toxic chemicals.
2-266	Address affordability issues when evaluating alternatives to existing flame retardant chemicals.
2-285	Inform substitution decisions in terms of the characteristics and risks presented by potential alternatives.
2-293	Do not attempt pre-market approval of chemicals or consumer products because this would be an incredibly burdensome and unworkable process.
2-297	Phase-out or restrict hazardous chemicals and chemicals with inadequate safety data.
2-299	Require safer alternatives to hazardous chemicals.
2-302	Act quickly to eliminate or restrict known chemicals for which we already have adequate data demonstrating that they cause serious harm from use in California and require safer alternatives when available.
2-311	Implement protective regulations, including restrictions and bans on chemicals for which the weight of evidence demonstrates a severe hazard to human health and/or the environment.
2-313	Recognize that we are being exposed to far too many chemicals in our daily environment and many of us are getting sick. It is especially necessary to get them out of commercial cleaning products that are used everywhere, from stores to doctor's offices and even hospitals.
3-1	Develop science-based criteria for determining whether a particular product is greener or safer than alternatives.
3-2	(a) Develop criteria for appropriate use of cosmetic pesticides and consider banning inappropriate use and (b) Ban the most toxic cosmetic pesticides via legislation/regulation; possibly create monetary incentives for new homebuilders to substitute non-toxic chemicals in landscaping or create more sustainable landscaping designs (i.e., drought tolerant landscaping, water conservation, plants indigenous to the region, etc).
3-7	Tap biomonitoring efforts to help fill exposure gaps. In evaluating and ranking chemicals, considerations should be given to the performance, and feasibility of alternatives.
3-8	Ban the use of single-use polystyrene and other plastic/non-biodegradable polymer materials in order to protect the natural environment for present and future generations, exercise environmental stewardship by reducing the amount of polystyrene and other non-biodegradable polymeric substances that enters our waste stream, storm drains, watershed and coastal environment.

OPTION SR-7:	***Eliminate the use of hazardous chemicals by prohibiting their use, replacing them with alternatives found to be preferable, or establishing pre-market approval requirements.***
3-10	(a) Prioritize protection of most vulnerable people and resources. For example, get information on exposures of children to harmful substances through toxics in products, and seek changes to reduce or eliminate these toxics. Focus on consumer products with lots of exposure potential. This needs a regulatory action. (b) Look for initial easy fixes by integrating existing programs that have identified actual sources of pollutants. (c) Drive the demand for cleaner products through state procurement practices. (d) Designate the Occupational and Environmental Health at UC Berkeley and UCLA as lead entities within the UC system to address research relevant to green chemistry and chemicals policy in California.
3-11	(a) Include human health and environmental considerations, performance, cost, and feasibility in evaluating alternative materials and processes. (b) Provide positive incentives for green chemistry. (c) Use the Green Chemistry principles articulated by Anastas in evaluating alternatives.
3-13	Remove hazardous substances from electronic devices.
3-14	Adopt work standards for diacetyl.
3-15	Ban brominated and chlorinated fire retardants.
3-16	Prohibit the use of phthalates in children's products.
3-17	Reduce toxics in lighting waste.
3-18	Reduce lead content in drinking water pipes and fittings.
3-19	Reduce hazardous packaging.
3-20	Prohibit products containing diacetyl.
3-21	Prohibit PBDE chemicals.
3-53	Work with major users of chemicals of very high and high concern to reduce or eliminate their use of these chemicals in their products.
3-71	Require safer substitutes where available; use regulatory authority to require safer substitutes, including non-chemical solutions, and seek additional legal authority if necessary to do so.
3-72	Ban hazardous chemicals over time with a robust phase-out program including specific timelines by which users/producers must comply.
3-78	Enact a California Toxic Substances Control Act which would require all new chemicals to be tested for toxicity before they are marketed in California, and would established requirements for toxicity testing of existing chemicals.
3-79	Increase funding for OEHHA to evaluate alternative chemicals to determine whether alternatives pose an unacceptable risk.
3-93	If we are going to promote green chemistry, then let's do it! A glass-bead product for highway markings from China is available and for a cheaper price, but you also could get significant levels of lead and arsenic in the product as a result. Another glass-bead product is domestically produced and does not contain dangerous levels of these heavy metals.

OPTION SR-7:	***Eliminate the use of hazardous chemicals by prohibiting their use, replacing them with alternatives found to be preferable, or establishing pre-market approval requirements.***
3-94	Use prohibitions of chemicals only when an unacceptable level of risk is identified that cannot be adequately mitigated or is not offset by benefits of the chemical..
3-102	In California's Green Chemistry Initiative, risk management efforts can involve a variety of approaches such as: substituting alternative input materials, making process changes during manufacturing, installing technological controls (e.g., pollution control equipment), requiring use of personal protective equipment, instituting a range of pollution prevention options, training, labeling, imposing various storage, transport and disposal requirements.
3-108	While a safety-based characterization scheme may focus on toxicity, persistence, and bioaccumulation, recognize that there are a number of other parameters which are relevant to the sustainable use of a particular chemical in a formulation such as raw material sourcing and carbon footprint. All relevant aspects of sustainability should be taken into consideration for a potential substitution decision.
3-112	Develop database of chemical alternatives that compares a number of sustainability parameters: performance, price, human health and environmental (e.g., toxicity, bioaccumulation, persistence) including carbon footprint and source sustainability.
3-138	Subject materials classified as PBT, vivo, or CMR category 2 to risk analysis. If risk levels are judged too high, then industry should have the opportunity to introduce appropriate measures to reduce risk within a given time span, or face phase out of the material. Within a phase out strategy, the potential use of alternatives must address any risks associated with such substitution. It should not be acceptable to propose substitution by a material for which there is little data on its characteristics. Fundamentally, lack of data should not be rewarded.
3-152	Address the problem of chemicals being used in our daily lives that have not been tested for neurotoxicity in children. Include restrictions and bans on chemicals that demonstrate a hazard to our health and/or environment.
3-176	Recognize that the industry itself will not focus on or develop alternatives unless there is a regulation. This results in a “chicken and egg” problem and the chemicals and products that pose problems continue to be used, exposing workers, people in the surrounding communities and consumers. An important feature of this model program should be the work on alternatives. It is important to use or establish independent entities with detailed technical knowledge and experience, to find, develop, test, and demonstrate viable and cost effective alternatives. The industries using the candidate chemicals or products must work with the independent entities to test potential alternatives. The health and environmental characteristics of the potential alternatives must be investigated and the alternatives must be safer than the original chemicals and products they will replaces
3-179	Note that too much emphasis has been placed in prior year on reducing exposure (risk) and too little emphasis on reducing toxicity (hazard). The transition movement within the chemical in industry, however, has begun. Emphasis on a transition to hazard reduction (i.e. green chemistry)is and will continue to build. However, GCI needs to forthrightly acknowledge that elimination of all toxicity through chemical substitution is not possible. At best, there will always be tradeoffs, which will need to be evaluated via life cycle analysis (LCA) methodologies.
3-181	Hold substitute chemicals to the same data requirements as the chemical(s) they are intended to replaces.

OPTION SR-7:	***Eliminate the use of hazardous chemicals by prohibiting their use, replacing them with alternatives found to be preferable, or establishing pre-market approval requirements.***
4-63	Develop legislation that would require new chemicals to be tested for toxicity prior to marketing in California. Toxicity testing would also be required for existing chemicals already being used and marketed in California. The set of required toxicity tests would be developed by a group of scientists with input from California government agencies and the public. California government agencies would evaluate the results of the toxicity testing and decide whether the chemical would be marketed (new chemicals) or whether the chemical would have to be removed from the market (existing chemicals). The criteria for deciding on this "up or down" vote on a chemical would be predetermined by the group of scientists who designed the toxicity test battery, along with input from California government agencies and the public.
4-67	Require the submission of safety data from chemical producers to address both hazard and use knowledge gaps. Start with lists already available to the state (e.g., Proposition 65 list) and set deadlines for data submission. Take action on substances of very high concern, including requiring permission for continued use of such chemicals. Include substitution planning to ensure movement toward safer and greener alternatives.
4-68	Develop criteria for low, medium, and high hazard chemicals. Publish lists of chemicals meeting these criteria to encourage movement away from high hazard chemicals and innovation toward low hazard chemicals.
4-75	Implement the policy that "no data means any market" meaning that chemicals for which safety data are not available are banned from sale or use.
4-85	Phase-out chemicals that harm human health or the environment or whose impacts are unknown.
4-92	Where safer alternatives exist for hazardous chemicals, mandate the use of these alternatives.
4-93	Do not wait to take immediate action while developing a sound, long-term chemicals policy. Chemicals currently in use that are known to be unsafe should be restricted or eliminated.
4-96	Carefully research and evaluate the possible unintended consequences of substituting one chemical for another.
4-113	Avoid programs that require pre-market approval of chemicals or consumer products (i.e., modeled on programs used for pesticides and drugs) because these would be far too expensive.
4-127	Ban the sale and use of certain products (e.g., toilet additives) that contain formaldehyde or other similar biocides and require the use of safer substitutes (e.g., bacterial or enzyme based additives).
4-130	Avoid banning in the absence of safer alternatives, which should be technically feasible, improve health/safety/environmental profile, be of comparable or superior performance, cost-effective, and be capable of persistence. If safer alternatives are not available, resources should be devoted to R&D or incentives should be provided to develop cost-effective alternatives.
4-132	Use the collaboration between industry, state government, and a third party expert in identifying solvent substitutes under SB 14 as a model. Take the following approach: 1) consider chemicals of top priority concern, 2) identify the specific applications or industry uses posing the greatest risk from those chemicals, and 3) apply a collaborative process of agency, industry and third-party experts to identify or develop viable alternatives that can maintain efficacy, but reduce risk in those targeted applications.
4-134	If a significant risk is identified, consider a wide range of acceptable risk management options, including improving personal protective equipment and enhancing process technology controls to elimination of specific substances in favor of alternatives.

OPTION SR-7:	***Eliminate the use of hazardous chemicals by prohibiting their use, replacing them with alternatives found to be preferable, or establishing pre-market approval requirements.***
4-135	Prioritize the evaluation and mitigation of toxic hazards in products that are widely used and already have known safer substitutes, such as commercial cleaning products.
4-141	Create a database on alternatives that compares a number of sustainability parameters: performance, price, human health and environmental (e.g., toxicity, bioaccumulation, persistence) including carbon footprint and source sustainability.

OPTION SR-8: Take immediate actions to prohibit or restrict the use of known hazardous substances	
1-19	Develop regulations to phase-out use of substances known to pose added risks and environmental harm.
1-144	Note that substitutions may change the nature of the problem rather than solve it.
1-145	Recognize mandatory bans and forced substitutions often are not a complete solution because, as one issue is addressed, another set of concerns may arise. This is the difference between "informed substitution" and "regrettable substitution," with the goal of "informed substitution" being to avoid "regrettable substitution." For example, the health and convenience of our lives has been greatly enhanced by modern refrigeration. Refrigerators originally used ammonia, a toxic chemical, as a coolant. As scientific discoveries were made, chlorofluorocarbons (CFCs) replaced ammonia. While CFCs are practically non-toxic, they were later implicated in depleting the ozone layer and eventually banned. CFCs were then replaced with hydrochlorofluorocarbons (HFCs), which have no impact on the ozone layer, are non-flammable, have low toxicity, and high energy efficiencies. Scientists have now learned that HFCs could contribute to global warming if released into the air. Alternative coolants such as hydrocarbons and carbon dioxide have been considered, but both need to be carefully examined because of the potential for emissions and the possible dangers from higher operating pressures.
1-146	Note that substituting one material for another is never as simple or straightforward as it might at first appear, i.e. mercury containing light bulbs.
1-147	Understand that substitutions may result in unintended adverse consequences.
2-16	Remove known chemical hazards from the market immediately, via Proposition 65, Silent Spring/Harvard study, tax incentives, etc.
2-32	Prohibit diacetyl.
2-34	Ban incandescent lamps.
2-36	Prohibit polystyrene containers.
2-37	Address marine debris via reduction and recycling.
2-87	Prioritize chemicals that should be restricted.
2-114	Until the Green Chemistry Initiative is operational, do not oppose legislative or other efforts to restrict exposures to toxic chemicals.
2-214	Take immediate action to reduce or eliminate the use of chemicals that are toxic, bioaccumulative, or persistent.
2-201	Ban non-refillable refrigerant cylinders to service air conditioning systems. This would eliminate the emission of greenhouse gases remaining in disposable containers when they are discarded. Also, it would save millions of pounds of steel and thousands of cubic yards of landfill space each year.
2-202	Require commercial dry cleaners to use carbon dioxide (CO_2) systems in place of perchlorethlyene ("perc") systems they now use.
2-203	Replace cutting oils and biocides in metal shops with CO_2, which is an excellent coolant and lubricant.
2-216	Phase-out chemicals that harm the health of humans or the environment or whose impacts are unknown.
2-259	Prohibit the import, sale, or use of certain recreational vehicle toilet additives containing formaldehyde and derivatives of formaldehyde.

OPTION SR-8: Take immediate actions to prohibit or restrict the use of known hazardous substances	
2-260	Place the burden of proof, when deciding if chemicals should be banned or not, on the chemical producing companies to fully disclose the chemicals in their products and to adequately demonstrate that the chemicals and products are safe. California should not fail to act in the face of uncertainty to ban chemicals suspected of toxicity. Chemical companies should be required to fund independent research of the impacts of their products, not just research conducted by their own scientists. The research should address the effects of multiple chemicals—only testing chemicals in isolation will fail to address the real world impacts. Chemicals found to be harmful to people or wildlife should be banned or phased out. Research efforts should also include the monitoring of various species, especially amphibians and upper trophic level predators, to better understand what chemicals are already present in the environment and what their impacts are. Incentives should be instituted that encourage the production and use of products that do not contain toxic chemicals.
2-297	Phase-out or restrict hazardous chemicals and chemicals with inadequate safety data.
2-302	Act quickly to eliminate or restrict known chemicals for which we already have adequate data demonstrating that they cause serious harm from use in California and require safer alternatives when available.
3-1	Develop science-based criteria for determining whether a particular product is greener or safer than alternatives.
3-2	(a) Develop criteria for appropriate use of cosmetic pesticides and consider banning inappropriate use and (b) Ban the most toxic cosmetic pesticides via legislation/regulation; possibly create monetary incentives for new homebuilders to substitute non-toxic chemicals in landscaping or create more sustainable landscaping designs (i.e., drought tolerant landscaping, water conservation, plants indigenous to the region, etc).
3-8	Ban the use of single-use polystyrene and other plastic and non-biodegradable polymer materials in order to protect the natural environment for present and future generations, exercise environmental stewardship by reducing the amount of polystyrene and other non-biodegradable polymeric substances that enters our waste stream, storm drains, watershed and coastal environment.
3-11	(a) Include human health and environmental considerations, performance, cost, and feasibility in evaluating alternative materials and processes. (b) Provide positive incentives for green chemistry. (c) Use the Green Chemistry principles articulated by Anastas in evaluating alternatives.
3-13	Remove hazardous substances from electronic devices.
3-14	Adopt work standards for diacetyl.
3-15	Ban brominated and chlorinated fire retardants.
3-16	Prohibit the use of phthalates in children's products.
3-17	Reduce toxics in lighting waste.
3-18	Reduce lead content in drinking water pipes and fittings.
3-19	Reduce hazardous packaging.
3-20	Prohibit products containing diacetyl.
3-21	Prohibit PBDE chemicals.
3-23	Establish emission limits for composition wood treated with formaldehyde.
3-25	Prohibit toxic packaging materials.

OPTION SR-8: Take immediate actions to prohibit or restrict the use of known hazardous substances	
3-36	Impose restrictions on amounts of hazardous chemicals in products that are released to the environment over the life of the product. California could require elimination of certain compounds known to be hazardous from products, such as carcinogens, mutagens, reproductive toxicants, developmental toxicants, and chemicals that are persistent and bioaccumulative.
3-52	Using data on toxicity and use, prioritize chemicals into low, medium, high, and very high concern categories. Develop clear criteria for manufacturers and users of chemicals prioritized into very high, high, medium, and low concern.
3-53	Work with major users of chemicals of very high and high concern to reduce or eliminate their use of these chemicals in their products.
3-70	Take early action on bad actor chemicals directed toward eliminating impacts to the most sensitive populations including vulnerable humans and ecosystems/species.
3-72	Ban hazardous chemicals over time with a robust phase-out program including specific timelines by which users/producers must comply.
3-94	Use prohibitions of chemicals only when an unacceptable level of risk is identified that cannot be adequately mitigated or is not offset by benefits of the chemical.
3-95	Subject materials classified as persistent bioaccumulative toxicants, very persistent or bioaccumulative, carcinogens, mutagens, or reproductive toxicants to an environmental and human health risk assessment conducted by the producer or importer and reviewed by OEHHA.
3-138	Subject materials classified as PBT, vPvB, or CMR category 2 to risk analysis. If risk levels are judged too high, then industry should have the opportunity to introduce appropriate measures to reduce risk within a given time span, or face phase out of the material. Within a phase out strategy, the potential use of alternatives must address any risks associated with such substitution. It should not be acceptable to propose substitution by a material for which there is little data on its characteristics. Fundamentally, lack of data should not be rewarded.
4-1	Assess chemicals within the context of alternatives. Criteria for better or worse green products should be clear.
4-56	Develop a process for rapid removal of products found to be toxic by new studies that is fair to industry—state subsidized transformations.
4-85	Phase-out chemicals that harm human health or the environment or whose impacts are unknown.
4-93	Do not wait to take immediate action while developing a sound, long-term chemicals policy. Chemicals currently in use that are known to be unsafe should be restricted or eliminated.
4-127	Ban the sale and use of certain products (e.g., toilet additives) that contain formaldehyde or other similar biocides and require the use of safer substitutes (e.g., bacterial or enzyme based additives).
4-130	Avoid bans in the absence of safer alternatives, which should be technically feasible, improve health/safety/environmental profile, be of comparable or superior performance, cost-effective, and be capable of persistence. If safer alternatives are not available, resources should be devoted to research and development. Or, incentives should be provided to develop cost-effective alternatives.
4-131	Exclude novel R&D chemicals, used in relatively tiny amounts in highly controlled settings, from any consideration of a restriction or mandate. Exemptions should also be allowed for select pilot demonstrations and testing.

OPTION SR-9:	***Reduce or restrict the use of hazardous substances through use reduction measures, standards setting, process or engineering changes, and product stewardship initiatives.***
1-24	Do not focus exclusively on chemicals in products and chemical inputs. Manufacturing and production processes using chemicals should also receive attention in order to address health and safety concerns of workers - and to address community concerns for inherent safety of chemical-using or producing facilities.
1-77	Ensure that product stewardship and risk management programs have mechanisms to assure exposures remain in the safe region for typical uses and foreseeable misuses.
1-169	Provide education regarding the broad scope of “green chemistry” includes “green engineering,” and that it is not limited to simplistic hazard substitution. Moreover, a concerted effort to disseminate appropriate information on the accomplishments, best practices, costs, and benefits of “green chemistry” would help assure that all interested stakeholders understand the concept and limitations of the approach. Health and safety information should never be considered proprietary or confidential information.
1-201	The successful management of chemicals already in the marketplace according to their characteristics and actual uses, rather than simply banning substances. This focus recognizes the important difference between risk and hazard, i.e., that hazardous substances properly managed may not pose actual risks, and would create a system that is based on successful management of identified risks, as opposed to establishing prohibitions based on potential hazard.
2-27	Identify priority chemicals for toxics use reduction and create a list as targets for toxics use reduction.
2-29	Require businesses that use large quantities of toxic chemicals to annually report on the quantities of toxic chemicals used, and prepare and biennially update toxics use reduction plans.
2-30	Survey California businesses to provide information regarding each facility it owns or operates in the state, the full-time equivalent number of employees at that facility, and whether a listed substance is manufactured, processed, or otherwise used in a facility. The total quantity used statewide should be established as a baseline against which toxics use reduction progress can be measured.
2-37	Reduce marine debris via reduction and recycling.
2-72	Adopt an expansive view of green chemistry that includes not only substitutes, but also processes, "designing" molecules, and addressing all potential exposures.
2-87	Prioritize chemicals that should be restricted.
2-194	Require that companies have a chemicals management programs based on sound scientific risk assessment to protect human health and the environment.
2-195	Require appropriate use-restrictions for chemical ingredients when scientific safety-based assessments indicate that they cannot be used safely in a consumer product or use application.
2-196	Promote consumer awareness of the importance of reading and following label instructions for safe product use, storage, and disposal.
2-214	Take immediate action to reduce or eliminate the use of chemicals that are toxic, bioaccumulative, and persistent.
2-269	Require that companies that manufacture chemicals in or import chemicals into California have a management system that includes process and product safety elements and be subject to third party certification by representatives of a nationally recognized auditing Board. They should affirm to the state that the management systems are in place and that third party certification has occurred.

