FOLLOW-UP QUESTIONS

of

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for the

UNITED STATES SENATE
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS

SENATOR JAMES M. INHOFE, CHAIRMAN
SENATOR JAMES JEFFORDS, RANKING MEMBER

OVERSIGHT HEARING ON THE TOXIC SUBSTANCES CONTROL ACT (TSCA) AND THE CHEMICALS MANAGEMENT PROGRAM AT EPA, AUGUST 2, 2006.

AUGUST 31, 2006

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QUESTIONS FROM SENATOR BOXER:

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Mr. Wilson, what do you think the ultimate consequence will be for the US if we lag behind other countries in adequately assessing and regulating the health risks of chemicals? Will we become a dumping ground for dangerous chemicals?

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Mr. Wilson, your report makes the point that Europe is leading the way in innovative chemical regulation policy.

Please describe the types of benefits that industries and individuals in the US would experience if the US government were to develop similarly innovative chemical regulation policies.

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Mr. Wilson, states seem to be addressing chemical threats and pollution with new and innovative types of legislation.

Please describe some of the benefits to industries and individuals from California's consumer notification law, Proposition 65, and the Toxic Use Reduction Act in Massachusetts?

QUESTIONS FROM SENATOR INHOFE:

1. Your report advocates the adoption of a REACH-like approach and indicates that the U.S. is behind Europe on chemicals regulation. How many chemicals have been evaluated under REACH? How many sets of data have been submitted in response to REACH? Isn't it true that REACH doesn't even exist yet?

RESPONSE OF MICHAEL P. WILSON

Dear Senator Inhofe,

Thank you for this question. It is appropriate to open a discussion of TSCA in the U.S. with a question pertaining to the European Union's proposed *Registration, Evaluation, and Authorization of Chemicals* initiative, known as REACH. As you know, we were asked by the California Legislature in January 2004 to evaluate chemical challenges facing California, and we, too, recognized the importance of REACH for the U.S. chemical industry and for chemicals policy in the U.S. and California. The UC report, *Green Chemistry in California: A Framework for Leadership in Chemicals Policy and Innovation*, which was released by the UC Office of the President to the Legislature on March 14, 2006, discusses REACH at some length for this reason. I will describe some key issues we identified in our analysis and then answer four specific issues you raise in your question.

QUESTION 1. DOES THE UC REPORT ADVOCATE THE ADOPTION OF A REACH-LIKE APPROACH?

RESPONSE OF MICHAEL P. WILSON

A. THE UC REPORT DOES NOT CALL FOR THE ADOPTION OF A REACH-LIKE APPROACH IN THE U.S.

The UC report proposes three overarching *goals* for chemicals policy in California: Close the Data Gap, the Safety Gap, and the Technology Gap. It then describes a number of issues that are important for policymakers to consider with respect to each of these goals (*Chapter 7*). The Data Gap refers to the lack of information in the market on the safety of chemicals. The Safety Gap refers to the barriers that government faces in its efforts to assess the hazards of chemicals and control those of greatest concern. The Technology Gap refers to the potential for the U.S. to fall behind globally in the science, technology, and commercial applicability of green chemistry.

We developed these three policy goals (*Chapter 3*) based on discussions with chemicals policy stakeholders in the U.S., on our participation in 35 chemicals policy meetings and conferences in the U.S. (*Appendix A*), and in studying reports published by the National Academy of Sciences (1984),[1] the U.S. General Accounting Office (1994),[2] the

Congressional Office of Technology Assessment (1995),[3] Environmental Defense (1997),[4] the U.S. EPA (1998),[5] the U.S. Government Accountability Office (2005), former EPA officials,[6] and academic researchers.[7] These reports all point to deficiencies in the U.S. Toxic Substances Control Act (TSCA) that have prevented the statute from serving as an effective vehicle for government, industry, consumers, and workers in the U.S. to assess chemicals in commercial circulation and control those of greatest concern. The UC report uses the terms Data Gap, Safety Gap, and Technology Gap to describe the set of conditions in the U.S. that have emerged as a consequence of these deficiencies.

B. THE UC REPORT DESCRIBES REACH AS THE E.U.'S STRATEGY TO ADDRESS A SET OF CHEMICALS POLICY PROBLEMS THAT ARE ESSENTIALLY IDENTICAL TO THOSE OF THE U.S. EXPERIENCE UNDER TSCA.

The chemicals policy deficiencies identified in the E.U. by the European Commission in its justification for REACH are essentially identical to those of the U.S.:[8]

- There is a lack of health, environmental, and other information on the great majority of chemicals in commerce; 99% of chemicals in commercial circulation in the E.U., by volume, lack adequate information on health and environmental effects.
- There is an implicit presumption that chemicals are safe unless proven otherwise by a public entity.
- The ability of public agencies to assess and demonstrate chemical risks has not kept pace with the rate of chemical production; only about 140 of 100,000 existing chemicals in the E.U. have been subject to risk assessments.[8]

The UC report indicates that an array of strategies could be employed to address this same set of problems in the U.S. The report devotes a chapter to a discussion of the experience in Massachusetts under the Toxics Use Reduction Act of 1989 (*Chapter 6*), and it lists 13 different policy mechanisms that could be used to directly or indirectly limit chemical hazards. It proposes a set of attributes of the most effective policy mechanisms, as follows (*Chapter 7*):

- meet the proposed objective in a measurable way,
- place the least demands on government,
- leverage market forces,
- leverage existing statutes and programs,
- be cost-effective and fair,
- consider impacts across the chemical life cycle (including the workplace),
- ensure public access and participation,
- integrate environmental and occupational health justice factors,
- emphasize prevention (including green chemistry) over mitigation,
- encourage continual learning by the regulated entity,
- motivate technology innovation and diffusion, and
- be adaptable to change.

The report finds that to close the Data Gap, Safety Gap, and Technology Gap, California will need to: (1) require the disclosure by chemical producers of more complete information on chemical toxicity, ecotoxicity, exposure and other information; (2) improve the capacity of government to act in an efficient and timely manner in controlling the most dangerous chemicals; and (3) implement additional incentives that motivate industry investment in green chemistry science and technology, and devote public resources to green chemistry education, research, and technical assistance programs. The first two of these parallel the intent of the REACH proposal, whereas the third is implied but not made explicit in REACH.

The similarities between the policy goals recommended in the UC report and those of REACH reflect the fact that both are responding to essentially the same problems; the similarities also reflect a general concern among the industry representatives we spoke with that harmonization of standards across jurisdictions is becoming increasingly important as these jurisdictions begin to contemplate chemicals policy strategies. To prevent a scenario in which U.S. producers are forced to contend with an increasingly diverse global regulatory environment, the UC report suggests that some aspects of REACH (such as data requirements) might be harmonized with chemicals policy initiatives in California and the U.S.

C. THE UC REPORT DRAWS FOUR BASIC CONCLUSIONS ABOUT THE IMPLICATIONS OF REACH FOR CALIFORNIA.

First, the report presents evidence suggesting that REACH will improve the technical and commercial viability of green chemistry by improving accountability and oversight in the chemicals market. Second, the report notes that REACH could present a unique challenge to California's small and medium-sized chemical producers, and that California could take steps now to assist these businesses in meeting REACH requirements. Third, the report proposes that REACH could present an opportunity for California to gather toxicity and other information on many chemicals in commercial circulation, and that for this information to be most useful, California will need to gather sales data on the *distribution* of chemicals sold in the state. Fourth, the report concludes that while REACH is expected to drive innovation in safer chemicals, it is also conceivable that some producers will seek to market "non- E.U.-compliant" hazardous chemicals in countries where regulatory oversight is weak, such as in the U.S., particularly during transitional "sell-through" periods.

QUESTION 2. DOES THE UC REPORT INDICATE THAT THE U.S. IS BEHIND EUROPE ON CHEMICALS REGULATION?

RESPONSE OF MICHAEL P. WILSON

A. THE UC REPORT CONCLUDES THAT THE U.S. HAS FALLEN BEHIND THE E.U. IN ADDRESSING LONG-STANDING CHEMICAL POLICY DEFICIENCIES AND THAT THIS WILL

HAVE IMPORTANT CONSEQUENCES FOR THE ECONOMY AND FOR PUBLIC HEALTH IN THE U.S.

Because REACH represents a concerted effort by the E.U. to solve chemical policy problems that are essentially identical to those of the U.S., it is reasonable to conclude that the U.S. has "fallen behind" the E.U. in this arena. The important question is, "Why does this matter?" In short, on the current trajectory, the UC report finds that the U.S. will face a growing burden of environmental, economic, and social costs associated with the continued production and use of hazardous chemicals; the E.U., on the other hand, will steadily bring these costs under control, thereby "freeing up" resources for new industrial investment and social needs.

Three cases illustrate the costs of the current chemical production system that are likely to expand in the U.S. on the present trajectory:

CHILDREN'S HEALTH. Establishing a link between chemical exposures and disease trends is difficult given the set of epidemiological and toxicological tools currently available.[9] Nevertheless, there is evidence that chemical exposures play a role in certain diseases among children in the U.S.[10] Landrigan et al. estimate that chemical exposures in air, food, water, and communities contribute to 100% of lead poisoning, 10% to 35% of asthma, 2% to 10% of certain cancers, and 5% to 20% of neurobehavioral disorders among children.[11] These chronic, extraordinarily costly conditions are of multifactorial origin and have been termed the "new pediatric morbidity."[A]

[A] The limitations of the construct in toxicology that "the dose makes the poison," first proposed by Paracelsus (1493-1541) in the late Middle Ages, are now well recognized, particularly with respect to children's health. Higher doses are expected to produce relatively higher responses, but it has been established that the toxic effects of chemicals in the human body and in ecosystems can be local or systemic, immediate or delayed, reversible or irreversible, as well as combinations of these attributes.[12] For the great majority of chemicals, the full range of toxic and ecotoxic effects is unknown. The health effects of exposure to chemical *mixtures* are largely unknown; it is well-established, however, that chemical mixtures can amplify or dampen the toxic effects of individual chemicals.[13-15] The timing of exposure, particularly with respect to exposures that occur during fetal and child development, is also highly significant. In 1993, the National Academy of Sciences reported that children are uniquely vulnerable to the effects of chemical exposures during all periods of fetal, infant, and child development. This vulnerability is attributable to four key factors, as follows:[16]

1) Sensitive physiological processes can be disrupted during the rapid growth and development characteristic of embryonic and fetal life and the first year following birth. Development of the brain, for example, requires the formation and interconnection of billions of neurological cells; development of the endocrine system and reproductive organs is guided by a precisely timed sequence of hormones that exert their effects in the parts-per-trillion range.

