

# WORKSHOPS ON CALIFORNIA'S EMERGING ENVIRONMENTAL CHALLENGES

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## SUMMARY

*A compilation of ideas collected from workshops held on:  
November 1, 1999 in Oakland  
November 2, 1999 in Van Nuys  
January 27, 2000 in Sacramento*

### **NOTE TO READER**

The Office of Environmental Health Hazard Assessment (OEHHA) is one of six constituent organizations under the California Environmental Protection Agency (Cal/EPA). This document is a record of the ideas collected during two one-day public workshops and a three-hour staff workshop on California's Emerging Environmental Challenges. The ideas presented in this document are those of the workshop participants. This summary does not necessarily reflect the policies or perspectives of OEHHA, Cal/EPA, or any of its boards or departments.

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## **1.0 Background**

The Emerging Environmental Challenges Program was established in the Office of Environmental Health Hazard Assessment (OEHHA) in fiscal year 1996/97, and charged with developing a capability to anticipate future environmental challenges which may confront programs in the California Environmental Protection Agency (Cal/EPA). The goal of the program is to identify environmental issues that may pose challenges to Cal/EPA boards and departments over the next five to ten years. By generating information on possible future issues, as well as by promoting future-oriented thinking in California's environmental protection efforts, the program will enhance Cal/EPA's ability to take proactive efforts to protect public health and environmental quality or to be better prepared to effectively address environmental challenges that may arise in the future. Tremendous benefits can be derived from early efforts to prevent the occurrence – or at least to minimize the adverse impacts – of future problems, as well as to take advantage of future opportunities.

As a first step in the program, a two-day workshop was convened in June 1998. Distinguished speakers presented their ideas about future environmental challenges, and workshop participants were encouraged to offer their own ideas. The proceedings of this workshop, published in February 1999, are posted at the OEHHA web site at [www.oehha.ca.gov](http://www.oehha.ca.gov).

Following the initial workshop, OEHHA convened additional workshops to provide further opportunities for a broader-based audience to contribute ideas about future environmental challenges for Cal/EPA, as follows: two one-day public workshops on November 1 and 2, 1999 in Oakland and Van Nuys, respectively; and a three-hour workshop for Cal/EPA staff on January 27, 2000 in Sacramento. This document presents a summary of the information collected at these workshops.

Ideas collected from the various workshops are systematically compiled, organized and maintained. From this pool of ideas, selected challenges will be explored in detail as the subject of issue-specific reports which will cover, among other things: current information about the issue; the "drivers" affecting the issue; possible consequences of the issue; "indicators" or observable conditions or factors that may signal the emergence of an issue; and potential options for addressing the issue.

## **2.0 Purpose of workshops**

The workshops were intended to elicit and collect ideas regarding future developments or changes impacting the environment and their potential implications for environmental protection in California.

The workshops were designed to be highly interactive and participatory, utilizing futures research techniques to encourage more creative and forward-looking ideas about possible environmental challenges.

The collection of ideas about future environmental challenges is an ongoing effort under the Emerging Environmental Challenges Program. The public workshops and the staff forum were convened to broaden the base from which such ideas are collected. The public workshops were held in the San Francisco Bay Area and in the greater Los Angeles Area to facilitate attendance by interested individuals from either region of the State.

### **3.0 Participants**

The Oakland workshop was attended by 23 participants; the Van Nuys workshop, by 10 participants. Workshop announcements were sent to over 500 entities on a mailing list maintained by the Emerging Environmental Challenges Program. The announcement was also published in the *California Regulatory Notice Register*, and posted on the OEHHA web site. Press advisories were also distributed.

About 50 participants from the Office of the Secretary and the boards, departments and office in Cal/EPA attended the Sacramento workshop. Participants represented diverse areas of expertise and different functional programs, at various organizational levels.

### **4.0 Workshop program/format**

The workshops began with a brief overview of the Emerging Environmental Challenges Program (see Appendix A), and an introduction to futures thinking (see Appendix B). The rest of the workshops consisted of a series of exercises to draw ideas from the participants regarding environmental issues, trends that may impact the environment, forces of change that have led or may lead to environmental issues, the consequences of these trends or forces, and their implications for California environmental protection. A technique called the “futures wheel” and a scenario exercise were used in generating ideas.

### **5.0 Outcomes**

The workshops generated three sets of ideas: (1) trends impacting the environment (from the public workshops) or factors or forces of change resulting in environmental issues (from the staff workshop); (2) the consequences of these trends or forces and their implications for environmental protection; and, (3) potential emerging environmental challenges.

The first workshop exercise was the construction of a “timeline” of significant past, present, and possible future environmental issues for California. This activity was

primarily intended to stimulate thinking about past and present environmental issues, and to provide insight on the forces that may have given rise to them, as well as forces that may lead to future issues. The list of issues generated at the workshop is included as Appendix C of this document.

## **5.1 Trends or Forces of Change**

### Definitions:

A **trend** is a verbal or numerical representation of a characteristic that can be estimated over time, providing an indication of the general direction of change. A trend may be a subjective assessment or an objective/numerical measure<sup>1</sup>.

A **force (or factor) of change** is a component of a system – including its internal organization and its external environment -- that can bring about or influence change in other components. Forces of change may include inherent or acquired characteristics or traits (such as a highly educated citizenry), events (such as the discovery of gold in California), developments (such as advances in chemical analysis), or trends (such as an increasing percentage of homes with personal computers).

**5.1.1 Trends presented by OEHHA staff.** Staff presented a sampling of trends relevant to environmental protection, which included:

- Continued population growth.
- A growing elderly population in California.
- Continued economic growth.
- Continued growth in the investment and services sectors, and decline in the manufacturing sector.
- Continued use of petroleum as the primary energy source.
- Increasing energy consumption by the transportation sector, California's largest consumer of energy.
- Continued urbanization.
- A continuing revolution in information technologies.

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<sup>1</sup> National Guard Bureau. *Anticipating Alternate Futures*. Office of Plans, Programs and Evaluation. Army Directorate. Washington, D.C. 1991.

- An explosive rate of biotechnology advancements.
- Increasing globalization.

Further details on these trends may be found in Appendix D.

**5.1.2 Trends or forces of change identified by participants.** Workshop participants were asked to respond to the following questions:

*What are some significant trends that may impact California environmental protection?*

*What are some forces/factors that may have given rise to the past and present environmental issues in the timeline? What forces/factors may give rise to future environmental issues?*

The following trends or forces of change were identified by participants (and organized under the categories below by OEHHA staff subsequent to the workshops):

#### **ENVIRONMENT**

- Limited water supply
- Increasing demands on water supplies
- Decreasing agricultural water use
- Increasing per capita energy use
- “Rural sprawl”
- Suburban sprawl
- Increasing mixed land use
- Increasing disease epidemics linked to global warming

#### **SCIENCE & TECHNOLOGY**

- Advancements in science and technology
- Advancements in biotechnology
- Accessibility of information via the Internet
- Increasingly accurate, inexpensive monitoring and testing tools/capabilities
- Decreasing number of scientists and engineers
- Increasing number of micromachines
- Greater understanding of ecosystems

#### **INSTITUTIONS/POLITICS**

- Ubiquitous news media (i.e., instant media coverage of practically anything deemed news-worthy)
- Changing role of the military
- Changes in land use values

- Decreasing resources for government
- Economic and environmental issues both included in the “bottom line”
- Increasing public-private partnerships
- Integration of agency and stakeholder efforts
- Decreasing government funding for environmental issues
- Deteriorating 19th century infrastructure, increasing 21st century infrastructure
- Devolution of regulations (from “play by U.S. EPA rules” to “play by State rules”)
- Reassessment of “community” (changing land use, increasing emphasis on sprawl, drawing boundaries)

### **ECONOMY**

- Fewer farmers (etc.) producing food
- Growing income disparities
- Free trade/multinationalism
- Changing (chaotic) world markets
- Money “delusion” (monetary value does not reflect actual value or cost)
- Cheap gasoline (compared to other places such as Europe)
- Economic prosperity and its long-term consequences
- Increasing agricultural imports into California
- Increasing consolidation, mergers, acquisitions
- Increasing e-commerce
- More companies leaving California due to compliance costs

### **SOCIETY**

- Changes in diet
- Increased population
- Changes in population densities globally, world markets, chaotic world
- Population shifts due to California earthquakes
- Immigration and changes in ethnic composition of population
- Greater cultural diversity, increasingly diverse population
- More educated population
- Increasing demand by the public for solutions/accountability
- Public participation in government/politics
- Increasing activism
- Increased materialism/affluence
- Increasing use of pharmaceuticals
- Large age difference between the very young and the very old
- Increased working at home
- Increasing disparity between “have’s” and “have not’s”
- Greed and ignorance
- Changes in spirituality and value base
- Increasing political distrust/ambivalence

- Increasing quantity of information, of uncertain quality (confusion by misinformation)
- “Wide open west” notion and how it is changing (demographics)
- Emphasis on cars, gas guzzlers
- Longer lifespan

**5.2 Consequences and Implications:** *What are the direct and indirect consequences of some of these trends or forces, and what are their future implications for California environmental protection?*

Definition: Consequences and implications refer to the impacts or results of a given force, individually and in combination with one or more additional forces.

Working in small groups, participants were asked to select three trends or “forces of change” to explore. For each of the selected trends or forces, the small group constructed a **futures wheel** (see sample wheel in Appendix E). With the selected force or trend written down as the center of the wheel, the small groups brainstormed its possible direct (or primary) consequences, and wrote these down as spokes emanating from the center of the wheel. Each of these primary consequences became the center of a new wheel, and the small groups then brainstormed their possible consequences (i.e., the secondary consequences of the selected force), as well as the consequences of these consequences, and so on. (The groups were encouraged to go as far as they could and as broadly as possible in identifying consequences.) To conclude each futures wheel, the environmental consequences of the highest order consequences (i.e., those farthest from the center of the wheel) were identified and listed.

Appendix F is an organized compilation of the environmental consequences that were included in the futures wheels developed at the workshops.