OPTION SR-9:	***Reduce or restrict the use of hazardous substances through use reduction measures, standards setting, process or engineering changes, and product stewardship initiatives.***
2-311	Implement protective regulations, including restrictions and bans on chemicals for which the weight of evidence demonstrates a severe hazard to human health and/or the environment.
3-2	(a) Develop criteria for appropriate use of cosmetic pesticides and consider banning inappropriate use. (b) Ban the most toxic cosmetic pesticides via legislation/regulation; possibly create monetary incentives for new home builders to substitute non-toxic chemicals in landscaping or create more sustainable landscaping designs (i.e., drought tolerant landscaping, water conservation, plants indigenous to the region, etc).
3-14	Adopt work standards for diacetyl.
3-17	Reduce toxics in lighting waste.
3-23	Establish emission limits for composition wood treated with formaldehyde.
3-27	Utilize any useful information developed by USEPA Design for the Environment program and work with industry and businesses to implement elements. These include: (a) Evaluate the human health and environmental impacts of its processes and products. (b) Identify what information is needed to make human health and environmental decisions (e.g., hazard characteristics data and identification of "safer" alternatives). (c) Consider cross-media impacts and the benefits of substituting chemicals. (d) Reduce the use and release of toxic chemicals through the innovation of cleaner technologies that use safer chemicals. (e) Reduce the use and release of toxic chemicals through the innovation of cleaner technologies that use safer chemicals. (f) Make products that can be more readily reused, refurbished, remanufactured, or recycled. (g) Monitor the environmental impacts and costs associated with each product or process. (h) Recognize that although change can be rapid, in many cases a cycle of evaluation and continuous improvement is needed. Partnerships with UC and CSUS could help implement these objectives. Incentives for applying these as core business practices might also help.
3-36	Consider imposing restrictions on amounts of hazardous chemicals in products that are released to the environment over the life of the product. California could require elimination of certain compounds known to be hazardous from products, such as carcinogens, mutagens, reproductive toxicants, developmental toxicants, and chemicals that are persistent and bioaccumulative.
3-38	Use EU REACH program as a model and do the following: (a) Register all chemicals in commerce in California and require a summation of the chemical properties, toxicity and hazard of each in order to be registered for use. (b) Develop a list of chemicals of concern based on usage and toxicity or hazard information. (c) Register products containing these hazardous materials including imported products and publish this information. (d) Require tiered sets of toxicity information according to usage, amounts produced/imported, or other indicators of exposure. (e) Eliminate the use and/or require strict regulation of use of highly persistent or bioaccumulative chemicals, carcinogens, mutagens, reproductive toxins developmental toxins, neurotoxicants, and any other compound capable of causing serious or irreversible harm. (f) Develop models to simulate exposure scenarios for common chemicals in common products to inform decisions on chemical management.

OPTION SR-9:	***Reduce or restrict the use of hazardous substances through use reduction measures, standards setting, process or engineering changes, and product stewardship initiatives.***
3-40	Work with industry to reduce toxics in products, and where that proves difficult because no safe alternative exists, California should require product take-back at no cost to the consumer. This shifts the physical and financial responsibility away from local governments and consumers back to the product manufacturer.
3-53	Work with major users of chemicals of very high and high concern to reduce or eliminate their use of these chemicals in their products.
3-73	Where no evidence exists for the safety of a chemical, restrict its use until safety can be comprehensively demonstrated.
3-102	In California's Green Chemistry Initiative, risk management efforts can involve a variety of approaches such as: substituting alternative input materials, making process changes during manufacturing, installing technological controls (e.g., pollution control equipment), requiring use of personal protective equipment, instituting a range of pollution prevention options, training, labeling, imposing various storage, transport and disposal requirements.
3-118	Establish a program to identify, assess, and manage priority chemicals based on an evaluation of hazard and potential for exposure. Move quickly by leveraging priorities identified in the Canadian Chemical Management Plan. Create a collaborative effort between California and Canada to accelerate progress in both geographies. Include a means for adding and deleting priority chemicals based on unique California circumstances. Leverage the recently assembled U.S. Inventory Update report to provide initial volume, use and exposure information. Identify uses and user industries for the high priority chemicals that raise the greatest concern. Expect producers of priority chemicals and manufacturers with high concern uses to provide hazard and exposure information on those chemicals/uses to the program. Provide the agency with authority and a due process to establish restrictions for uses of priority chemicals that have unacceptable risks.
3-128	Include process technology considerations as alternative chemistry is being evaluated. This technology can have a significant impact on minimizing potential adverse health or environmental effects of a chemical substance. Process technology can reduce both human and environmental exposures to chemicals, for example, through enclosed systems, recycling of by-products, and controlling potential environmental releases. Use of these process technologies can eliminate the need for substitution of critical raw materials.
3-129	Impose appropriate use restrictions for chemical ingredients when scientific safety-based assessments indicate they cannot be used safely in consumer product or use application..
3-134	Work with scientific experts to examine best practices and to develop a toolkit for safety assessment programs and for safety assessments. Companies also could make a description of their safety assessment process available on the Internet. This could help provide context for product ingredient communication.
3-138	Subject materials classified as PBT, vPvB, or CMR category 2 to risk analysis. If risk levels are judged too high, then industry should have the opportunity to introduce appropriate measures to reduce risk within a given time span, or face phase out of the material. Within a phase out strategy, the potential use of alternatives must address any risks associated with such substitution. It should not be acceptable to propose substitution by a material for which there is little data on its characteristics. Fundamentally, lack of data should not be rewarded.
3-139	Provide incentives to develop products with improved characteristics, e.g. non-PBT or polymeric chemical additives. Similarly, improved stewardship, such as driven by the BFR industry's Voluntary Emission Control Action Program (VECAP) should be encouraged and rewarded.
4-12	Identify specific industry sectors that generate the most toxic products and identify green production and processing for those sectors.

OPTION SR-9:	***Reduce or restrict the use of hazardous substances through use reduction measures, standards setting, process or engineering changes, and product stewardship initiatives.***
4-78	Seek continuous improvement to achieve the "greenest" or "safest" possible results; link standards to the best, safest available technology/chemical.
4-93	Do not wait to take immediate action while developing a sound, long-term chemicals policy. Chemicals currently in use that are known to be unsafe should be restricted or eliminated.
4-108	Provide Cal/EPA with the statutory authority to establish restrictions on uses of priority chemicals.
4-110	California should expect and encourage manufacturers of consumer and commercial products sold in California to employ comprehensive product safety management systems that include: (a) Assessments to ensure the safety of products prior to marketing; (b) Rigorous control of production from raw material specifications, to formulation management, to process and quality control; (c) Safe operations that protect the health and environment of employees and the surrounding community; (d) Compliance with all applicable product safety, labeling and regulatory requirements including transportation, waste management and product disposal; (e) Constant vigilance in post market surveillance with rapid response to identified concerns; (f) Innovation that improves product performance, value and environmental quality based on life-cycle considerations; (g) Transparency in communicating information about safety management systems and products; and, (h) Ongoing evaluation and improvement of systems performance.
4-134	If a significant risk is identified, consider a wide range of acceptable risk management options, including improving personal protective equipment and enhancing process technology controls to elimination of specific substances in favor of alternatives.
4-137	In implementing the green chemistry initiative, look at the chemical information that is already available. Make it clear that the Green Chemistry Initiative process will be governed by a risk-based science approach. Support an understanding of both the benefits and the burdens of new regulatory proposals. Consider process technology as part of a green chemistry program.
4-142	In addressing toxics in products by accident, identify a few key product areas, and work with the affected industry sectors to either promote existing standards (and many such standards already exist) or develop new ones.

OPTION SR-10: Expand the regulatory authority and funding for state programs.	
1-35	Develop a database of ingredients used in consumer products similar to the Skin Deep database that is currently available for cosmetics. In order to ensure accuracy, California would need the regulatory authority to regulate consumer products and to require disclosure of ingredients in consumer products.
1-119	Increase the budget for state agencies responsible for evaluating human and ecological risk, i.e. OEHHA.
1-163	Adopt the output of the Canadian Chemical Management Plan (based on Canada's categorization and prioritization of the existing chemical inventory) as a solid, scientifically sound foundation.
1-164	Take advantage of the August 2007 Montebello Agreement between the US, Canada, and Mexico, which will result in significant chemical evaluation work being completed in a relatively short timeframe. Use the upcoming work to be conducted by the US, Canada, and Mexico. This would clearly allow DTSC to save time and resources, while advancing the protection of health and the environment. It would also allow DTSC to be viewed as a global leader in integrating the Montebello evaluation outcomes into its own process.
1-168	Do not wait for the conclusion of the CGCI to engage in discussions with USEPA and the Canadian government on how the State can coordinate with and leverage those programs in support of the CGCI.
1-227	As part of the agreement signed in Montebello, the three countries agreed to share data, information and safety assessments so that all North Americans would have continued access to safe and effective products with improved sustainability and environmental quality profiles. With California's expertise at the table, collaborating with the agencies involved could accelerate the benefits of this effort across the North American region.
1-244	Assure sufficient funding is available to conduct the necessary process steps that lie ahead.
2-31	Establish fees on businesses that use toxic chemicals. Such fees should be used to fund agency toxics use reduction activities, including data analysis, and the provision of technical assistance.
2-122	Consider a bond act to provide funding.
2-135	Enact a California Toxic Substances Control Act (CAL TSCA), which would require all new chemicals to be tested for toxicity before they are marketed, as would all existing chemicals sold in the State; DTSC with assistance from OEHHA would evaluate the results. OEHHA should be given more resources to speed up its current evaluation process and to implement CAL TSCA. ARB authority should be expanded to forbid the use of aerosol products where there are greener alternatives, and of certain toxics determined under CAL TSCA as a threat.
2-167	Re-establish funding for Technology Development staff to review and validate the green chemistry/ green engineering performance claims made by companies seeking economic incentives in the form of grants, low interest revolving loans, and preferred equity funding – without the certification component. Look at USEPA Design for the Environment program.
2-178	Avoid California-specific data development requirements and pre-market approval process for chemicals or consumer products. Rather, DTSC should collaborate with other government efforts, such as Canada's Chemicals Management Plan and the Montebello Agreement between Mexico, Canada, and the US.
2-182	Ensure that chemicals regulated by other agencies are not subject to duplicative reporting and/or contradictory regulation.
2-274	Adopt the output of the Canadian Chemical Management Plan (based on Canada's categorization and prioritization of the existing chemical inventory) as a solid, scientifically sound foundation for a California program.

OPTION SR-10: Expand the regulatory authority and funding for state programs.	
3-50	Create legislation that includes chemicals used in personal care products under DTSC authority. Partner with Europeans who have been working on this.
3-79	Provide more funding for OEHHA to evaluate alternative chemicals to determine whether alternatives pose an unacceptable risk.
3-80	Expand ARB authority to apply to other types of products, not just aerosolized products, which would increase the ability to forbid the use of certain toxic chemicals in consumer products.
3-97	Expand ARB authority to apply to other types of products, not just aerosolized products, which would increase the ability to forbid the use of certain toxic chemicals in consumer products.
3-188	Re-establish program funding for DTSC Science Pollution Prevention and Technology Development group to review and validate the green chemistry/ green engineering performance claims made by companies seeking economic incentives in the form of grants, low interest revolving loans, and preferred equity funding.
3-189	Begin an immediate effort to ramp-up state capability for life cycle analysis (LCA). Unquestionably, one cannot envision competency in cradle-to-cradle techniques without enhanced in-house LCA capability.
4-64	Expand the budget of OEHHA to speed the evaluation of toxicity test results and determination of whether particular chemicals pose an unacceptable risk.
4-65	Grant greater regulatory authority and flexibility to ARB to regulate whole consumer product types and establish regulations based on the characteristics of existing safer and greener alternatives (e.g., allow ARB to establish VOC limits for aerosol deodorant and antiperspirant products based on the low or no VOC content of existing roll-on substitutes, effectively forbidding the use of aerosol products when a roll-on alternative is available).
4-72	Increase the number of inspectors in the field for retail products and food.
4-74	Build technical capacity in state agencies such as OEHHA in the use of QSAR (quantitative structure activity relationship) models; review and consider how these methods can be applied in identifying chemicals of concern as well as safer alternatives.
4-108	Provide Cal/EPA with the statutory authority to establish restrictions on uses of priority chemicals.

OPTION SR-11: Coordinate and harmonize laws and regulatory requirements with the federal government, other states, and other countries.	
1-7	Develop and use a "global approach." Work with other states, countries, and multiple organizations to ensure restrictions applicable to products are applicable to imports.
1-13	Realign and leverage with existing federal, state, and local mandated reporting activities to avoid duplication and waste of resources.
2-1	Harmonize chemical policy worldwide; avoid creating its unique requirements.
2-2	Harmonize state law with other states and countries.
2-8	Perform a comprehensive gap analysis at the outset to avoid duplicative and possibly contradictory regulatory actions (e.g. laws, existing databases, inventories, etc.).
2-9	Compile a comprehensive list of all reports that must be filed with federal, state, and local agencies, including the information and data submission requirements for each; determine whether current reports provide sufficient baseline information, and if additional information should be obtained.
2-46	Do not impede discovery through unnecessary legislation and regulation.
2-90	Harmonize its program with other leaders.
2-104	Streamline regulations.
2-124	Do not reinvent the process, as a whole new process could have a negative effect; study the Canadian list, EU REACH, and others to determine their usefulness and validity.
2-140	Leverage the Security & Prosperity Agreement between US-Mexico-Canada, not duplicate.
2-141	Evaluate elements of EU REACH and CEPA and choose those most relevant to California.
2-147	Collaborate with different agencies; government agencies should work together, as with in Canadian system.
3-39	Evaluate best practices for chemical management schemes pointed out in the April 2007 report entitled "Not That Innocent: A comparative analysis of Canadian, European, and United States Policies on Industrial Chemicals" by Richard Denison for application to a California Green Chemicals Policy.
3-42	Coordinate across agencies for a comprehensive green chemistry program and smooth implementation.
3-46	Evaluate what other states have done and utilize appropriate elements from those programs, including the Massachusetts Toxics Use Reduction Act, the Oregon Toxics Use and Hazardous Waste Reduction Act, and the Oregon Executive Order to reduce persistent, bioaccumulative, and toxicants.
3-65	Establish partnerships with states to create an interstate clearing house of environmental health and safety data.
3-92	Note that the US, Canada, and Mexico have now agreed to a program to screen thousands of chemicals to see if further research is necessary to protect human health. Follow work already being done in Canada prioritizing chemicals based on whether they show strong evidence of persistence, bioaccumulation, and toxicity. USEPA has ongoing projects with the domestic chemical industry to gather data about large volume chemicals and fill in necessary information gaps. California should piggy-back any new chemical policy onto these programs rather than try to create its own testing agenda.

OPTION SR-11: Coordinate and harmonize laws and regulatory requirements with the federal government, other states, and other countries.	
3-119	Organize this overall effort in a collaborative approach involving chemical producers, targeted users/industries, the agency and appropriate academic and other 3rd party experts. Engage with USEPA and the recently announced Canada-US-Mexico Montebello Agreement to avoid duplication and expedite action on priority chemicals in California and throughout North America..
3-125	Incorporate the work that will be developed as a result of the Montebello Agreement between the United States, Canada, and Mexico. The environmental agencies of the three companies will coordinate efforts to advance chemical assessment and management in North America.
3-132	Join and share expertise are part of the Montebello agreement to share data and assessments so that all North Americans would have continued access to safe and effective products with improved sustainability and environmental quality profiles.
3-151	Evaluate what regulations and information are currently available and whether these tools are being appropriately implemented and applied prior to developing new programs. Indeed, we expect this analysis is already underway, pursuant to the mandate to conduct a "baseline assessment" of existing programs and information described in the April 20 memorandum from Secretary Linda Adams announcing the Green Chemistry Initiative.
3-153	Build chemical data development efforts on existing statutory and regulatory structures, voluntary initiatives, and data development efforts, and collaboration by California in ongoing work by other government agencies to assess chemicals and consumer products. Leverage efforts by Health and Environment Canada in addressing priority chemicals in the Chemicals Management Plan. California could also participate in the Security and Prosperity Partnership (SPP) under the Montebello Agreement involving trilateral cooperation among the governments of Canada, the United States and Mexico to share chemical information and safety assessments.
3-158	Conduct a detailed, comprehensive assessment of existing chemical toxicity reporting and data availability programs and ensure access to those data as applicable to California. Assurances of some measure of formulation confidentiality would encourage producers and manufacturers to make toxicity and use data available.
3-167	Establish a California-specific chemical evaluation process to identify uses of concern for priority chemicals that were not on the original CEPA categorization process or that will not be addressed under the Montebello Agreement in the timeframe required. The process should utilize a tiered approach, in which chemicals and their uses are prioritized for further evaluation. The process should also utilize risk-based screening and should focus on potential "data needs" versus "data gaps". Producers and users of identified priorities should be engaged in a collaborative process to bring hazard, use and exposure information to improve decision-making. As California proceeds with its process, it should leverage information already generated or that will be generated under regulatory or voluntary chemical evaluation programs. California must be transparent in the processes used to make risk evaluation and risk management decisions.
3-177	Consider all existing programs that regulate chemicals. As each of these specific program elements and specific data requirements is evaluated for purpose and benefit, a shorter list can be compiled of specific program elements that should be examined more closely. Additionally, gaps in programs that could lead to exposures that could give rise to unacceptable levels of risk should also be noted. The objective of this review is to focus further efforts on those topics where risks are not now managed at an acceptable level.
4-62	Make a baseline assessment of chemical information that is already available to the state.
4-81	Negotiate a data sharing agreement between the state (likely through Cal/EPA) and the European Union so that the state can access the data submitted under EU REACH.

OPTION SR-11:	***Coordinate and harmonize laws and regulatory requirements with the federal government, other states, and other countries.***
4-83	Evaluate whether the agencies that implement EU REACH and CEPA could be identified as authoritative bodies under Proposition 65 so that the information generated under these programs could be directly used by California to identify chemicals as known to cause cancer or reproductive/developmental toxicity.
4-103	Assess opportunities to enhance the level of cooperation and coordination between Cal/EPA and USEPA, and with international agencies.
4-136	Participate in the effort launched in August during the Security and Prosperity Partnership (SPP) with under the Montebello Agreement involving trilateral cooperation among the governments of Canada, the United States and Mexico to share chemical information and safety assessments.

OPTION SR-12: Establish metrics to assess the effectiveness of chemical management strategies implemented.	
1-214	In order to assess the performance of these programs and measure the impact of these reforms, monitor metrics that will assess releases of chemicals to the environment and exposure to humans.
1-123	Develop and adopt green chemistry performance indicators and metrics with a commitment to transparency and proactive responses to new information. This would provide a method for evaluating the success of green chemistry measures and whether changes are needed.
1-178	Develop and adopt green chemistry progress metrics with a commitment to transparency and proactive response to new information on any risk or benefit posed by chemicals.
1-234	Develop metrics and demonstrate cost-effectiveness, long-term benefits, health impacts, environmental impacts, etc.

Chapter 4—Voluntary Measures Options

Advancing green chemistry through non-regulatory approaches

SYNOPSIS

Given the complexity of many of today's environmental challenges, effective environmental policy often draws upon a variety of tools and approaches—from voluntary to the mandatory actions. A comprehensive green chemistry policy could be formulated using a combination of these tools, which include economic incentives, information, technical assistance, command-and-control approaches, and voluntary programs. At the same time, stakeholders questioned whether voluntary measures were sufficient, some offering criticism and others suggesting voluntary measures be balanced by mandated requirements.

Voluntary measures to develop chemical information, reduce chemical use, and find safer substitutes were mentioned often by stakeholders as part of the Conversation with California. They proposed 48 discrete options for non-regulatory approaches that could advance green chemistry. These are organized here into two main categories: (1) those that call for an evaluation of existing programs that could serve as models for California and (2) other options that were more specific, primarily involving public-private partnerships. Voluntary measures represented roughly 3% of the total number of comments submitted.

BACKGROUND

There are a number of voluntary programs in place, both in government and industry, which reduce chemical use or encourage the use of safer chemicals. Voluntary or non-regulatory approaches can:

- Help reduce program implementation costs for government;
- Allow a greater degree of flexibility and motivation for innovation; and,
- Accelerate achievement of desired outcomes.

An exhaustive review of existing voluntary programs for environmental protection was not conducted during the Conversation with California. Rather, participants highlighted those programs that they thought are relevant to a particular green chemistry topic in their detailed comments. Within Cal/EPA, several programs seek environmental improvement through cooperative, non-regulatory means; these include:

- Pollution prevention: DTSC works with selected industry sectors each year to develop and implement pollution prevention programs. These programs include best practices, waste reduction, self-monitoring, and other actions which businesses in a given sector can take. Similar programs administered by USEPA (Design for the Environment, High Production Volume Challenge, and other programs), the military, and others were also highlighted.

- Technology advancement: The California Energy Commission, ARB, CIWMB, and other state departments collaborate with research institutions, federal agencies, and industry—generally through joint funding arrangements—to develop, test, and use better technologies. These programs, while small, focus strategically on innovative processes

and equipment that is more energy and resource efficient and more effective in controlling pollution.