2) Children's metabolic pathways, especially in fetal life and in the first month after birth, are immature. Among other factors, growth of the blood-brain barrier, which can provide protection against some chemicals, is incomplete during fetal and early child development, such that chemicals are able to move directly from the maternal blood stream into the developing fetal brain.

3) Relative to their size, children's intake of air, water, and food is far greater than that of adults. The amount of air a resting infant breathes, for example, is twice that of an adult, normalized by body weight. Children therefore experience disproportionately higher doses of environmental agents, including

The prevalence of asthma among children approximately doubled between 1980 and 1995, from about 4% to 8%.[10] Between 1994 and 1996, asthma caused U.S. children to miss 14 million days of school. The National Academy of Sciences reported in 2000 that, although data are limited, there is evidence suggesting that indoor air pollutants such as volatile organic compounds, plasticizers, nitrogen dioxide, and pesticides may play a role in childhood asthma.[17] A 2005 study of 14,000 children reported a dose-response relationship between childhood wheezing and pre-natal exposure to chemical consumer products.[18]

The prevalence of childhood cancers, including leukemias (acute lymphoblastic and acute myeloid), central nervous system tumors, lymphomas (Hodgkin's lymphoma, non-Hodgkin's lymphoma), thyroid carcinoma, and malignant melanoma, appears to have stabilized since 1990 after steady increases since 1975.[10] In absolute numbers, childhood cancer deaths have declined since 1975, largely due to improvements in treatment.[19]

Between 3% and 8% of infants born each year in the U.S. are—or will be—affected by neurodevelopmental disorders, including autism, mental retardation or attention-deficit/hyperactivity disorder (ADHD).[10] The causes of these disorders are unknown in the great majority of cases. It is well-established, however, that at low levels certain industrial chemicals—such as lead, methylmercury, PCBs, and others—disrupt the developing brain and nervous system.

WORKER HEALTH AND SAFETY. The European Commission expects the benefits of REACH to outweigh the costs over a 30-year period in the form of health and environmental improvements.[20] A study published by the University of Sheffield, United Kingdom, estimated that the incidence of occupationally related asthma, chronic obstructive pulmonary disease (COPD) and dermatitis in the 25 nations of the E.U. per million persons per year is 400, 500 and 400 respectively, and that the proportion of those cases potentially preventable by REACH is 50%, 10% and 50%, respectively.[21] Based on an E.U. population of 200 million, the number of future cases per year that would be avoided by REACH is 40,000 for asthma, 10,000 for COPD, and 40,000 for dermatitis. The European Commission estimated in 2003 that REACH would also prevent about 4,300 occupational cancer cases per year and would save €50 billion ($60 billion)[22] over a 30-year period in total cancer cases avoided.[23] By preventing a large portion of the burden of morbidity and mortality among workers, the E.U. will reap an array of social and economic benefits.

In California, about 23,000 new cases of chemically related deadly chronic disease are identified each year; another 6,500 die as a result of deadly chronic diseases attributable to

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chemicals.

4) Children have more years of future life than adults and thus have more time to develop diseases initiated by exposures early in life. Many chronic diseases, including cancer and neurodegenerative diseases, appear to arise as a result of cellular changes that take place many years before the actual manifestation of the disease. Critical windows of exposure to hazardous chemicals *in utero*, during early child development, and during puberty are more likely to produce chronic disease than similar exposures encountered later.

chemical exposures on the job. These figures most likely underestimate the true rates. The total cost of these illnesses and deaths in California is a function not only of medical care and rehabilitation but also of home care, lost wages, effects on the economic security of families, and years of productive life lost.

HAZARDOUS WASTE. Assuming current U.S. regulatory and industrial practices remain the same, the U.S. EPA expects that by 2033, 217,000 new hazardous-waste sites will appear and require cleanup in the U.S., on top of 77,000 current sites.[24, 25] A significant portion of these sites will result from chemical contamination. The EPA estimates that efforts to clean-up the new sites will cost about $250 billion over this period.

The U.S. Agency for Toxic Substances and Disease Registry (ATSDR) has identified 275 chemicals present at *existing* "National Priority" hazardous waste sites and has rated those chemicals on the basis of both toxicity and exposure potential.[26] Of the top 50 chemicals on the list, 38 (76%) are "reasonably anticipated" to cause, or are "possibly" or "probably" capable of causing, cancer in humans; 28 (56%) are expected to cause developmental defects in children; and 27 (54%) are suspected of causing acute and/or chronic neurotoxic effects.[27] Preventing the generation of hazardous waste would of course save enormous resources that could otherwise be invested in socially useful purposes; the E.U. is taking steps to do this through the REACH initiative.

By choosing not to address chemicals policy deficiencies, the U.S. will allow certain health effects among children, diseases among workers, hazardous waste, air and water pollution, and other externalities of the present chemical production system to continue largely unchecked, particularly in states with growing populations like California. REACH is broadly intended to place the E.U. on a trajectory in which these externalities are gradually brought under control.

B. AS REACH IS IMPLEMENTED, E.U. PRODUCERS WILL STEADILY INCREASE THEIR INVESTMENTS IN GREEN CHEMISTRY INNOVATION, WHERE THEY COULD GAIN A GLOBAL COMPETITIVE ADVANTAGE.

Over a period of 11 years, REACH will introduce new responsibilities and a greater degree of government oversight for producers of chemicals and chemical products that manufacture in, or import into, the E.U. Producers will be responsible for disclosing more information about the health and safety of the chemicals they produce (particularly for chemicals sold in larger volumes); they will be required to distribute this information into supply chains to end users; and they will be required to gather better information from end users to ensure that chemicals are used appropriately. REACH will gradually remove the distinction between chemicals already on the market (so-called "existing" chemicals) and "new" chemicals. Together, these and other changes implemented under REACH are expected to introduce a new level of accountability in the global chemicals market.

By improving accountability in the chemicals market, REACH will steadily improve the scientific, technical, and commercial viability of next-generation environmental technologies, including green chemistry. This will likely lead to improved investment

conditions in this sector.[B] E.U. chemical producers and entrepreneurs are expected to respond to these developments and could take the lead in innovating these next-generation environmental technologies; some explained to us that they will market their products as the "safest chemical products in the world." [C]

In the U.S., meanwhile, the deficiencies of TSCA (if left uncorrected) will allow hazardous chemicals to remain competitive in the market. As noted in the UC report, this will continue to dampen the motivation of U.S. chemical producers and entrepreneurs to invest substantively in green chemistry innovation. Lacking a robust domestic market, it is unlikely that green chemistry will advance scientifically, technically, or commercially in the U.S.; leadership in this arena could thus be ceded to the E.U.

C. AS REACH IS IMPLEMENTED, THE U.S. COULD BECOME A MARKET FOR CERTAIN HAZARDOUS CHEMICALS THAT ARE BARRED FROM THE E.U.

It is not possible to predict how producers throughout the global economy will respond to the new levels of accountability and oversight that REACH will require. The UC report finds that REACH is expected to drive innovation in safer chemicals, but it also suggests that REACH could cause some producers to market "non-REACH-compliant" chemicals in countries with rich markets and weak regulatory oversight, such as the U.S.[D] With the potential for up to 1,400 chemicals to come under the REACH authorization process, it is reasonable to expect that some producers will seek to market some of those chemicals outside the E.U., including in the U.S. The pressure to do so is likely to be particularly acute during transitional "sell-through" periods as REACH is implemented. On the other hand, some producers could move toward uniform specifications for individual chemicals sold in the E.U. and the U.S. Under this scenario, these producers would strive to meet REACH requirements with these products and then market those

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[B] Innovest Research Director Marc Brammer noted in 2005 that "There is significant potential for a sea-change in the market for chemicals as knowledge about toxicity expands under the new E.U. REACH directive and similar efforts elsewhere. There is little toxicity data available on many currently commercialized chemicals." The European Social Investment Forum reported in 2005 that "over the next five to ten years, green chemical innovation could be a significant source of competitive advantage for companies manufacturing chemicals used in consumer products, particularly in markets where brand or product differentiation based on green credentials is a key component of value for the final customer."[28] Great Britain's Crystal-Faraday Partnership[B] projected that consumer and commercial demand will grow during the period 2003–2013 for chemical products that are "more environmentally friendly whilst still delivering high performance," and for which there is complete "traceability of all raw materials and ingredients."[29]

[C] The importance of safer chemical products in the market is suggested by trends in the cosmetics industry, where the U.S. non-toxic cosmetic sector is projected to grow at 8% per year (to $1.1 billion) in 2009, compared to overall growth in cosmetic and toiletry chemicals of 5.7% per year (to $7.6 billion) in 2009.[30]

[D] For example, the German chemical company BASF will continue to produce and sell the monoester di[2-ethylhexyl] phthalate (DEHP) in the U.S. even though it will be permanently banned in the E.U. for use in toys in 2006.[31] BASF will discontinue production of DEHP and its raw material, 2-ethylhexanol, in the E.U., where it will introduce a substitute whose safety, according to the company, "is beyond all question."

products globally. The decision as to which path producers follow will probably occur on a chemical-by-chemical basis.