A scenario exercise followed. (Due to time limitations, not all the small groups completed the scenario exercise.) The scenarios were constructed by considering the potential consequences of the “convergence” of at least two of the trends or forces explored by each small group. The groups were asked to answer the following questions: *What may occur as a result of the trends occurring concurrently (the “joint consequences”)? How will they affect each other? What new patterns may result? Are there any stories emerging from your scenarios about what the future may be like? Briefly describe these resulting “possible futures.”*

The following consequences and implications of the convergence of two or more trends or forces (i.e., the “joint consequences”) were identified by workshop participants:



## **ENVIRONMENT**

### ***Resource demands***

- Increased impacts on natural resources, including the loss of unrecoverable resources
- Decreased use of new raw materials and increased recycling/reuse, less waste
- More efficient use of local resources
- Increased competition among countries for natural resources, leading to environmental destruction from wars
- Need for sustainable communities
- Changes (increase or decrease) in water availability
- Decreased per capita water use
- Decreased water quality
- Better use of recycled water

### ***Energy***

- Increased energy needs (how to meet demand?)
- Need for more clean energy sources
- Increased fuel consumption due to increased consumerism and an increased number of "gas guzzling" cars

### ***Ecological impacts***

- Introduction of, and increase in non-native species
- Decreased habitat for native species
- Increased habitat loss/damage
- More monoculture, less biodiversity on a global level (fewer number of crops grown globally, potentially leading to loss or extinction of certain crops)
- Cheap land and use of marginal areas resulting in unpredictable mutations (induced by pressures to adapt to environmental conditions)
- Pressures on aquatic and wildlife resources, on agriculture, and on the environment, in general
- Growth of specialty (drought-tolerant, land-intensive) and genetically engineered crops; where crops are grown will be determined by water availability
- More efficient water use leading to more water available for environmental use

### ***Human health impacts***

- Potential emerging disease pool
- Greater risk of disease and pests in food supply
- Changes in health status
- Attempts to achieve reduction of human and environmental risks

**Environmental quality/Pollution**

- New environmental consequences
- Higher probability of pesticide exposure
- Increased and new pollution issues to deal with
- Reduction in air pollution, including decreased air quality impacts from transportation
- Changes in the nature of pollution (e.g., “high tech” pollution instead of smokestacks), and in the sources of emissions and waste (e.g., more lead and acid, less steel/aluminum recycling)
- Shift in pollution to the Third World

**SCIENCE & TECHNOLOGY**

- New (often smarter, i.e., capable to doing more) businesses, products and services; new products/new technologies requiring improved health assessments
- Improved use of environmental technology and innovation in efficient resource use and in transportation (“greener” transportation technologies)
- Increase in new water-related technology (for the analysis, treatment, use and extraction of water)
  - “Design for the environment”
  - More environmentally acceptable materials
  - Export of cleanup technologies
  - New tools for exposure assessment impacting the regulatory system and stimulating environmental investigation
  - Increased privatization of research and development
  - Biotechnology and information technologies decrease traditional manufacturing and associated pollution, increase “exotic” chemicals for new technologies
  - Increase in genetically engineered medicines and foods due to diverse ethnic markets
- Improved use of communication technology, including increased public involvement made possible by the Internet; examples of uses include discussion and lobbying on water issues on the Internet, e-marketing of water
  - Increased focus on technology and innovation
  - Technology providing solutions as well as problems

**INSTITUTIONS/POLITICS****Education**

- More environmental education/outreach efforts
- Need for better education (including environmental education) that keeps pace with changes

**Infrastructure**

- Need for smarter, integrated infrastructures
- Increased need for public transportation
- Increased need for congestion relief (e.g. through mass transit)
- Creation of sacrificial areas (designated areas in which higher levels of contamination are permitted), leading to increased unrest and decreased economic productivity
- Increase in land use planning and personal safety, resulting in increased productivity
- More delivery mechanisms for water

**Government**

- Increasing demands on government for services and goods, including technology advancement efforts
- Change in state identity
- Increased exchange of natural resource regulations
- Increased cooperation between countries, including international cooperation on water use
- Increase in local control, development of new local environment zoning controls
- Changes in regulatory approaches (e.g., incentives, less/more regulations)
- Differences in sources of tax revenue; loss of fuel and sales taxes
- Decreased government funding
- Increased funding to remove non-native species from waterways
- More information in more languages on the Internet posted by California agencies on issues of environmental concern, e.g., genetically engineered pesticides
- Less honest communication, decreased credibility in government and increase in human and ecological risk
- Uncertainty in standards, increase in labels
- Increased pressure to reduce regulatory standards in California (to create an “even playing field” with the rest of the country)
- Lack of state/local control due to global constraints
- Lower permissible exposure levels leading to business flight and use of marginal areas
- More pollution prevention programs by Cal/EPA
- Increased (positive and negative) interactions among government, business, public, environmental groups and the media; better communication with the public, Agency and the Legislature; improved trust in, and value of stakeholders' input
- Increased legislation (including new laws on water quality) and increased regulatory activity for Cal/EPA, requiring more staff and changes in regulatory structure

- Increased interest in environmental indicators, performance and monitoring: need for checks and balances, environmental accountability, and measures of success
- More complex regulatory demands because of a larger universe to regulate; greater difficulty in governance
- Coordination and standardization among Cal/EPA programs and internationally to bring down the cost of regulation and increase efficiency; more international treaties and pacts
- Better coordination in Cal/EPA leading to a unified voice on legislative issues
- Impacts on land use decisions, planning and control; locations of new residential subdivisions need to be redefined
- More complex, more interdisciplinary decision-making
- More proactive planning and allocation of available resources on priority environmental issues
- Environmental issues so contentious and controversial, that the political process is increasingly relied upon in environmental decision-making; regulators hit road blocks, leading either to public alienation or to increased social activism
- Better data collection on water use to enable better decision-making
- Greater reporting responsibilities

## **ECONOMY**

- Globalization of trade and of environmental issues; increased global transportation, increased traffic due to increased distribution of goods, more people
- Global companies producing an effect (positive or negative) on politics
- Multi-national economic effects
- Decreased ability to attract new and certain (agriculture, biotech) businesses
- Increased cost of living in California
- Increased underground economy
- Trade imbalances resulting from free trade in an information-based economy
- Regulatory costs and free trade impacting California agriculture
- Increased “green” choices -- increased market pressures for products designed to be environmentally sound from “cradle to grave”

## **SOCIETY**

### ***Societal attitudes***

- Increased conservation and stewardship, increased sense of responsibility among government, business, the public

- Ethic for recycling, conservation and re-use (e.g. new products with more recyclable content) and greater accountability/ responsibility by industry (the “triple bottom line”), government and individuals for environmental and social issues
- More “disposable” society generating more solid waste
- Changed approach to regulation (public interest groups)
- Increased corporate sensitivity to diversity as a result of increased global trade
- Unification of culturally and economically diverse groups as a result of environmental education and awareness; increased understanding and tolerance
- Decreased tolerance
- Increased knowledge to make decisions in general, and more informed decision-making on a larger pool of products
- Greater environmental/grassroots activism (in part due to industry influence?)
- More issues to be “socially active” about
- Social values (instead of science) driving decisions
- Increased affluence leading either to more time/resources for social activism, or to less time for social activism because both partners are working to maintain affluence
- Increased localization (smaller scale/local issues) of environmental issues: “It’s happening in my backyard!”
- Activists hit road blocks, leading either to alienation or to increased social activism; alienation leading to a lack of confidence in government/political process
- More people aware/self-empowered for selfish or universal reasons
- Better education on water issues

### ***Demographics***

- Demographically-induced political changes
- Population increase leading to less affluence
- Water demands affected by where people live, affected through use of the Internet
- Emigration due to decreased water supply, increased cost, easily moved businesses
- Longer life expectancy, healthier/happier life
- Identification of susceptible populations leading to increase in environmental management and less pollution
- Living closer to work or telecommuting
- Fewer juvenile/older adult populations
- Increase in distinct communities with critical mass

**Equity**

- Environmental inequities
- Increased gap between rich and poor
- Increased social inequity, more power in fewer individuals
- Greater divergence in access to health care and other quality of life measures

**5.4 Possible emerging environmental challenges: What possible challenges to California environmental protection may arise in the future?**

Participants were asked to consider how the impacts and other future possibilities identified in the earlier workshop exercises may be relevant to environmental protection in identifying possible future environmental challenges. The environmental challenges identified were:

**NEW ENVIRONMENTAL STRESSORS OR SOURCES OF STRESSORS (AND THEIR POTENTIAL ADVERSE EFFECTS)**

- Increased population growth
- New exotic chemicals
- New exotic species
- Decreased methane gas emissions
- Increasing demand and declining supply of finite resources (ensuring that resources do not get used up too fast)
- Changes in public consumption patterns
- Population shift to more rural counties
- Public education: changing needs
- Bioengineered organisms (used in waste site clean-up) and their environmental consequences
- Increased need to be mobile as a result of population increase
- Ubiquitous chemical turns out to be hazardous
- Increased energy demands as a result of new technology
- Environmental consequences of recycling
- Handling increased traffic (of all sorts) and its consequences (e.g. pollution, exotics, congestion)
- Shift in education delivery infrastructure
- Increase in global trade
- Disparity of income
- Wealth gap: increase in consumption?