DISCUSSION OF OPTIONS

OPTION VM-1: Evaluate existing voluntary programs that can serve as models for the California Green Chemistry Initiative.

Many businesses have put processes in place to screen chemicals prior to use in products and in manufacturing processes. Participants pointed out that businesses are interested in ensuring the safety of their products and their workplaces. During the "Conversation with California," a number of individuals and companies described some of the voluntary programs related to green chemistry.

Several stakeholders felt California should identify, evaluate, and encourage existing voluntary programs, both in the private and government sectors. They listed chemical and product stewardship, safety, and environmental programs in private industry. For example, several commenters noted the American Chemistry Council's Responsible Care program, which includes evaluations of chemical products and their uses to assure that they deliver their intended benefits while protecting public health and the environment, and a management system certified by third-party auditors. At the federal level, USEPA has promoted green chemistry and sustainability through its voluntary programs recently, as have industry groups. DTSC's Pollution Prevention program has operated for nearly a decade as a voluntary program aimed at reducing hazardous waste and offering safer chemical substitutes to large and small business sectors.

More specifically, stakeholders wrote that California should recognize the value and role of industry stewardship programs, and create incentives or otherwise encourage these and other entities to resume or adopt these programs. Participants suggested that California could identify voluntary programs, including the:

- American Chemical Council Responsible Care Program,[20/]
- joint USEPA-industry High Production Volume Challenge Program,
- American Chemical Society Green Chemistry Institute,
- Consumer Specialty Products Association's Product Care program, and
- BFR Voluntary Emission Control Action Program.

Participants recommended that the State review their effectiveness and determine whether one or more of these programs can serve as models green chemistry. As part of this evaluation, they said, the state could survey California businesses to determine what strategies they use to implement environmental management systems. An advisory panel of business and industry representatives could be convened to provide input to this assessment. Voluntary measures could be part of an overall strategy, along with other regulatory measures where necessary.

OPTION VM-2: Encourage Public-Private Partnerships among Government, Universities, and Industry, and between Industries and Manufacturers.

Many stakeholders strongly urged California to promote and encourage partnerships and other forms of collaboration between government and industry, between manufacturers, and even between international concerns.

We received both general and specific advice on how to encourage collaboration. Some stakeholders urged working directly with major users of chemicals of high concern to eliminate or reduce the use of these chemicals in their products, while others suggested encouraging public and private partnerships across disciplines and institutions to develop greener products and ingredients. This was echoed by a suggestion that government, industry, and third party experts work together to identify or develop viable alternatives that will sustain efficacy but reduce risk in their targeted applications.

One stakeholder proposed tapping federal programs, such as the USEPA Design for the Environment program, for useful information to be shared with California's industries, possibly establishing partnerships with the University of California and the California State universities to help implement "design for the environment" principles. Several stakeholders advocated that California collaborate with Canada and their Chemicals Management Program as well as participate in the Security and Prosperity Partnership (SPP) under the Montebello Agreement.

Some stakeholders offered very specific advice on collaboration, such as:

- Work with scientific experts to develop a toolkit for safety and chemical assessment programs;
- Encourage companies to work together to identify "beyond MSDS" information needs along the supply chain, and establish processes to communicate those needs;
- Work with industries to provide consumers with ingredient information;
- Provide assistance to small manufacturers and encourage pooling of resources;
- Develop international technology exchanges;
- Work with other state agencies to develop and share information on green purchasing;
- Partner with the University of California to review new products;
- Expand education and training programs through partnerships with industry; and
- Partner with other states to create an interstate clearing house of environmental safety and health data.

Some voluntary measures that were mentioned included 'mentoring' ideas, where companies with established chemical use reduction or safer alternatives programs could share their experiences and assist smaller or other companies that are not so far along in implementation. Finally, one stakeholder proposed establishing a Green Chemistry Coordination Council to collect and promote the sharing of information, highlight businesses with green practices, provide assistance to businesses lacking resources, and educate consumers.

OPTION VM-3: The Debate—Voluntary, Regulatory, or Both?

Underlying much of the discussion in the Conversation with California was the question whether using safer chemicals and chemical manufacturing processes could be achieved by voluntary measures (including incentives such as recognition and economic incentives) or whether California should adopt a regulatory framework to attain green chemistry goals.

Some stakeholders adamantly argued against regulation, supporting rather innovation through incentives and partnerships. Others argued for a balance between the two approaches. The same stakeholder, for example, who proposed recognition for early adaptors and outstanding achievements in green chemistry, also recommended this be complemented with regulatory measures to meet public expectations for safe chemical management. Similarly, another stakeholder called for voluntary collaboration with regulatory clout to eliminate or minimize hazards while simultaneously promoting innovation and substitution.

Direct criticism of voluntary measures was also stated. Using the USEPA High Production Volume challenge as an example, commenters maintained that, because the program is voluntary, USEPA and others have very limited ability to gain high quality or complete data from industry—even after identifying deficiencies in what industry has submitted. Some stakeholders noted that voluntary measures may only affect a small fraction of all consumer products or businesses. They pointed out that consumers will still be able to buy many unsafe products, or products for which little health or environmental information is available, and that non-participating businesses will still be able to use and release highly toxic chemicals.

CHAPTER TEAM

The following Green Chemistry team staff members served as principal editors for this chapter:

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Jesse Schnell, DTSC

The team compiled each of the comments relating to voluntary measures for green chemistry. They organized the comments that stakeholders made during the Conversation with California. The chapter team worked closely with the overall team, whose members are given in the Acknowledgements. The references for each of the three major options summarized in this chapter are presented in the next section of this report.

REFERENCES

The tables below cross-reference each option to Appendix B. The figures shown in the first column represent the "challenge area" and the option number.

OPTION VM-1: Evaluate existing voluntary programs that can serve as models for the California Green Chemistry Initiative.	
1-21	Foster "Reduce Energy/ Resource Consumption" through take back programs.
2-13	Identify voluntary programs (USEPA Industry HPV Challenge Program, etc.), program requirements, number of participants, sectors represented and effectiveness.
2-14	Survey a statistically significant sample of California businesses to determine if they have adopted strategies or programs to implement environmental management systems; convene a chemical business and industry stakeholder or advisory panel.
2-98	Recognize the value and role of industry stewardship programs (e.g., American Chemistry Council's Responsible Care, which includes evaluations of chemical products and their uses to assure that they deliver their intended benefits while protecting public health and the environment, and a management system certified by third-party auditors). Create incentives for others to take similar steps.
3-27	Utilize any useful information developed by USEPA Design for the Environment program and work with industry and businesses to implement elements. These include: (a) Evaluate the human health and environmental impacts of its processes and products. (b) Identify what information is needed to make human health and environmental decisions (e.g., hazard characteristics data and identification of "safer" alternatives). (c) Consider cross-media impacts and the benefits of substituting chemicals. (d) Reduce the use and release of toxic chemicals through the innovation of cleaner technologies that use safer chemicals. (e) Reduce the use and release of toxic chemicals through the innovation of cleaner technologies that use safer chemicals. (f) Make products that can be more readily reused, refurbished, remanufactured, or recycled. (g) Monitor the environmental impacts and costs associated with each product or process. (h) Recognize that although change can be rapid, in many cases a cycle of evaluation and continuous improvement is needed. Partnerships with UC and CSUS could help implement these objectives. Incentives for applying these as core business practices might also help.
3-139	Provide incentives to develop products with improved characteristics, e.g. non-PBT or polymeric chemical additives. Similarly, improved stewardship, such as driven by the BFR industry's Voluntary Emission Control Action Program (VECAP), should be encouraged and rewarded.
3-165	Recognize and encourage product stewardship programs, which are designed for better management of the supply chain and continually minimize a chemical's impact.
4-95	Review the Consumer Specialty Products Association's Product Care program as a model stewardship program in which consumer and institutional specialty product companies have agreed to go beyond government regulations in emphasizing health.
4-97	Review the ACC Responsible Care program as a model for reducing potential hazards which includes a rigorous EHS&S management system that is certified by third-party auditors.

OPTION VM-2:	***Encourage public/private partnerships among government, universities, and industry, and between industries and manufacturers.***
1-2	Develop a partnership with academia and establish a research program.
1-9	Foster outreach and education through partnerships to stakeholders.
1-14	Establish a product safety organization or partnership with the University of California to develop a checklist for review new products.
1-82	Look at other industries and partnership (e.g. the military "green munitions" program) in order to make information and tools available for green chemistry.
1-116	Encourage greater collaboration and partnership across disciplines and institutions to increase overall knowledge. For example, consider the model of how pharmaceutical companies make decisions on which chemicals are too hazardous to pursue.
2-41	Look at the Pollution Prevention (P2): Design for the Environment Program.
2-55	Examine ways to expand education and training programs for students and chemists through partnerships with industry.
2-67	Collaborate with the University of California, state agencies, and industry.
2-111	Create a partnership between state government, industry, the public, etc.
2-147	Collaborate with different agencies, i.e. government agencies should work together, as in the Canadian system.
2-184	Develop pilot applications in close collaboration with key stakeholders to test various green chemistry policy options.
2-197	Support collaborative efforts to encourage public and private partnerships to develop "greener" products and "environmentally responsible" ingredients.
2-208	Establish partnerships with other states to create an interstate clearing house of environmental safety and health data
2-258	Include the following policy elements to further Green Chemistry in California: (a) Strengthen the recognition and pursuit of green chemistry processes and products by establishing clear criteria and voluntary certification based on comprehensive lifecycle considerations. (b) Explore models to provide needed chemical hazard data throughout the supply chain. (c) Establish a Green Chemistry Coordination Council to collect and promote the sharing of information, highlight businesses with green practices, provide assistance to businesses lacking resources, and educate consumers. (d) Prioritize chemicals for screening, testing and appropriate restrictions. (e) Invest in pollution prevention in the short term as well as extension of the current state pollution prevention model to downstream chemical users. (f) Continue the Conversation with California to sustain progress in Green Chemistry.

OPTION VM-2:	***Encourage public/private partnerships among government, universities, and industry, and between industries and manufacturers.***
3-27	Utilize any useful information developed by USEPA Design for the Environment program and work with industry and businesses to implement elements. These include: (a) Evaluate the human health and environmental impacts of its processes and products. (b) Identify what information is needed to make human health and environmental decisions (e.g., hazard characteristics data and identification of "safer" alternatives). (c) Consider cross-media impacts and the benefits of substituting chemicals. (d) Reduce the use and release of toxic chemicals through the innovation of cleaner technologies that use safer chemicals. (e) Reduce the use and release of toxic chemicals through the innovation of cleaner technologies that use safer chemicals. (f) Make products that can be more readily reused, refurbished, remanufactured, or recycled. (g) Monitor the environmental impacts and costs associated with each product or process. (h) Recognize that although change can be rapid, in many cases a cycle of evaluation and continuous improvement is needed. Partnerships with UC and CSUS could help implement these objectives. Incentives for applying these as core business practices might also help.
3-53	Work with major users of chemicals of very high and high concern to reduce or eliminate their use of these chemicals in their products.
3-60	Advance the science by developing, road-testing and sharing new toxicology testing methods and strategies that account for endocrine disruption, developmental neurotoxicology, timing of exposure, toxicogenomics, etc, including high throughput screening methods. Collaboration with the federal government and universities is important.
3-121	(e) Expect and encourage manufacturers of consumer products to communicate information about the ingredients in products, either on the package or on the internet at the manufacturer's discretion and with appropriate provisions for protection of Confidential Business Information. (f) Expect and encourage chemical and product manufacturers to update their MSDS document to the new 16-section ANSI standard and to reflect the latest hazard information from voluntary (e.g. HPV) and regulatory (e.g. Canada CMP) programs. (g) Encourage companies in important value chain sectors to work together to identify "beyond MSDS" information needs both upstream and downstream and to establish processes for communication to meet those needs. (h) Leverage California's capability and interest to assemble a chemical information system on hazard, use, and exposure from global sources.
3-127	Rather than imposing regulatory burdens, promote innovation through green chemistry with positive incentives and partnerships. Green Chemistry should be encouraged through the sharing of expertise, financial support for research, information exchange, and public education. Incentives could be offered for companies to pursue and foster Green Chemistry and Green Engineering.
3-130	Push collaborative efforts to encourage public and private partnerships, with a goal of developing greener products and environmentally responsible ingredients based on life-cycle considerations, rather than mandatory and voluntary state labeling programs that endorse green products or programs that stipulate a single third-party certification of green products or numerical ranking.
3-131	Collaborate with the Canadian government not only on the priority list of chemicals but the program in general. In our opinion, this collaboration would avoid needless duplication, inefficiencies, and burdens, as well as take advantage of credible, high-quality scientific work already completed.
3-133	Work with affected industries to implement a means of ingredient communication that would provide consumers with the information they can use to make even better informed decisions regarding the products they use in their homes.

OPTION VM-2: Encourage public/private partnerships among government, universities, and industry, and between industries and manufacturers.	
3-134	Work with scientific experts to examine best practices and to develop a toolkit for safety assessment programs and for safety assessments. Companies also could make a description of their safety assessment process available on the Internet. This could help provide context for product ingredient communication.
3-153	Build chemical data development efforts on existing statutory and regulatory structures, voluntary initiatives, and data development efforts, and collaboration by California in ongoing work by other government agencies to assess chemicals and consumer products. Leverage efforts by Health and Environment Canada in addressing priority chemicals in the Chemicals Management Plan. California could also participate in the Security and Prosperity Partnership (SPP) under the Montebello Agreement involving trilateral cooperation among the governments of Canada, the United States and Mexico to share chemical information and safety assessments.
3-155	Engage in collaborative efforts to encourage public and private partnerships with the goal of developing "greener" products and "environmentally responsible" ingredients rather than mandatory and voluntary state labeling programs that endorse green products or programs that stipulate a single third-party certification of green products.
3-185	Note that numerous opportunities exist to reclaim process streams that may require refining (i.e. distillation, filtration, etc) prior to recycling the material back into the same process. The Chemical Industry Council of California and DTSC have embarked on a partnership to promote voluntary pollution prevention and reduce waste. CICC is eager to work with DTSC to implement regulations allowing more flexibility for generators to reclaim streams onsite without having to go through tiered permitting or Part B Permit. CICC recommends that we work collaboratively with DTSC to fix this problem and reduce waste generation.
4-32	Provide assistance to small manufacturers and encourage pooling of resources to improve safeguards and quality control on inputs.
4-35	Develop international technology exchanges between companies to capture knowledge on how to successfully mass-produce products using less toxic alternatives.
4-43	Work with other state agencies, including DGS, to develop information on green purchasing and disseminate this information to other government agencies, including county and city level, as well as private businesses.
4-98	Consider a wide range of incentives to motivate changes in the behavior of industry and/or consumers: Production tax credits; Rebates to consumers or business; Investment tax credits; R&D tax credits; R&D grants; Equipment grants; Loans or loan guarantees; Public infrastructure development; Government support to deploy environmentally preferred products or technologies; Public/Private partnerships; Employee training and workforce development; CEQA exemption on qualified projects or other regulatory relief and special status once qualified (Fast track permits; Environmental Leaders programs) or other expedited permitting programs; Government preferred purchasing or government sponsored preferences; Government specified product standards; Use of consensus standards; Use of third party standards and certification; Product labeling programs; Web based consumer information
4-132	Use the collaboration between industry, state government, and a third party expert in identifying solvent substitutes under SB 14 as a model. Take the following approach: 1) consider chemicals of top priority concern, 2) identify the specific applications or industry uses posing the greatest risk from those chemicals, and 3) apply a collaborative process of agency, industry and third-party experts to identify or develop viable alternatives that can maintain efficacy, but reduce risk in those targeted applications.
4-136	Participate in the effort launched in August during the Security and Prosperity Partnership (SPP) with under the Montebello Agreement involving trilateral cooperation among the governments of Canada, the United States and Mexico to share chemical information and safety assessments.

OPTION VM-3: The Debate: Voluntary, Regulatory, or Both?	
1-3	Foster participation in development of innovative alternatives through incentives for stakeholders. Do not regulate.
1-100	Because the HPV Challenge is voluntary, USEPA has very limited ability to ensure that the data submitted by sponsors are of high quality and complete. While USEPA and other commenters have often identified deficiencies in initial submissions, there is no legal or binding obligation on the part of sponsors to heed those comments.
1-177	Voluntary collaboration with regulatory clout will support a green chemistry infrastructure to eliminate or mitigate hazard while promoting innovation and substitution.
1-179	Pursue enforcement efforts in two directions: voluntary with incentives and regulatory to dictate changes. The California Green Chemistry Initiative should leverage voluntary industry efforts to create better alternatives to high hazard substances, to mitigate risk and to make full use of market-based incentives. Recognition should be given for early adaptors and/or outstanding achievements in green chemistry. These would then be complemented by regulatory compliance to meet public expectations for safe chemical management.
1-181	Develop a technical center of excellence in green chemistry as a key element of the California Green Chemistry Initiative. The center would be available to provide technical assistance, lead development of a green chemistry curriculum for undergraduate and graduate programs, and conduct state- of- the-art research on green chemistry innovations.
1-189	Build on existing statutory and regulatory structures, voluntary initiatives, and data development efforts.
2-185	Encourage voluntary industry efforts to create better alternatives to high hazard substances, to mitigate risk and to make full use of market- based incentives. Recognition should be given for early adaptors and/or outstanding achievements in green chemistry. These would then be complemented by regulatory compliance to meet public expectations for safe chemical management.
3-127	Rather than imposing regulatory burdens, promote innovation with positive incentives and partnerships. Green Chemistry should be encouraged through the sharing of expertise, financial support for research, information exchange, and public education. Incentives could be offered for companies to pursue and foster green chemistry and green engineering..
3-153	Build chemical data development efforts on existing statutory and regulatory structures, voluntary initiatives, and data development efforts, and collaboration by California in ongoing work by other government agencies to assess chemicals and consumer products. Leverage efforts by Health and Environment Canada in addressing priority chemicals in the Chemicals Management Plan. California could also participate in the Security and Prosperity Partnership (SPP) under the Montebello Agreement involving trilateral cooperation among the governments of Canada, the United States and Mexico to share chemical information and safety assessments.
4-94	Develop a robust framework for regulating chemicals to accompany incentives for the development of greener chemicals and technologies; voluntary programs alone are not sufficient.

Chapter 5—Education and Outreach Options

Increasing public awareness and enhancing academic programs to advance green chemistry

SYNOPSIS

Numerous comments were submitted by stakeholders expressing the need for education and outreach on green chemistry. This chapter summarizes the 164 options that could increase the knowledge base and enable chemical users and consumers (i.e., the public) to be active participants in advancing green chemistry in California. The three options summarized in this chapter focus on:

- Augmenting science curriculum for kindergarten through grade 12;
- Expanding academic programs in institutions of higher education; and,
- Providing clear and meaningful information to consumers and the public.

Options regarding education and outreach include those designed to reach school-age children, university students, consumers, and the public. The options summarized in subsequent sections further detail stakeholders' recommendations to:

- Cultivate, through education, an understanding of basic principles of chemistry, toxicology, environmental sciences, and sustainability;
- Foster an interest in careers in science, engineering, and other relevant disciplines;
- Build, through academic training at institutions of higher learning, a workforce equipped with the scope and breadth of knowledge and skills to advance green chemistry, and an intellectual environment that catalyzes the development of new ideas and technological innovations; and,
- Develop a well-informed citizenry capable of actively engaging in demanding and supporting green products and processes, and avoiding unsafe chemical use and disposal practices.

Education and outreach represented roughly 11% of the total number of comments received throughout the Conversation with California.

BACKGROUND

In the last few years, under various statutes, California has initiated a program to incorporate environmental principles and concepts into the State's curriculum and standards for K-12 public schools. This program, known as the Education and the Environment Initiative (EEI), promotes unified, comprehensive curriculum that includes multiple environmental themes—such as water, air, waste, energy, etc. An Office of Education and the Environment (which is housed within the California Integrated Waste Management Board [CIWMB]) coordinates the EEI program, develops curriculum units for K-12 grades in science, mathematics, language arts, etc. Several stakeholders suggested that the State include green chemistry concepts in the EEI units for science education.

Existing law (Health and Safety Code section 25170) requires DTSC to maintain a toll-free "Toxic Substances Hotline," to provide information on toxic substances to the regulated community and the public. Existing law also requires that DTSC develop and implement training and education for generators of hazardous wastes. That includes the general public. The program is designed to increase awareness of and compliance with hazardous waste management requirements. As part of outreach efforts, DTSC prepares fact sheets which are available to consumers as well as businesses.

In addition, DTSC—along with other regulatory entities in state and local government—proactively solicit stakeholder input and participation by providing free information to and from the community, as well as identifying and considering community concerns related to projects and the management of hazardous wastes.

Other participants also noted existing "right to know" programs, such as the federal Toxics Release Inventory and the California Proposition 65 program. They said these programs are aimed at providing consumers and citizens some information about hazardous chemicals.