QUESTION 3. HOW MANY CHEMICALS HAVE BEEN EVALUATED UNDER REACH?

RESPONSE OF MICHAEL P. WILSON

REACH has not yet been implemented, so chemicals have not yet come under evaluation.

QUESTION 4. HOW MANY SETS OF DATA HAVE BEEN SUBMITTED IN RESPONSE TO REACH?

RESPONSE OF MICHAEL P. WILSON

REACH has not yet been implemented, so producers have not yet submitted data on chemicals.

QUESTION 5. ISN'T IT TRUE THAT REACH DOESN'T EVEN EXIST YET?

RESPONSE OF MICHAEL P. WILSON

REACH has not become law yet in the E.U.; rather, it is a legislative proposal that is moving toward becoming law in 2007. Most observers expect that something very close to the present form of REACH will become law in the E.U. Some U.S. companies have already prepared the data sets to ensure compliance. While "REACH doesn't even exist yet," it is clear for the following reasons that preparing for its adoption in the E.U. is an appropriate course of action for government, businesses, and industry in the U.S.

A. REACH COULD HAVE IMPORTANT IMPLICATIONS FOR THE CALIFORNIA AND U.S. ECONOMY.

California businesses and industry are becoming increasingly aware that regulatory developments that occur in the E.U. are of great economic importance. The E.U. recently adopted regulations pertaining to the electronics industry that have deeply affected this sector of California's economy. The *Waste Electrical and Electronic Equipment* (WEEE) directive (effective August 2005) requires producers to recover and reuse electrical and electronic waste.[32] It is intended to encourage the use of new materials in electronic products that are easier to handle during recycling and recovery. The *Restriction of Hazardous Substances in Electrical and Electronic Equipment* (RoHS) directive (effective July 2006) prohibits the use of certain materials in electronics products that are sold in the E.U., including lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls, and certain polybrominated diphenyl ethers (PBDEs).[33, 34] For the first time in the

industry's history, this has required electronics manufacturers to identify these materials in complex, global supply chains and find alternative materials that are equally effective.

These policy developments are extraordinarily important to U.S. companies that conduct business with the E.U. (or hope to do so in the future) because the E.U. can use the new regulations to impose restrictions on access to its 25-nation, 460 million person market. The California electronics industry cannot afford to lose access to the E.U. market, and electronics producers around the world have reached the same conclusion. WEEE and RoHS are thus affecting the design and manufacture of electronic and electrical equipment worldwide.

REACH is of great relevance to the chemical industry largely for the same reason. In its present form, REACH will require chemical producers to *register* and supply basic health and environmental information to an E.U. Chemicals Agency for up to 30,000 chemicals that are already on the market.[35] Of these, about 5,000 higher-volume chemicals will undergo more extensive *evaluation* by the Agency.[36] About 1,400 "chemicals of very high concern" will be presumptively removed from commercial circulation in an *authorization* process in which producers will bear the burden of proof in seeking government approval to use such chemicals.[37] [E] Chemical producers that fail to meet the REACH regulation could see their products barred from the E.U. market. Companies that do not prepare adequately for REACH could be vulnerable to losing market share or having their supply chains disrupted.

B. REACH WILL AFFECT THE WAY MANY CHEMICALS ARE DESIGNED, PARTICULARLY WITH RESPECT TO THEIR TOXICITY AND ECOTOXICITY, WHICH WILL AFFECT BUSINESSES AND PUBLIC HEALTH IN THE U.S.

Over the last 150 years, the U.S. chemical industry has played a key role in the U.S. economy. The industry's contributions to economic growth, employment, and improvements in health and living conditions in the U.S. are widely acknowledged.[38-41] Chemicals are a basic feedstock to nearly all industrial activity in the U.S.; they appear in thousands of consumer and commercial products and are used in innumerable industrial processes. In 2002, the American Chemistry Council (ACC) reported that U.S. businesses purchased $288 billion in U.S. chemical products and industry exports totaled $81 billion.[42] The ACC reports that the industry contributed directly or indirectly to 5.5 million U.S. jobs, or about 5% of the total U.S. workforce in 2002, and it paid $24.5 billion in federal, state, and local taxes.[43]

[E] Chemicals subject to *evaluation* are those produced or imported at 1,000 metric tons or more per year, per manufacturer. Chemicals subject to *authorization* ("chemicals of very high concern") consist of chemicals that are carcinogenic (causing cancer), mutagenic (causing changes in the DNA of chromosomes), or toxic to reproduction; chemicals that are persistent, bioaccumulative, and toxic; chemicals that are "very persistent and very bioaccumulative," irrespective of toxicity; and other chemicals considered to be particularly hazardous, such as endocrine-disrupting agents. Chemicals meeting these criteria will be presumptively removed from commerce unless chemical producers can demonstrate that the risks associated with their use are adequately controlled or that their risks are outweighed by their socioeconomic benefits.

In California, the ACC reports that the chemical industry employed about 81,000 people in 2004,[F] and that another 505,000 jobs were produced in the state indirectly by chemical industry activity in California and other states.[44] Together, this produced $28.6 billion in worker earnings and $1.7 billion in state and local tax revenues. The ACC reports that industries for which 10% or more of material inputs are derived from chemicals employ more than 4.3 million Californians.

The chemical industry is also important because its products are ubiquitous. In California, 164 million pounds of chemical consumer and commercial products are sold each day, or about 4.5 pounds per capita.[45] In 2001, the U.S. produced or imported 42 billion pounds of chemicals each day,[46] the equivalent (if converted to gallons of water) of about 623,000 gasoline tanker trucks per day, each carrying 8,000 gallons.[G] These chemicals are used in innumerable processes and products, and at some point in their life cycle many of them come in contact with people—in the workplace, in homes and through air, food, water, and waste streams. Eventually, in one form or another, many of them enter the earth's finite ecosystems. On the current trajectory, global chemical production is expected to double in size every 25 years, together with the expanding global consumer economy.

Given the importance of the chemical industry in the U.S. economy and the scale and pace of global chemical production, public policies such as REACH that could influence the way chemicals are designed, manufactured, used, and disposed of – and how toxic and ecotoxic they are – are of great public importance. It is in the interest of the U.S. to pay close attention to REACH and to support U.S. businesses and industry in navigating the REACH regulatory process.

C. ACTIVITIES AMONG U.S. BUSINESSES AND IN U.S. STATES INDICATE THAT TSCA IS NOT SERVING AS AN EFFECTIVE VEHICLE FOR CHEMICALS POLICY.

The deficiencies of TSCA are reflected by activities among downstream businesses that use chemicals in the U.S. A growing number of these businesses are demanding better information on the health and safety of the chemicals they purchase, and some are taking steps to "clean" their supply chains of hazardous chemicals.[H] Some are finding that once

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[F] Includes pharmaceuticals and pesticide producers.

[G] An MC-407 gasoline tanker carries about 8,000 gallons of fuel. Estimates are based on the following: $(1.52 \times 10^{13}$ pounds/year)*(0.016 ft^3/lb water)*(7.48 gallons/1 ft^3)*(1 truck/8,000 gallons)*(1 year/365 days) = 623,000 trucks/day.

[H] Kaiser Permanente, the largest private health-care provider in the U.S. and the largest private-sector employer in the San Francisco Bay Area, recently implemented a procurement policy for chemicals and materials for its 30 hospitals and 430 medical office buildings nationwide that calls for "avoiding the use of carcinogens, mutagens and reproductive toxins and persistent, bioaccumulative and toxic chemicals."[47] Kaiser's purchasing agent, the Consorta Group, handles an annual purchase volume of $4.1 billion and has adopted a purchasing policy to screen-out hazardous chemicals and materials by requiring manufacturers to produce data on the toxicity and ecotoxicity of their products.[48] Firms with operations in California that are adopting chemical and material screening programs include Kaiser Permanente, Catholic Healthcare West,[49] Intel,[50] Hewlett-Packard,[51] Bentley Prince Street,[52] IBM,[53] and Apple.[54] In November 2005 Catholic Healthcare West awarded a five-year, $70 million contract to Braun Medical Inc. for the supply of polyvinyl chloride (PVC)/di-2-ethylhexyl phthalate (DEHP)-free intravenous (IV) bags, solutions, and tubing to the system's 40 hospitals in California, Arizona, and Nevada.[49] Other U.S. and E.U. companies working to

they identify safer chemical products or processes, they realize savings that contribute to the bottom line. Getting to this point, however, is fraught with problems engendered by the TSCA Data and Safety Gaps. Identifying hazardous chemicals and tracking down safer ones (that also perform the necessary function) can be an extremely difficult and costly undertaking even for large businesses; for most, it is simply not possible. The demand for better chemical information and safer chemicals is likely to grow among U.S. businesses as REACH is implemented and standardized chemical information becomes available to the full range of downstream businesses that use chemicals.

Chemicals policy initiatives taking place in U.S. states are also a natural reaction to the deficiencies of TSCA, and they reflect ongoing public concern over the health and environmental effects of chemicals. The UC report found that in 2005, the California Legislature deliberated on about 35 bills related to chemicals policy. During this same period, about 18 U.S. states considered or passed various forms of chemicals policy legislation. The report suggests that the number of state-based initiatives in the U.S. is likely to grow in the future as the public becomes increasingly aware of REACH and other developments.[33, 34]

Thank you very much for giving me the opportunity to answer your questions. I would be happy to discuss these and other questions with you. Please feel free to contact me at UC Berkeley, mpwilson@berkeley.edu or 510-642-5703.