**NEW CONCERNS FOR CAL/EPA**

- Improved use of communication technology
- Public expectations that Cal/EPA staff are aware of all other activities in other Cal/EPA programs

- Potential retirement of agricultural land to protect water quality and supply
- Exposures from multiple pollutants and interactions
- Need for more multimedia considerations
- Choices of what information to release
- Cost-effective environmental monitoring tools
- Balancing public demand for timeliness against the reality of good science
- More efficient water use
- Recycling water
- Dealing with pollution
- Decrease in biodiversity
- Funding for environmental research and implementation
- California's loss of ability/flexibility to impose environmental regulations (due to underground economy, global preemption)
- Standards/labels provision and verification
- Increased conflict between local and state/federal governments
- Equity issues
- Increased litigation

## **NEW OPPORTUNITIES FOR ENVIRONMENTAL PROTECTION**

- Reducing environmental problems by reducing social fears (e.g. reducing fear of crime in the cities could reduce the number of people who move to the suburbs)
- Creation of an in-house information center in Cal/EPA
- More risk communication tools
- Improving risk communication through early public involvement
- Increased credibility with the public by improving our communication of our successes
- Greater right-to-know information change
- Promoting a sustainability ethic
- Increased participation by citizens in monitoring pollution
- Improving public confidence by enforcing environmental regulations
- Better educated public
- Stepping up public education and outreach by programs or contracting out
- Dialogue with Legislature to get better science-based programs
- Reducing redundant regulations
- Designing novel regulatory approaches (incentives)
- Creation of new positions/careers to solve problems
- Cross-training staff to achieve improved understanding of issues between departments
- Increased competency in non-traditional areas (e.g., conflict analysis, futures thinking, etc.)

- Bringing other neighboring states up to California standards
- Coordination and standardization among the boards, departments and office in Cal/EPA and internationally
- Moving into new Cal/EPA building
- New (zero) emission control technologies
- Identifying alternative energy sources, and developing renewable energies
- Achieving “green” products and energy
- Emerging information technologies that allow capitalizing on existing knowledge base, use of G.I.S.
- Decommissioned dams
- Increase in information technology

## 6.0 Analysis and Conclusions

The workshops employed structured thinking exercises to encourage participants to think broadly in considering the possible consequences of selected trends or forces of change, and their implications for California environmental protection.

The list of challenges in the preceding section includes some very general issues (such as “dealing with pollution,” “designing novel regulatory approaches,” and “equity issues”). In addition to this list, many of the environmental consequences from each futures wheel and the “joint consequences” identified in the scenario exercises can themselves be considered possible emerging environmental challenges. Appendix F is an organized compilation of the environmental implications identified at the workshops.

Some of the major themes from the three workshops are:

***Greater emphasis on closer and more effective interactions within Cal/EPA as well as with other governmental entities (at various levels, including internationally), with industry, with public interest groups, and with the public, in general:*** Several forces will lead to increased interactions within Cal/EPA and between Cal/EPA and external parties. Public expectations will dictate that Cal/EPA staff be better informed about environmental issues – including those outside of their respective programs. To meet such expectations, new resources will need to be available to Cal/EPA staff, such as training in risk communication, cross-training in other Cal/EPA programs, and access to an in-house information center. The Agency’s working relationship with the public can be enhanced by seeking public involvement early in the decision-making process, and on an ongoing basis; a better informed and more socially active public may lead to the extension of the scope of “public involvement” beyond participation in the formulation of decisions to include other aspects of environmental regulation, such as actual “monitoring” of sites for compliance.



The pressures brought to bear by the increasingly global nature of trade present both a threat and an opportunity for California: California may be compelled to loosen its environmental standards to conform with those of other states and with other countries, or, conversely California may have an opportunity to influence neighboring states to bring their standards on par with its own.

An improvement in California's relationships with the public and with industry may facilitate the departure from traditional command-and-control mechanisms and the move toward more flexible mechanisms for environmental improvement, such as voluntary programs or agreements.

***Increasingly complex environmental regulation and the need for multi-disciplinary decision-making:*** The increased complexity of environmental issues can only be effectively addressed using multi-disciplinary solutions, underscoring the importance of involving all interested parties early in the decision-making process. Actions to address environmental pollutants will move away from single-pollutant approaches, considering instead the interactions among multiple pollutants using a multimedia perspective. In many cases, efforts to address non-environmental issues can have significant environmental impacts (for example, infill housing development, improving urban schools, or efforts directed at reducing crime in urban areas, could reduce sprawl). With a more socially active, better informed, and more empowered public, environmental issues may become more contentious, potentially politicizing environmental regulation. Environmental issues are increasingly becoming recognized as local issues. Social values, rather than science, may increasingly drive environmental decisions, and public demand for timeliness will need to be balanced against good science.

***Increased interest in environmental indicators and in environmental accountability:*** A more pervasive sustainability ethic in industry, a more flexible regulatory framework, and a more socially active public will heighten the interest in environmental accountability – i.e., monitoring environmental performance and measuring successes. Improved interactions and partnerships between government and industry, and a rational view of risk from a more informed public will lead to the establishment of more serious, less contentious goals. The process of setting, and determining progress toward achieving, environmental goals and targets will promote environmental reporting, monitoring and data collection.

***Information and communications technologies as tools in environmental protection:*** Cal/EPA needs to consider how to take full advantage of advances in information and communications technologies. Information technologies can enhance the dissemination, use and management of the extensive data and information that currently exist within the boards and departments. Potential new applications for the data are vast, including incorporation of data on environmental

levels of contaminants into a geographic information system. Further, with increasing public demand for real-time information, Cal/EPA must compete with other sources of information of uncertain reliability (such as Internet websites) and implement a process for deciding when and how much information must be released. The Internet may also provide a medium for public discussion of and input into environmental issues, or for the trading of water rights or pollution credits.

***Effectively disseminating environmental information to a diverse audience:***

In light of the increasing volume of information on the Internet, the increasingly ethnically diverse California population, and a potentially widening gap between the “have’s” and the “have-not’s,” Cal/EPA will need to ensure that information is made available by a variety of means, including “low-tech” media and non-English documents.

***Changes in chemical use patterns (as a result of biotechnology applications, new technology, or increased globalization):***

In addition to new, uncharacterized chemicals that will require evaluation, changes in the types and quantities of chemicals that are used may reduce “traditional” pollution, while increasing “new” pollution.

***Movement of pollution outside the State, or the country:*** A number of factors (such as the increased internationalization of trade, increased consumption due to population growth, and differences in environmental regulations) may result in traditional manufacturing moving out of California (or the United States). Instead of pollution originating from traditional manufacturing facilities in California, ports (or other points of entry of manufactured goods into the State) may become new toxic hot spots. Certain environmental equity issues may also arise – for example, will certain states (or countries) become “less safe” as a result of the new facilities? Will a facility in another country be using chemicals banned in the United States, and can these subsequently result in exposures to these chemicals through products shipped back for sale into the United States? The environmental benefits and problems resulting from such movement will require thorough examination.

***The impacts of land use changes on exposure sources or patterns:***

Population growth, economic growth, increased pollution, and the relocation of manufacturing facilities, among other things, will place new and potentially different demands on the use of land. New zoning criteria may need to be developed, contaminated areas will likely be cleaned up and designated for certain land uses. Certain locations may be designated as “sacrifice” areas, purposely selected for less environmentally desirable uses (for example, as sites for industrial facilities). The ecological and human health consequences of these changes will need to be examined ahead of time.

***A potential loss of flexibility in implementing environmental regulations:***

The globalization of the economy may have the effect of restraining California's (and local governments') ability to promulgate and implement environmental regulations that historically have been more stringent than national (or, to the extent that they exist, international) standards. The increasingly global nature of the economy may spur an increasing number of international trade agreements or multi-national conventions that seek to adopt the "lowest common denominator" among the environmental regulations of the entities involved. The ability to implement State and local standards may further be compromised by a potentially growing "underground" economy engaged in the distribution of prohibited products.

***The need for a "sustainability ethic" in industry, government, and individuals:***

The increasing pressures placed on natural resources need to be met with an understanding of the need to use them wisely. While the responsibility has been traditionally placed upon industry, it is becoming increasingly important to likewise hold government as well as individuals accountable. An ethic for conservation, recycling, re-use and other environmentally sound practices will be critical to ensuring sustainability.

***Opportunities for advancing environmental protection co-exist with the challenges:***

While the potential adverse consequences of population growth, economic growth, globalization, increasing energy consumption, new technologies and many other trends are more evident, they likewise present opportunities for less waste generation, less pollution, and beneficial ecological impacts. Efforts to address the adverse impacts of these trends can stimulate the development of environmentally beneficial technologies, products, or fuels, as well as the adoption of new, environmentally sound practices and processes.

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## The Emerging Environmental Challenges Program



**California Environmental Protection Agency (Cal/EPA)**

Created in July 1991 to unify the State's environmental authority under a single, cabinet-level agency.


**Mission:** To improve environmental quality to protect human health, the welfare of our citizens, and California's natural resources.



California's Emerging Environmental Challenges

Cal/EPA consists of:

- Air Resources Board
- Department of Pesticide Regulation
- Department of Toxic Substances Control
- Integrated Waste Management Board
- Office of Environmental Health Hazard Assessment
- State Water Resources Control Board and nine Regional Water Quality Control Boards




California's Emerging Environmental Challenges

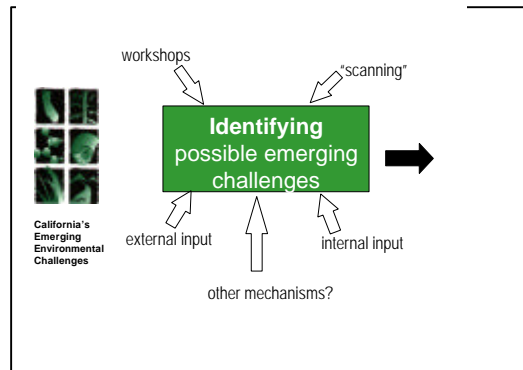
**The Emerging Environmental Challenges Program**

**Goal:** To identify environmental issues that may pose challenges to Cal/EPA programs in the next five to ten years.

- ❖ collecting, researching and generating information on possible future environmental issues on an ongoing basis;
- ❖ promoting futures-oriented thinking in California's environmental protection efforts; and,
- ❖ providing Cal/EPA policymakers with information to consider when formulating future plans.




