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Slide 1. Thank you very much, Stan, for that introduction and for inviting me to the symposium today. It is very much a pleasure and honor to join you today in speaking about green chemistry in the context of chemicals policy, which we explored in the UC publication: Green Chemistry in California: A Framework for Leadership in Chemicals Policy and Innovation. I would like to acknowledge co-authors Dan Chia and Bryan Ehlers, who conducted research for the report during their graduate studies in public policy at UC Berkeley.

Slide 2. As many of you know, COEH was established 25-years ago under AB3414 to conduct research, teaching, and service to California in the environmental health sciences. The northern California center is located at Berkeley, Davis and SF.

Slide 3. The California Policy Research Center, under the aegis of the UC Office of the President, served as the fiscal sponsor for the report, along with our center, COEH. In general, the Report assesses problems and opportunities in chemicals policy in CA and proposes broad policy goals.

It was commissioned in January 2004 by the Senator Byron Sher; and Assemblymember John Laird. These Legislators asked the University of California to characterize the chemical problems facing California, describe the root causes of those problems, and propose policy goals that would address those problems.

The report was released to Joe Simitian and Ira Ruskin about two years later on March 14, this year. Senator Simitian held hearings on the report on June 28 and on October 3, where he announced that it was his intention to see that California become the first state in the U.S. to craft and implement a modern, comprehensive chemicals policy.

Slide 4. The scope of the report includes the chemical sector covered by the federal Toxic Substances Control Act; that is, chemical products, basic chemicals, and specialty chemicals. The report does not address pharamaceuticals, pesticides, or cosmetics as finished products, though it is intended to apply to chemicals as they are used in industrial processes in these sectors.

Slide 5. We employed six primary methods in the analysis.

Slide 6. The report required an analysis that was more global than we were used to, so we convened an Advisory Committee representing a relatively wide range of academic disciplines, including medicine, law, policy, environmental health, philosophy, business, and engineering.

Slide 7. Our findings are similar to those of many other analyses that have been produced over the last 20 years.

Slide 8. Anyone here could undoubtedly describe the many challenges inherent in chemicals policy. Many of you face these challenges on a daily basis. Our perspective was partially informed by our experience in tracking down the cause of a debilitating neurological disease among a group of automotive mechanics in California, who had lost sensation and motor function in their limbs as a consequence of using a solvent product that contained hexane and acetone.

Mechanics use these products in “aerosol” spray cans, and they typically go through 5-10 cans each day.

Slide 9. We found that the combination of hexane and acetone is uniquely neurotoxic. This slide for example, shows results from an animal study in which rats were exposed to water, hexane, acetone, and a hexane-acetone blend for 6 weeks. Their neurological function was evaluated by timing the length that they were able to balance on an accelerating rod. The researchers found that rats exposed to hexane and acetone together were affected more profoundly in both severity and duration compared to rats exposed to water or to hexane or acetone alone.

Slide 10. When we conducted exposure studies,

Slide 11. …we found that the mechanics that used these products indeed experienced breathing zone exposure to both hexane and acetone in proportions similar to those of the product itself.

Slide 12. In looking at the ARB sales data for consumer products, we found that at least 4,300 shops in California were using products formulated with hexane and acetone.

Slide 13. We surveyed 17 manufacturers of these products (constituting 90% of the solvent market), we found that the industry had introduced hexane-based products in 1989 and that hexane-acetone products in 1997. This slide shows the year of introduction by each of the 17 companies. These 7 companies eventually captured 90% of the market for non-chlorinated products.

Slide 14. We found that hexane had been introduced as an unintended consequence of California decision (for good reasons in my view) to list chlorine-contaminated oil as a hazardous waste and that hexane-acetone blends had been introduced as an unintended consequence of California's decision to exempt acetone from VOC caps in these products.

Moreover, we found that manufacturers of these products reformulated to hexane and hexane-acetone nationally.

Slide 15. The point here is to illustrate the difficulty that we face as a society in attempting to control individual chemical hazards in the absence of a comprehensive strategy. It is becoming clear that a systems approach to chemicals policy is needed.

Indeed, when we look at the history of chemicals management efforts over the last 30 years or so, we have seen an evolution from disposal and dilution, to waste treatment and pollution control, to chemical-by-chemical toxics policy, to chemicals policy approaches emerging in the European Union that focus on the design of chemicals, on markets, on chemical life cycles and so forth. The UC report was informed by, and reflects, this fourth stage of development.

Slide 16. The UC report is grounded on this idea; that a systems approach, as compared to a fragmented approach, to public policy is needed to affect substantive, enduring change in an economic sector, including in the chemicals sector.