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"clean" their supply chains and produce safer products include Herman Miller, Shaw Carpets, Coastwide Labs, S.C. Johnson, Samsung, Sony, Fujitsu, Nike, Marks and Spencer, and Boots Group PLC.[55, 56]

QUESTIONS FROM SENATOR JEFFORDS:

1. Dr. Wilson, in the ever-expanding global market, will the European Union's REACH initiative alter chemical industry behavior in the United States? If so, to what extent?

2. Dr. Wilson, if hazardous chemicals are banned in the European Union but not at home, will the U.S. market for such chemicals expand?

RESPONSE OF MICHAEL P. WILSON

Dear Senator Jeffords,

Thank you for these questions. It is appropriate to open a discussion of TSCA and chemicals management in the U.S. with a question pertaining to the European Union's proposed *Registration, Evaluation, and Authorization of Chemicals* initiative, known as REACH. As you know, we were asked by the California Legislature in January 2004 to evaluate chemical challenges facing California, and we, too, recognized the importance of REACH for the U.S. chemical industry and for U.S. and California chemical management programs. Our report, *Green Chemistry in California: A Framework for Leadership in Chemicals Policy and Innovation*, which the UC Office of the President released to the Legislature on March 14, 2006, discusses REACH at some length. I will refer you in some questions to responses I prepared for Senator Inhofe, above, which describe issues related REACH.

QUESTION 1. IN THE EVER-EXPANDING GLOBAL MARKET, WILL THE EUROPEAN UNION'S REACH INITIATIVE ALTER CHEMICAL INDUSTRY BEHAVIOR IN THE UNITED STATES? IF SO, TO WHAT EXTENT?

RESPONSE OF MICHAEL P. WILSON

It is clear that REACH will affect all U.S. producers of chemicals and chemical products that manufacture in, or import into, the E.U. It will also indirectly affect all U.S. companies whose supply chains include chemicals or chemical products that are manufactured in the E.U., or that are manufactured in the U.S. and exported into the E.U. It is not possible to predict how REACH will affect "behavior" among U.S. producers of chemicals and chemical products; however, some chemical industry observers expect that important changes could occur in the chemicals market as REACH is implemented, and others suggest that the political climate surrounding chemicals policy in the U.S. could be affected. These potential developments are summarized below.

A. REACH WILL INTRODUCE A NEW LEVEL OF ACCOUNTABILITY FOR CHEMICAL PRODUCERS WITH OPERATIONS IN THE E.U.

Over a period of 11 years, REACH will introduce new responsibilities and a greater degree of government oversight for U.S. producers of chemicals and chemical products (that manufacture in, or import into, the E.U.). Generally speaking, producers will be responsible for disclosing more information about the health and safety of the chemicals they produce (particularly for chemicals sold in larger volumes); they will be required to distribute this information into supply chains to end users; and they will be required to gather information from end users to determine how chemicals are being used. REACH will gradually remove the distinction between chemicals already on the market (so-called "existing" chemicals) and "new" chemicals. Producers will need to seek government approval for certain chemicals on a use-by-use basis.[37] [I] These so-called "chemicals of very high concern" will be *presumptively* removed from commercial circulation unless the producer can demonstrate that the production and use of these chemicals can take place under adequately controlled conditions, or if this is not the case, that their "socio-economic benefits outweigh the risk to human health or the environment…and if there are no suitable alternatives."[57] These measures represent a degree of responsibility and oversight that is new in the global chemical production system, including that of the U.S. This will engender a new level of accountability in some sectors of the global chemicals market, including that of the U.S.

B. AS REACH IS IMPLEMENTED, E.U. PRODUCERS WILL INCREASE THEIR INVESTMENTS IN GREEN CHEMISTRY INNOVATION, WHERE THEY COULD GAIN A GLOBAL COMPETITIVE ADVANTAGE.

[Please refer to my response to Mr. Inhofe under this same heading, Question 2, Response B, above.]

C. AS REACH IS IMPLEMENTED, U.S. INDUSTRY RESISTANCE TO TSCA REFORM COULD DISSIPATE.

The implementation of REACH will likely produce changes in the political dynamic among U.S. chemical producers that could set the stage for reforming TSCA.[59] As noted above, REACH will require U.S. chemical producers with operations in the E.U. to disclose – or develop – information on the health and safety of their products. U.S. and offshore producers that do *not* manufacture products in (or for) the E.U., however, will be free of the costs inherent in this process. As REACH is implemented, U.S. chemical

[I] Chemicals subject to *evaluation* are those produced or imported at 1,000 metric tons or more per year, per manufacturer. Chemicals subject to *authorization* ("chemicals of very high concern") consist of chemicals that are carcinogenic (causing cancer), mutagenic (causing changes in the DNA of chromosomes), or toxic to reproduction; chemicals that are persistent, bioaccumulative, and toxic; chemicals that are "very persistent and very bioaccumulative," irrespective of toxicity; and other chemicals considered to be particularly hazardous, such as endocrine-disrupting agents. Chemicals meeting these criteria will be presumptively removed from commerce unless chemical producers can demonstrate that the risks associated with their use are adequately controlled or that their risks are outweighed by their socioeconomic benefits.[57] *Authorization* can also be triggered on the basis of information that becomes apparent during *registration* and *evaluation*.[58]

producers with operations in the E.U. will likely become less resistant to TSCA reforms that require information disclosure by all producers in the U.S., thus neutralizing this disparity. Harmonizing the data requirements with those of REACH would facilitate this process in the U.S. REACH could thus lead to a gradual improvement in the disclosure and dissemination of important chemical health and safety information in the U.S.

The downstream users of chemicals that will be the recipients of improved chemical information under REACH are also likely to exert an influence in the U.S. with regard to TSCA reform. As noted above in my response to Mr. Inhofe in subsection 5C, leading businesses in the U.S. are already demanding better information on the health and safety of the chemicals they purchase, and they are taking steps to "clean" their supply chains of hazardous chemicals. U.S. producers of chemicals and chemical products are responding to these demands, which will likely increase as REACH is implemented and standardized health and safety information becomes available to the full range of downstream business customers of the chemical industry. Over time, this could reduce the resistance among U.S. chemical producers to new rules under TSCA that would require producers to disclose and distribute more complete chemical information to end users.

QUESTION 2. IF HAZARDOUS CHEMICALS ARE BANNED IN THE EUROPEAN UNION BUT NOT AT HOME, WILL THE U.S. MARKET FOR SUCH CHEMICALS EXPAND?

RESPONSE OF MICHAEL P. WILSON

A. AS REACH IS IMPLEMENTED, THE U.S. COULD BECOME A MARKET FOR CERTAIN HAZARDOUS CHEMICALS THAT ARE BARRED FROM THE E.U.

[Please refer to my response to Mr. Inhofe under this same heading, Question 2, Response C].

Thank you very much for giving me the opportunity to answer your questions. I would be happy to discuss these and other questions with you. Please feel free to contact me at UC Berkeley, mpwilson@berkeley.edu or 510-642-5703.

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QUESTIONS FROM SENATOR BOXER:

QUESTION 1: REFORMING TSCA

Mr. Wilson, what do you think the ultimate consequence will be for the US if we lag behind other countries in adequately assessing and regulating the health risks of chemicals? Will we become a dumping ground for dangerous chemicals?

QUESTION 2: WORKER SAFETY AND CHEMICALS

Mr. Wilson, your report makes the point that Europe is leading the way in innovative chemical regulation policy.

Please describe the types of benefits that industries and individuals in the US would experience if the US government were to develop similarly innovative chemical regulation policies.

QUESTION 3: STRONG STATE CHEMICAL REGULATION PROGRAMS

Mr. Wilson, states seem to be addressing chemical threats and pollution with new and innovative types of legislation.

Please describe some of the benefits to industries and individuals from California's consumer notification law, Proposition 65, and the Toxic Use Reduction Act in Massachusetts?

RESPONSE OF MICHAEL P. WILSON

Dear Senator Boxer,

Thank you for these questions. It is appropriate to open a discussion of TSCA and chemicals management in the U.S. with a question pertaining to the European Union's proposed *Registration, Evaluation, and Authorization of Chemicals* initiative, known as REACH. As you know, we were asked by the California Legislature in January 2004 to evaluate chemical challenges facing California, and we, too, recognized the importance of REACH for the U.S. chemical industry and for U.S. and California chemical management programs. Our report, *Green Chemistry in California: A Framework for Leadership in Chemicals Policy and Innovation*, which the UC Office of the President released to the Legislature on March 14, 2006, discusses REACH at some length. I will refer you in some questions to responses I prepared for Senator Inhofe, above, which describe issues related REACH. I will then respond to your questions pertaining to California's Proposition 65 and the Massachusetts Toxic Use Reduction Act.

QUESTION 1. WHAT DO YOU THINK THE ULTIMATE CONSEQUENCE WILL BE FOR THE U.S. IF WE LAG BEHIND OTHER COUNTRIES IN ADEQUATELY ASSESSING AND REGULATING THE HEALTH RISKS OF CHEMICALS? WILL WE BECOME A DUMPING GROUND FOR DANGEROUS CHEMICALS?

RESPONSE OF MICHAEL P. WILSON

For the reasons I have described in my response to Senator Inhofe, it is reasonable to conclude that the U.S. is indeed "falling behind" the E.U. on chemicals regulation. As you point out, the important question is, "Why does this matter?" I suggest there are at least three key considerations:

Please refer to my responses to Mr. Inhofe, above, as follows:

QUESTION 2, RESPONSE A. THE UC REPORT CONCLUDES THAT THE U.S. HAS FALLEN BEHIND THE E.U. IN ADDRESSING LONG-STANDING CHEMICAL POLICY DEFICIENCIES AND THAT THIS WILL HAVE IMPORTANT CONSEQUENCES FOR THE ECONOMY AND FOR PUBLIC HEALTH IN THE U.S.