California's Emerging Environmental Challenges



**Organizing ideas**


*compile, organize and maintain in a database*




California's Emerging Environmental Challenges

**Screening**

*Is the issue relevant to Cal/EPA?*



California's Emerging Environmental Challenges




California's Emerging Environmental Challenges

**Scoring issues**

*Attention needed?  
Scope?  
Severity?*

➔



California's Emerging Environmental Challenges


**Characterizing selected emerging challenges**

➔



California's Emerging Environmental Challenges

**Communicating findings**



California's Emerging Environmental Challenges

**Today's forum...**

**Purpose:** To elicit and collect ideas from Cal/EPA staff regarding environmental challenges which may confront environmental protection programs in the next five to ten years.


**Outcome:** Emerging environmental challenges identified will be added to database; a summary of issues will be prepared.

## Introduction to Futures Studies

**Here Comes the Future**  
**Principles of Futures Studies**  
 Dr. Peter C. Bishop  
 Studies of the Future  
 University of Houston-Clear Lake  
 Emerging Environmental Challenges  
 California Environmental Protection Agency  
 Oakland/Van Nuys CA  
 November 1-2, 1999


**Can We Study the Future?**

*Can we study the weather?      Can we study the stars?*




*Can we study the earth?      Can we study the past?*

**Four key questions**




Can we predict the future?  
 Can we know the future?  
 Can we control the future?  
 Can we influence the future?

**Four key questions**



~~Can we predict the future?~~  
 Can we know the future? **YES**  
~~Can we control the future?~~  
 Can we influence the future? **YES**

**The Benefits of Stories**



- ▶ They convey images more than facts.
- ▶ They contain the essence not the details.
- ▶ They capture the assumptions and forces of the future.
- ▶ They portray the future in a vivid, engaging manner.

**The Cone of Plausibility**

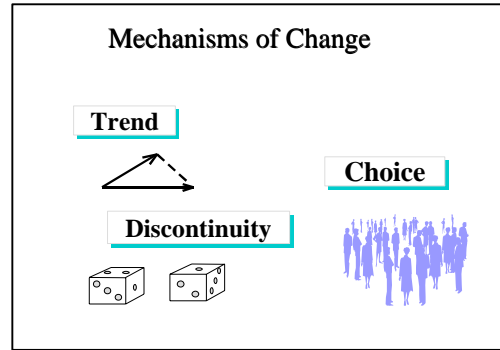
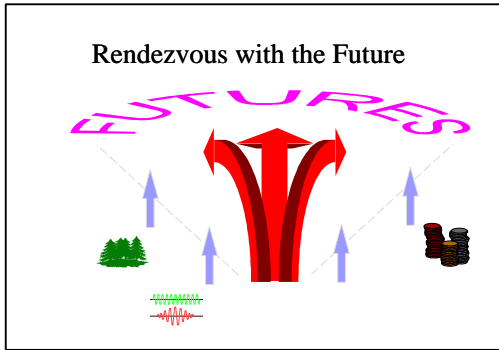
Source: Charles Taylor, Army War College

**The Language of Plausibility**

<u>Declarative</u>	<u>Subjunctive</u>
<del>Will</del>	May
<del>Must</del>	Might
<del>Should</del>	Could

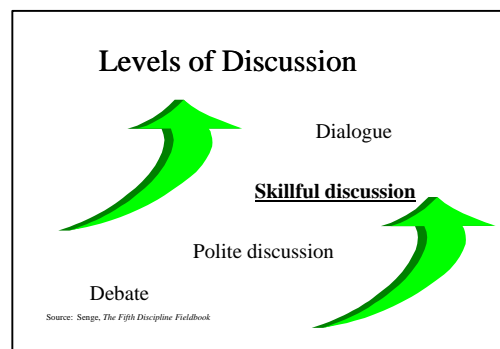
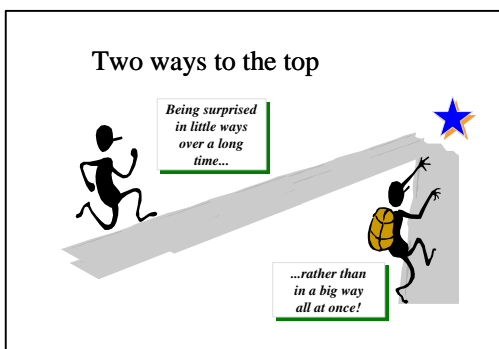
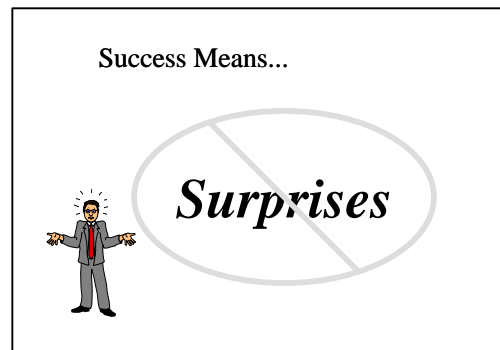
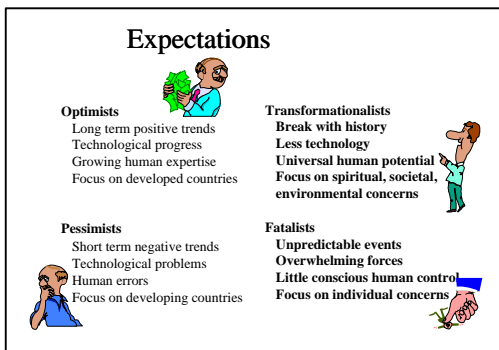
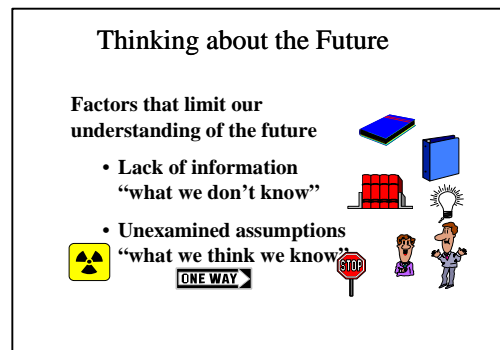
Past
Present
Future →

**The Sources of Change**



### Three Types of Futures Thinking

Futures	Forces	Thinking	Techniques
<i>Probable</i>	Constants Trends	Definite Scientific	Historical analogy Extrapolation
<i>Plausible</i>	Discontinuities Surprises	Speculative Imaginative	Scenarios Simulation
<i>Preferable</i>	Choices Images	Visionary Empowered	Visioning Planning





### Listening as an ally

- The amount of equipment is proportional to its importance
- Quieting the voice within
  - evaluating, filtering
  - constructing the response
- New ideas, like infants, must be nurtured to grow
- Listening for a teacher, even in disagreements
- Acceptance does not have to be agreement
- The delight of being surprised
- The delight of being heard



### The Trick of Futures Studies

You cannot know the future exactly,  
but you can know many possibilities in the future.

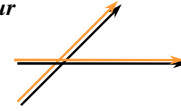
***Knowing something is better than  
knowing nothing!***

### Rules for Talking about the Future

- |   |                            |
|---|----------------------------|
| 1. The future is uncertain                        | <i>Admit uncertainty</i>   |
| 2. The future is plural                           | <i>Talk possibilities</i>  |
| 3. Different assumptions create different futures | <i>Uncover assumptions</i> |
| 4. The future is being created--                  |                            |
| -- outside in the environment                     | <i>Tell stories</i>        |
| --- inside people's aspirations                   | <i>Encourage visions</i>   |

### A Final Word

***Learning faster than your  
competitors is  
the only sustainable  
competitive advantage  
in an environment of  
rapid innovation and change.***




-- Arie de Geus, former Director  
Corporate Planning  
Royal Dutch Shell Group

### For Additional Information

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## Introduction to Futures Studies



**Staff Forum  
on  
California's Emerging  
Environmental Challenges**

**January 27, 2000  
Sacramento**

California's  
Emerging  
Environmental  
Challenges



**What is  
“futures studies”?**


Futures studies is a field of inquiry that involves systematic and explicit thinking about alternative futures.

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**Some Key Assumptions  
in  
Futures Studies**


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➤ *Key assumption:*  
**There are many possible futures.**

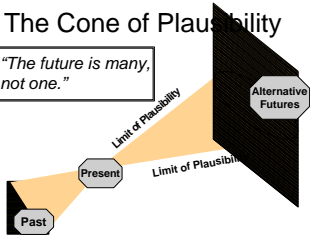
*There is no single future.  
There is, instead, a range of alternative futures.*

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Environmental  
Challenges




**The Cone of Plausibility**

*“The future is many, not one.”*



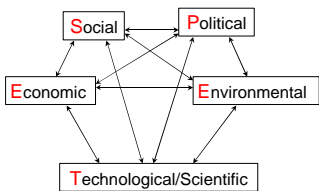
Source: Charles Taylor, Army War College

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**Forces of Change**

There are multiple, complex forces at play that can effect changes in the future.



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Challenges



➤ *Key assumption:*  
**The future is uncertain.**

*There are no facts about the future.*

*The future is not knowable with absolute certainty in advance.*

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Environmental  
Challenges



➤ *Key assumption:*  
**The future can be influenced.**

*The future can be shaped by decisions and actions taken in the present.*


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Environmental  
Challenges



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➤ *Key assumption:*  
**The world is so interrelated that no system can be viewed as totally isolated.**


*Exploring the future adequately requires holistic, trans-disciplinary perspectives.*



California's Emerging Environmental Challenges

“When we try to pick out anything by itself, we find it hitched to everything else in the Universe.”


- John Muir, 1911



California's Emerging Environmental Challenges

Futures studies are useful in:


- interpreting the past;
- understanding the present;
- deciding and acting in the present; and,
- balancing the use of present and future resources.



California's Emerging Environmental Challenges

Uses of Futures Studies


- ◆ To inform decision-makers.
- ◆ To identify likely developments that must be dealt with, whether or not they can be influenced (an “early warning system”).
- ◆ To identify and explore alternative futures: the possible, the probable, the preferable.
- ◆ To widen the range of considerations, resulting in an enriched awareness of the factors shaping the future.



California's Emerging Environmental Challenges


Can we develop “environmental foresight”?

YES!



California's Emerging Environmental Challenges

What limits our understanding of the future?