DISCUSSION OF OPTIONS

OPTION EO-1: Augment the science curricula for kindergarten through grade 12 with age-appropriate content related to green chemistry.

Numerous stakeholders indicated that cultivating a basic understanding of concepts in chemistry, toxicology, environmental sciences, and sustainability is essential to transform how the next generation, their parents, teachers, and school administrators view and use science in making everyday decisions that reflect environmentally preferable choices. Additionally, incorporating these principles into the science curricula would foster interest and inspire students to pursue higher education and careers in these areas.

Stakeholders recommended curriculum augmentation with close collaboration between the Department of Education, other educational professionals, and technical experts. So as not to compromise academic advancement, stakeholders suggested compliance with existing Academic Performance Index requirements (and other legal requirements imposed on schools) for annual improvements in reading fluency and mathematical computations. Further, programs for K-12 should focus on scientific literacy to better prepare young consumers and leaders for the future. Depending upon the complexity and extent of the content, specific modules or teacher training may be necessary.

Stakeholders suggested a directive from the governor or specified funding for augmenting the K-12 curriculum to ensure uniformity throughout the state. Some stakeholders suggested expanding the existing outreach and education programs within Cal/EPA and its BDOs to explicitly include Green Chemistry. The Education and the Environment Initiative[21] (EEI), which is aimed at developing a unified strategy on education about the environment in California's primary and secondary schools was specifically cited. The program is administered by the CIWMB, the State Board of Education, the Office of the Secretary for Education, the Curriculum and Supplemental Materials Commission, the State Department of Education, and the California Resources Agency.

Additional recommendations to reduce associated costs to state and local government included collaborative efforts with nonprofit organizations, foundations and businesses that invest in K-12 education as part of their public outreach or corporate communications mandate. These entities could provide access to expertise, resources, promotional opportunities, or endorsements. Junior Achievement for example is an organization whose mission is to inspire and prepare young people to succeed in a global economy. Businesses that develop, market, or sell educational materials could also defray costs; hence, opportunities that enable them to promote and sell products that have been deemed credible and effective by the State (or other designated authority) could be explored.

OPTION EO-2:	***Establish or enhance academic programs at colleges and universities to supply the technical expertise and advanced designs needed to promote an environmentally sustainable economy.***

Stakeholders agreed that higher education is essential to advancing the State's environmental, economic, social and cultural well-being. They said the role of higher education is two-fold: (a) educating and training graduates with the necessary expertise and skills to enter the workforce and (b) stimulating discovery, new ideas, and inventions through its research programs. Numerous recommendations were made to re-evaluate accreditation requirements to ensure that degrees in chemistry, environmental sciences, and relevant engineering fields require coursework relevant to green chemistry. Participants also suggested that degrees in other fields of study cover green chemistry topics at the appropriate level of detail. Stakeholders further agreed that to advance a green economy a diverse workforce consisting of professionals who have the rigorous academic training in their respective areas of expertise, and an understanding of chemistry, toxicology, public health, environmental sciences, and policy in necessary.

Numerous recommendations to stimulate innovation through product and technology development through the colleges and universities were made. Such strategies could include international exchange programs for students and professionals, scholarships, and funding for technology development.

Stakeholders recommended collaboration between academia, government, and industry to effectively exchange new ideas and emerging technologies, offset research and development costs, and train personnel. These partnerships could expedite the development and commercialization of new, environmentally preferable technologies, help create, attract, and fill jobs, as well as boost California's economy.

OPTION EO-3:	***Facilitate public access to clear and objective information to enable informed choices.***

Many stakeholders noted that consumers, through their purchasing power, play a vital role in driving the demand for products and consumer goods that are manufactured and placed in the market. Further, an increase in consumer awareness and understanding of their role is essential in creating a more sustainable future. (See also Chapter 2, Economic Incentives.)

Commenters made numerous recommendations about alternatives that government and industry can collectively undertake to ensure that consumers are well informed about the products that they consume. They said education and outreach for consumers and the public must:

- Provide clear and unbiased information and
- Increase the consumer understanding of the relevance and connection between the products they use and their impact on their own health, and the local and global environment.

Recommendations for consumer education ranged from simple pamphlets to the more sophisticated educational television programs through partnerships with Hollywood and Public Television. Other forms of consumer education and outreach included: brochures and materials distributed through local forums; public relations messages through news releases; web-based information; and commercials on mass media such as television, radio or billboard messages; and product labels with specific mandated information.

Some participants suggested that funding for consumer outreach programs could be appropriated by the Legislature or incorporated into existing efforts (such as "Flex Your Power"). Alternatively, others suggested that direct raw material taxes or taxes on consumer goods and product manufacturing could support outreach efforts.

CHAPTER TEAM

The following Green Chemistry team staff members served as principal editors for this chapter, Data Collection and Use:

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The team compiled each of the comments relating to education and outreach. They organized those comments from the Conversation with California. The chapter team worked closely with the overall team, whose members are given in the Acknowledgements. The references for each of the three major options summarized in this chapter are presented in the next section of this report.

REFERENCES

The tables below cross-reference each option to Appendix B. The figures shown in the first column represent the "challenge area" and the option number.

OPTION EO-1:	***Augment the science curricula for kindergarten through grade 12 with age-appropriate content related to green chemistry***
1-2	Develop a partnership with academia and establish a program.
1-9	Foster outreach and education through partnerships to stakeholders.
1-14	Establish a product safety organization or partner with the University of California to develop a checklist for review new products.
1-32	Teach green chemistry and green design at schools.
1-156	Encourage C2C curriculum (K-12 and post-secondary).
1-182	Promote public education and awareness of chemicals used in commerce and the principles of green chemistry. Programs addressed to consumers or primary (K-12) education should focus on scientific literacy to create a broader understanding of the costs and benefits of both chemicals policy and product innovation. These programs should provide the foundation for effective communication using product labels, hazard warnings, etc., and other policy options.
1-190	Recognize education plays a key role in effective decision-making, uncovering innovations, and training the next generation of society's leaders in science, business, health, and public policy. With a topic like green chemistry, where effective decisions will require collaborative approaches and solutions not yet imagined, education needs to play a key role. Green chemistry requires integrated, systems approaches and knowledge on a broad range of topics. For example, chemists need an understanding of toxicology, while policy makers need to understand business processes and markets to develop efficient and effective policies. Successful implementation of green chemistry requires a level of collaboration not often taught or practiced today.
1-191	Use the National Science Resources Center and its Science and Technology for Children® (STC®) program, which is a comprehensive, researched-based K-6 science curriculum consisting of 24 instructional units that explore the life, earth, and physical sciences and technological design.
2-25	Expand green chemistry curriculums from middle school through post-secondary education.
2-59	Recognize that education and training—at various levels including, but not limited to, K-12 programs—is critical to advancing green chemistry.
2-121	Incorporate into K-12 education and the Education and the Environment Initiative (EEI).
2-188	Promote public (including K-12) education and awareness of chemicals used in commerce and the principles of green chemistry. Programs should focus on scientific literacy and effective communication on using product labels, hazard warnings, etc.
2-249	Provide universal training in green chemistry starting in K-12 education and development of a curriculum to train our future scientists. Data gaps should be identified and filled and we should create a usable info depot/clearing house to make the system consumer friendly
2-312	Make educational programs a key component of its Green Chemistry Initiative, considering the full range of educational opportunities: sponsored research, collaborative grants, modules for courses K-12 and at the university level, programs to educate consumers, media and policy makers.

OPTION EO-1: Augment the science curricula for kindergarten through grade 12 with age-appropriate content related to green chemistry	
3-60	Advance the science by developing, road-testing and sharing new toxicology testing methods and strategies that account for endocrine disruption, developmental neurotoxicology, timing of exposure, toxicogenomics, etc, including high throughput screening methods. Collaboration with the federal government and Universities is important.
3-96	Schools (primary, secondary, and colleges and universities) as the trainers of tomorrow's leaders and the institutions conducting foundational research, should play a critical role in the Green Chemistry Initiative. California should engage educators to develop curricula, sponsor research, and educate consumers, the media, and policymakers.
3-190	At the Lawrence Hall of Science, UC Berkeley began a program some 20 years ago known then as the Chemical Education Public Understand Project (CEPUP), now the Science Education Public Understanding Project. W e recommend California consider how this program might accelerate outreach and conversely how green chemistry concepts might be incorporated into the teaching modules.
4-13	Develop educational programs for children.
4-51	Expand education in building a sustainable technology base.
4-104	Promote private business sector sponsorship of training and education programs at all levels (including elementary, high school and university). Conflict of interest concerns could be avoided by using an independent third party to manage the funding.
4-124	Make use of the Education and the Environment Initiative (EEI) to incorporate green chemistry concepts into education.

OPTION EO-2:	***Establish or enhance academic programs at colleges and universities to supply the technical expertise and advanced designs needed to promote an environmentally sustainable economy.***
1-14	Establish a product safety organization or partnership with University of California to develop a checklist for review new products.
1-32	Teach green chemistry and green design at schools.
1-74	Chemistry has enabled the development of countless products that consumers use every day, and consumers want to understand what impact these products may have on the environment and on their health. Industry shares this desire, and continues to strive to develop, produce, and market products that are both beneficial and safe for people and the environment.
1-107	Talk to chemistry departments at universities so that they understand the importance of the hazard traits of toxicity, persistence, and bioaccumulation. Encourage the development of new curriculum and requirements for chemistry undergraduate and graduate students.
1-113	Overcome gaps in education related to new methods. Some of these may include computational toxicology and bioinformatics, as well as other things that we have discussed. Building such capacity (e.g., more training, resources, and scientists) may lead to better models and approaches.
1-116	Encourage greater collaboration and partnership across disciplines and institutions to increase overall knowledge. For example, consider the model of how pharmaceutical companies make decisions on which chemicals are too hazardous to pursue.
1-156	Encourage C2C curriculum (K-12 and post-secondary).
1-162	Establish research and development centers focused on sustainable chemistry and/or sustainable engineering within its University of California system, such as Centers for Excellence in Sustainable Chemistry at leading University of California campuses that are networked to address major sustainability opportunities and issues.
1-169	Recognize the need for education in the broad scope of “green chemistry” includes “green engineering,” and that it is not limited to simplistic hazard substitution. Moreover, a concerted effort to disseminate appropriate information on the accomplishments, best practices, costs, and benefits of “green chemistry” would help assure that all interested stakeholders understand the concept and limitations of the approach. Health and safety information should never be considered proprietary or confidential information.
1-181	Develop a technical center of excellence in green chemistry as a key element of the California Green Chemistry Initiative. The center would be available to provide technical assistance, lead development of a green chemistry curriculum for undergraduate and graduate programs, and conduct state- of- the- art research on green chemistry innovations.
1-190	Education plays a key role in effective decision-making, uncovering innovations, and training the next generation of society’s leaders in science, business, health, and public policy. With a topic like green chemistry, where effective decisions will require collaborative approaches and solutions not yet imagined, education needs to play a key role. Green chemistry requires integrated, systems approaches and knowledge on a broad range of topics. For example, chemists need an understanding of toxicology, while policy makers need to understand business processes and markets to develop efficient and effective policies. Successful implementation of green chemistry requires a level of collaboration not often taught or practiced today.
2-24	Create a green chemistry program at the University of California.
2-25	Expand green chemistry curriculums from middle school through post-secondary education.

OPTION EO-2:	***Establish or enhance academic programs at colleges and universities to supply the technical expertise and advanced designs needed to promote an environmentally sustainable economy.***
2-44	Support research, development, technical assistance, entrepreneurial activity, and education in green chemistry science and technology
2-55	Examine ways to expand education and training programs for students and chemists through partnerships with industry.
2-57	Collaborate with universities to further the study and application of green chemistry.
2-58	Support research and development through various initiatives (e.g. university-based center, government funding, cooperative state research, etc
2-59	Recognize that education and training—at various levels including, but not limited to, K-12 programs—is critical to advancing green chemistry.
2-61	Advance the science (improve toxicological methodology; use biomonitoring data; press industry and federal government to move forward, collaborate with universities).
2-67	Collaborate between UC, state agencies, and industry.
2-68	Promote the exchange of information about best management practices, incentives and barriers among industries/corporations, and between industry and customers; one way to do this is through a mentoring program (e.g., large corporations mentoring small ones, or via the "ACC" (American Chemical Council)) is suggested.
2-91	Develop a more involved relationship between the industry and academia to develop and exchange toxicology information.
2-95	Promote academic programs in green chemistry. Enhance current programs, including training in ecotoxicity and green chemistry for chemistry students.
2-110	Create a Green Chemistry Department. [Note: this is unclear whether this means an academic department or a state agency.]
2-132	Provide more education for business groups; involve UC Extension.
2-133	Invest in green chemistry research and development, develop leading university centers; invest in EDC (endocrine disrupting chemicals) research, encourage collaborative work between green chemists and EDC researchers to foster strategies for avoiding EDCs in new products; promote public education into the dangers of EDCs and the need for alternatives
2-162	Encourage public private arrangements between universities and private industry, particularly as they relate to green chemistry solutions.
2-166	Host a Green Chemistry Symposium IV dedicated entirely to technology transfer, start-up funds, equity funding, and possible CalPERS investment in California companies with homegrown technology that solve California environmental problems.
2-171	Ensure that GCI has a strong science foundation.
2-186	Create a clearinghouse of best green chemistry practices.
2-187	Develop a technical center of excellence in green chemistry. The center would provide technical assistance, lead development of a green chemistry curriculum for undergraduate and graduate programs, and conduct state-of-the-art research on green chemistry innovations.
2-192	Foster innovation and encourage universities, educational institutions, and industry to partner in developing effective “greener” ingredients that reduce environmental impact

OPTION EO-2:	***Establish or enhance academic programs at colleges and universities to supply the technical expertise and advanced designs needed to promote an environmentally sustainable economy.***
2-205	Develop requirements to obtain hazardous traits data to support a comprehensive assessment of chemical hazards for chemicals currently in use and those proposed for use.
2-208	Establish partnerships with other states to create an interstate clearinghouse of environmental safety and health data.
2-262	Incorporate toxicology into the formal training of chemists.
2-271	Make risk assessment, including toxicology and life cycle thinking, part of the required curriculum for chemistry and/or chemistry related degrees conferred by state institutions.
3-32	Work with the UC system to develop a green chemistry curriculum for all chemistry and engineering majors.
3-96	Schools (primary, secondary, and colleges and universities) as the trainers of tomorrow's leaders and the institutions conducting foundational research, should play a critical role in the Green Chemistry Initiative. California should engage educators to develop curricula, sponsor research, and educate consumers, the media, and policymakers.
3-123	Develop a registry in which all stakeholders can document Green Chemistry successes. Develop an extension service through the UC system to expand reapplication of successes across the potential user community.
3-135	Close the “technology gap” through market-based incentives to support green chemistry. This could include funding for university research grants, scholarships, and similar programs, as well as awards for innovation, tax credits, low-interest loans, and other incentives. These positive incentives should be open to all companies that are innovators and sell products in California—not simply limited to companies located in California.
3-183	Conduct a base-line review of physical and intellectual capabilities to support and nurture the green chemistry R&D initiative. Additionally, CICC recommends that public private arrangements between universities and private industry be encouraged, particularly as it relates to green chemistry solutions.
3-190	At the Lawrence Hall of Science, UC Berkeley began a program some 20 years ago known then as the Chemical Education Public Understand Project (CEPUP), now the Science Education Public Understanding Project. W e recommend California consider how this program might accelerate outreach and conversely how green chemistry concepts might be incorporated into the teaching modules.
4-37	Establish academic programs in product stewardship; develop and implement cradle-to-cradle design curriculum into multiple disciplines.
4-42	Work with the UC system to develop a green chemistry curriculum for all chemistry and engineering majors.
4-51	Expand education in building a sustainable technology base.
4-52	Encourage that chemists should have university courses in green chemistry emphasizing toxicity and ecotoxicity.
4-53	Encourage universities to develop green business and law courses, etc.
4-57	Encourage the use of existing environmental management systems (e.g., ISO 14000) and work with international standards setting organizations (e.g., International Organization for Standardization) to develop green chemistry technical standards.

OPTION EO-2:	***Establish or enhance academic programs at colleges and universities to supply the technical expertise and advanced designs needed to promote an environmentally sustainable economy.***
4-60	Establish green chemistry scholarships and international exchange programs for students and scientists (sponsored by California government and/or industry).
4-99	Construct incentives that: foster innovation in the private sector and academia; create markets; facilitate increasing demand for the desired products and solutions; periodically are reviewed to assess the ongoing need of the incentives change; are as comprehensive and equitable as possible; provide transparent and user friendly information to consumers.
4-104	Promote private business sector sponsorship of training/education programs at all levels (including elementary, high school and university). Conflict of interest concerns could be avoided by using an independent third party to manage the funding.
4-112	Develop an extension service through the UC system to promote successful green chemistry methods and processes.
4-124	Use the Education and the Environment Initiative (EEI) to incorporate green chemistry concepts into education.
4-128	Develop a technical center of excellence in green chemistry to provide technical assistance, lead development of a green chemistry curriculum for undergraduate and graduate programs and conduct state-of-the-art research on green chemistry innovations.
1-74	Chemistry has enabled the development of countless products that consumers use every day, and consumers want to understand what impact these products may have on the environment and on their health. Industry shares this desire, and continues to strive to develop, produce, and market products that are both beneficial and safe for people and the environment.
1-114	Educate the public and consumers and other users of products about how to select and use “safer” products. We need to address their information needs in ways that are understandable to make it possible for them to do so.
1-120	Create a unified database that includes data from sources around the world. This database would have to be designed to be accessible to different users (chemical products, users, consumers, etc) and should be made public. The “E-Chem” unified data portal newly introduced by OECD might be considered a “baby step” toward this.
1-121	Ensure that data are available to the public and address limitations related to confidential business information.
1-130	Recognize concerns about the growing tide of consumer deceptive trade practices and litigation, some of it based on product labels. The State of California is a significant jurisdiction for such claims, including class action lawsuits. Any eco-labeling program developed and overseen by the state should exempt eco-labeling from forming the basis for such liability, relying instead on state regulatory controls to enforce eco-labeling standards. It would defeat the public policy goals of having an eco-labeling program, if the very program that the State designs to inform consumer decision-making becomes the basis for private parties to claim money damages for purported misinformation. Additionally, any eco-labeling program must be harmonized with existing state and federal regulations.
1-131	Provide consumers with accurate information upon which they can make informed decisions could be a very useful tool in driving changes. Many programs are predicated on consumer choice. Cars are labeled with expected fuel efficiency ratings. Major home appliances have energy labels, which can be used for comparisons. Plumbing fixtures show the water use. The clear intent is that consumers will use these labels to make more informed purchasing decisions.

OPTION EO-2:	***Establish or enhance academic programs at colleges and universities to supply the technical expertise and advanced designs needed to promote an environmentally sustainable economy.***
1-133	While most of the initial consumer labels focused on single attributes (water, energy, or fuel efficiency), most purchasing decisions are not that simple. Typically, in green chemistry, a number of attributes must be evaluated. A food nutrition label is perhaps a more analogous situation where consumers need to consider a variety of factors (sugar, protein, fat), various desirable nutrients (vitamins, minerals) and some to be avoided or minimized (sodium, saturated fat).
1-135	Note that Environmentally Preferred Purchasing (EPP) can be an effective approach to drive change by assigning an advantage in the purchasing process for products and services that meet a pre-determined set of "green" or “sustainable” attributes. Using this approach, brand owners, retailers, and government regulations set the marketplace expectations and develop market demand for new technologies. It is up to manufacturers – and their suppliers to deliver products and services that meet the market demand, or risk being left behind.
1-136	Develop and market materials to meet rising consumer demand for “green” or sustainable products.

OPTION EO-3: Facilitate public access to clear and objective information to the public to enable informed choices.	
1-8	Factor environmental, societal, environmental justice, and economics into decisions.
1-10	Mandate full disclosure of substances contained in products. "Green labeling" should be used with restraint.
1-17	Standardize terminology and definitions to promote the necessary and real change towards creating more sustainable, social and environmental solutions.
1-21	Foster "Reduce Energy/ Resource Consumption" through take back programs.
1-23	Advertise green businesses.
1-31	Educate the companies and consumers worldwide.
1-35	Develop a database of ingredients used in consumer products similar to the Skin Deep database that is currently available for cosmetics. In order to ensure accuracy, California would need the regulatory authority to regulate consumer products and to require disclosure of ingredients in consumer products.
1-37	Develop an information clearinghouse. This information would include hazard and use data as well as information about safe alternatives.
1-137	As a key material solutions partner, work with our customers and their customers to better understand the impact of the product throughout its life cycle so they can make better informed decisions.
1-138	Apply science-based EPP definitions so that measurable environmental improvements can be delivered.
1-139	Use government preferred purchasing or government sponsored preferences.
1-140	Build the appropriate infrastructure to take and recycle emerging waste streams before government specified product standards (e.g., CAFE standards, energy efficiency standards for buildings, bans on incandescent lighting bulbs, etc.). For example, mercury-containing bulbs are routinely disposed of with residential wastes. More energy efficient but equally harmful in the environment if not handled properly.
1-141	Think about the “signals” that are being sent to markets to avoid unintended consequences. For example, specifying increased recycle content will significantly raise barriers to entry and delay introduction of new, innovative materials since recycling infrastructure and markets take time to develop. A flexible, performance based approach avoids the government picking technological winners and losers, but it must be done using a holistic, long-term view.
1-149	Involve people at the business and community level.
1-154	Provide consumer education so consumers know what questions to ask.
1-155	Provide consumer education on what will be hazardous when product is thrown away; wake up consumers that there is no “away.”
1-161	Require that a company that manufactures chemicals in or imports chemicals into California have a publicly available overview of the approach it uses for chemical evaluation and assessment. Companies should affirm to the state that the chemical evaluation and assessment approach is publicly available.