QUESTION 2, RESPONSE B. AS REACH IS IMPLEMENTED, E.U. PRODUCERS WILL STEADILY INCREASE THEIR INVESTMENTS IN GREEN CHEMISTRY INNOVATION, WHERE THEY COULD GAIN A GLOBAL COMPETITIVE ADVANTAGE.

QUESTION 2, RESPONSE C. AS REACH IS IMPLEMENTED, THE U.S. COULD BECOME A MARKET FOR CERTAIN HAZARDOUS CHEMICALS THAT ARE BARRED FROM THE E.U.

QUESTION 2. YOUR REPORT MAKES THE POINT THAT EUROPE IS LEADING THE WAY IN INNOVATIVE CHEMICAL REGULATION POLICY. PLEASE DESCRIBE THE TYPES OF BENEFITS THAT INDUSTRIES AND INDIVIDUALS IN THE U.S. WOULD EXPERIENCE IF THE U.S. GOVERNMENT WERE TO DEVELOP SIMILARLY INNOVATIVE CHEMICAL REGULATION POLICIES.

RESPONSE OF MICHAEL P. WILSON

Please refer to my responses to Mr. Inhofe, above, as follows:

QUESTION 2, RESPONSE A. THE UC REPORT CONCLUDES THAT THE U.S. HAS FALLEN BEHIND THE E.U. IN ADDRESSING LONG-STANDING CHEMICAL POLICY DEFICIENCIES AND THAT THIS WILL HAVE IMPORTANT CONSEQUENCES FOR THE ECONOMY AND FOR PUBLIC HEALTH IN THE U.S.

QUESTION 2, RESPONSE B. AS REACH IS IMPLEMENTED, E.U. PRODUCERS WILL STEADILY INCREASE THEIR INVESTMENTS IN GREEN CHEMISTRY INNOVATION, WHERE THEY COULD GAIN A GLOBAL COMPETITIVE ADVANTAGE.

D. AS REACH BECOMES LAW IN THE E.U., THE U.S. WILL FACE A CHOICE OF BECOMING EITHER A LEADER OR A LAGGARD IN MEETING THE "TRIPLE BOTTOM LINE" OF ECONOMIC, ENVIRONMENTAL, AND SOCIAL SUSTAINABILITY IN THE DESIGN, PRODUCTION, AND USE OF CHEMICALS.

In its 1996 *Vision 2020* report, the U.S.-based Council for Chemical Research, together with the American Chemical Society, the American Institute of Chemical Engineers, the American Chemistry Council, and the Synthetic Organic Chemical Manufacturers Association, wrote that the vast majority of chemical products are manufactured in the U.S. using technologies developed 40 to 50 years ago and that new technologies are needed that incorporate economical and environmentally safer processes, use less energy, and produce fewer harmful byproducts.[60] Ten years after the *Vision 2020* report, the websites of the 50 largest U.S. chemical companies all contain a statement of commitment to achieving sustainability goals, but their spending on research and development has decreased or remained flat since 2000, according to the National Science Foundation.[61, 62]

It is not surprising, therefore, that the *Committee on Grand Challenges for Sustainability in the Chemical Industry*, convened by the National Academy of Sciences, concluded in its December 2005 report that in "going forward, the chemical industry is faced with a major conundrum—the need to be sustainable (balanced economically, environmentally, and socially in order to not undermine the natural systems on which it depends)—and a lack of a more coordinated effort to generate the science and technology to make it all possible." The committee included academic scientists as well as representatives of Dow, PPG Industries, ConocoPhillips, and Agraquest.[61]

The U.S. private sector is simply not investing vigorously enough in cleaner technologies, such as green chemistry, that are likely to mark the next era of innovation and growth in the global chemicals market. It is a reflection of the current state of the chemicals market (as framed by TSCA) that with very few exceptions one can earn a Ph.D. in chemistry at U.S. universities without demonstrating even a rudimentary understanding of how chemicals affect human health and the environment.[63] U.S. chemistry graduate students are not required to gain an understanding of the principles of toxicology. The UC report argues that the lack of opportunities for chemistry students to study the principles of toxicology or the science of green chemistry represents a serious problem not only for public and environmental health in the U.S. but for the long-term competitiveness of the U.S. chemical industry itself.

U.S. universities, of course, are simply responding to the chemicals market, which has undervalued the toxicity and ecotoxicity of chemicals compared to their function and price. Most U.S. chemical producers, however, recognize that the future of the industry rests not in a "race to the bottom" with other nations in the production of chemicals that are already on the market, but rather in technological innovation, including in next generation of

environmental technologies, such as green chemistry. Though it could be costly in the short term, a gradual transition to these technologies will improve the capacity of the industry to compete over the long run on the basis of its contribution to the three primary dimensions of environmental, social, and economic sustainability—often known as the "triple bottom line." A modern, comprehensive chemicals policy will be needed in the U.S. to support, motivate, and compel the chemical industry to invest in these technologies at a level commensurate with the enormous scale and pace of chemical production today. A chemicals policy that meets this objective will build the foundation for an economically and environmentally sustainable chemical industry; it will solve a host of costly chemical problems that are affecting public health, businesses, and government; and it will support U.S. industry leaders in becoming globally competitive in green chemistry and other cleaner technologies.

QUESTION 3: STATES SEEM TO BE ADDRESSING CHEMICAL THREATS AND POLLUTION WITH NEW AND INNOVATIVE TYPES OF LEGISLATION. PLEASE DESCRIBE SOME OF THE BENEFITS TO INDUSTRIES AND INDIVIDUALS FROM CALIFORNIA'S CONSUMER NOTIFICATION LAW, PROPOSITION 65, AND THE TOXIC USE REDUCTION ACT IN MASSACHUSETTS?

RESPONSE OF MICHAEL P. WILSON

Chemicals policy is naturally the domain of TSCA; a growing number of reports, however, have documented the deficiencies of TSCA over a period of 20 years, and the federal government has chosen not to act in correcting these deficiencies.[J] Meanwhile, as illustrated in the UC report, these deficiencies have adversely affected businesses, government, and public health in U.S. states, particularly California, and new opportunities for implementing changes in chemicals policy have emerged as a result of the E.U. REACH proposal. Because states are the most directly affected by the deficiencies of TSCA, it is not surprising that they are emerging as leaders in chemicals policy reform in the U.S.

California in particular is taking steps to consider a broad approach to chemicals policy that could begin to correct the chemical Data Gap, Safety Gap, and Technology Gap in the U.S. If California is successful in doing so, it will reap a host a benefits for businesses that use chemicals, chemical producers themselves, government agencies, and public health. I will summarize the findings of the UC report, which documents the kinds of problems TSCA's deficiencies have created in California and proposes that to solve these problems California will have to correct these deficiencies through a comprehensive approach to chemicals policy. I will then describe the benefits and limitations of California's *Safe*

J. This include reports published by the National Academy of Sciences (1984),[1] the U.S. General Accounting Office (1994),[2] the Congressional Office of Technology Assessment (1995),[3] Environmental Defense (1997),[4] the U.S. EPA (1998),[5] the U.S. Government Accountability Office (2005), former EPA officials,[6] and academic researchers.[7]

Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65) and the Massachusetts *Toxics Use Reduction Act* of 1989.

A. THE DEFICIENCIES OF TSCA ARE AFFECTING BUSINESSES, GOVERNMENT, AND PUBLIC HEALTH IN CALIFORNIA.

As documented in the UC report, California is facing chemical problems that are affecting businesses, public and environmental health, and government in the state, including the California Legislature:

- As a result of the TSCA Data Gap, businesses and industry lack standardized information on chemical toxicity and ecotoxicity for most chemicals on the market, so it is often not possible for them to identify hazardous chemicals in their supply chains or to choose safer chemicals. This results in costs for these businesses related to chemical handling, hazardous waste, worker exposures, liability, and public relations.
- As a result of the TSCA Safety Gap, government agencies do not have the information they need to systematically identify and prioritize chemical hazards, nor the legal tools to efficiently mitigate known chemical hazards. As a consequence, businesses and consumers are purchasing hazardous chemicals for which safer substitutes might be readily available.
- Although California's Proposition 65 has provided marginal improvements in the information available to buyers in the chemicals market, businesses and consumers still do not have the right kinds of information they need to identify and use safer chemical products.
- The lack of information on chemical toxicity and ecotoxicity weakens the deterrent function of the product liability and workers' compensation systems; it also contributes to underestimates of the social burden of worker, public, and environmental damage related to chemical exposures.
- With TSCA providing a limited federal role in chemicals management, and with the limited ability of state agencies to generate and gather chemical information and to act on it, the California Legislature has essentially become the "last stop" for public concerns regarding chemicals. About 35 bills pertaining to chemicals were introduced in 2005, most of which addressed a single, rather narrowly defined chemical issue. On the current trajectory, the number of bills is likely to grow in the future.
- The lack of both market and regulatory drivers has dampened the motivation of chemical producers and entrepreneurs to invest in new green chemistry technologies, which could lead to California lagging in the global economy in this arena.

Meanwhile, evidence of public and environmental health problems related to chemicals continues to accumulate. There is growing scientific concern over the biological implications of chemical exposures that occur over the human lifespan, particularly during the biologically sensitive period of fetal and child development. Hundreds of chemicals that are released into the environment are accumulating in human tissues; the U.S. EPA

found just under 700 such chemicals in a nationwide survey of Americans in 1987. Many of these chemicals enter the developing organ systems of fetuses and infants through the maternal bloodstream and through breast milk. Animal studies and early human studies indicate that some can interact with and disrupt the development of these systems, such as the endocrine system, at very low doses. Among children, chemical exposures are estimated to contribute to 100% of lead poisoning cases, 10% to 35% of asthma cases, 2% to 10% of certain cancers, and 5% to 20% of neurobehavioral disorders (*see Inhofe Question 2, Response A, Children's Health, above*).