- ❖ Mechanical extrapolation (*tomorrow is not simply a continuation of today*)
- ❖ Unexamined assumptions (*what we think we know*)
- ❖ Lack of information, limited expertise (*what we don't know*)
- ❖ Lack of imagination

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## ENVIRONMENTAL ISSUES IDENTIFIED BY WORKSHOP PARTICIPANTS

### **Pre-1950's**

Gold mining  
Fires  
Logging

### **1950's**

Urbanization  
Air pollution (autos)  
Broad spectrum organic pesticides (e.g., DDTs)  
Baby boom  
Resource management  
Suburban sprawl  
California State Water Project  
London "smog" episodes  
Haggin Smit photosmog studies

### **1960's**

Rachel Carsons's *Silent Spring*  
1968 Santa Barbara oil spill (a catalyst for the environmental movement)  
Cuyahoga River fire  
Raw sewage discharges  
Atmospheric nuclear testing  
Student activism  
Porter-Cologne Water Quality Act  
Firing of Sierra Club Executive Officer

### **1970's**

Love Canal: waste disposal  
Creation of the U.S. Environmental Protection Agency  
Bioengineering  
"Oil Shortage"  
Agent Orange  
Chlorofluorocarbons and ozone depletion  
Worker protection: agricultural workers  
California Environmental Quality Act  
Federal and State funding of sewage treatment plants

**1980's**

Urbanization  
Bhopal incident: right-to-know  
Medfly spraying over urban population  
Economic recession (leading to pressure to make regulations affordable)  
Global warming  
Leaking tanks  
McFarland cancer clusters  
Proposition 65  
California delta smelt and water delivery

**1990's to Present**

North American Free Trade Agreement (NAFTA)  
Environmental justice  
Population growth  
Cantera (Dunsmuir) spill  
Inspection of military installations  
Tire fires  
50% waste reduction mandate (AB 939)  
Agricultural/urban interface (e.g., Lompoc)  
Methyl tert-butyl ether (MTBE)  
Economic recession leading to decreased environmental regulations  
Droughts  
International border issues

**Future**

Cancer clusters  
Catastrophic release of hazardous materials during next major earthquake  
Climate change issues  
Consumer products  
Control of urban development in marginal areas  
Dioxins as significant ecological (rather than human health) threat  
Disposal of low-level radioactive wastes  
Eco-terrorism  
Epidemics and antibiotic resistance  
Exotic species  
Food safety (pesticides, genetically modified organisms, natural carcinogens, etc.)  
Geriatric disease due to toxins  
Global trade and its possible consequences, including "unequal" environmental laws, costs, disease outbreaks, exotic species  
Groundwater pollution and depletion  
Immunotoxicity, more types of chemical sensitivity, chemical releases-viral disease link?  
Inadequate water supply/drinking water supply shortages

Increasing information posted on the Internet, uncertain reliability (everyone can be an “expert”); grassroots organizations’ need to deal with increased, more complex information

Justice and equity, have's and have-not's

Life cycle analysis

Major regional ecosystem collapse

Massive changes (e.g. in infrastructure) to protect endangered species

Nano-/ultra-fine particulates, air toxics

New chemicals, new materials (with little information available/known)

New “urban corridors” with limits on densities

“NIMBY”<sup>\*</sup> resulting in the “floating facility” (analogous to the floating barge)

Nonpoint source pollution

Outbreak of disease due to global warming

Packaging (i.e., the “reduce” in “reduce, reuse, recycle)

Permitting/local agency actions inhibiting economic growth

Pesticides

Productivity of oceans dropping, including species loss

Shift from “command-and-control” regulatory process to performance standards, other approaches (having reached the point of diminishing returns)

Shift in focus of regulations from industry to individuals

Sprawl, loss of farmland/open space/habitat

Susceptible/sensitive populations (e.g., kids)

Switch from hydrocarbon-based fuels (emergence of hybrid fuel vehicles)

Toxic hot spots identification

Transportation-related pollution (fuels, sports utility vehicles) and waste disposal (auto bodies, tires, fuels, fuel cells, etc.: what has value and can be recycled?)

Transportation-related issues (lack of affordable housing near workplace; expansion of ports, harbors, airports)

The “underground economy” (circumventing regulations, e.g. CFC smuggling)

Voter and community education in science and technology

Water availability

---

\* “Not in my backyard”

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## A SAMPLING OF TRENDS RELEVANT TO ENVIRONMENTAL PROTECTION

- ***Population growth continues.***
  - California's growth rate -- which jumped following a big decline between 1993 and 1995 -- is projected to remain at about twice the nation's growth rate.
  - California's current population of 33.3M is projected to grow to 58.7M in 2040.
  - California will likely remain the most populous state in the US.
  - Two-thirds of the State's population live in eight counties with populations >1M. Five of these eight counties are in Southern California.
  
- ***California's elderly population is growing.***
  - The proportion of Californians aged 65 and over is projected to increase from about 10% in the 1990s to 18% in 2040.
  - The working age group (20-64 year-olds) will decline from about 60% to 54%.
  - The youngest age group will remain relatively stable, declining only from 29% to 28%.
  - The dependency ratio (the number of individuals aged 0 to 19 and over 65 for each individual aged 20-64) will increase from 0.66 in the 1990s to 0.85 in 2040.
  
- ***Economic growth continues.***
  - The 1990s witnessed significant growth in gross domestic product.
  - Per capita personal income and disposal personal income are increasing.
  - Unemployment rates are declining.
  - While the economy is expected to remain healthy, growth is anticipated to slow down.
  
- ***The investment and services sectors continue to grow, while the manufacturing sector declines.***
  - The financial investment/real estate and the services sectors are the biggest contributors to California's GSP.
  - While manufacturing's contribution remains high, it has been declining.
  - Most jobs will continue to be in the services and the wholesale/retail sectors.

- ***Petroleum continues to be the primary energy source.***
  - Petroleum represents 50% of the energy used in California, compared to 39% in the US, and 41% in the world.
  - Natural gas is the second most significant source of energy.
  - California ranks second in the US (after Texas) in its use of petroleum, natural gas and electricity.
  
- ***Energy consumption by California's largest consumer of energy -- the transportation sector -- is increasing.***
  - The transportation sector accounts for over 40% of the State's energy consumption. Nationwide, the industrial sector consumes the most energy. (These patterns are not predicted to change significantly in 2012.)
  - Meanwhile, the number of vehicles registered in California is increasing. Nationwide, fuel economy is declining, the truck market share is increasing, and fuel economy is being traded for vehicle weight and performance.
  
- ***Urbanization continues.***
  - Following declines in previous years, the statewide urbanization rate increased in 1994-96. Converted agricultural land accounted for 65% of the new urban land.
  - In 1900, 52% of California's population lived in urban areas; in 1990, the percentage increased to 93%. (Percentages for the US are 40% in 1900 and 75% in 1990.)
  
- ***The revolution in information technologies continues.***
  - Information and communication technologies have ushered in the "Information Age," affecting the way people work, live, learn, play, communicate and govern themselves (e-commerce, e-trade, e-mail, distance-learning, teleworking, e-tc.).
  - Computing speed increased by almost 4,200 times since the 1970s; at the same time, computing costs are about 1000 times cheaper.
  - In 1997, more than one in three US households had computers; almost three in four children used the Internet at home; nearly half of the adults used a computer, and one in five Americans used the Internet.
  
- ***Biotechnology advancements are occurring at an explosive rate.***
  - Breakthroughs in biotechnology can lead to new applications in agriculture, human and veterinary medicine, the chemical industry, and environmental management.
  - Between 1975 and 1996, nearly 1,000 biotechnology companies were established.
  - California continues to be the world's leading center for biotechnology, with more than one-third of all U.S. biotechnology companies being located in the State, generating \$8.4 billion in revenue.

- ***Globalization is increasing.***

- International trade is increasing.
- Foreign direct investments in research and development are increasing.
- Global communications technologies are uniting the world.
- There is an increasing recognition of the need to address certain issues at a global level.

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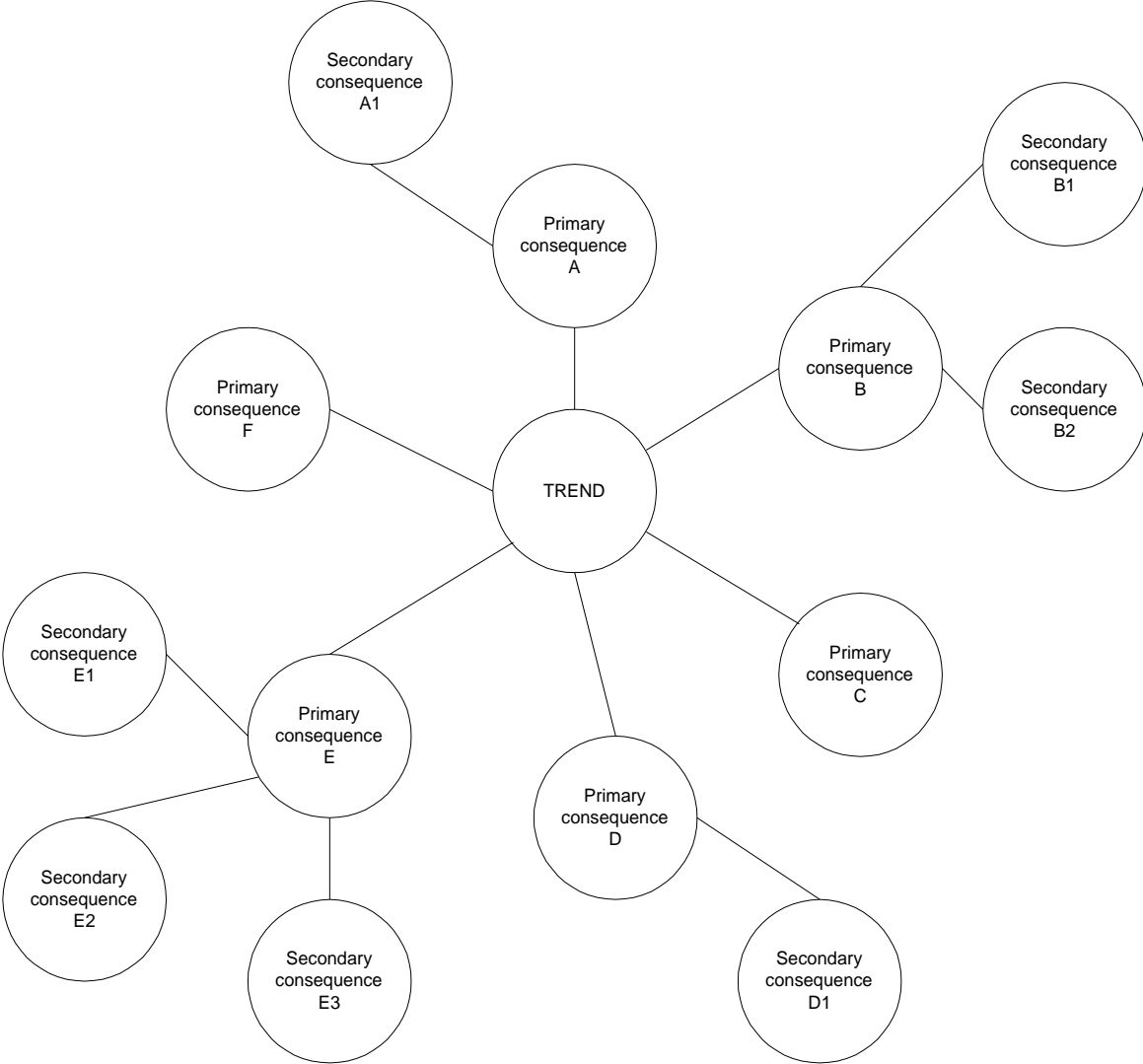
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# The "Futures Wheel"



