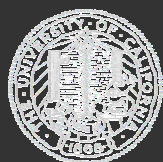


GREEN CHEMISTRY: Cornerstone to a Sustainable California



Michael P. Wilson, PhD, MPH
Timothy F. Malloy, JD
Megan Schwarzman, MD, MPH

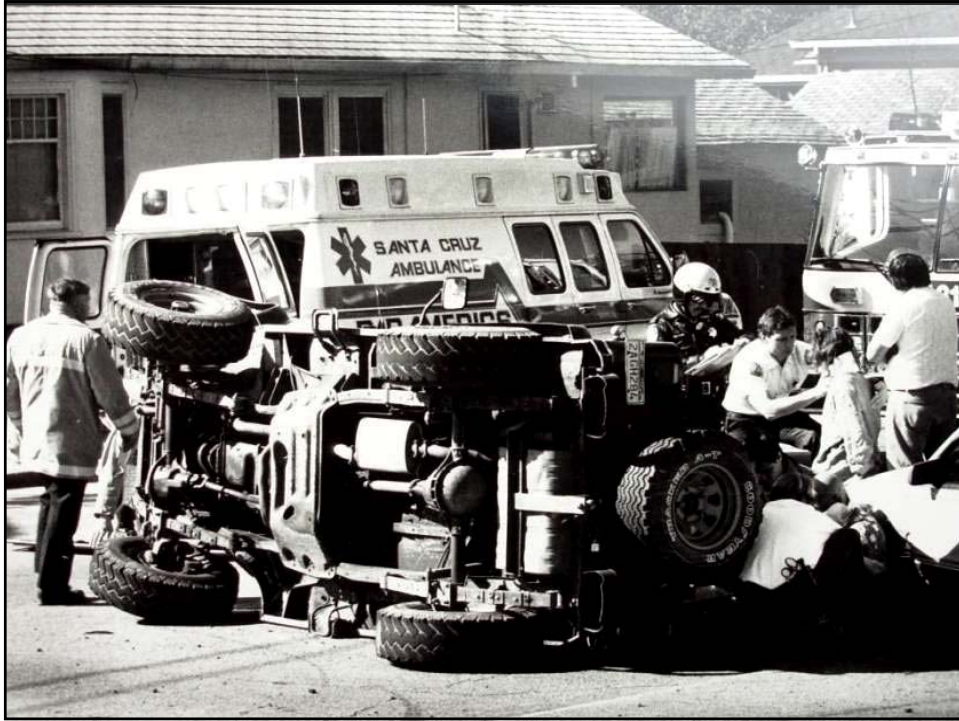
UC Berkeley School of Public Health, UCLA School of Law
UC Centers for Occupational & Environmental Health



OVERVIEW



- Background
- Scale of chemical production
- Core policy weaknesses
- Consequences in California
- Green chemistry alternative
- Solutions
- Opportunity for California leadership





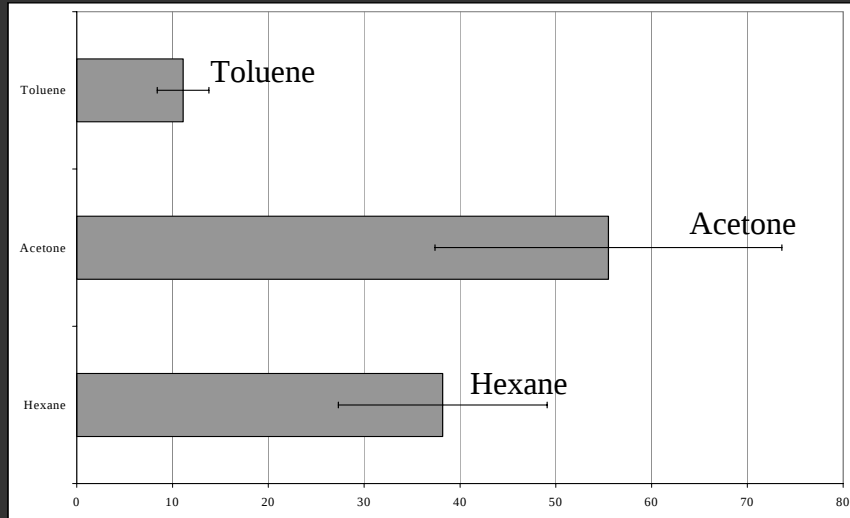


Hexane-induced peripheral neuropathy in the California
vehicle repair industry.



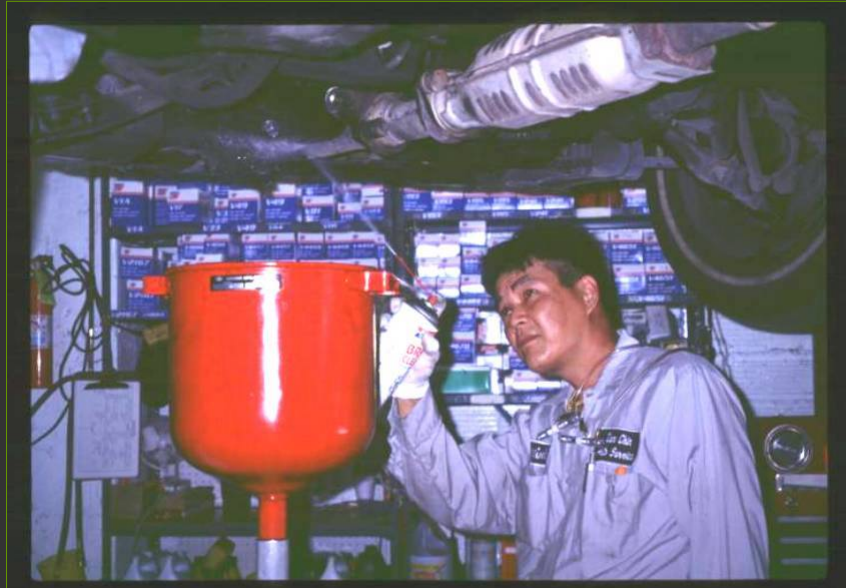
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8h time-weighted average exposure concentration, mg/m³ (n=23)



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Worker exposures to hexane: an unintended consequence of perchloroethylene phase-out in California.