Occupational disease continues to exact a tremendous toll in California. Each year, an estimated 23,000 Californians are diagnosed with a preventable, deadly chronic disease that is attributable to chemical exposures in the workplace; another 6,500 Californians die as a result of a chronic disease linked to chemical exposures on the job. Immigrants, minorities, and lower-income groups—as workers and as residents—are at particular risk of exposure to hazardous chemicals. Government protections for worker health and safety in California are woefully under-resourced. The California and federal OSHA programs have adopted workplace exposure limits for only 193 (or about 7%) of the 2,943 chemicals produced or imported in the U.S. at more than one million pounds per year. The California OSHA program now consists of less than two hundred field personnel to address the health and safety protection of the state's 16.5 million workers. The state's Hazard Evaluation System and Information Service (HESIS), a public entity charged with anticipating and preventing chemical exposures in California workplaces, now consists of only three full-time scientific staff members.

As noted above, between now and 2033, the U.S. EPA expects about 600 new hazardous waste sites to appear each month in the U.S. and require cleanup, adding to 77,000 current sites. Many of these sites will be related to chemicals. Efforts at site mitigation are expected to cost about $250 billion. Many of these sites will be located in California. (*see Inhofe Question 2, Response A, Hazardous Waste, above*).

B. ON THE CURRENT TRAJECTORY, CALIFORNIA'S CHEMICAL PROBLEMS WILL WORSEN IN COMING YEARS.

By 2050, global chemical production is expected to grow four-fold and California's population is expected to grow by about 50%, from 36 to 55 million residents. On the current trajectory, California's growth over this period will be accompanied by an expanding set of economic, public health, and environmental problems related to the design, production, use, and disposal of chemicals. California is already an enormous market for chemicals. Not including chemicals used in industrial processes, California residents and businesses purchase 164 million pounds of chemicals in commercial and consumer products each day.[45] Most of these chemicals come in contact with people, and at some point in their lifecycle chemical lifecycle, most of them enter the state's finite ecosystems. In coming years, the mass of chemicals moving through commercial circulation in California will expand along with the state's population.

C. AS ITS POPULATION EXPANDS, CALIFORNIA WILL NEED TO IMPLEMENT POLICIES THAT MOTIVATE INDUSTRY INVESTMENT IN THE DESIGN, PRODUCTION, AND USE OF SAFER CHEMICALS.

To address these problems, California will need to implement policies that motivate industry investment in green chemistry. The UC report proposes that the overarching objective of a modern, comprehensive chemicals policy in California should be to amplify the *positive* contributions of the chemical industry to society while steadily *reducing* its negative impacts. In principle, such a policy would elevate the issue of chemical *toxicity* to the level of importance afforded the price and function of chemicals in the market. This will shift the market steadily toward the design, production, and use of chemicals that are inherently safer for human and ecological health, known collectively as green chemistry.

Green chemistry represents a primary, long-term solution to the chemical problems facing California, and it is a key element of an industrial development strategy that is economically and environmentally sustainable. Green chemistry *products* are less toxic, they do not accumulate in the body, and they break down more readily in the environment. Green chemistry *processes* use safer chemicals, less energy, and they produce less hazardous waste. A green chemistry *development strategy* holds the promise of new industrial capacity and employment opportunities in the design, production, and use of safer chemicals, as compared to a strategy based on the production of chemicals that other nations in the global economy can produce at one-fifth the cost.

D. THE DEFICIENCIES OF TSCA REPRESENT A KEY BARRIER TO THE SCIENTIFIC, TECHNICAL, AND COMMERCIAL SUCCESS OF GREEN CHEMISTRY.

The UC report characterizes deficiencies in the design and implementation of TSCA as having produced a Data, Safety, and Technology Gap in the U.S. chemicals market. These Gaps, together with the narrow scope of other U.S. environmental statutes and a lack of government support for research and education in green chemistry, have produced an inefficient chemicals market in the U.S. that lacks the information necessary for actors to make informed decisions about the safety of the chemicals they purchase. This has discouraged the great majority of U.S. chemical producers, product manufacturers, and entrepreneurs from substantively investing in green chemistry at a level commensurate with the scale and pace of chemical production and importation. As a consequence, the science, technology, and commercial success of green chemistry remain in their infancy, and the U.S. market for green chemistry has yet to be established.

E. TO MOTIVATE INVESTMENT IN GREEN CHEMISTRY, CALIFORNIA WILL NEED TO CORRECT THE DEFICIENCIES OF TSCA.

To motivate, support, and compel industry investment in green chemistry, California will need to implement policies that correct the deficiencies of TSCA by closing the Data, Safety, and Technology Gap, which will improve chemical information in the market, regulatory oversight, and public investment in green chemistry research, education, and development. The UC report points out that California can close the Data Gap by

requiring chemical producers to disclose information on the safety of their products, and it can close the Safety Gap by providing government with better tools to efficiently evaluate chemicals and reduce the commercial circulation of the most dangerous ones. These steps will begin to shift the chemicals market so that it favors investment in green chemistry, which will gradually close the emerging U.S. Technology Gap in this area. California can go further by offering a range of incentives to companies that implement green chemistry solutions, and it can fund green chemistry research and education. This will support the state's leading companies, it will save businesses and the state enormous expenditures related to chemical hazards, and it will put California at the forefront of global developments in green chemistry.

F. A MODERN CHEMICALS POLICY WILL BUILD THE FOUNDATION FOR SUSTAINABLE PRODUCTION AND CLEAN TECHNOLOGY EMPLOYMENT IN CALIFORNIA.

Because chemicals and chemical products are essential to nearly all forms of industrial activity, the chemical industry is important to employment and economic growth in California. A California Public Policy Institute study of employment trends in the state over the period 1999 to 2002 concluded that the primary drivers of job growth in California were the expansion of existing firms and the birth of startup companies.[66] During this period, California employers created 450,000 new jobs through payroll expansion, and startup firms created 220,000 jobs. About 11,000 jobs left California, representing about 1.6% of job creation during this period.

Changes in the nature and organization of the workplace in California (e.g., decreased job stability, decreased unionization in the private sector, expanding income inequality, lower rates of health insurance coverage) have heightened the vulnerability of a growing number of Californians. Income inequality, for example, has grown nearly everywhere in the U.S. in recent decades, but it has been more extreme in California, especially in the Los Angeles metropolitan area.[67] Between the late 1970s and late 1990s, average real (before-tax) income for the poorest 20% of California workers dropped 5.5%, while average real income for the state's wealthiest 20% grew by 37.4%. Average real income of the top 5% of income earners in California grew by 50.4% during this period. The UC report illustrates that employment in California during the economic expansion from 1992 to 2002 showed growth in the bottom and top ends of the income scale, with declines in middle-income jobs. This growth pattern contrasts with that of California's economic expansion during the 1960s, when new jobs were distributed more evenly across the income spectrum.

It is well-recognized that lower-wage jobs offer less economic security and are less likely to offer benefits such as health insurance, paid sick days, paid vacation time, and retirement programs. Because economic status is a key driver of health status in the U.S., growth in income inequality and poverty in California represents a growing public-health problem in the state. A modern, comprehensive chemicals policy that motivates industry investment in green chemistry processes and products could expand sustainable production in California and could contribute to the growth of clean technology employment.

G. CALIFORNIA'S PROPOSITION 65 HAS IMPROVED INFORMATION IN THE CHEMICALS MARKET, WHICH HAS MOTIVATED REDUCTIONS IN CERTAIN TOXIC MATERIALS IN INDUSTRIAL EMISSIONS AND CONSUMER PRODUCTS.

The market system operates most efficiently when all of its participants have equal access to information; market distortions and failures result when there is asymmetrical access to information. The UC report documents the condition of asymmetrical information that has emerged in the U.S. chemicals market under TSCA. California's Proposition 65 (the *Safe Drinking Water and Toxic Enforcement Act* of 1986) has played an important role in improving information in the chemicals market. In numerous cases, this has motivated manufacturers to reformulate products or reduce industrial emissions.[7, 68-71] The statute requires that businesses provide clear and reasonable warnings prior to exposing individuals to chemicals that cause cancer or reproductive harm, and it prohibits the discharge of those chemicals into any source of drinking water. Since its enactment, Proposition 65 has lead to substantial reductions in industrial air emissions of lead, ethylene oxide, perchloroethylene and other substances. It has motivated manufacturers of consumer products to reduce the toxic chemical content in ceramic tableware, brass faucets, calcium supplements, water meters, water filters, galvanized pipe, crystal decanters, foil caps on wine bottles, brass keys, hand tools of various types, exercise weight-training equipment, raincoats and other plastic clothing, electrical tape, electrical cords and wires, compact disk wallets, baby rash powders and creams, bicycle cable locks, anti-diarrheal medicines, hair dyes, nasal sprays, correction fluid, spot remover, paint strippers, shoe waterproofing sprays, canned food products, nail care products, dandruff shampoos, bottled water, wooden playground structures, portable classrooms and other products.[68] It has improved consumer information in areas where reformulation is not feasible, notably with mercury in fresh fish. Product formulations motivated by Proposition 65 are often implemented nationally.

Proposition 65 has served as a reasonably effective model for providing a narrow set of information in the chemicals market; this has lead to reductions in direct human exposure to a number of important toxic chemicals and to reductions in the generation and disposal of certain types of toxic materials from industrial processes.