This slide illustrates per capita electricity use in California versus the rest of the U.S. California's trajectory has resulted from a series of policy choices that have used regulations and incentives to reduce per capita electricity. We now use 50% of the electricity compared to the rest of the U.S. It now saves the average household $1,000 a year; total savings have reached $56 billion; and it has greatly reduced our emissions of greenhouse gases. The recent climate change bill goes even further, of course.

The UC report proposes that we can provide this same kind of leadership in chemicals policy in a way that steadily shifts our chemical production system to one based on green chemistry, and that in doing so, we will address a host of chemical problems while also opening an array of new business and investment opportunities in California.

Slide 17. The report focuses primarily on the barriers and drivers of green chemistry, and proposes that California should reduce the barriers and take full advantage of the drivers.

Slide 18. Green chemistry, of course, and John Warner illustrated, is the design of chemical products and processes to reduce or eliminate substances hazardous to human health and the environment.

From a policy perspective, the power of this idea is that it links <u>solutions</u> to public and environmental health problems caused by chemicals with new business and investment <u>opportunities</u>.

Slide 19. Like clean energy, green chemistry is truly the only alternative available to us that offers the possibility of placing California on the path to a sustainable future. This is evident when we consider that global chemical production is doubling every 25 years.

Slide 20. …such that by 2050, when California's population reaches 55 million, global chemical production will expand four-fold from what it is today. On the current trajectory, the report concludes that we will face a deepening set of health and environmental problems. We can affect this trajectory by motivating industry to invest in the design of chemicals that are safer for biological systems, through green chemistry.

Slide 21. The report evaluates the barriers and drivers of green chemistry. It concludes that to motivate new investment in green chemistry, we will need to address the well-documented policy barriers that have weakened the market for green chemistry technologies. There is much we can do to support innovation in green chemistry, but the report is very clear that what is needed are policies that "get the market signals right;" this will motivate private sector investment in this arena.

Slide 22. The report finds that the primary barrier to green chemistry has been the well-documented weaknesses in chemicals policy in the U.S., specifically with the U.S. Toxic Substances Control Act, or TSCA.

The weaknesses of TSCA have had three main effects that have undermined the commercial viability of green chemistry.

The first is the Data Gap. There is a Data Gap in the amount and quality of information in the U.S. market on the hazards of chemicals (such as toxicity and ecotoxicity) because TSCA does not require producers to generate and disclose this information to EPA and to downstream users. (Information that EPA does receive is often unavailable due to the confidential business information provisions of TSCA.) As a consequence, buyers are unable to identify and choose the safest chemicals; hazardous chemicals have therefore remained competitive in the market.

There is a Safety Gap in government oversight because TSCA overly constrains the ability of government to assess and control chemical hazards. (EPA has been able to use its formal rulemaking powers to regulate five chemicals since 1979. One was asbestos, which was overturned in the 5rth circuit court, which concluded that EPA had failed to meet its burdens of proof under TSCA.)

There is a Technology Gap in green chemistry technologies that stems from the Data and Safety Gaps and from the lack of U.S. public investment in green chemistry research and education.

Slide 23. There are at least five key implications of the weaknesses of TSCA for green chemistry.

1) Businesses and consumers are unable to identify hazardous chemicals or choose safer ones.

2) The market thus “undervalues” the hazardous properties of chemicals compared to their function, price, & performance.

3) Hazardous chemicals have therefore remained competitive in the market.

4) This has impeded the market for green chemistry…

5) and has left businesses with the problems that result from using hazardous chemicals.

Slide 24. For example, imagine you are running a vehicle repair shop and need to purchase chemicals such as an aerosol degreasing product for cleaning oil and grease off the vehicle.

In making your purchasing decision, you would take into account four things: the products intended **function**, its **price**, its **performance**, and its **hazardous properties**. In the case of chemicals, this refers to toxicity, ecotoxicity and other attributes.

Slide 25. As a result of the TSCA Data Gap, the hazard piece of the purchasing decision is largely unknown. The U.S. chemicals market functions with this same lack of information on chemical toxicity, from small vehicle repair shops to the largest multinational companies in the Silicon Valley.

As a result, companies can’t choose the safest chemicals, and they end up being responsible for handling hazardous chemicals. Companies are spending $7-10 dollars handling every dollar’s worth of chemicals they purchase.

Slide 26. If you are a scientist working at a state agency to evaluate and prioritize chemical hazards in the state, you need information on the **identity** of chemicals sold in the state, their **sales volume**, their **uses**, and their **hazardous properties**.

Slide 27. Again, due to the weaknesses of TSCA, this information is routinely unavailable to state agencies.