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## ORGANIZED COMPILATION OF POSSIBLE ENVIRONMENTAL IMPLICATIONS OF CERTAIN TRENDS

The environmental consequences from each futures wheel developed at the workshops are presented below, along with the trend or “force of change” from which these may arise. Where the consequence was identified as a “joint consequence” of two or more trends or forces during the scenario exercise, “jointly” appears in the second column, followed by the trends or forces explored by the break-out group. Most of these consequences can be considered possible emerging environmental challenges.

Consequence	As a result of...
<b>CHARACTERIZING NEW RISKS</b>	
Increased need to test biotechnology products (including genetically modified crops) to determine risks of introducing engineered species; engineered species may drive out other species. An increase in genetically engineered medicines and foods may occur in response to diverse ethnic markets.	biotechnology advancements, globalization
New, uncharacterized chemicals requiring analysis or cleanup	biotechnology advancements, information technologies
Changes in chemical use patterns: fewer “traditional” pesticides and more “other” chemicals; less reliance on chemistry/petrochemicals, resulting in less traditional pollution; or, increased pesticide use	biotechnology advancements, globalization
Import or export of environmental challenges or problem industries, including importation of banned toxics, importation of industries with new, unexpected pollutants	globalization
Unintended consequences of new/super materials, e.g. new toys, new exposures, new health risks; more research needed	new/super materials
Changes in source of products (food, fish) resulting in many more things to test and evaluate and a need to re-assess assumptions about food consumption	changes in California's ethnic makeup
Changes in fuel composition/renewables: hydrogen, propane use leading to increased hazard of explosions. Accidents may have different consequences (e.g., toxic fumes, metals released).	advancements in low emission vehicles

Consequence	As a result of...
<b>POSITIVE ECOLOGICAL IMPACTS</b>	
Less stress on natural habitat due to more open space outside city	urbanization
More sustainable architecture (no suburban homes)	urbanization
More "set asides" reserved for natural habitats as a result of watershed modification	limited water supply
Increased wetlands restoration due to increased use of watershed models	decreased water availability
Decreased use of new raw materials and more efficient use of local resources	jointly: decreased water availability, population growth, globalization
Change in resource needs as a result of shift to an information-based economy	increased access to information
Less paper use	decreased water availability
Import or export of environmental challenges or problem industries leading to the development of sustainable business	globalization
<b>ADVERSE ECOLOGICAL IMPACTS</b>	
Habitat disturbance and increased ecological damage due to increased offshore oil drilling, deforestation and mining to meet increased demands for fuel and natural resources. The increased movement of people and goods between countries will contribute to the increased demand.	economic growth, increased fossil fuel use, globalization
Exploitation of natural resources and increased pressure to develop oil reserves due to depletion of existing sources	cheap vehicular fuel
Waste of resources as a result of large number of gas guzzling cars	cheap vehicular fuel
Increased disease, increased pollution and increased entry of non-native species due to increased distribution into and out of California. Invasion of non-native (exotic) species will cause ecosystem instability and decreased biodiversity.	globalization
Decreased natural habitat resulting in invasion by more exotic species, species loss and increased wildlife interaction	population growth
More exotic species introduced, leading to increased pesticide use and increased environmental costs	free trade; affluence
Increased pollution, cheap land, increased business and urban blight resulting from the creation of national "sacrifice" areas	regulatory authority transfer

Consequence	As a result of...
<b>ADVERSE ECOLOGICAL IMPACTS, continued</b>	
Increased life expectancy leading to greater consumption, which results in increased land use	genetic diagnoses
Bigger cities resulting in lack of green space, need for urban renewal (sustainable communities), increased energy demands and the resulting increased energy supplies (nuclear, other sources) and lack of natural amenities (trees, rivers, etc.). More low-density housing, sprawl and less open spaces result in habitat loss, increased congestion, and regional pollution.	population growth
Land use changes leading to and resulting from water availability issues; land use changes (including sprawl) also lead to increased agricultural/urban interface (and resultant problems with odors, pesticide exposures)	free trade; affluence; jointly: water quality and availability, public participation, global warming
More competition for resources; increased competition among countries for natural resources, leading to environmental destruction from wars	globalization
Resource depletion and increased environmental stress (leading to increased regulation)	consumerism (with respect to resource conservation)
Changes in consumer habits (including more paper use) leading to increased demand for, and loss of available (in some cases, unrecoverable) natural resources	greater accessibility of information through the Internet; jointly: cultural and economic diversity, limited water supply, catastrophic events; jointly: more market/lifestyle choices from increased affluence, social activism; jointly: cultural and economic diversity, limited water supply, catastrophic events
Species and habitat loss and changes, increased water demand, need to allocate emergency resources as a result of catastrophic events	limited water supply; catastrophic events
More monoculture, less biodiversity on a global level	jointly: have's/have-not's gap, urbanization, globalization
Increased environmental degradation (maybe) due to increased economic standard of living for US (and possibly the Third World)	globalization
Greater demand for natural resources leading to decreased species habitats and mining of landfills, in turn resulting in increased air pollution and increased or decreased groundwater contamination.	population growth

Consequence	As a result of...
<b>ADVERSE ECOLOGICAL IMPACTS, continued</b>	
Pressures on aquatic, wildlife resources, agriculture and the environment, in general	jointly: drinking water supply contamination, interactions between government and industry, changing public perception of environmental problems and personal responsibility
Loss of ecosystems	have's/have-not's gap
More damming of rivers and less health and recreation in response to shortage of fuels	increased energy consumption
Increased global warming leading to rising water levels	increased energy consumption
Increased climate change and increased ecological damage due to increased fuel blends in response to increased pollution	increased fossil fuel use
Changes in fuel composition/renewables impacting agriculture, causing differences in CO <sub>2</sub> and affecting global warming	advancements in low emission vehicles
Intensification of agriculture leading to decreased water quality, increased use of pesticides and of fertilizers, and increased fuel consumption	jointly: cheap vehicular fuel, consumerism (with respect to resource conservation)
More paper use	greater accessibility of information through the Internet
<b>REDUCED POLLUTION/WASTE</b>	
Decreased fossil fuel use resulting in reduced emissions, reduced global warming	advancements in low emission vehicles
Decreased smog as a result of increased teleworking	increased access to information
Fewer hot spots as a result of a more evenly spread population and decreased urbanization (people stay at home, travel/commute less)	information technologies
Less air pollution per capita due to fewer cars as a result of better public transportation	urbanization
Distrust of industry leading to "greener" industry	changing public perception of environmental problems and personal responsibility

Consequence	As a result of...
<b>REDUCED POLLUTION/WASTE, continued</b>	
Greater industrial accountability resulting in more health risk assessments, less waste or less pollution	new/super materials
Increase in environmental management leading to less pollution prompted by changes in social issues	increased environmental justice awareness
Less waste by re-use, resulting in less pollution	new/super materials
Changes in materials for car construction making disposal designed-in and leading to changes in recycling and changes in technologies for disposal	advancements in low emission vehicles
Increased recycling and more prudent use of resources by lower income groups	cultural and economic diversity
More recycling or the development of recycling technology in response to increased waste generation and new markets	have's/have-not's gap
More prisons resulting in cheap labor and more recycling	have's/have-not's gap
Greater demand for natural resources leading to increased recycling	population growth
<b>INCREASED POLLUTION</b>	
Increased greenhouse gases and global warming	cheap vehicular fuel
Increased pollution, remediation and waste and decreased resources due to increased material consumption	economic growth
Increased pollution, cheap land, increased business and urban blight resulting from the creation of national "sacrifice" areas	regulatory authority transfer
Increased pollution (air, oceans, exotic species) and increased traffic/congestion due to increased movement of people and goods between countries	globalization
Urban sprawl, traffic congestion, water pollution, air pollution, reduction in agricultural production due to increased number of miles driven	cheap vehicular fuel; population growth; affluence
Traffic congestion leading to increased air pollution and associated increased health effects	population growth
Increased disease, increased pollution and increased entry of non-native species due to increased distribution into and out of California	globalization