H. DESPITE ITS SUCCESSES, PROPOSITION 65 REPRESENTS ONLY ONE PIECE OF A COMPREHENSIVE APPROACH TO CHEMICALS POLICY.

A comprehensive chemicals policy would correct the Data, Safety, and Technology Gaps engendered by TSCA; that is, it would require chemical producers to disclose a reasonably broad set of information on toxicity, ecotoxicity, exposure and other attributes of their products to the public and to government agencies; it would provide a range of tools for government to efficiently evaluate chemicals and reduce the commercial circulation of the most dangerous ones; it would put in place additional incentives to motive industry investment in green chemistry processes and products; and it would direct public resources to green chemistry research, education, training, and technical assistance. These steps will help to shape the chemicals market so that it better protects public health and favors

investment in green chemistry. In most of these areas, Proposition 65 falls short. For example:

- It does not require producers to provide information to a government agency and the public on a broad range of chemical toxicity and ecotoxicity endpoints;
- It can be triggered only *after* a chemical or chemical product has been introduced into commercial circulation;
- It does not allow government agencies to routinely gather data on the identity, quantities and types of use, exposures, and other information on chemicals sold in the state;
- It is limited to carcinogens and reproductive toxicants, so it cannot address chemicals that are toxic to the endocrine, neurological, immune, respiratory, dermal, and other physiological systems;
- It is limited to carcinogens and reproductive toxicants, so it can cause industry to favor the use of chemicals that may be toxic to other physiological systems;
- It does not provide tools that would allow government to efficiently control the sale of the most dangerous chemicals;
- It does not provide a vehicle for consumers or businesses to identify and purchase safer chemical substitutes.

While Proposition 65 represents an important example of the "power of information" in the chemicals market, it represents only one piece of a comprehensive approach to chemicals policy.

I. THE MASSACHUSETTS TOXICS USE REDUCTION ACT OF 1989 PROVIDES IMPORTANT LESSONS FOR CHEMICALS POLICY IN THE U.S.

The Massachusetts Toxics Use Reduction Act (TURA) of 1989 is another model that is relevant to the development of a comprehensive chemicals policy in California and the U.S. TURA is unique among U.S. environmental statutes in that it requires firms to report their *use* of certain hazardous chemicals to a state agency, rather than their *releases* of chemical pollutants, and it requires firms to evaluate their operations and develop plans to reduce their use of certain hazardous chemicals. It is the only chemicals statute in the U.S. that funds an institute, the Toxics Use Reduction Institute (using fees assessed against the use of certain hazardous chemicals) that provides ongoing technical assistance, training, and research for Massachusetts businesses in "toxics use reduction" strategies.[K] Together,

[K] TURA aims to "sustain, safeguard and promote the competitive advantage of Massachusetts businesses, large and small, while advancing innovation in toxics use reduction and management." Toxics use reduction is defined under TURA as "in-plant changes in production processes or raw materials that reduce, avoid, or eliminate the use of toxic or hazardous substances or the generation of hazardous byproducts per unit of product, so as to reduce risks to the health of workers, consumers or the environment, without shifting risks between workers, consumers, or parts of the environment." TURA defines hazardous chemicals as those listed under Section 313 of the Emergency Planning and Community Right-to Know Act (EPCRA), commonly known as the Toxics Release Inventory (TRI), and those listed under Sections 104(14) and 102 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), known as the Superfund. TURA established six toxics use reduction techniques: input substitution, product reformulation, production unit redesign or modification, production unit modernization, improved operations and maintenance, and in-process recycling, reuse, or

these elements of TURA have motivated and supported continual innovation by Massachusetts firms in strategies to reduce their use of hazardous chemicals. TURA takes a few steps toward correcting the Data, Safety, and Technology Gaps. The UC report concludes that California can learn from (and build on) the 16 years of experience by government and industry in Massachusetts under TURA.

J. TURA TAKES INITIAL STEPS TO CLOSE THE DATA, SAFETY, AND TECHNOLOGY GAPS.

To close the Data Gap, TURA requires firms to account for, evaluate, and disclose their use of chemicals listed under the federal Emergency Planning and Community Right-to Know Act (EPCRA), commonly known as the Toxics Release Inventory (TRI), and those listed under Sections 104(14) and 102 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), known as the Superfund. This has allowed Massachusetts to identify the most prevalent hazardous chemicals used by large producers in the state.

To close the Safety Gap, TURA makes the assumption that chemicals listed under the TRI and CERCLA are inherently hazardous and their use in processes should be steadily reduced; TURA does not rely on quantitative risk assessments for individual chemicals as the basis for decision-making and action. On the other hand, it does not *mandate* implementation of toxics use reduction plans by firms, nor does it enable government to prioritize chemical hazards and take additional actions to reduce those of greatest concern.

To close the Technology Gap, TURA assigns fees and reporting requirements to the use of TRI and CERCLA chemicals, thereby disadvantaging them in the market and encouraging the use of nominally safer substitutes. It encourages continual learning and innovation in industry by requiring regular evaluation of chemical inputs and processes and by providing technical assistance, training, education, and research in toxics use reduction strategies.

K. TURA PROVIDES INDUSTRY WITH TECHNICAL ASSISTANCE IN DEVELOPING AND IMPLEMENTING TOXICS USE REDUCTION PLANS.

The Toxics Use Reduction Institute (TURI) at the University of Massachusetts at Lowell provides technical assistance, training, education, and research in toxics use reduction strategies. TURI also trains toxics use reduction planners, who are then certified to practice in industry by the Massachusetts Department of Environmental Protection.

TURA also funds the state Office of Technical Assistance (OTA) within the Massachusetts Department of Environmental Protection to provide technical assistance to industry in toxics use reduction. During the period 1989 and 2004, OTA conducted over 1,400 site visits to about 600 firms in support of toxics use reduction activities.[72] During the same

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extended use of production materials. Out-of-process recycling was not included as a toxics use reduction strategy. Green chemistry would play a role primarily in "input substitution" and "product reformulation."

period, OTA sponsored over 200 toxics use reduction conferences, workshops, and other events for Massachusetts firms.

California and other U.S. states do not have the institutional capacity to provide research, training, and technical assistance of this magnitude to businesses and industry.

L. TURA HAS PRODUCED MARKED IMPROVEMENTS IN ENVIRONMENTAL PERFORMANCE BY MASSACHUSETTS FIRMS.

The initial objective of TURA was to reduce the use of TRI and CERCLA-listed chemicals in Massachusetts by 50% by 1997, with a baseline year of 1987. This goal was met in 1998 and then surpassed in 1999, adjusted for a 45% increase in production.[73]

A 2000 study based on 35 case studies and interviews with plant personnel found that between 1990 and 1997 Massachusetts companies decreased their volume of toxic chemical byproduct by 40%, indexed to production.[74] In about half the cases analyzed, improved worker health and safety was cited as a benefit of the toxics use reduction projects. Volatile solvents were eliminated or reduced in 63% of cases. About half of the companies profiled introduced water-based chemicals in the place of more volatile ones, and acids and caustics were reduced or eliminated in about 20% of the cases. Following implementation of TURA, Massachusetts firms outperformed virtually every other manufacturing state in the country on releases of substances under the TRI.[72]

An analysis of the effects of TURA showed that even though only one in 10 firms initially viewed TURA as positive, the mandatory planning, reporting, and continual learning process it requires of firms has led to an atmosphere of innovation in Massachusetts that has caused even reluctant firms to improve their environmental performance.[72] TURA has pushed firms to better understand their chemical processes (and costs) and has pointed them to options for toxics use reduction through case studies, training, and examples from leading firms. A survey of Massachusetts firms showed significant improvements in involvement by firms in six measures of environmental performance before and after passage of TURA (Table A).[72]

Table A. Involvement of Massachusetts firms in six environmental performance areas before and after passage of TURA.[72]

	Percentage of respondents 'very involved' in activity	
Activity	Before TURA	After TURA
Tracking quantities of wastes generated	49%	89%
Tracking quantities of chemicals used	48%	90%
Establishing a corporate or facility environmental team	24%	68%
Setting goals for waste reduction	24%	73%
Reviewing changes in production processes for their environmental, health and safety impact	30%	76%
Allocating environmental costs to processes or products	21%	52%

M. THERE IS SOME EVIDENCE THAT IMPROVEMENTS ARE NEEDED IN CHEMICAL MANAGEMENT PRACTICES AMONG CALIFORNIA FIRMS.

California law requires businesses to comply with a number of requirements in the handling of chemicals, but the state has yet to develop a strategy such as TURA that would motivate businesses to carefully account for and steadily reduce their use of hazardous chemicals. An evaluation of 300 California companies conducted by the consulting firm 3E found that chemical management practices tended to be undisciplined.[75] 3E made the following findings:[L]

- About a third of the chemicals and chemical products used at the 300 companies were improperly inventoried, were listed but not used, or were used and unaccounted for.
- Chemical toxicity was "massively overlooked."
- There was only about 12% commonality in the chemicals used between firms, even when those firms performed the same function and were owned by the same company.
- Combined, the 300 companies were unaware of the presence of about 55 carcinogenic chemicals and over 200 "extremely hazardous substances" used in chemical products.

The experience of Massachusetts firms under TURA and that of California chemical management service providers illustrates that businesses are often unaware of the costs associated with chemicals management, which can range from seven to 10 times the purchase cost.[72, 76, 77] Chemical accounting systems, such as those required under TURA, motivate businesses to quantify and reduce these costs. Doing so, however, takes time and

[L] In light of the chemical Data Gap, 3E's findings probably understate true conditions in the surveyed firms, particularly with respect to chemical toxicity and the presense of carcinogens and "extremely hazardous substances."

money, and most businesses will not invest in these efforts without a regulatory driver, such as TURA. Under California's largely voluntary SB 14, for example, the California Department of Toxic Substances Control (DTSC) found that 29 of 40 California firms evaluated in 1998 in the Chemicals and Allied Products sector were significantly out of compliance.[78] DTSC reported that "the underlying problem may be that company management lacks commitment to devoting the necessary resources to evaluate source reduction options."

The experience in Massachusetts under TURA also illustrates that technical assistance by a state agency in chemical accounting systems and toxics use reduction strategies can be very helpful, particularly for small and medium-sized businesses.