Slide 28. If you are a regulator, you face a basic logical paralysis that underlies the Safety Gap. That is, you carry the burden of proving risk, but under TSCA producers are under no obligation to provide the information necessary for you to do so.

TSCA requires EPA to produce the public health evidence of risk, and to demonstrate that these risks outweigh the chemical's socioeconomic benefits, yet the agency does not have access to the information from producers needed to build its case. This is why EPA has turned entirely to voluntary approaches in the TSCA arena.

Slide 29. It is not surprising, therefore, that you can earn a PhD at U.S. universities without demonstrating even a rudimentary understanding of toxicology; how chemicals affect human health and ecosystems. Is this because universities or students don't care? Of course not.

Our universities simply reflect what is demanded in the market. The report argues that this will lead to a green chemistry Technology Gap as other countries, particularly the E.U., invest in green chemistry research and development. The lack of education in green chemistry represents a long-term problem not only for public and environmental health in the U.S. but for the chemical industry itself.

Slide 30. The E.U.'s initiatives in electronic waste, cosmetics, chemicals and other areas have made them the global leaders in environmental policy, a position once held by the U.S. The E.U. is creating global changes at the level of design – in the design of electronics, in the design of chemicals – and it will likely emerge as commercially very successful in these new markets. The U.S. has clearly fallen behind the E.U. in environmental policy.

Slide 31. Or, as GE's Jeffrey Immelt puts it: "…the deregulatory agenda favored by the U.S. business community – particularly on environmental issues – is not providing American companies with a competitive advantage over their European counterparts." GE's Ecomagination initiative is now investing $1.5 billion annually in clean technology and has been enormously successful.

Slide 32. So the barriers to green chemistry are illustrated in the report in roughly this schematic.

Slide 33. The report describes a number of drivers of green chemistry. I will briefly describe the E.U. REACH initiative and the efforts of downstream users.

Slide 34. REACH will require registration of about 30,000 chemicals produced at one ton or more per year per producer, it will subject about 5,000 of these to an evaluation, and it will subject a subset of these (1,400 to 2,000) to Authorization, wherein chemicals that are CMRs, PBTs, or vPvBs will be presumptively removed from use unless the producer can demonstrate that they are adequately controlled.

One of effects of REACH could be to close the Data Gaps, which would improve the function of the chemicals market and allow buyers to choose safer chemicals if they are so inclined. This, along with the heightened level of government oversight under the Authorization process, will improve the investment environment for green chemistry.

Slide 35. We are seeing a growing number of downstream users demanding better information on the hazards of the chemicals and materials they are purchasing. These leading firms are finding this process to be frustrating and time-consuming. In many cases, the manufacturers of chemical products do not know the hazardous properties of the chemicals they are using the formulation of products and materials.

Many other companies would probably follow the lead of these companies if doing so was a simple process; for example, if California implemented a basic data requirement for chemicals sold in the state.

Slide 36. So, "How can California address the barriers to green chemistry?"

Slide 37. The report recommends that to craft a modern, comprehensive chemicals policy, California will need to close the three Gaps by implementing measures to improve the flow of information in the chemicals market, improve the capacity of government to act in timely and efficient manner, and implement other incentives for green chemistry research and education.

The report describes issues related to each of these goals, and it proposes that ideal mechanisms would leverage market forces, address the full chemical life cycle, place the least demands on government, motivate technology innovation and diffusion and so forth.

Will this happen overnight? Of course not. The chemical production system is enormously complicated and is integrated with nearly all productive activity in the economy. The U.S. imports and produces a total of 42 billion pounds of chemicals every day, or the equivalent in gallons of water of 623,000 gasoline tanker trucks, enough to reach from SF to DC and back…each day…if you lined them up end-to-end.

California purchases over 600 million pounds of chemicals just in consumer and commercial products, each day.

Slide 38. At the same time, it is likely that if California chooses not to pursue a modern chemicals policy, we can expect that our existing chemical problems will expand, the state could become a dumping ground for chemicals and materials no longer permitted for sale in the E.U. and other regions that adopt E.U. standards, such as Japan, Taiwan, South Korea, and we will cede leadership in green chemistry to other U.S. states and regions.

Slide 39. As I noted earlier, California has demonstrated that we can exert enormous influence over the trajectory of complex economic systems, such as the way electricity is used. The recent climate change bill is another illustration of this.

The UC report proposes that California can provide this same kind of leadership in chemicals policy in a way that steadily shifts our chemical production system to one based on green chemistry and that in doing so, we will solve a host of pressing public and environmental health problems and we will open new investment opportunities in California that are likely to find an expanding global market.

Slide 40. Thank you very much, and I would be happy to take questions, or open the floor for discussion, if there is time.

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