OPTION EO-3: Facilitate public access to clear and objective information to the public to enable informed choices.	
1-169	Recognize the need for education in the broad scope of “green chemistry” includes “green engineering,” and that it is not limited to simplistic hazard substitution. Moreover, a concerted effort to disseminate appropriate information on the accomplishments, best practices, costs, and benefits of “green chemistry” would help assure that all interested stakeholders understand the concept and limitations of the approach. Health and safety information should never be considered proprietary or confidential information.
1-174	Describe and communicate effectively chemical hazards and risks with extensive and accessible data management.
1-190	Education plays a key role in effective decision-making, uncovering innovations, and training the next generation of society’s leaders in science, business, health, and public policy. With a topic like green chemistry, where effective decisions will require collaborative approaches and solutions not yet imagined, education needs to play a key role. Green chemistry requires integrated, systems approaches and knowledge on a broad range of topics. For example, chemists need an understanding of toxicology, while policy makers need to understand business processes and markets to develop efficient and effective policies. Successful implementation of green chemistry requires a level of collaboration not often taught or practiced today.
1-199	Recognize that education of consumers and other organizations will be critical to driving change and fostering innovation within other groups. We challenge DTSC to develop educational components as a part of the overall approach to California’s Green Chemistry Initiative.
1-200	Include organizations, which put accurate, unbiased information into the hands of consumers. They are also an important component.
1-209	Retain certain business information as confidential in order to protect intellectual capital. Health and environmental information should not be considered confidential.
1-213	Develop a database of chemical alternatives that compares a number of sustainability parameters: performance, price, human health and environmental (e.g., toxicity, bioaccumulation, persistence) including carbon footprint and source sustainability.
1-215	Increased transparency and access to information on chemicals in commerce.
1-228	Focus resources and attention on a limited number of chemicals that are important to evaluate. The process should be collaborative and should include scientific experts in toxicity and exposure from academia, chemical manufacturers, product formulators, and non-governmental organizations. The manufacturers of the chemicals and consumer products could provide toxicity and exposure/use data to determine whether the uses of “priority chemicals” are safe or should be restricted.
2-26	Develop a "Safe Home Environment" place for children to visit and learn.
2-37	Address marine debris via reduction and recycling.
2-94	Educate consumers. Provide green information to consumers to change the marketplace and consumer attitudes, enable informed choices, and drive green chemistry. Create a database for the public to get green information.
2-108	Classify or rank existing chemicals (green, light green, yellow, and red).
2-117	Develop criteria for determining safe alternatives, including multi-media considerations; identify and publicize safe alternatives.
2-131	Establish a "green seal," reflecting a specified level of greenness, or certification of approval.
2-136	Recognize and award green products, which would be a strong motivator because they can lead to greater sales and preferential purchase by environmentally conscious consumers. Recognition with the use of a logo would be most effective. See German Blue Angel award.

OPTION EO-3: Facilitate public access to clear and objective information to the public to enable informed choices.	
2-138	Include information geared towards the general public, particularly related to the purchase and use of certain products, on websites. Include: lists of manufacturers and products that have received “green" awards to motivate submission of information to DTSC for review, information on the environmental impacts of plastics, greener alternatives to household chemicals, disposal options for universal waste, information on green chemistry, a page called "What can I do to help the environment?" Increase awareness and enable the general public to put greater pressure on manufacturers and legislatures to make green chemistry and environmental protection a priority.
2-139	Use environmental certification (German "The Blue Angel" program) as a model for the certification of products and services.
2-155	Bring social science into the picture to help stimulate behavior change in consumers and businesses.
2-174	Establish a Green Chemistry Coordination Council to collect and promote the sharing of information, highlight businesses with green practices, provide assistance to businesses lacking resources, and educate consumers.
2-196	Promote consumer awareness of the importance of reading and following label instructions for safe product use, storage, and disposal
2-197	Support collaborative efforts to encourage public and private partnerships to develop “greener” products and “environmentally responsible” ingredients.
2-221	Support workshops and education forums that are accessible to communities so they can hear about the green chemistry issues.
2-222	Provide grants funded from revenue from fees imposed on companies using toxic chemicals to groups engaged in grassroots outreach and education on green chemistry issues.
2-223	Make information about chemicals to which the public and workers may be exposed more accessible, including mandatory labeling, indicating the presence of chemicals that may be hazardous.
2-253	Foster a social attitude adjustment that includes a ratcheting down of solid waste acceptance both by government and consumers. Current waste streams must be turned into resource streams and the cost can be internalized.
2-257	Develop an integrated program that features the following: (a) require all existing chemicals undergo a tiered process of scrutiny for their environmental, social, and health/toxicity impacts; (b) require that this information should be passed in a standard form along the supply chain; (c) require manufacturers to label consumer products with all the chemicals and materials (including nanotechnology) that these contain; (d) develop interactive consumer tools and technologies that assist consumers to interpret and use labeling data in their shopping; (e) require industry to conduct green chemistry assessments for chemical products sold or used within California; (f) expand greatly the investment of resources into green chemistry education and research at California State-supported universities, including the UC system (g) adopt a modest toxicity tax on all intermediates and chemical products used or sold within the State of California.
2-261	Make educational programs a key component of its Green Chemistry Initiative.
2-309	Continue to broaden the tent of stakeholders as the Green Chemistry Initiative moves forward.

OPTION EO-3: Facilitate public access to clear and objective information to the public to enable informed choices.	
3-4	Expand consumer education regarding product life cycle costs and impacts (e.g. appropriate selection, use, disposal, and alternative materials or practices) since well-informed consumers will not only handle and dispose of chemicals more safely, and will demand safer products with closed loop lifecycles. Disseminate information through traditional media as well as outreach through community partners as well as the private sector. Educate people how chemicals are created, screened for use, and managed through a process. Show people "a day in the life of a chemical." Provide complete transparent chemical risk information in a way the public can access, understand, and absorb. Create convenient, credible chemical evaluation tools that businesses, schools or individuals can easily use when selecting chemical products. These could use prior art such as the Green Screen or Pfizer's Solvent Alternatives Chart. These tools could show examples of the risk as well as hazard, and define hazard/risk as high, medium and low and compare to products and services used by consumers everyday. If something is a hazard, show the alternatives or how the risk relates to the pathways for exposure. (Is it in a product, or solely for use in a process? If it is in a product, what entails safe use? etc.)
3-5	Create a labeling system that is accessible, and accurate. Enable and streamline disposal of household hazardous waste (curbside pick-up or more local collection centers.), and improve the publicity of and accessibility to this disposal, and ensure safety of the collection sites. Include, as part the education and outreach, manufacturers public disclosure of product selection and chemicals used in those products. Define and identify toxic and non-toxic chemicals in specific products, proper use, dangers of inappropriate use, and include information about disposal. Include life cycle analysis and impacts thereof.
3-6	Create a task force by collaborating with regulatory agencies, UC, Chemical Abstract Service, industry manufacturers, and the public to create a web portal to identify chemicals (toxic and non-toxic), how each is created/screened for use/managed through a process, and disseminate/access information.
3-7	(a) Prioritize chemicals used in commerce in California based on exposure potential and toxicity, and work to reduce exposure to the most hazardous substances. To do this, gather data regarding all chemicals manufactured in or used in commerce in California, including in what products, how and in what volumes they are used. Additional data regarding available toxicity characteristics should also be gathered for each of those chemicals. Identify gaps in toxicity and exposure data. (b) Use this data to prioritize or rank chemicals in terms of hazard as a function of toxicity and exposure. Tools for such ranking are available from other efforts such as Canada's CEPA program and USEPA. Evaluate these for use in California. Focus subsequent efforts on working with industry to find viable, safer alternatives for the highest ranked chemicals (i.e., those that pose the biggest threat in terms of toxicity and exposure). At the same time, engage industry and our university system to fill in important gaps regarding toxicity and exposure data. (c) Tap biomonitoring efforts to help fill exposure gaps. In evaluating and ranking chemicals, considerations should be given to the performance and feasibility of alternatives.
3-9	Work with the military and aerospace industry as well as the plating industry, to evaluate and revise outdated mill specifications to allow for more "environmentally friendly" plating chemistries. Technological advances have generated more environmentally friendly electroplating technologies (e.g., cyanide-free plating solutions). However, a widespread switch to more "green" plating practices has been hampered by outdated "milspecs" (i.e., the military specifications for most plating done for military and aerospace applications).

OPTION EO-3: Facilitate public access to clear and objective information to the public to enable informed choices.	
3-27	Utilize any useful information developed by USEPA Design for the Environment program and work with industry and businesses to implement elements. These include: (a) Evaluate the human health and environmental impacts of its processes and products. (b) Identify what information is needed to make human health and environmental decisions (e.g., hazard characteristics data and identification of "safer" alternatives). (c) Consider cross-media impacts and the benefits of substituting chemicals. (d) Reduce the use and release of toxic chemicals through the innovation of cleaner technologies that use safer chemicals. (e) Reduce the use and release of toxic chemicals through the innovation of cleaner technologies that use safer chemicals. (f) Make products that can be more readily reused, refurbished, remanufactured, or recycled. (g) Monitor the environmental impacts and costs associated with each product or process. (h) Recognize that although change can be rapid, in many cases a cycle of evaluation and continuous improvement is needed. Partnerships with UC and CSUS could help implement these objectives. Incentives for applying these as core business practices might also help.
3-28	Develop layperson information on common chemicals in common commercial products for educating the public.
3-29	Develop a fact sheet on chemicals policy in the US and post it on their GCI website to educate the general public.
3-30	Engage in culturally appropriate outreach to consumers to help them make informed choices and move purchasing towards greener products. Media such as television commercials (featuring Arnold Schwarzenegger, perhaps), comic books, radio, could be utilized. Partnering with Hollywood would go a long way.
3-31	Develop guidance on what its citizens as individuals could do to move towards greener, sustainable living.
3-33	Work with other state agencies including DGS to develop information on green purchasing, and disseminate this information to counties and cities and to private sector businesses for their use.
3-58	Require updates of MSDS to reflect all available data.
3-59	Require disclosure of chemicals in consumer products, focusing initially on high concern chemicals.
3-77	If California considers an eco-label program, base labeling on science and life cycle analysis, and involve a multi-stakeholder working group to generate the standards for eco-labeling.
3-82	Develop model life cycle analysis paradigm, starting with a single widely used product with environmentally detrimental properties, and analyze every aspect of that product's lifecycle, from the harvesting and processing of raw materials, to that product's ultimate disposal or "end of life" management.
3-87	Consider a marketing program (perhaps akin to the "California cows" and dairy ads currently on television) whereby the state would promote companies that are actively engaged in Green Chemistry and Green Engineering, and products that are the result of Green Chemistry and Green Engineering.
3-124	Continue the Conversation with California via ongoing workshops, symposia, and other communication approaches to maintain and build on the momentum established in the program to date.

OPTION EO-3: Facilitate public access to clear and objective information to the public to enable informed choices.	
3-134	Work with scientific experts to examine best practices and to develop a toolkit for safety assessment programs and for safety assessments. Companies also could make a description of their safety assessment process available on the Internet. This could help provide context for product ingredient communication.
3-145	Establish a Green Chemistry Coordination Council to collect and promote the sharing of information, highlight businesses with green practices, provide assistance to businesses lacking resources, and educate consumers. Catalog and make easily available information regarding best practice screening processes, green chemical design, collaborative efforts such as the ACS Green Chemistry Institute, and international efforts such as the Global Harmonization System. All stakeholders still have a lot to learn in this dynamic area, and everyone stands to gain from continued information sharing. DTSC leadership in this area should be continued by establishing it as a central clearinghouse of information for the state and beyond. We further suggest building upon and making readily available the information provided by existing efforts: ACS Green Chemistry Institute, Cleangredients, USEPA Design for Environment Program, Performance Track, the chemical industry's HPV testing program, eChemPortal, EPEAT, and DTSC Technical Resource Center.
3-148	Continue the Conversation with California to sustain progress in Green Chemistry. The dialogue between DTSC and stakeholders has been very helpful and will result in more well-developed, effective policy.
3-154	Work with industry to implement a means of ingredient communication that would provide consumers with the information they can use to make informed decisions regarding the products they use in their homes.
3-162	Seek input from animal protection stakeholders, who have a unique set of qualifications and can specifically address the reduction and replacement of in vivo animal tests, before recommending testing strategies or regulations. The National Academy of Science's recent report addressing the future of toxicity testing should be embraced as part of a GC initiative, not only in the interest of animal welfare, but in the interest of a healthy environment
3-168	Require manufacturers to label consumer products with all the chemicals and materials (including nanotechnology) that these contain. Consumers currently lack the information required to discriminate between products based on their toxicity impacts, so industry has few incentives to develop new green chemistry products. In parallel, develop interactive consumer tools and technologies that assist consumers to interpret and use labeling data in their shopping. The Toxics Release Inventory succeeded because information tools made its data highly accessible.
3-173	Provide clear and transparent characterization of chemical hazards to the public. Many entities can and are making decisions and take action that contribute to adoption of safer or lower hazard chemicals and products. To support such efforts, businesses, agencies, and the public need comprehensive, current, accurate, and reliable information about the relative hazard of different chemicals. California should develop a matrix of information about the hazard traits of chemicals in use or considered for use, presented in ways that are useful and understandable to various audiences. This matrix should also make clear when gaps in data exist, so that businesses and individuals can choose to avoid chemicals with unknown hazards as well as those that are higher hazard.
4-1	Assess chemicals within the context of alternatives. Criteria for better or worse green products should be clear.
4-9	Educate the public on what items they use that are toxic and natural alternatives that could be used instead
4-11	Use sound scientific information to define what is "toxic" and "non-toxic."

OPTION EO-3: Facilitate public access to clear and objective information to the public to enable informed choices.	
4-12	Identify specific industry sectors that generate the most toxic products and identify green production and processing for those sectors.
4-23	Develop a "green" rating system for products with agreed upon criteria.
4-38	Develop a fact sheet on chemicals policy in the US and post it on the Green Chemistry Initiative website to educate the general public.
4-39	Develop layperson information on common chemicals in common commercial products.
4-40	Engage in culturally appropriate outreach to consumers to help them make informed choices and move toward greener products. Use television commercials (could feature Arnold Schwarzenegger), comic books, radio, and the Internet. Partner with Hollywood.
4-41	Develop guidance on what citizens of California could do to move toward greener, sustainable living.
4-43	Work with other state agencies, including DGS, to develop information on green purchasing and disseminate this information to other government agencies, including county and city level, as well as private businesses.
4-45	Require responsible parties to identify the individual constituents of their products or, if that information is considered to be confidential business information, to provide the appropriate health information on their products.
4-70	Develop educational programs for consumers on the consequences of excessive consumption.
4-71	Create a list to be posted on the Internet of "bad actor" chemicals that have been found in products and the associated suppliers/manufacturers.
4-73	Create "feeder" lists of chemicals to provide an early indication of potential chemicals of concern; such feeder lists would require a lower threshold of data than a list such as Proposition 65. Publish the lists on the Internet.
4-77	Review a case study to examine the factors that are useful and appropriate in determining what is "safer." For example, use flame retardants to evaluate how best to identify a safer alternative (e.g., safer chemical, alternative non-chemical technology, change in performance standards etc.). Develop a technical and a layperson document describing the results of the case study, and use this information for developing policy and doing education and outreach.
4-84	Create a unified database to capture toxicity and exposure data sources from around the world. Make the database public (on the Internet) and accessible to various types of users (chemical products users, consumers etc.) Review the OECD "E-Chem" portal as an example of this.
4-87	Support activities that increase the capacity of individuals and communities to act in their own interest to reduce exposure to toxic chemicals.
4-95	Review the Consumer Specialty Products Association's Product Care program as a model stewardship program in which consumer and institutional specialty product companies have agreed to go beyond government regulations in emphasizing health.
4-97	Review the ACC Responsible Care program as a model for reducing potential hazards which includes a rigorous EHS&S management system that is certified by third-party auditors.
4-101	In developing and implementing “eco-labeling,” ensure that: the analysis of the product is credible and based on scientific study; the products meet agreed upon criteria and the eco-labels are not reliant on unsubstantiated claims by the producer; an independent third party audits the eco-label.

OPTION EO-3: Facilitate public access to clear and objective information to the public to enable informed choices.	
4-109	Facilitate informed substitution in moving to alternatives for restricted uses of priority chemicals. Although "toxics use reduction" is an admirable goal, failure to adequately assess the multimedia and lifecycle implications of forcing a shift to alternatives can result in significant unintended consequences.
4-116	Promote consumer education and responsibility. For example, how consumers collectively handle chemical products has an enormous effect (for example, nail polish remover can be easily poured down a household sink, which would not be allowed in the workplace). Further, consumers should read and follow label directions.

Chapter 6—Research and Technology Options

Providing the research needed to support green chemistry

SYNOPSIS

Research and closely related topics comprised approximately 2% of the total number of comments received throughout the Conversation with California. Participants proposed 25 options involving research and technology for green chemistry. These include:

- Researching alternative starting materials for use in chemical synthetic processes;
- Conducting research to develop analytical screening methods for toxics in commercial products; and
- Developing new, safer technologies and industrial processes.

The industrial revolution in the 20th century was driven by strong research in basic chemistry and physics. Today's green chemistry efforts will be heralded by the latest scientific methods. Research could be performed in several areas. Research could help identify safer alternative starting materials and substitutes for the hazardous chemicals which are currently used. This can make processes safer for businesses and workers as well as make products safer for the consumer and the environment.

Engineering design can reframe older processes to make them produce less waste and ensure that new processes contain environmentally friendly design factors from the beginning through the final phases of production. Research in this area—and in new technologies—can generate a considerable amount of scientific information.

The Green Chemistry vision includes research as a key driver in changing practices in chemistry and engineering. The wastes created during processes leading to commercial end-products can be significantly reduced or possibly eliminated altogether. Products could become raw materials for the next generation of products or biodegrade at the end of their useful life. New research and technology can promote reformulation of molecules by identifying alternative feed stocks and new catalysts that accomplish desired results using new pathways. All of the changes—driven by research—can sustain economic growth while at the same time greatly reducing the quantities of waste generated in the creation, use, and disposal of commercial goods and products.

BACKGROUND

Stakeholders noted that industry conducts extensive chemicals research as part of their business. Several commenters mentioned substantial investment and resources devoted to industry-based research, which supports not only new products but also less hazardous approaches. A few state programs cosponsor focused research and development work in particular areas—such as less polluting combustion, more energy efficient technologies, water conservation, etc. Federal agencies partner with universities and industry for major research initiatives. In California, the University of California operates national laboratories (i.e., Lawrence Livermore National Laboratory, Lawrence Los Alamos National Laboratory, and the Ernest O. Lawrence Berkeley

National Laboratory) for advanced research. Many of these programs, stakeholders said, have green chemistry-related elements.

DISCUSSION OF OPTIONS

OPTION RT-1:	***Conduct research to identify safer alternative starting materials for products that are now known to employ hazardous substances at the beginning of the process.***

Participants in the Conversation with California called for research in safer alternatives, feed stocks, and raw chemicals processes. They said such work could be conducted by public and private sector laboratories, including:

- **State of California laboratories.** DTSC, ARB, and DPH each operate state laboratories, which are capable of conducting green chemistry research in their respective areas (hazardous materials, air quality, and public health).

- **Private sector laboratories.** Stakeholders said private laboratories could be used or contracted with for research in clearly defined specified areas.

- **University of California laboratories.** The University of California's Center for Occupational and Environmental Health on the Berkeley and Los Angeles campuses was mentioned as a resource for research projects.

Option RT-2:	***Conduct research to develop analytical chemistry screening methods for commercial products.***

The frequency and wide variety of recent product recalls, participants commented, demonstrates a need to screen for chemicals of concern in products manufactured both domestically and overseas. Before products can be screened for the presence of chemicals of concern, analytical chemistry screening technologies are needed. New research could identify and help develop analytical methods that work both in laboratory and field conditions. They said research can provide detailed information about what these chemical screening tools will be, how they will work chemically, and what their limitations are. Research can result in the creation of new methodologies to identify the chemical contents of products. Finally, research can aid in the development of new screening technologies for detecting toxic substances in consumer goods.