Consequence	As a result of...
<b>INCREASED POLLUTION</b>	
Increased underground economy leading to “trashing” of the environment, increased emission sources, increased government costs and increased resistance to environmental regulations	have's/have-not's gap
Increase in heavy metals, acids, hazardous wastes	advancements in low emission vehicles
Shortage of fuel leading to more nuclear energy and disposal of high-level nuclear waste	increased energy consumption
Increased food needs producing air quality impacts	population growth
Increased sprawl/cities leading to high-density housing and increased pollution concentration	population growth
More jobs leading to increased water and air pollution, increased wastes	population growth
Affordable desalination technology leading to the problem of brine residue disposal	drinking water supply contamination; limited water supply
More waste from increased population, from increased consumption of bottled water, from increased affluence and from increased commercialism	drinking water supply contamination; more market/lifestyle choices from increased affluence; population growth; increased affluence
Increased packaging waste due to increased e-commerce	information technologies
Increased waste generation due to increased water cleanup technology	decreased water availability
Two wage-earner working poor leading to consumption of more fast food and more disposable containers	have's/have-not's gap
More "disposable" society generating more solid waste	jointly: have's/have-not's gap, urbanization, globalization
<b>REDUCED ENERGY CONSUMPTION</b>	
Decreased fossil fuel use in vehicles, fewer emissions resulting from less industry, from people staying at home and traveling/commuting less, and from increased fuel cost. Less energy use from urbanization.	information technologies, increased fossil fuel use, urbanization
Innovation in, and increased manufacture of energy-efficient products and better energy-efficient processing	increased energy consumption, new/super materials, increased fossil fuel use

Consequence	As a result of...
<b>REDUCED ENERGY CONSUMPTION, continued</b>	
Improved technology, energy-efficient appliances as a result of the use of alternative fuels	global warming
Greater demand for natural resources leading to increased use of fossil fuels, in turn resulting in increased alternative fuel technologies and more efficient machines	population growth
<b>INCREASED ENERGY CONSUMPTION</b>	
Increased energy use from new water treatment technology	drinking water supply contamination
Increased energy use due to increased teleworking	increased access to information
Increased energy demand and use resulting from time-saving devices	information technologies
Increased demand for fuels/natural resources due to increased movement of people and goods between countries	globalization
<b>HUMAN HEALTH IMPACTS</b>	
Water-borne pathogens, spreading diseases from contaminated drinking water supply	drinking water supply contamination; limited water supply
Higher probability of pesticide exposure	jointly: cultural and economic diversity, limited water supply, catastrophic events
Increased exposure to toxics (people live closer to sources) due to higher housing densities; increased cancer risk and increased incidence of adverse reproductive outcomes due to more hot spots (from capacity constraints)	economic growth, population growth
Increased disease (potential emerging disease pool), increased pollution and increased entry of non-native species due to increased distribution of goods into and out of California	globalization
Reduced human and environmental risk as a result of a better quality of life (safer cars, etc.)	new/super materials
Attempts to achieve reduction of human and environmental risks	jointly: new/super materials, have's/have-not's gap, increased energy consumption
Greater risk of disease and pests in food supply	jointly: have's/have-not/s gap, urbanization, globalization

Consequence	As a result of...
<b>WATER ISSUES</b>	
Increased water reuse and recycling	decreased water availability; water quality and availability; lack of water/increasing demand
Decreased per capita water use; reduction in water-utilizing devices; conservation measures, including forced rationing, limits on swimming pool size/use, and changes in consumer habits; increased recapture of water	decreased water availability/limited water supply; lack of water
Increased pressure for solutions, increased outrage, change in water standards, and improvements in infrastructure resulting from decreased water quality	decreased water availability
Increased water demands leading to increased conservation, increased salinization, better enforcement of water rights, moving away from polluting fuels, increased recycling of water	population growth
Greater demand for natural resources leading to increased use of water, in turn resulting in increased water treatment technologies, lower water quality and use of marginal water sources	population growth
Increased construction resulting in increased water runoff and increased concrete, leading to decreased water quality, decreased wetlands quality and decreased water supply	population growth
Acquisition of water from other states, other countries leading to treaties/pacts, construction of water conveyances	jointly: cultural and economic diversity, limited water supply, catastrophic events
Fewer water rights resulting from more rigorous protection of groundwater	limited water supply
Increased water diversions and new ways of allocating water resources (industrial, agricultural, urban; north vs. south; environmental use)	limited water supply; water quality and availability
Competing water uses (agriculture, residential, species protection); increased regulation of all (including agricultural) water uses; statewide water allocation; proposals to increase water delivery	water quality and availability; lack of water
New regulations affecting industry, consumers, the environment, including more stringent water standards	drinking water supply contamination
Shift in management of water from the public to the private sector, leading to new environmental laws, changes in water rights allocations	lack of water/increasing demand
Growth of specialty (e.g., drought-tolerant) crops	jointly: cultural and economic diversity, limited water supply, catastrophic events
Improvements in monitoring point source discharge	water quality and availability



Consequence	As a result of...
<b>WATER ISSUES, continued</b>	
More and bigger publicly-owned treatment works	water quality and availability
MTBE (methyl tert-butyl ether)	water quality and availability
Recreational impacts	water quality and availability
Water pollution from expansion of oil refineries	cheap vehicular fuel
e-Marketing of water	jointly: lack of water/increasing demand, greater accessibility of information through the Internet
Emigration due to decreased water supply, increased cost, easily moved businesses	jointly: decreased water availability, population growth, globalization
<b>CLEANER PRODUCTS, FUELS</b>	
Creation of new market niches: more green products, green labeling requirements, promoting the dissemination of the "environmental message"	jointly: more market/lifestyle choices from increased affluence, social activism
Increased clean production of goods due to increased technological advances as a result of greater proliferation of, and dependence on, computers	information technologies
Less air pollution per person due to increased development of clean technology (e.g. fuel cells)	information technologies
Development of less polluting rocket fuels as a result of increased use of satellites to support new infrastructure	information technologies
Challenges to waste system resulting in increased research in recycling, including the design of "green" materials	new/super materials
More innovation (wind and solar energy, fuel cells) leading to clean energy and a clean environment; potential new energy sources	increased energy consumption; new/super materials
Increased energy demand, higher energy tax and high cost of energy (poor people can't buy energy) leading to research/incentives to increased use/development of new/alternative fuels or sources	increased energy consumption, population growth

Consequence	As a result of...
<b>MOVEMENT OF POLLUTION TO OTHER LOCATIONS</b>	
Movement of pollution offshore due to increased internationalization of trade. Ports become hot spots due to shifts in manufacturing patterns.	information technologies
Movement of pollution offshore and water and air quality issues due to lower environmental standards resulting from trade agreements (e.g. NAFTA) necessitated by increased global trade	economic growth
Business flight to less regulation and migration of pollution result in some states becoming safer than others (exposures are greater in certain areas) and decreased environmental justice and environmental quality; adverse impacts in unregulated countries and border issues as a result of increased production of imports into California	regulatory authority transfer; consumerism (with respect to resource conservation); more market/lifestyle choices from increased affluence
Less manufacturing-related pollution due to manufacturers leaving the US or California	globalization
Increased consumption resulting in increased manufacturing of goods out of California, shifting pollution to the manufacturing state	population growth
Changes in land use patterns resulting in cleanups, use of marginal areas, relocation of manufacture, and development of new zoning criteria	increased environmental justice awareness
<b>INFORMATION DISSEMINATION</b>	
More rational public view of risk	changing public perception of environmental problems and personal responsibility
Greater demand/need for information resources by a more educated and a more socially active population	cultural and economic diversity
Changes in basic research funding from government to private leading to more proprietary information and a greater demand for right-to-know information	decreased government funding
Coordination and improvements in electronic communication resources (and paperless offices) resulting from better use of electronic communication	public participation
Need for Cal/EPA to compete with other, inaccurate sources of information; also, with the Internet allowing people to get involved, public expectations are higher (e.g., pressure to provide real-time information increases), and lack of information or data/information gaps become more evident	jointly: more market/lifestyle choices from increased affluence, social activism
OEHHA and Cal/EPA must make information available by low-tech means to address (increased) inequality of information access, greater division between have's and have not's	information technologies

Consequence	As a result of...
<b>INFORMATION DISSEMINATION</b>	
More Cal/EPA staff (trained in communication) needed to address environmental justice issues, to interface with parties in conflict or the public in general, or to work on industry-government agreements. The increase in government placators may lead to either honest or less honest communication	increased environmental justice awareness; jointly: drinking water supply contamination, interactions between government and industry, changing public perception of environmental problems and personal responsibility
More and better, up-to-date education and outreach efforts, requiring the allocation of resources by government and industry	jointly: drinking water supply contamination, interactions between government and industry, changing public perception of environmental problems and personal responsibility; jointly: cultural and economic diversity, limited water supply, catastrophic events; jointly: information technologies, population growth, economic growth
Need for government to listen more to both sides (industry and the public); better communication with the public, Agency and the Legislature	social activism; jointly: water quality and availability, public participation, global warming
More information in more languages on the Internet posted by California agencies on issues of environmental concern, e.g., genetically engineered pesticides	jointly: biotechnology advancements, information technologies, changes in California's ethnic distribution
Need to provide quality control on the increased amount of environmental information of uncertain reliability	information technologies
No environmental indicators	information technologies
<b>IMPACTS ON ENVIRONMENTAL PROGRAMS</b>	
More money for environmental programs due to lower government cost from more efficient use of infrastructure; increased taxes and public revenue producing more regulatory jobs	urbanization; population growth
More monies for environmental investments as a result of increased taxes/revenues	economic growth