N. DESPITE ITS SUCCESSES, THE MASSACHUSETTS TOXICS USE REDUCTION ACT REPRESENTS ONLY ONE PIECE OF A COMPREHENSIVE APPROACH TO CHEMICALS POLICY.

Despite the economic and environmental improvements it has brought to Massachusetts, TURA is limited in important ways. For example, it does not apply to firms that manufacture or process less than 25,000 pounds of listed chemicals per year, or that *use* less than 10,000 pounds of listed chemicals per year, or that employ fewer than 10 employees. In aggregate, small and medium-sized firms can generate significant chemical uses and emissions. Chemical exposures among workers may also be magnified among smaller firms that lack the resources to recognize, evaluate, and control exposures. Some chemicals may be hazardous even in small quantities. Importantly, the TURA list of hazardous chemicals reflects the state of knowledge prevailing in the 1980s and does not account for improved scientific understanding of chemical hazards. TURA is therefore constrained in the scope of exposures and health risks it targets.

Nor does TURA include regulatory tools that would allow government to compel recalcitrant firms to implement their toxics use reduction plans. The lack of a regulatory "hammer" may be allowing some companies to gain a competitive advantage in Massachusetts through poor environmental performance. There has been little public participation in TURA activities and limited public disclosure of information on toxic use reduction performance by companies. The law does not link fiscal incentives such as grants or tax credits to industry research and development in toxics use reduction, and it employs only weak fiscal tools to discourage the use of listed hazardous chemicals. TURA has not resulted in the development of criteria for identifying and promoting green chemistry technologies.

Perhaps most importantly, TURA is intended primarily to address industrial *processes*. The law does not oblige chemical producers and product manufacturers to evaluate the toxicity and ecotoxicity of chemicals used in intermediate or final chemical *products,* or to disclose this information to consumers, workers, businesses, and industry. It does not require business and industrial buyers of chemicals to evaluate the toxicity and ecotoxicity of the chemicals they use. It therefore does not support the efforts of U.S. firms that are attempting to "clean" their supply chains.

O. TURA OFFERS LESSONS FOR CHEMICALS POLICY IN CALIFORNIA AND FOR REFORM OF TSCA.

Despite its weaknesses, TURA represents a chemicals policy approach that appears to motivate innovation by industry, as reported by O'Rourke and Lee in 2004:[72]

> TURA makes clear that regulation can and should promote industry self-monitoring and exploration of process improvements. Regulatory implementation should be supported through new mechanisms of transparency, accountability and learning, rather than rigid technology-based standards. Perhaps most importantly, the history of TURA shows that regulations need to transform the attitudes of managers, and then support their efforts at change. Regulations can provide some "commands" to motivate action, and some assistance to guide explorations. TURA's basic requirements of reporting and planning can motivate creative thinking, exploration, experimentation and "surprises." TURA represents the potential for what could be termed a sort of "command-and-innovation" regulation.[72]

With modernizing and adaptation to the circumstances of other states and the federal government, TURA represents a potential model for important aspects of a comprehensive chemicals policy.

P. A TURA-LIKE APPROACH COULD BE STRENGTHENED IN A NUMBER OF WAYS:

The UC report proposes a number of changes that would strengthen a TURA-like approach to chemicals policy:

- Establish a system for chemical reporting by companies and a system of chemical screening, evaluation, and priority-setting to identify chemicals for toxics use reduction planning, rather than relying on pre-existing lists of hazardous chemicals.
- Ensure that the scope of the regulation includes small and medium-sized firms.
- Require chemical producers, suppliers, and product manufacturers to review their products for chemical toxicity and ecotoxicity and distribute this information in standardized form to end-users.
- Establish mandatory toxics use reduction schedules based on lowest-, low-, medium-, high-, and highest-priority chemicals using basic measures of toxicity and exposure.
- Expand technical assistance and training programs to meet the needs of a larger set of businesses and industry, particularly small and medium-sized firms.
- Incorporate green chemistry technologies more explicitly into the technical assistance, research, education, and training aspects of the regulation.
- Structure the regulation so that it better motivates innovation and use of green chemistry processes and products.
- Improve public participation in decision-making regarding the design, implementation, and updating of the regulation.
- Improve public disclosure of the performance of firms in meeting toxics use reduction targets.
- Ensure full integration of worker health and safety in toxics use reduction strategies.

- Include mechanisms to efficiently update the regulation in response to new information.

Q. CALIFORNIA HAS THE POTENTIAL TO LEAD THE NATION IN THE DEVELOPMENT OF CHEMICALS POLICY THAT PROTECTS PUBLIC HEALTH, SUPPORTS BUSINESSES, AND MOTIVATES INVESTMENT IN GREEN CHEMISTRY.

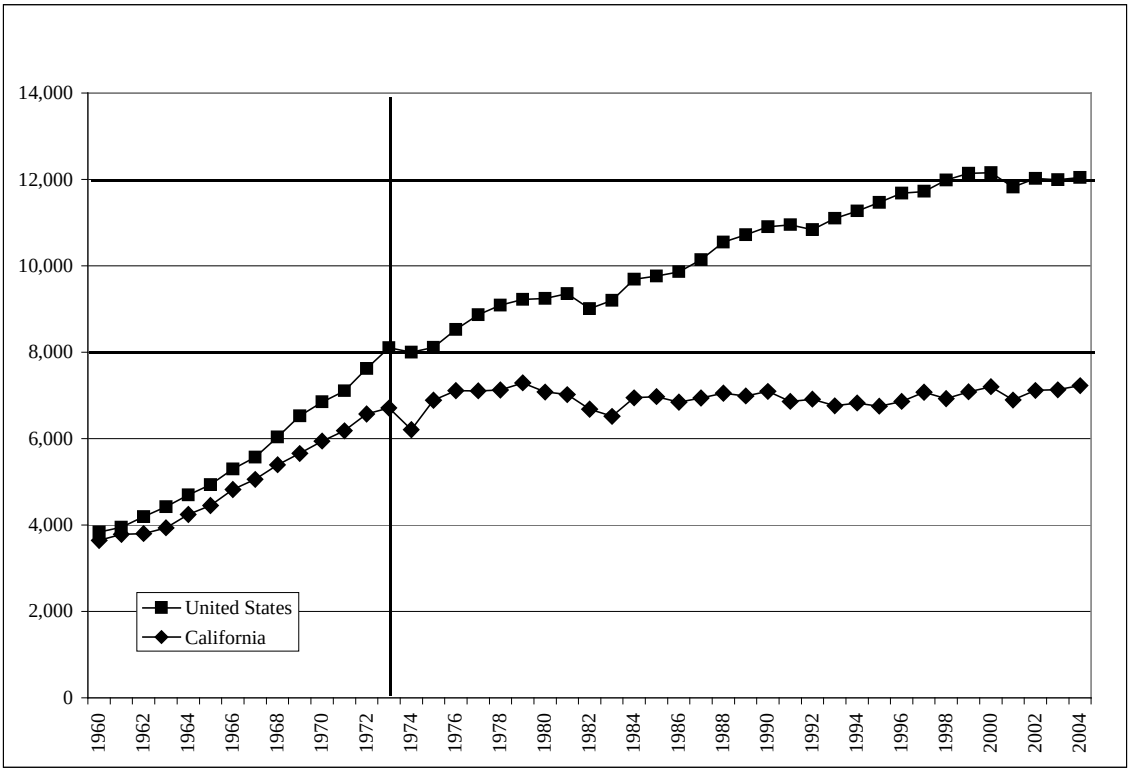
The role of public policy in motivating technological change is apparent in changes that have occurred in energy consumption per capita in California compared to the rest of the U.S.[79, 80] Over a period of 25 years, California has adopted some of the strictest energy efficiency requirements in the nation, such that California now uses half as much energy per capita compared to the U.S. as a whole (Figure 1, following page).[81] This has saved the average household $1,000 each year, with total savings of more than $56 billion, and it has reduced California's contribution to greenhouse-gas emissions that contribute to global warming.[82] California's energy efficiency regulations have altered the orientation of the energy market, which, like the chemicals market (with respect to green chemistry), is otherwise structured such that it hampers, rather than encourages, energy efficiency.

California is now poised to become the first state in the U.S. to require a 25% reduction in greenhouse-gas emissions from industrial sources by 2020.[83] While the state's Chamber of Commerce opposed the legislation, venture capitalists and businesses, including Pacific Gas and Electric Company, argued that the bill will create a new clean-technology energy sector that could rival the high-technology boom.

California can provide a similar level of leadership in the arena of chemicals policy. California can take steps to correct the long-standing federal chemicals policy weaknesses of TSCA and build the foundation for new productive capacity in green chemistry. This approach to chemicals policy will link economic development in California with improved health and environmental quality. Doing so, however, will require much more than isolated chemical bans and other piecemeal approaches that currently characterize the Legislature's efforts in this arena. It will require a long-term commitment to chemicals policy on the part of the California Legislature.

Given California's unparalleled capacity for innovation and its scientific, technical, and financial resources, a modern, comprehensive chemicals policy could position California to become a global leader in green chemistry innovation. The report illustrates that to do so, California will need to adopt a chemicals policy that greatly improves chemical information, regulatory oversight, and support for green chemistry research, development, technical assistance, and education. Meeting this challenge will build the foundation for an economically and environmentally sustainable chemical industry; it will solve a host of costly chemical problems that are affecting public health, businesses, and government; and it will support industry leaders in becoming globally competitive in green chemistry and other cleaner technologies.

Figure 1. Per Capita Electricity Sales (not including self-generation) in kilowatt-hours/person, 1960-2004.[81]



Thank you very much for giving me the opportunity to answer your questions. I would be happy to discuss these and other questions with you. Please feel free to contact me at UC Berkeley, mpwilson@berkeley.edu or 510-642-5703.

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