Option RT-3:	***Use green engineering research to develop and assess green designs and production processes.***

Stakeholders mentioned that green engineering process improvements are as much a part of green chemistry as starting material substitutions. Chemical processes often can be made greener and more efficient by designing processes differently. They called for basic research in this area; they noted that this would benefit a wide variety of industries by addressing issues common to many (e.g., solvent recycling). Research into the engineering side of processes can produce

decisive changes to save not only energy but also starting materials and solvents in the production of green chemical product.

CHAPTER TEAM

The principal editors for this chapter were:

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The team compiled each of the comments relating to chemical and engineering research and technology. They organized the comments that stakeholders made during the Conversation with California. The references for each of the three major options summarized in this chapter are presented in the next section of this report.

REFERENCES

The tables below cross-reference each option to Appendix B. The figures shown in the first column represent the "challenge area" and the option number.

OPTION RT-1:	***Conduct research to identify safer alternative starting materials for products that are now known to employ hazardous substances at the beginning of the process.***
1-2	Develop a partnership with academia and establish a research program.
1-12	Research and develop new testing methods on relative toxicity and synergistic effects of substances.
2-12	Require real world information about how chemicals interact with each other.
2-22	Designate the Center for Occupational and Environmental Health at UC Berkeley and UCLA as the lead entities within the University of California system to address matters pertaining to chemicals policy and green chemistry in California.
2-23	Partner with the University of California to create an institute for sustainable manufacturing and green chemistry research.
2-24	Create a green chemistry program at the University of California.
2-44	Support research, development, technical assistance, entrepreneurial activity, and education in green chemistry science and technology.
2-57	Collaborate with universities to further the study and application of green chemistry.
2-58	Support research and development through various initiatives; for example, university-based center, government funding, cooperative state research, etc.
2-61	Advance the science (improve toxicological methodology; use biomonitoring data; press industry and federal government to move forward; collaborate with universities).
2-67	Collaborate between the University of California, state agencies, and industry.
2-91	Develop a more involved relationship between the industry and academia to develop and exchange toxicology information.
2-105	More research and development (R&D) for private sector and government, including R&D prior to using chemicals in products.
2-133	Invest in green chemistry research and development. Develop leading university centers. Invest in endocrine disrupting chemicals (EDC) research. Encourage collaborative work between green chemists and EDC researchers to foster strategies for avoiding EDCs in new products. Promote public education into the dangers of EDCs and the need for alternatives.

OPTION RT-1:	***Conduct research to identify safer alternative starting materials for products that are now known to employ hazardous substances at the beginning of the process.***
3-10	(a) Prioritize protection of most vulnerable people and resources. For example, get information on exposures of children to harmful substances through toxics in products, and seek changes to reduce or eliminate these toxics. Focus on consumer products with lots of exposure potential. This needs a regulatory action. (b) Look for initial easy fixes by integrating existing programs that have identified actual sources of pollutants. (c) Drive the demand for cleaner products through state procurement practices. (d) Designate the Occupational and Environmental Health at UC Berkeley and UCLA as lead entities within the UC system to address research relevant to green chemistry and chemicals policy in California.
4-61	Establish a centralized testing laboratory for toxics in products that would accept testing requests from the public.
4-128	Develop a technical center of excellence in green chemistry to provide technical assistance; lead development of a green chemistry curriculum for undergraduate and graduate programs; and conduct state-of-the-art research on green chemistry innovations.
4-130	Avoid bans in the absence of safer alternatives, which should be technically feasible, improve health, safety, and environmental profile; provide comparable or superior performance; and be cost-effective and sustainable. If safer alternatives are not available, devote resources to research and development or provide incentives for developing alternatives.

OPTION RT-2: Conduct research to develop analytical chemistry screening methods for commercial products.	
2-20	Invest in new testing methods since many of the current testing methods are out of date or do not exist.
2-28	Identify accurate and effective methods to test for and evaluate the potential hazard traits of chemical substances.
2-61	Advance the science (improve toxicological methodology; use biomonitoring data; press industry and federal government to move forward; collaborate with universities).
2-75	Develop testing methods.
4-58	Develop fast, effective screening technologies for toxics in products (e.g., x-ray fluorescence [XRF]).
4-143	To identify and eliminate impurities in chemicals, improve and fund research in new analytical methods for detection and quantification. Support for key process-related research could yield important new means to reduce the presence of unwanted toxics due to synthesis.

OPTION RT-3: Use green engineering research to develop and assess green designs and production processes.	
1-24	Do not focus exclusively on chemicals in products and chemical inputs. Manufacturing and production processes using chemicals should also receive attention in order to address health and safety concerns of workers. Address community concerns for inherent safety of chemical using or producing facilities.
2-102	Ensure that green chemistry will be governed by science. Examine the basis for assumptions about the adequacy of current protective measures in the process of identifying policy options. Understand both the burdens and benefits of new regulatory approaches. Acknowledge that engineering and process improvements are as much a part of "green chemistry" as product improvements or substitutions.

Chapter 7—Technical Assistance Options

Facilitating business transition toward green chemistry

SYNOPSIS

Stakeholders stated that technical assistance enables businesses, especially those that lack the necessary expertise or resources, to explore environmentally preferable alternatives for their processes and products. Even large and sophisticated companies can benefit an outside perspective, they said. Many business entities are willing to initiate such changes, particularly when presented with the potential to realize environmental and economic benefits. However, the time, expertise, and costs associated with identifying and evaluating alternatives can be high.

Technical assistance can take several forms: fact sheets, brochures, and checklists; hotline or duty officers to answer questions; regulatory and compliance information; electronic databases of information; software or programs that can be used to sort options or analyze alternatives; seminars, workshops, and symposia; on-site assessments and evaluations; and approved third party auditors and evaluations.

The three options presented in this chapter summarize the 98 options submitted during the Conversation with California. Roughly 12% of all comments referenced technical assistance. The options include:

- Providing technical assistance to businesses in evaluating alternatives;
- Establishing partnership networks to promote information sharing among state agencies, industry, academia, and the pubic; and,
- Publicizing guidelines, chemical databases, and evaluation tools.

This chapter addresses options for assisting industry in making sound environmental choices in designing and producing their products. A key element is access to information. Many of the stakeholders talked about information needs of “consumers” or “customers”. Comments related to these are primarily address under the Education and Outreach chapter. However, we acknowledge that businesses are also “consumers” or “customers” of other businesses that provide the goods or materials essential to their manufacturing processes. The information that is produced and made available to the general public may need to be displayed and accessed though different means than a technical assistance program designed for business and industry use.

BACKGROUND

Presented below is a list of some of the programs that were either specifically mentioned in the Green Chemistry discussions or exist within Cal/EPA:

- **DTSC**—The department provides technical assistance on green chemistry, pollution prevention, technology evaluation, and, to a lesser degree, life cycle assessment. Staff have worked with a number of California’s industry sectors, including: auto body and paint; vehicle service and repair industry; hospitals (mercury removal); chemical manufacturers; petroleum; semiconductor; pharmaceutical; and metal finishing industries. In addition to targeting industry sectors DTSC has done work on identifying

and promoting alternatives to specific waste stream such as solvents or products such as engine oil filters. DTSC often works in conjunction with local partners who assist with the outreach to small businesses.

- **DPR**—The department works closely with County Agricultural Commissioners to provide technical assistance to farmers, formulators and pesticide applicators. This assistance is broader than just answering compliance questions. DPR produces and distributes information on best management practices and safer alternatives such as Integrated Pest Management (IPM). DPR technical assistance efforts are not just limited to farmers. They also conduct focused outreach, education and assistance targeting schools and day care facilities.

- **CIWMB**—The board promotes and operates the Recycling Market Development Zone (RMDZ) Program with local zone managers and provides generic business assistance to companies not currently located within an RMDZ. Local resources combine with State-level incentives to create a tandem package of recycling business assistance services. State and local government join in a three-way partnership with business to boost the availability of recycled-content products. Typical technical assistance offered locally include help with siting; referrals to grants and financing; and a as help finding feedstock, marketing recycled products, networking, and advocacy.

- **ARB**—The board administers a Small Business Assistance Program through the Office of the Ombudsman. One of the goals is to ensure that everyone has access to the regulatory process and the information needed to operate within the rules. ARB also develops practical, rule-specific publications which describe source processes and emission control equipment, clarify rule requirements, identify compliance issues, and promote self-regulation for better compliance. Short self-inspection handbooks and longer, more detailed technical technical manuals for inspectors are available. ARB also periodically publishes Compliance Advisories. Information on pollution prevention practices can be found through ARB Business Assistance Program publications. For example, Pollution Prevention Primer, and Pollution Prevention Guide contain information that can help a business implement pollution prevention practices that will reduce waste, environmental impact, and operating costs.

- **SWRCB**—The board and regional boards conduct an outreach program, which has assembled specific education materials, activities, and contacts to help stakeholders achieve their water quality objectives. Specific industry and business links exist for agriculture, industrial and commercial operations, forestry, and manufacturing (which are now being developed).

- **USEPA**—The agency formed a partnership with a broad range of stakeholders for the Design for the Environment (DfE) Program. This program focuses on industries that combine the potential for chemical risk reduction and improvements in energy efficiency with a strong motivation to make lasting, positive changes. DfE convenes partners, including industry representatives and environmental groups, to develop goals and guide the work of the partnership. Partnership projects evaluate the human health and environmental considerations, performance, and cost of traditional and alternative technologies, materials, and processes. As incentives for participation and driving change, DfE offers unique technical tools, methodologies, and expertise. The USEPA DfE program has reached more than 200,000 business facilities and approximately 2 million workers.

- **University of California Cooperative Extension**—The service has farm, nutrition, family and consumer science advisors based in more than 50 county offices. In addition, Cooperative Extension specialists are headquartered at UC Berkeley, UC Davis, and UC Riverside, where they conduct research and coordinate advisors' activities. As a land-grant institution, the Cooperative Extension mandate is tied to the welfare, development, and protection of California agriculture, natural resources, and people. The county farm advisors' work is aimed at enhancing California agricultural productivity and competitiveness. Together with farmers, pest control advisors, and industry representatives, they identify current and emerging agricultural opportunities and problems.

DISCUSSION OF OPTIONS

OPTION TA-1:	***Provide technical assistance to businesses in evaluating alternative products and processes.***

Numerous stakeholders suggested that businesses need for technical assistance and inferred that technical assistance would facilitate implementation of green chemistry. For the most part, stakeholders did not give detailed comments on how to organize a technical assistance program. Instead, they highlighted several existing programs or features of those programs.

Participants told us that many programs exist and could be used as a model for a California program. Some commenters suggested expanding certain programs to include California. Several stakeholders point to the following programs in other jurisdictions:

- **Massachusetts Toxics Use Reduction Institute** (TURI) was established in 1990 through the passage of the Massachusetts Toxics Use Reduction Act. This far-reaching law was enacted to promote a new "preventive approach" to environmental protection, requiring over 600 firms in Massachusetts to inventory the toxic chemicals that they manufacture, process, or otherwise use; report annually on use of the chemicals; and create a plan for reducing or eliminating their use. The Institute was established to provide the education, research, and technical support services that promote the mission of the law. The Institute, which is often referred to simply as "TURI", was set up at the University of Massachusetts Lowell Campus to take advantage of the faculty and student resources of this long-recognized technical college. TURI is part of the state's toxics use reduction program, which is supported primarily by fees paid by Massachusetts companies that participate in the program.

- **Oregon Department of Environmental Quality Sustainability Program** involves using, developing, and protecting resources at a rate and in a manner that enables people to meet their current needs and also provides that future generations can meet their own needs. DEQ has a number of projects and programs that support sustainability. Its clients include: educational Institutions, industrial organizations, non-profit organizations, small business, administrative agencies, consumers, sustainableoregon.net communicates developments in Oregon state government and connects you with local agencies, organizations and businesses taking leadership roles in sustainable development.

Stakeholders remarked that the size, scope, and focus of a technical assistance program could be linked with other aspects of green chemistry. They said technical assistance programs do not happen in the abstract. Such programs need to be connected to research, information, databases, and the business community they are striving to serve.

Participants also told us that the scope of the services that could be provided range from preparing and distributing simple fact sheets to formal on-site technical assistance. Service providers can range from State and local staff, to university based advisory to private consultants who are in some way registered or approved by the state. The availability of funding will influence any decisions on technical assistance options. One stakeholder suggested that program funding could come from fees paid by businesses using toxic chemicals.

OPTION TA-2: Establish a partnership network for information sharing and dissemination.

Many comments discussed the need for technical assistance. In this option, they talked about who or how this assistance should be provided. Several commenters suggested some kind of technical center of excellence in green chemistry to research alternatives and provide technical assistance. Such a center could be sponsored by government, the University of California, or other universities. Most commonly it was suggested that it be operated in partnership with private industry. One stakeholder suggested a Green Chemistry Coordinating Council to collect and promote the sharing of information that highlights businesses with green practices and provide assistance to businesses lacking resources. Another stakeholder specifically suggested the use of third party experts to identify or develop viable alternatives.

Some existing partnerships were mentioned as possible models or starting points. These include: the UC Cooperative Extension Program, the USEPA Design for the Environment effort, the Department of Defense "green munitions" program, the DTSC partnership with California Chemical Industry Council, and the UC Berkeley Science Education Public Understanding Project.

One of the possible functions for a partnership or center could be to serve as a clearinghouse for information on safe or safer alternative. Others suggested that a web portal that provided access to chemical health and safety information that could be used by businesses to compare or rank alternatives. The Data Collection and Use chapter of this report expands on the need to acquire health and environmental impact information. A technical assistance program could be involved in sharing the results with businesses that need the information. Another stakeholder suggested partnering with the Department of General Services to develop information on green purchasing and to distribute this information to both local government and private businesses. A theme mentioned in several comments was the concept of stewardship programs as something that could help with greening the supply chain and addressing the cradle to cradle concerns. The American Chemical Council "Responsible Care" program, an industry lead program, was mentioned as an example.

Some other different kinds of technical assistance partnership were also offered as possibilities. One suggested a "mentoring" effort where large businesses could assist smaller businesses who make lack resources to evaluate alternatives. Another suggested partnering should be broader than just California and that we should look internationally for solutions to share or possibly work with the International Standards Organization to develop green technology standards that could be shared.

Interestingly, none of the comments on partnerships or centers specifically mentioned local programs. Yet, most of the existing technical assistance programs (see above) work closely with local agencies who serve as liaison or conduits in delivering information. Some pointed out that DTSC has a long history working with a network of local pollution prevention "champions".

OPTION TA-3: Publicize guidelines, chemical databases, evaluation tools, and other information to simplify the selection of preferable alternatives.

This option addresses content; what kinds of information businesses want or need, according to participants. This list of options in closely related to and intertwined with the research options. Stakeholders have said what they want some of this information may already exist other suggested needs will have to be developed first before it can be provided as a guideline or put into a readily available data base. The point of this option is to highlight where assistance is most needed or desired.

A re-occurring theme is that businesses need help in understanding what specifically constitutes "green chemistry". To this end, stakeholders identified the need for more information on what characteristics or attributes make for "green products". Businesses are looking for convenient, credible chemical evaluations or evaluation tools that they can use in making their choices. More specifically, some individuals suggested the need for automated web-based assessments to assist in product design and procurement. An example of this is the US Army Defense Ammunition Center work with Chemical Compliance Systems, Inc to web based modules that are used to analyze options. In the pharmaceutical industry, they have a more simplified approach which leads to certain chemicals being identified as ones that are too hazardous to pursue. A third example is some of the guidance distributed by DTSC to evaluate and compare solvent alternatives. One commenter was so specific as to suggest that a green chemistry symposium dedicated entirely to technology transfer be held.

Stakeholders encouraged that evaluations or evaluation tools should have the capability for use up and down the supply chain and that we should look internationally for sources that could be pulled into a database. Another common theme was the suggestion that "life cycle" (LCA) be brought in and applied to the evaluations. Several stakeholders also identified the need for some standardization in life cycle analysis so results are more comparable and transparent.

The recommendations went from simple lists of "safe chemicals" to recommending specific proprietary evaluation systems developed by private for profit companies. Some Stakeholders suggests, grading, ranking or scorecard with a wide range of latitude from the very simple (green-OK, yellow-caution, red-restricted or low-medium-high-very high) to very formal multimedia independently third party certified.

If a decision is made to include and pursue technical assistance, stakeholder said that attention must to be given to the types of information that will be developed and how it should be delivered to address the needs in the most cost effective fashion. For example, government sometimes think businesses are looking for information on cost effectiveness, fiscal impacts or financing options, yet relatively few of the comments identified this need. Again, the delivery of information through technical assistance is linked closely what information is needed and with the research to collect, compile and/or develop the material.

CHAPTER TEAM

The principal editors for this chapter were:

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Kim Wilhelm, DTSC

The chapter team worked closely with the overall team, whose members are given in the Acknowledgements. They compiled each of the technical assistance comments and organized those into the three major options in this chapter. The references are presented in the next section of this report.

Chapter 7—Technical Assistance Options

REFERENCES

The tables below cross-reference each option to Appendix B. The figures shown in the first column represent the "challenge area" and the option number.

OPTION TA-1: Provide technical assistance to businesses in evaluating alternative products and processes.	
1-181	Develop a technical center of excellence in green chemistry as a key element of the California Green Chemistry Initiative. The center would be available to provide technical assistance, lead development of a green chemistry curriculum for undergraduate and graduate programs, and conduct state-of-the-art research on green chemistry innovations.
2-21	Provide technical expertise to organizations lacking internal resources.
2-31	Establish fees on businesses that use toxic chemicals. Such fees should be used to fund agency toxics use reduction activities, including data analysis, and the provision of technical assistance.
2-41	P2: Design for the Environment Program
2-44	Support research, development, technical assistance, entrepreneurial activity, and education in green chemistry science and technology.
2-56	Disseminate information on accomplishments, best practices, costs, and benefits.
2-68	Promote the exchange of information about best management practices, incentives, and barriers among industries and corporations, and between industry and customers. One way to do this is through a mentoring program (e.g., large corporations mentoring small ones or via the American Chemical Council).
2-70	Ensure that information is transmitted through all consumers in the supply chain.
2-77	Provide technical assistance to industry.
2-96	Create a green business program to educate and encourage companies and recognize companies incorporating green chemistry practices.
2-132	Educate business groups; involve UC Extension.
2-176	Increase investment in pollution prevention in the short term as well as extension of the current CA Pollution Prevention model to downstream chemical users as an element of the long-term green chemistry strategy.
2-187	Develop a technical center of excellence in green chemistry. The center would provide technical assistance, lead development of a green chemistry curriculum for undergraduate and graduate programs, and conduct state-of-the-art research on green chemistry innovations.
2-208	Establish partnerships with other states to create an interstate clearing house of environmental safety and health data
2-261	Make educational programs a key component of its Green Chemistry Initiative.

OPTION TA-1: Provide technical assistance to businesses in evaluating alternative products and processes.	
3-27	Utilize any useful information developed by USEPA Design for the Environment program and work with industry and businesses to implement elements. These include: (a) Evaluate the human health and environmental impacts of its processes and products. (b) Identify what information is needed to make human health and environmental decisions (e.g., hazard characteristics data and identification of "safer" alternatives). (c) Consider cross-media impacts and the benefits of substituting chemicals. (d) Reduce the use and release of toxic chemicals through the innovation of cleaner technologies that use safer chemicals. (e) Reduce the use and release of toxic chemicals through the innovation of cleaner technologies that use safer chemicals. (f) Make products that can be more readily reused, refurbished, remanufactured, or recycled. (g) Monitor the environmental impacts and costs associated with each product or process. (h) Recognize that although change can be rapid, in many cases a cycle of evaluation and continuous improvement is needed. Partnerships with UC and CSUS could help implement these objectives. Incentives for applying these as core business practices might also help.
3-40	Work with industry to reduce toxics in products, and where that proves difficult because no safe alternative exists, California should require product take-back at no cost to the consumer. This shifts the physical and financial responsibility away from local governments and consumers back to the product manufacturer.
3-47	Promote chemical reclamation and recycling technology to reduce chemical waste, which in turn reduces chemical manufacture.
3-53	Work with major users of chemicals of very high and high concern to reduce or eliminate their use of these chemicals in their products.
3-114	Expand access to information on chemicals for consumers, businesses and regulators by leveraging its preeminence in data management and mining in order to organize the world's chemical data. For example, the dossiers for the USEPA High Production Volume (HPV) Chemical Challenge program, and the related European program are often difficult to find and the data difficult to extract. By partnering with the information technology sector (e.g., Internet search firms), the State could expand access to chemical information, support its local industry and raise awareness of chemical safety information currently available.
3-127	Rather than imposing regulatory burdens, promote innovation in green chemistry positive incentives and partnerships. Green chemistry should be encouraged through the sharing of expertise, financial support for research, information exchange, and public education. Incentives could be offered for companies to pursue and foster green chemistry and green engineering.
3-143	Strengthen the recognition and pursuit of green chemistry processes and products by establishing clear criteria and voluntary certification based on comprehensive lifecycle considerations. Equally important, consumers need to be educated about responsible choices and practices.
3-147	Increase investment in pollution prevention in the short term as well as extension of the current CA Pollution Prevention model to downstream chemical users as an element of the long-term green chemistry strategy. Pollution prevention programs and policies such as SB 14 have been promoted for quite some time, yet they never receive anywhere near adequate funding and attention. This suggests the possibility of 1) taking chemicals of top priority concern, 2) identifying the specific applications or industry uses posing the greatest risk from those chemicals, and 3) applying a collaborative process of agency, industry and third-party experts to identify or develop viable alternatives that can maintain efficacy, but reduce risk in those targeted applications
4-10	Educate companies on greener alternatives and penalize companies for selling toxic items
4-32	Provide assistance to small manufacturers and encourage pooling of resources to improve safeguards and quality control on inputs.