Consequence	As a result of...
<b>IMPACTS ON ENVIRONMENTAL PROGRAMS, continued</b>	
Increased legislation and resultant changes in funding allocations due to alienation resulting from non-governmental organization and public distrust	jointly: drinking water supply contamination, interactions between government and industry, changing public perception of environmental problems and personal responsibility
Decreased ability to respond to emerging problems due to decreased funding for regulation and research (may increase human and ecological risks)	regulatory authority transfer
Cuts in government programs and decreased regulation and oversight resulting in decreased EPA, shift to local environmental controls, increased environmental releases, less testing, more communication between agencies, increased bottom line responsibility and increased political influence	decreased government funding
Decoupling of the inverse relationship between environmental and economic progress, leading to more government-business partnerships, increased interactions among government, business, the public, environmental groups and the media	jointly: drinking water supply contamination, interactions between government and industry, changing public perception of environmental problems and personal responsibility
Improved, more informed environmental decisions due to greater participation by regulated community and the public, improved trust and value of stakeholder input; interdisciplinary decision-making and expertise; regulatory transparency and better consistency increasing public confidence	increased access to information; increased public participation; jointly: water quality and availability, public participation, global warming
Compliance assistance	interactions between government and industry
Changes in priority/flexibility as a result of interactions between government and industry, resulting in changes in program allocations	jointly: drinking water supply contamination, interactions between government and industry, changing public perception of environmental problems and personal responsibility
More voluntary programs due to changes in government priorities	changing public perception of environmental problems and personal responsibility

Consequence	As a result of...
<b>IMPACTS ON ENVIRONMENTAL PROGRAMS, continued</b>	
Increased adoption of ISO 14001 or other environmental management systems	interactions between government and industry
"Trashing" of the environment and increased emission sources as a result of an increased underground economy and increased homelessness	have's/have-not's gap
More pollution prevention programs in Cal/EPA	jointly: drinking water supply contamination, interactions between government and industry, changing public perception of environmental problems and personal responsibility
More proactive planning	jointly: water quality and availability, public participation, global warming
More environmental investigations leading to reassurance or increased worry and cleanups	increased environmental justice awareness
Serious environmental goals and targets as a result of government-business partnerships and a more informed public with a more rational view of risk	changing public perception of environmental problems and personal responsibility
Increased interest in environmental indicators, performance and monitoring; emphasis on checks and balances, environmental accountability and measures of success	jointly: drinking water supply contamination, interactions between government and industry, changing public perception of environmental problems and personal responsibility
Greater difficulty in governance; more complex regulatory demands due to larger universe to regulate	jointly: cultural and economic diversity, limited water supply, catastrophic events; jointly: increased access to information, free trade, increased/decreased cost of energy
Increased government costs leading to greater resistance to regulations	have's/have-not's gap
Restraints on/challenges to California and local (environmental) regulation resulting in decreased local regulations, increased pollution, uncertain food standards, more food labels. Alternatively, restraints may result in increased protection, better environment.	globalization
Increased underground and internet economy resulting in increased circumvention of regulations	globalization

Consequence	As a result of...
<b>IMPACTS ON ENVIRONMENTAL PROGRAMS, continued</b>	
Inability to promulgate environmental regulations or slower regulatory change due to governmental budgets inadequate to deal with an empowered public and increased participation by regulated community	increased access to information
Coordination and standardization in California environmental regulation and internationally, bringing down the cost of regulation and increasing efficiency	jointly: increased access to information, free trade, increased/decreased cost of energy
Better coordination: unified voice on legislative issues	jointly: water quality and availability, public participation, global warming
Impacts on the future of closed landfills in California (need for better coordination)	water quality and availability
Increased political nature of environmental decisions, and increased legal or political oversight; increased potential for the promotion of "hidden agenda" in the guise of environmental protection or social justice; decisions deferred to the political process, resulting in less or delayed environmental protection; increased lobbying decreasing government/corporate influence	jointly: more market/lifestyle choices from increased affluence, social activism
Increased regulatory activity for Cal/EPA: more regulations/legislation resulting from public distrust of industry, from public perception that government is falling short, and from increased public participation	increased environmental justice awareness; jointly: drinking water supply contamination, interactions between government and industry, changing public perception of environmental problems and personal responsibility
Decreased influence, increased accountability of industry	social activism
Identification of susceptible population resulting in increased environmental litigation and more regulation, and lower permissible exposure levels	genetic diagnoses
Unpredictable mutations (due to cheap land and use of marginal areas) resulting in increased regulation and increased waste	genetic diagnoses
Increased costs for regulatory controls due to increased fuel blends prompted by increased pollution	increased fossil fuel use
Increased exchange of natural resource regulations	jointly: decreased water availability, population growth, globalization
Increase in local control, development of new local environment zoning controls	jointly: regulatory authority transfer, increased environmental justice awareness, genetic diagnoses

Consequence	As a result of...
<b>NEW TOOLS FOR ENVIRONMENTAL PROTECTION</b>	
Tools that help solve environmental problems, e.g., GIS, and increased environmental applications resulting from increased technological advances	information technologies
New tools for exposure assessment resulting in increased environmental consulting/investigation and decreased environmental pollution	genetic diagnoses
Increased cooperation between countries, including international cooperation on water use; globalization of environmental issues	jointly: decreased water availability, population growth, globalization
Agreements (streamlined permitting and regulations, consistent, cross-cutting inspection and enforcement, "green" programs, consumer education and outreach, joint program stewardship, negotiated settlements)	interactions between government and industry
Improved use of environmental and of communication technologies	jointly: water quality and availability, public participation, global warming
Eco-services to address deforestation, extinction, other adverse impacts on environment	population growth
More technology and resources to lower exposures to hazardous chemicals	increased affluence
<b>EQUITY ISSUES</b>	
Environmental justice issues arising from changes in access to health care and information. A lack of consensus in addressing problems will lead to increased social turmoil and decreased environmental justice and quality.	information technologies, regulatory authority transfer, have's/have-not's gap
Environmental justice resulting from differences in ability to afford home purification systems, from non-governmental organization and public distrust, from language barriers, from new ways of allocating water, and from social inequities due to increased consumerism	cultural and economic diversity; limited water supply; consumerism (with respect to resource conservation); more market/lifestyle choices from increased affluence; jointly: drinking water supply contamination, interactions between government and industry, changing public perception of environmental problems and personal responsibility

Consequence	As a result of...
<b>EQUITY ISSUES, continued</b>	
Business flight to less regulation and migration of pollution result in some states becoming safer than others (exposures are greater in certain areas) and decreased environmental justice and environmental quality	regulatory authority transfer
An education divide making it harder to "reach" people on environmental issues	have's/have-not's gap
Greater disparity in environmental protection because "the squeaky wheel gets the grease"	social activism
<b>CATASTROPHIC EVENTS</b>	
Ecoterrorism due to changes in social structure resulting from (increased) inequality of information access/greater division between have's and have not's	information technologies
Increased opportunities for environmental disasters due to fuel trade deficits	increased fossil fuel use
<b>SOCIETAL ATTITUDES</b>	
Greater "NIMBY" sentiment and greater political activism from a larger middle class	economic growth
Increased cultural diversity (more opinions, more time needed to come to solution) delaying action on fixing environmental problems, or providing more solutions	globalization
On-again, off-again support of environmental issues as a result of more economic volatility due to wealthy people speculating in investments	have's/have-not's gap
Decrease in true democracy leading to greater increase in special interest and environmental issues	have's/have-not's gap
Changes in political structure and increased grassroots activism as a result of competition for funding (e.g., prisons vs. environmental protection) and decreased importance of government	decreased government funding
Different environmental behaviors (the "throw-aways" vs. those who hold the environment in high regard) due to differences in cultural, wealth	cultural and economic diversity
Increased individualism resulting in less focus on environmental issues	more market/lifestyle choices from increased affluence
More environmental advocacy groups resulting from increased social activism, leading to more complex processes for regulatory action, increased localization of environmental issues, and more community-appropriate decisions	jointly: more market/lifestyle choices from increased affluence, social activism



Consequence	As a result of...
<b>SOCIETAL ATTITUDES, continued</b>	
Ethic for recycling, conservation and re-use (e.g., new products with more recyclable content) and greater accountability/responsibility by industry (the "triple bottom line"), government and individuals for environmental and social issues; increased sense of responsibility, increased conservation and stewardship by government, business, the public; environment held in high regard	cultural and economic diversity; jointly: drinking water supply contamination, interactions between government and industry, changing public perception of environmental problems and personal responsibility; jointly: information technologies, population growth, economic growth
Social values, rather than science, driving decisions	jointly: more market/lifestyle choices from increased affluence, social activism
Alienation, lack of confidence in government/political process	jointly: more market/lifestyle choices from increased affluence, social activism
<b>DEMOGRAPHICS-BASED ISSUES</b>	
Fewer recessive genes expressed due to increased inter-racial marriages	changes in California's ethnic makeup
Identification of susceptible population resulting in increased environmental litigation and more regulation, and lower permissible exposure levels	genetic diagnoses
Increased cultural diversity requiring increased education efforts on environmental issues	population growth
Growth constraints and population shifts (e.g., less urban sprawl) due to water resource limitations	limited water supply; lack of water/increasing demand
Increased size of border populations leading to lower environmental standards	free trade
<b>NEW TECHNOLOGY</b>	
"Designer" babies tolerating higher exposure levels	genetic diagnoses
More innovative technology in response to greater resources/energy demand and associated higher costs	have's/have-not's gap

Consequence	As a result of...
<b>NEW TECHNOLOGY, continued</b>	
More research in pollution reduction/pollution technology as a result of increased pollution increase	increased energy consumption, have's/have-not's gap
Export of cleanup technologies	jointly: decreased water supply, population growth, economic growth
Increasing demands on government for services and goods, including technology advancement efforts	jointly: information technologies, population growth, economic growth
Increased research due to new economic or technological ideas	interactions between government and industry
More water-treatment technology	jointly: drinking water supply contamination, interactions between government and industry, changing public perception of environmental problems and personal responsibility
Decoupling of energy use and prosperity brought about by new energy technologies in cars, air conditioning, lighting, etc.	increased cost of energy
Slower development of new technology, requiring public education to change attitudes toward new technology and regulatory action to force new technologies	cheap vehicular fuel
More innovation spurred by the need for recycling and for more landfill capacity to handle increased volume of product packaging and increased volume due to larger population	consumerism (with respect to resource conservation); more market/lifestyle choices from increased affluence; population growth; greater accessibility of information through the Internet