OPTION TA-1: Provide technical assistance to businesses in evaluating alternative products and processes.	
4-35	Develop international technology exchanges between companies to capture knowledge on how to successfully mass produce products using less toxic alternatives.
4-57	Encourage the use of existing environmental management systems (e.g., ISO 14000) and work with international standards setting organizations (e.g., International Organization for Standardization) to develop green chemistry technical standards.
4-59	Develop "demonstration projects" and workshops to address common green chemistry problems.
4-77	Review a case study to examine the factors that are useful and appropriate in determining what is "safer." For example, use flame-retardants to evaluate how best to identify a safer alternative (e.g., safer chemical, alternative non-chemical technology, change in performance standards etc.). Develop a technical and a layperson document describing the results of the case study, and use this information for developing policy and doing education and outreach.
4-98	Consider a wide range of incentives to motivate changes in the behavior of industry and consumers, including: production tax credits; rebates to consumers or business; investment tax credits; R&D tax credits; R&D grants; equipment grants; loans or loan guarantees; public infrastructure development; government support to deploy environmentally preferred products or technologies; public/private partnerships; employee training and workforce development; CEQA exemption on qualified projects or other regulatory relief and special status once qualified (fast track permits; environmental leaders programs) or other expedited permitting programs; government preferred purchasing or government sponsored preferences; government specified product standards; use of consensus standards; use of third party standards and certification; product labeling programs; web based consumer information.
4-120	Catalog, and make easily available, information regarding best practice screening processes, green chemical design, collaborative efforts, international efforts, and examples of product development decisions and substitutions that have resulted in reduced waste produced and energy inputs.
4-132	Based on the model collaboration between industry, state government, and a third party expert in identifying solvent substitutes under SB 14, take the following approach: 1) consider chemicals of top priority concern, 2) identify the specific applications or industry uses posing the greatest risk from those chemicals, and 3) apply a collaborative process of agency, industry and third-party experts to identify or develop viable alternatives that can maintain efficacy, but reduce risk in those targeted applications.

OPTION TA-2: Establish a partnership network for information sharing and dissemination.	
1-82	Look at other industries and partnership (e.g. the military's "green munitions" program) in order to make information (CCS tools) available.
1-115	Understand the information needed by businesses using chemicals to make informed choices and evaluate how to address these information needs throughout the supply chain (i.e., information transfer up and down the supply chain between manufacturers to chemical users).
1-180	Create a clearinghouse of best green chemistry practices. There are numerous initiatives being conducted around the world with an existing and developing body of knowledge that can be leveraged to speed implementation.
2-56	Disseminate information on accomplishments, best practices, costs, and benefits.
2-60	Develop and share production/use information (data on amounts, facility locations, and uses of chemicals; MSDS updated to include all data; consumer product contents disclosure)
2-67	Increase collaboration between UC, state agencies, and industry.
2-68	Promote the exchange of information about best management practices, incentives, and barriers among industries and corporations, and between industry and customers. One way to do this is through a mentoring program (e.g., large corporations mentoring small ones or the American Chemical Council).
2-91	Develop a more involved relationship between the industry and academia to develop and exchange toxicology information.
2-92	Look to universities to work on alternatives.
2-93	Recognize that companies are innovators. Companies and industry associations should be encouraged to share best practices in regards to green chemistry and sustainability including incentives and barriers. Large companies can mentor small companies.
2-97	Use large associations and organizations, such as the American Chemistry Council, to facilitate interactions between suppliers and customers, including mentoring.
2-98	Recognize the value and role of industry stewardship programs (e.g., American Chemistry Council's Responsible Care, which includes evaluations of chemical products and their uses to assure that they deliver their intended benefits while protecting public health and the environment, and a management system certified by third-party auditors) and create incentives for others to take similar steps.
2-111	Create a partnership between state, industry, the public, etc.
2-132	Educate business groups; involve UC Extension.
2-147	Increase collaboration of different agencies (i.e. government agencies should work together) as with in Canadian system.
2-156	Promote product stewardship and manufacturer responsibility, which will lead to greener products and production.
2-162	Encourage public private arrangements between universities and private industry, particularly as they relate to green chemistry solutions.
2-169	Consider how UC Berkeley's Science Education Public Understanding Project (SEPUP), and educational outreach program, might accelerate outreach and conversely how green chemistry concepts might be incorporated into the teaching modules.
2-172	Establish clear criteria and voluntary certification for green chemistry based on comprehensive lifecycle considerations (including energy, C02 impact, water usage, packaging, recyclability, etc.)

OPTION TA-2: Establish a partnership network for information sharing and dissemination.	
2-187	Develop a technical center of excellence in green chemistry. The center would provide technical assistance, lead development of a green chemistry curriculum for undergraduate and graduate programs, and conduct state- of- the- art research on green chemistry innovations.
2-192	Foster innovation and encourage universities, educational institutions, and industry to partner in developing effective “greener” ingredients that reduce environmental impact.
2-197	Support collaborative efforts to encourage public and private partnerships to develop “greener” products and “environmentally responsible” ingredients.
2-208	Establish partnerships with other states to create an interstate clearing house of environmental safety and health data.
2-258	Include the following policy elements to further green chemistry in California: 1) strengthen the recognition and pursuit of green chemistry processes and products by establishing clear criteria and voluntary certification based on comprehensive lifecycle considerations; 2) explore models to provide needed chemical hazard data throughout the supply chain; 3) establish a green chemistry coordination council to collect and promote the sharing of information, highlight businesses with green practices, provide assistance to businesses lacking resources, and educate consumers; 4) prioritize chemicals for screening, testing and appropriate restrictions; 5) greater investment in pollution prevention in the short term as well as extension of the current ca pollution prevention model to downstream chemical users; and 6) continue the Conversation with California to sustain progress in green chemistry.
3-8	Ban the use of single-use polystyrene and other plastic/non-biodegradable polymer materials in order to protect the natural environment for present and future generations, exercise environmental stewardship by reducing the amount of polystyrene and other non-biodegradable polymeric substances that enters our waste stream, storm drains, watershed and coastal environment.
3-9	Work with the military and aerospace industry as well as the plating industry, to evaluate and revise outdated mill specifications to allow for more "environmentally friendly" plating chemistries. Technological advances have generated more environmentally friendly electroplating technologies (e.g., cyanide-free plating solutions). However, a widespread switch to more "green" plating practices has been hampered by outdated "milspecs" (i.e., the military specifications for most plating done for military and aerospace applications).
3-27	Utilize any useful information developed by USEPA Design for the Environment program and work with industry and businesses to implement elements. These include: (a) Evaluate the human health and environmental impacts of its processes and products. (b) Identify what information is needed to make human health and environmental decisions (e.g., hazard characteristics data and identification of “safer” alternatives). (c) Consider cross-media impacts and the benefits of substituting chemicals. (d) Reduce the use and release of toxic chemicals through the innovation of cleaner technologies that use safer chemicals. (e) Reduce the use and release of toxic chemicals through the innovation of cleaner technologies that use safer chemicals. (f) Make products that can be more readily reused, refurbished, remanufactured, or recycled. (g) Monitor the environmental impacts and costs associated with each product or process. (h) Recognize that although change can be rapid, in many cases a cycle of evaluation and continuous improvement is needed. Partnerships with UC and CSUS could help implement these objectives. Incentives for applying these as core business practices might also help.
3-33	Work with other state agencies including DGS to develop information on green purchasing, and disseminate this information to counties and cities and to private sector businesses for their use.

OPTION TA-2: Establish a partnership network for information sharing and dissemination.	
3-65	Establish partnerships with states to create an interstate clearing house of environmental health and safety data.
3-111	For alternatives identified, require a separate life cycle assessment by an outside party, or state-funded Center for Excellence in order to confirm that there is no loss in performance with the alternative, to avoid unintended consequences, and to assist in commercialization. The state also could develop a cooperative extension-type program to assist companies in cradle-to-cradle product design/formulation and assist in adoption of new alternative chemistries and processes. .
3-120	In pursuing the objective of the Green Chemistry Initiative to expand toxicology information on chemicals, encourage the use of alternatives to animal testing and require testing only as a last resort. Work with other experts to provide assistance on alternative screening methodologies that can be utilized to provide adequate toxicology information for recommendations and decisions about priority chemical uses.
3-130	Push collaborative efforts to encourage public and private partnerships, with a goal of developing greener products and environmentally responsible ingredients based on life cycle considerations, rather than mandatory and voluntary state labeling programs that endorse green products or programs that stipulate a single third-party certification of green products or numerical ranking.
3-145	Establish a Green Chemistry Coordination Council to collect and promote the sharing of information, highlight businesses with green practices, provide assistance to businesses lacking resources, and educate consumers. Catalog and make easily available information regarding best practice screening processes, green chemical design, collaborative efforts such as the ACS Green Chemistry Institute, and international efforts such as the Global Harmonization System. All stakeholders still have a lot to learn in this dynamic area, and everyone stands to gain from continued information sharing. DTSC's leadership in this area should be continued by establishing it as a central clearinghouse of information for the state and beyond. We further suggest building upon and making readily available the information provided by existing efforts: ACS Green Chemistry Institute, Cleangredients, USEPA Design for Environment Program, Performance Track, the chemical industry's HPV testing program, eChemPortal, EPEAT, and DTSC Technical Resource Center.
3-147	Increase investment in pollution prevention in the short term as well as extension of the current CA Pollution Prevention model to downstream chemical users as an element of the long term green chemistry strategy. Pollution prevention programs and policies such as SB 14 have been promoted for quite some time, yet they never receive anywhere near adequate funding and attention. This suggests the possibility of 1) taking chemicals of top priority concern, 2) identifying the specific applications or industry uses posing the greatest risk from those chemicals, and 3) applying a collaborative process of agency, industry and third-party experts to identify or develop viable alternatives that can maintain efficacy, but reduce risk in those targeted applications.
3-155	Engage in collaborative efforts to encourage public and private partnerships with the goal of developing "greener" products and "environmentally responsible" ingredients rather than mandatory and voluntary state labeling programs that endorse green products or programs that stipulate a single third-party certification of green products.
3-165	Product stewardship programs, designed to better management throughout the supply chain of the substance, & continued minimization of the impact of the substance, should be recognized & encouraged.
4-10	Educate companies on greener alternatives and penalize companies for selling toxic items
4-32	Provide assistance to small manufacturers and encourage pooling of resources to improve safeguards and quality control on inputs.
4-35	Develop international technology exchanges between companies to capture knowledge on how to successfully mass produce products using less toxic alternatives

OPTION TA-2: Establish a partnership network for information sharing and dissemination.	
4-57	Encourage the use of existing environmental management systems (e.g., ISO 14000) and work with international standards setting organizations (e.g., International Organization for Standardization) to develop green chemistry technical standards
4-112	Develop an extension service through the UC system to promote successful green chemistry methods/processes.
4-119	Establish a Green Chemistry Coordination Council to collect and promote the sharing of information and successful programs and to provide assistance to businesses lacking resources.
4-128	Develop a technical center of excellence in green chemistry to provide technical assistance, lead development of a green chemistry curriculum for undergraduate and graduate programs and conduct state-of-the-art research on green chemistry innovations.

OPTION TA-3:	***Publicize guidelines, chemical databases, evaluation tools and other information to simplify the selection of preferable alternatives***
1-42	Use an automated, web-based assessment of "green" chemicals, products, and processes for product design and procurement.
1-73	In 2000, the U.S. Army Defense Ammunition Center (DAC) began working with Chemical Compliance Systems, Inc. (CCS) to use CSS's extensive centralized Relational Chemical and Product Databases as the basis for a series of integrated, web-based modules within what has become the Munitions Analytical Compliance Suite (MACS). (CCS's centralized databases included over 650 regulatory lists.) MACS include eight modules. In a few months, the 9th and 10th automated modules the Emissions Risk Assessment and Human Health Risk Assessment–will be added. The most comprehensive of the MACS modules is the "Green" Munitions Analytical Compliance System (G-MACS).
1-115	Understand the information needed by businesses using chemicals to make informed choices and evaluate how to address these information needs throughout the supply chain (i.e., information transfer up and down the supply chain between manufacturers to chemical users).
1-116	Encourage greater collaboration and partnership across disciplines and institutions to increase overall knowledge. For example, consider the model of how pharmaceutical companies make decisions on which chemicals are too hazardous to pursue.
1-120	Create a unified database that includes data from sources around the world. This database would have to be designed to be accessible to different users (chemical product users; consumers, etc) and should be made public. (The "E-Chem" unified data portal newly introduced by OECD might be considered a "baby step" toward this.)
1-126	Combine life cycle analysis with trade-off rules, boundaries, and critical thinking. Understanding the purpose of the analysis and the good or service delivered allows for a good comparative analysis. However, there are a number of potential problems that must be considered to ensure good results.
1-137	As a key material solutions partner, work with our customers and their customers to better understand the impact of the product throughout its life cycle so they can make better informed decisions.
1-150	Give people at the business and community level a tool that will work for them.
1-180	Create a clearinghouse of best green chemistry practices. There are numerous initiatives being conducted around the world with an existing and developing body of knowledge that can be leveraged to speed implementation.
2-10	Develop a centralized database of chemicals and properties.
2-43	Strengthen government tools for identifying, prioritizing, and mitigating chemical hazards.
2-69	Create a database of "safe" chemical alternatives.
2-70	Ensure that information is transmitted through all consumers in the supply chain.
2-100	Utilize Chemical Compliance Systems, Inc. and their Green Product Compliance Analytical System, Green Process Analytical Compliance System and Green Munitions Analytical Compliance System web-based tools, developed for the U.S. Defense Ammunition Center to assess munitions from a green perspective (considers 43 ecological health and safety criteria)
2-103	Purchase the Chemical Compliance System's (www.chemply.com) Hazardous Material Management System database, which provides information on over 220,000 chemicals and their environmental characteristics. Making this tool available on the web will enable informed choices by consumers and assist in the selection of chemicals based on scores for ecology, human health, and safety.

OPTION TA-3:	***Publicize guidelines, chemical databases, evaluation tools and other information to simplify the selection of preferable alternatives***
2-108	Classify or rank existing chemicals (green, light green, yellow, and red).
2-115	Clarify the scope of "Green Chemistry."
2-117	Develop criteria for determining safe alternatives, including multi-media considerations; identify and publicize safe alternatives.
2-129	Establish a process, rather than creating a list; lists are only as good as the data (need current, accurate data).
2-131	Establish a "green seal," reflecting a specified level of greenness, or certification of approval.
2-137	Develop a grading or award system for products that meet certain green criteria as a joint effort within Cal/EPA; use of both green energy and green chemistry technologies should be considered. A standard, easily recognizable green logo could be used, reflecting different levels of "greenness" (bronze, silver, gold, and platinum); this would enable consumers to choose green products and motivate manufacturers to invest research and energy into the development of green products.
2-151	Identify less hazardous chemicals, as Canada did.
2-285	Inform substitution decisions in terms of the characteristics and risks presented by potential alternatives.
2-286	Create a “green chemistry scorecard” for suppliers, which would allow specific materials and their applications to be rewarded through favored purchasing policies.
2-287	Develop a matrix of information about the hazard traits of chemicals in use or considered for use, presented in ways that are useful for various audiences.
2-288	Fund development of the ingredient database.
2-300	Create an easily understood matrix of all chemicals currently in use with information on their hazard traits and biological consequences for use by downstream users, consumers, and other interested parties.
3-1	Develop science-based criteria for determining whether a particular product is greener or safer than alternatives.
3-4	Since well-informed consumers will not only handle and dispose of chemicals more safely, and will demand safer products with closed loop lifecycles, expand consumer education regarding product life cycle costs and impacts (e.g. appropriate selection, use, disposal, and alternative materials or practices). Disseminating information could occur through traditional media as well as outreach through community partners as well as the private sector. Educate people how chemicals are created, screened for use, and managed through a process. Show people “a day in the life of a chemical.” 2. California should provide complete transparent chemical risk information in a way the public can access, understand, and absorb.
3-112	Develop database of chemical alternatives that compares a number of sustainability parameters: performance, price, human health and environmental (e.g., toxicity, bioaccumulation, persistence) including carbon footprint and source sustainability.
3-143	Strengthen the recognition and pursuit of green chemistry processes and products by establishing clear criteria and voluntary certification based on comprehensive lifecycle considerations. Equally important, consumers need to be educated about responsible choices and practices.

OPTION TA-3:	***Publicize guidelines, chemical databases, evaluation tools and other information to simplify the selection of preferable alternatives***
3-145	Establish a Green Chemistry Coordination Council to collect and promote the sharing of information, highlight businesses with green practices, provide assistance to businesses lacking resources, and educate consumers. Catalog and make easily available information regarding best practice screening processes, green chemical design, collaborative efforts such as the ACS Green Chemistry Institute, and international efforts such as the Global Harmonization System. All stakeholders still have a lot to learn in this dynamic area, and everyone stands to gain from continued information sharing. DTSC's leadership in this area should be continued by establishing it as a central clearinghouse of information for the state and beyond. We further suggest building upon and making readily available the information provided by existing efforts: ACS Green Chemistry Institute, Cleangredients, USEPA Design for Environment Program, Performance Track, the chemical industry's HPV testing program, eChemPortal, EPEAT, and DTSC Technical Resource Center.
3-173	Provide clear and transparent characterization of chemical hazards to the public. Many entities can and are making decisions and take action that contribute to adoption of safer or lower hazard chemicals and products. To support such efforts, businesses, agencies, and the public need comprehensive, current, accurate, and reliable information about the relative hazard of different chemicals. The State of California should develop a matrix of information about the hazard traits of chemicals in use or considered for use, presented in ways that are useful and understandable to various audiences. This matrix should also make clear when gaps in data exist, so that businesses and individuals can choose to avoid chemicals with unknown hazards as well as those that are higher hazard
4-1	Chemicals should be assessed within the context of alternatives. Criteria for better or worse green products should be clear.
4-23	Develop a "green" rating system for products with agreed upon criteria
4-71	Create a list to be posted on the Internet of "bad actor" chemicals that have been found in products and the associated suppliers/manufacturers
4-141	Create a database on alternatives that compares a number of sustainability parameters: performance, price, human health and environmental (e.g., toxicity, bioaccumulation, persistence) including carbon footprint and source sustainability.

Chapter 8—Recognition, Awards, and Certification Options

Using recognition programs to stimulate green chemistry

SYNOPSIS

Awards and certification programs recognize the progress businesses are making toward green chemistry in their products and processes and help businesses and the public to identify and select certified alternatives. Stakeholders submitted 18 options, which are organized as two options in this chapter:

- Developing an awards program to publicly recognize green chemistry achievement and guide environmentally preferable purchasing and
- Establishing a program with specified criteria to certify and promote green products and services.

Throughout the Green Chemistry Initiative, at the symposia, and in other meetings, participants commented how recognition programs can help stimulate green chemistry. They frequently mentioned awards and recognition programs as "consensus" ideas. Stakeholders told us that many consumers and businesses in California are willing to preferentially select environmentally friendly products and services, but lack reliable, neutral, and accessible information to effectively make such choices. Many businesses, the said, also cite positive public recognition as a motivating factor for their green business decisions. Many comments recommended setting clear criteria for certifying products or granting awards with associated labels or logos. Altogether, recognition, awards, and certification ideas represent roughly 13% of the total number of comments submitted during the Conversation with California.

BACKGROUND

Although a detailed survey of existing recognition programs was not conducted, stakeholders mentioned a variety of current programs, in industry, in other states, and in other countries. Cal/EPA administers the following award programs:

- Governor's Environmental and Economic Leadership Award: An annual program recognizing notable, voluntary contributions which conserve resources, protect and enhance our environment, and build public-private partnerships.
- Pollution Prevention Program: A DTSC program recognizing businesses through the Mercury Elimination Leadership Program and vehicle service and repair model shop program.
- DTSC and Chemical Industry Council of California (CICC) Pollution Prevention Challenge Program. The department and CICC jointly developed this program as part of the pollution prevention workplan for 2006-08 (pursuant to the *Hazardous Waste Source Reduction and Management Review Act of 1989*[22/]). The program recognizes accomplishments in pollution prevention, waste reduction, and other environmentally friendly practices by members of CICC. Awards were presented to three California companies in 2007.

- Cal/EPA Environmental Technology Certification Program: From 1994 to 2002, the award-winning California Environmental Technology Certification Program (CalCert) was an independent, recognized scientific and engineering evaluation of environmental performance. Technology manufacturers and developers defined their performance claims and submitted supporting data to Cal/EPA. Staff reviewed the information, and when necessary, required additional testing to verify claims. The technologies, equipment, and products that are were proven received certification verifying their performance claims. The program was voluntary and self-supporting, which meant participating companies paid the cost of evaluating and certifying claims.

  CalCert recognition gave products, processes, and equipment greater visibility in the market and offered credibility to those technologies proven to have an environmental benefit. The Cal/EPA program partnered with and assisted in launching similar programs in six other states, the USEPA ETV program, the Canadian program (now known as Environmental Choice).

  Due to the current budget shortfall for the State of California, and associated budget uncertainty, Cal/EPA is not accepting any new applications into the Environmental Technology Certification Program. Although still authorized in several state statutes, the program is moribund.

DISCUSSION OF OPTIONS

OPTION RAC-1: Develop an awards program to publicly recognize green chemistry achievement and guide environmentally preferred purchasing.

The challenge of motivating businesses to develop and select safer alternatives with fewer environmental and health impacts is a key component of green chemistry. Stakeholders told us that a variety of incentives can stimulate this type of innovation and change within a company or an industry, including recognition of significant and noteworthy efforts through an awards program. Awards programs, they said, can be structured around specified criteria or may be developed to be more competitive, in which only outstanding candidates are honored.
To stimulate creativity, an awards program can focus on specific products, inventions, processes, or even ideas. Several commenters to the "Conversation with California" identified some of the more well-known awards programs, which are highlighted below. This is not an exhaustive list, however, of existing private or public sector programs.

According to commenters, the primary benefit of an awards program is the recognition and honor conferred by the award. They stated awards identify the recipient as a leader in green chemistry, raising its profile within its industry and market. A green chemistry award can also offer a secondary benefit to consumers by identifying manufacturers and products that have received awards for green chemistry. Increasing consumer uncertainty over the safety of a variety of common consumer products has resulted in a growing public preference for safer and greener alternatives. Among the options submitted, some suggested that a list of green chemistry award winners would help provide a level of assurance to consumers wanting to make green buying decisions and can result in greater sales for award recipients. An on-line list of green chemistry award winners intended for the general public would make the information particularly accessible, they asserted.

Several commenters said an awards program could be developed and administered by government as a stand-alone initiative, or the State could form a partnership with a third party to sponsor a program. Examples of existing green chemistry awards, cited in the comments during the Conversation with California, include:

- **Presidential Green Chemistry Awards**. Since 1996, USEPA has partnered with the chemical community to present the annual "Presidential Green Chemistry Challenge Awards." This awards program recognizes work that incorporates the principles of green chemistry to help achieve pollution prevention. The program typically gives awards for achievements in five categories: small business; academics; the use of greener synthetic pathways; the use of greener reaction conditions; and the design of greener chemicals. Nominations are judged by an independent panel of experts convened by the American Chemical Society using award selection criteria that focus on science and innovation, human health and environmental benefits, and applicability.

  Although the program does not provide independent green chemistry grants, it has supported the USEPA and National Science Foundation (NSF) partnership for environmental research. In the past, "Technology for a Sustainable Environment" grant solicitations have been available through this partnership to addresses the technological and environmental issues of design, synthesis, processing, production, and use of products in continuous and discrete manufacturing industries.

- **USEPA National Program for Environmental Priorities (NPEP)** is a voluntary program administered by the federal agency; it recognizes companies for accomplishments in areas such as waste and energy reduction, water conservation, and other environmental areas. NPEP encourages public and private organizations to form voluntary partnerships with USEPA that reduce the use or release of any of 31 priority chemicals. Ultimately, the program's goal is to work with industry and the public to reduce the use or release of 4 million pounds of priority chemicals by 2011. Organizations interested in becoming NPEP partners are eligible to receive public recognition for their contributions.

- **England's Green Chemistry Network,** which the Royal Society of Chemistry initially organized and supported, is a self-supporting endeavor housed within the Department of Chemistry at the University of York. The Green Chemistry network promotes green chemistry education, training, and practice through a variety of efforts including awards and prizes:

  - The IChemE environment awards, given since 2003, for sustainable development. Awards focus on reducing impact on the environment and for excellence in green chemistry and engineering;

  - The Crystal Faraday Green Chemical Technology awards, which celebrate outstanding achievement in the commercialization of green and sustainable chemical technology. These also have been awarded since 2003.

  - The UK Green Chemistry Awards, offered by the Royal Society of Chemistry since 2000.

- **Australian Green Chemistry Challenge Awards** have been offered since 1999 by the Royal Chemical Australian Institute (RACI). The Australian Green Chemistry Challenge

Awards recognize and promote fundamental and innovative chemical methods that accomplish pollution prevention through source reduction and that have broad applicability in industry. These awards also recognize contributions to education in green chemistry. The Green Chemistry Challenge Awards are open to all individuals, groups and organizations, both non-profit and for profit, including academia, government, and industry. The nominated technology must have reached a significant milestone within the past five years in Australia (e.g. one that has been researched, demonstrated, implemented, applied, patented, etc.). The awards must be an example of one of three green chemistry focus areas: alternative synthetic pathways; alternative reaction conditions; or the design of alternative safer or less toxic chemicals. In addition, the awards must benefit human health or the environment, and must be applicable to a large and broad-based segment of chemical manufacturers, users, or society. The award categories include small business, an academic or government institution, and green chemistry education.

- **Germany Haltermann Innovation Prize** started in 1998 and is awarded every two years for chemical-technical developments in the areas of product and process integrated environmental protection. The special emphasis is on processes for substance separation and environmentally sound products based on renewable resources.

- **Italian Green Chemistry Award** had its first deadline early in 1999. The 50 nominations were judged on scientific merit and economic and environmental impact. The first awards were given in March 1999 in the categories: (1) processes, (2) products, and (3) recycling.

- **American Chemical Society (ACS)** provides a number of recognition and monetary awards for green chemistry activities.[23] Two notable examples are the Kenneth G. Hancock Memorial Award, which honors outstanding student contributions to green chemistry, and the ACS National Award for Affordable Green Chemistry, which recognizes innovations in green chemistry that are less costly or of comparable costs to traditional counterparts.

OPTION RAC-2:	***Establish a program with specified criteria to certify and promote green products and services. Use existing certification programs, such as USEPA's Technology Verification Program, LEED Certification, or the Blue Angel, as models.***

To translate green chemistry innovations into permanent shifts toward safer products and production processes, commenters said a green chemistry program needs a mechanism to promote alternatives that are developed. Throughout the Conversation with California, stakeholders referenced a number of certification programs and how they can stimulate green chemistry by providing consumers with the purchasing information they need to make greener choices. For example, a green chemistry certification could inform buyers that products meet reliable standards or criteria.

Among the options submitted, several commenters suggested that California could develop a certification program that recognizes businesses that utilize green technology or product green products and services. A recognizable "green seal" or other type of standardized, easily recognized logo would identify certified products with relative levels or grades of green achievement designated on the product labels. Typically, participants noted, these types of programs are voluntary. These approaches can help to promote green products, increasing market

exposure, enabling consumers to choose green products, and motivating manufacturers to invest research and energy into the development of green products. They also suggested that government could promote green-certified products on government websites and provide links to the criteria used to grant the certification. Some contributors suggested that recognition or certification of green chemistry processes and products could be based on comprehensive life cycle considerations. Others suggested establishing a registry for companies seeking to align their business practices with green chemistry principles. Such a registry could accumulate examples of product development decisions and substitutions that have resulted in reduced waste produced and energy inputs.

Commenters said the criteria used for certification programs are critical to the acceptance and usefulness of the certifications. Both green energy and green chemistry technologies could be considered as criteria, as well as, energy use, waste generation, use of recyclable materials, and use of non-toxic ingredients. They recommended drawing on existing certification processes and criteria to serve as models. Green business programs, established in a number of California counties, certify businesses that adhere to greener practices. Other certification programs for green technology include the USEPA Environmental Technology Verification Program, the German Blue Angel environmental certification process, Green Seal, Energy Star, and Green Buildings/LEED certifications. From the comments received, several of these programs are described below:

- **Green Business Programs**. Green business programs, which certify that businesses meet specified standards of environmental performance, can be an effective means of stimulating green practices by companies, stakeholders said. Several programs administered by local governments were noted in the comments. For example, over 20 different industries, including auto repair shops, printers, hotels, restaurants, landscapers, wineries, janitorial and laundry services, grocery and retail stores, home remodelers, attorneys, architects, engineers, gift services, and a variety of office and home-based businesses, have successfully met the standards and are now recognized as Bay Area Green Businesses.

- **USEPA Environmental Technology Verification (ETV) Program** was established in 1995 to verify (not "certify") the performance of specific claims about innovative environmental technologies. Among the ETV program goals, the agency seeks performance data needed for widespread acceptance and implementation of new technologies. USEPA partners with independent testing organizations to develop test methods and protocols to assess innovative technologies in a variety of categories.

- **German Blue Angel** is the oldest environment-related label for products and services. Created in 1977 by the German government and administered by its environmental agencies, the Blue Angel eco-label promotes both environmental protection and consumer protection. It is awarded to products and services which are environmentally beneficial and which also promote occupational and consumer health and safety. Important factors include economical use of raw materials, production, usage, service life and disposal. Products awarded the label bear the logo of the Blue Angel directly on the product, while service companies use it on materials used to offer their services. About 3,700 products and services in 80 product categories currently have been granted the Blue Angel label.

- **LEED (Leadership in Energy and Environmental Design).** In 1998, the United States Green Building Council (USGBC) launched its "Leadership in Energy and Environmental Design" (LEED) program. The program instituted a rating system to identify and certify "green" buildings. In this program, external reviewers evaluate the environmental performance (inside and out) from a whole building perspective using life cycle analysis. Certification can be obtained for new construction projects as well as existing buildings and homes. It is a performance-oriented system where points are earned for satisfying specified criteria. Different levels of certification can be achieved based on the number of points earned, namely "certified, silver, gold, and platinum."

  A LEED applicant can earn points in six categories:

  - sustainable sites
  - water efficiency
  - energy and atmosphere
  - materials and resources
  - indoor environmental quality, and
  - innovation in upgrades, operation, and maintenance.

  The United States Green Building Council is a non-profit organization established in 1993 to promote the construction, maintenance, and certification of sustainable buildings (green buildings). Many stakeholders said the council is considered a consensus organization; the membership, which includes representatives in the following fields: architects, attorneys, builders, contractors, consultants, corporations, retail businesses, engineers, lending institutions, interior designers, landscape architects, city planners, environmental organizations, universities, media, utilities companies, and federal, state, local and agencies.

- **Green Seal.** The Green Seal organization presents a product or service with a "Green Seal" if it meets the environmental standard for its category, as demonstrated by rigorous evaluation, testing, and a plant visit. The non-profit organization uses a life cycle approach, evaluating a product or service throughout its development and production, from material extraction, through manufacturing and use, and ending with recycling and disposal. The Green Seal may be used on the product, on packaging, in advertising, promotional materials, catalogs, and in product descriptions. Green Seal charges applicants a fee based on the preliminary application for the assessment and certification service.

  Green Seal develops its standards with widespread input from a diverse group of stakeholders, including manufacturers, trade associations, universities, environmental and consumer groups, government officials, and the public. When a final standard is published, Green Seal provides a written response to all the comments received, and opens the standard to a formal appeal. Green Seal periodically reviews and updates its standards to reflect advances in technology and the marketplace.

  Green Seal supplements its in-house technical staff through partnerships with research institutions and individual experts around the world. Its primary research partner is the Center for Clean Products and Clean Technologies at the University of Tennessee at Knoxville. Other Green Seal partners include: Ecos Consulting Services, Healthy

Housekeeping Solutions, JP Kusz Ltd., GreenShift, Environmental Problem Solving Enterprises, GreenGuard, and Woolsafe.

- **Environmental Choice.** Begun in Canada and now operating in North America, the Environmental Choice Program (ECP) certifies and recognizes products and services that are environmentally preferable. It develops and promotes higher standards of environmental performance against which products and services can be assessed.

  These higher standards are called "Certification Criteria Documents" (or CCDs) and contain the exact environmental and performance requirements an applicant must meet to become ECP certified. CCDs are developed in cooperation with a broad range of stakeholders including representation from industry, environmental groups, consumer groups, academia and government. The criteria are intended to encourage and recognize reduced environmental impacts, to outline appropriate performance characteristics and to be challenging yet feasible. An important part of this development process is the four to eight week public review period in which comments are solicited from any interested stakeholders and the general public. Comments submitted to the ECP during this period are considered and the criteria revised accordingly. EcoLogo, which offers the Environmental Choice seal, belongs to the Canadian Government. The program is run by TerraChoice Environmental Marketing.

- **Scientific Certification Systems**. SCS is a third party evaluation and certification organization. Its programs focus on agriculture, electricity, manufactured goods, forestry, and fisheries. SCS provides certification, auditing and testing services, and standards. Their goal is to recognize the highest levels of performance in food safety and quality, environmental protection and social responsibility in the private and public sectors, and to stimulate continuous improvement in sustainable development.

CHAPTER TEAM

The principal editors for this chapter were:

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The chapter team worked closely with the overall team, whose members are given in the Acknowledgements. They compiled each of comments about recognition, award, and certification ideas; these are organized as two options in this chapter. The references for those two major options are presented in the next section of this report.

Chapter 8—Recognition, Awards, and Certification Options

REFERENCES

The tables below cross-reference each option to Appendix B. The figures shown in the first column represent the "challenge area" and the option number.

OPTION RAC-1: Develop an awards program to publicly recognize green chemistry achievement and guide environmentally preferred purchasing.	
2-56	Disseminate information on accomplishments, best practices, costs, and benefits.
2-84	Develop a program to recognize green chemistry achievement, such as awards
2-96	Create a green business program to educate and encourage companies and recognize companies incorporating green chemistry practices.
2-98	Recognize the value and role of industry stewardship programs (e.g., American Chemistry Council's Responsible Care, which includes evaluations of chemical products and their uses to assure that they deliver their intended benefits while protecting public health and the environment, and a management system certified by third-party auditors) and create incentives for others to take similar steps
2-112	Offer incentives or awards for good ideas on products or project. Establish a "green inventor" or "imagineer" award.
2-136	Recognize and award green products because they can lead to greater sales and preferential purchase by environmentally conscious consumers. Use a logo in recognition or award program; see German Blue Angel award.
2-138	Include information geared towards the general public, particularly related to the purchase and use of certain products. Include: lists of manufacturers and products that have received "green" awards; information on the environmental impacts of plastics; greener alternatives to household chemicals; disposal options for universal waste; information on green chemistry; and a page called "What can I do to help the environment?" Increase awareness and enable the general public to put greater pressure on manufacturers and legislatures to make green chemistry and environmental protection a priority.

OPTION RAC-2: Establish a program with specified criteria to certify and promote green products and services. Use existing certification programs, such as USEPA Technology Verification Program, LEED Certification, or The Blue Angel, as models.	
1-131	Provide consumers with accurate information upon which they can make informed decisions could be a very useful tool in driving changes. There are many programs that are predicated on consumer choice. Cars are labeled with expected fuel efficiency ratings. Major home appliances have energy labels that can be used for comparisons. Plumbing fixtures show the water use. The clear intent is that consumers will use these labels to make more informed purchasing decisions.
1-132	Polls have shown that consumers want to have the information they desire readily available to them so that they are able to make informed decisions about the products they purchase. This must be a shared responsibility of the value chain.
2-53	Consider a certification program for green technology similar to USEPA ETV program
2-79	Develop labeling process for identifying and comparing green products and green product certification.
2-88	Develop a credible and effective third party labeling system for green products
2-131	Establish a "green seal," reflecting a specified level of greenness, or certification of approval.
2-134	Use Green Buildings LEED Certification as a model for green labeling or product certification. Include the following as criteria: use of green energy during manufacturing, waste generation, use of recyclable materials, use of non-toxic ingredients.
2-136	Recognize and award green products because they can lead to greater sales and preferential purchase by environmentally conscious consumers. Use a logo in recognition or award program; see German Blue Angel award.
2-137	Develop a grading or award system for products that meet certain green criteria as a joint effort within Cal/EPA. Consider green energy and green chemistry technologies. A standard, easily recognizable green logo could be used, reflecting different levels of "greenness" (bronze, silver, gold, and platinum). This would enable consumers to choose green products and motivate manufacturers to invest research and energy into the development of green products.
2-138	Include information geared towards the general public, particularly related to the purchase and use of certain products. Include: lists of manufacturers and products that have received "green" awards; information on the environmental impacts of plastics; greener alternatives to household chemicals; disposal options for universal waste; information on green chemistry; and a page called "What can I do to help the environment?" Increase awareness and enable the general public to put greater pressure on manufacturers and legislatures to make green chemistry and environmental protection a priority.
2-139	Use environmental certification in Germany, "The Blue Angel," as a model for the certification of products and services.
4-23	Develop a "green" rating system for products with agreed upon criteria
4-36	Encourage media publicity and engagement on toxics in products.

Endnotes

1. Chapter 1218, Statutes of 1989, adding article 11.9 (commencing with section 25244.12, chapter 6.5, division 20) of the Health and Safety Code (Senate Bill 14).

2. More information about the US program is posted at http://www.cdc.gov/exposurereport/default.htm

3. Chapter 599, Statutes of 2006, adding chapter 8 (commencing with section 105440, part 5, division 10) of the Health and Safety Code (Senate Bill 1379, Perata).

4. For more information on this database, see www.epa.gov/iris/intro.htm.

5. Examples of how QSARs are used in federal programs are posted at:

   www.oehha.ca.gov/multimedia/green/pdf/MathewsOct2_07.pdf
   www.oehha.ca.gov/multimedia/green/pdf/HenryOct2_07.pdf

6. More information is posted at http://www.epa.gov/pbt/tools/toolbox.htm.

7. More information is posted at http://www.ec.gc.ca/CEPARegistry/the_act/.

8. More information is posted at http://ec.europa.eu/enterprise/reach/index_en.htm.

9. More information is posted at http://www.mass.gov/dep/toxics/toxicsus.htm

10. More information is posted at http://www.deq.state.or.us/wmc/hw/tuwrap/tur.html

11. Dolphin Software offers a series of tools that integrates MSDS automation, regulatory compliance, hazard communication, environmental reporting, inventory management and total chemical management in one solution. More information is posted at http://www.dolphinmsds.com/default.asp?id=17

12. Developed by the non-profit Clean Production Action, the Green Screen evaluates the environmental preferability of chemicals based on four benchmarks, each defining a progressively safer chemical. More information is posted at http://www.cleanproduction.org/Green.Greenscreen.php

13. Chemical Compliance Systems, Inc. has developed hazardous materials databases, including one with chemical ratings based on 43 ecological, health and safety criteria. More information is posted at http://www.chemply.com/database.htm##2.

14. The first and oldest environment-related label in the world for products and services, The Blue Angel, is administered by Germany's Federal Environmental Agency, with the quality assurance and product labeling institute RAL Deutsches Institut für Gütesicherung und Kennzeichnung e.V. More information is posted at http://www.blauer-engel.de/englisch/navigation/body_blauer_engel.htm

15. Health and Safety Code section 25214.1 et. seq. For more information on the lead in jewelry law, see http://www.dtsc.ca.gov/LeadInJewelry.cfm.

16. From the definition used by the European Commission, see: http://ec.europa.eu/enterprise/csr/index_en.htm

17. From Industry Canada, see: http://strategis.ic.gc.ca/epic/site/csr-rse.nsf/en/Home

18. HARP is an integrated software package used by the local air districts, facility operators, and other parties to develop facility and emission inventories and health risk assessments. Further information is at http://www.arb.ca.gov/toxics/harp/harp.htm

19. Numerous books, essays, and articles have been written about assessing risk, hazard, life cycle, and alternatives in an environmental regulatory context. See, for example, *Making Better Environmental Decisions—An Alternative to Risk Assessment*, Mary O'Brien, 2002, for a detailed discussion about risk versus alternatives assessment.

20. ACC's Responsible Care® Management System (RCMS), which requires companies to measure and publicly report their performance in key areas: community awareness and emergency response, security, distribution, employee health and safety, pollution prevention, process safety, and product stewardship. Performance is verified by a third party and focuses on continued improvements.

21. The Education and the Environment Initiative is authorized by Chapter 926, Statutes of 2001, (Senate Bill 373, Torlakson) and Chapter 665, Statutes of 2003, (Assembly Bill 1548, Pavley). More information about EEI is located at http://www.calepa.ca.gov/Education/EEI/default.htm.

22. Chapter 1218, Statutes of 1989, adding article 11.9 (commencing with section 25244.12, chapter 6.5, division 20) of the Health and Safety Code (Senate Bill 14).

23. For more information, see ACS Green Chemistry Awards.