Phase-out year

Rationale

1970: Stoddard solvent

Fire hazard

1978: CFCs

Ozone depletion

1980: Methylene chloride

Carcinogen

1985: 1,1,1-Trichloroethane

Ozone depletion

1990: Perchloroethylene

Dioxin emissions

2002: Hexane/acetone blends

Neurotoxin

Next: 1-Bromopropane

Repro toxin

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Meanwhile, over at the Legislature...



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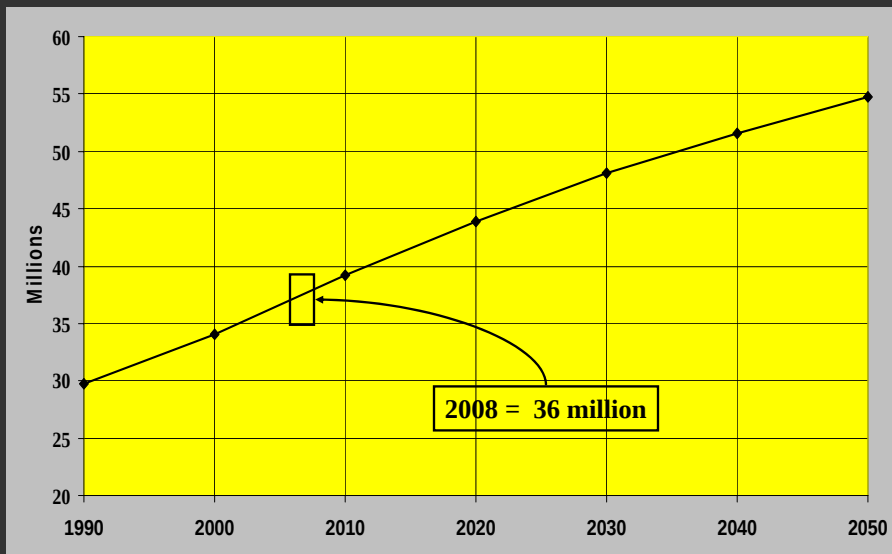
AB 121 (Vargas)
AB 263 (Chan)
AB 289 (Chan)
AB 319 (Chan)
AB 342 (Baca)
AB 597 (Montanez)
AB 623 (Aanistad)
AB 639 (Aghazarian)
AB 752 (Karnette)
AB 815 (Lieber)
AB 816 (Lieber)
AB 848 (Berg)

AB 908 (Chu)
AB 912 (Ridley-Thomas)
AB 966 (Saldana)
AB 985 (Dunn)
AB 990 (Lieber)
AB 1125 (Pavley)
AB 1337 (Ruskin)
AB 1342 (Assem ESTM)
AB 1344 (Assem ESTM)
AB 1354 (Baca)
AB 1415 (Pavley)
AB 1681 (Pavley)

SB 419 (Simitian)
SB 432 (Simitian)
SB 484 (Migden)
SB 490 (Lowenthal)
SB 600 (Ortiz)
SB 838 (Escutia)
SB 849 (Escutia)
SB 982 (Sen EQ comm)
SB 989 (Sen EQ comm.)
SB 1067 (Kehoe)
SB 1070 (Kehoe)

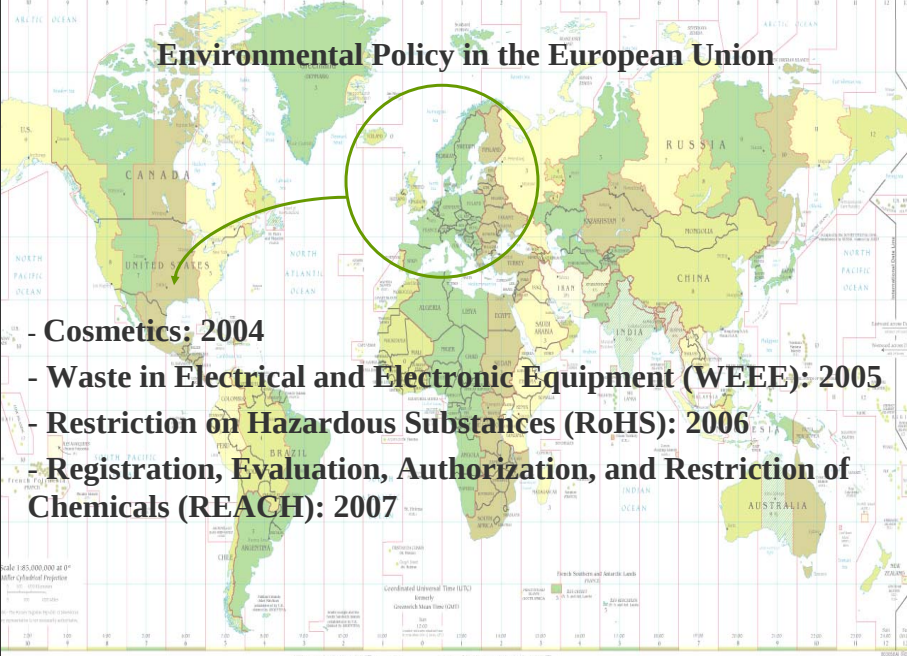
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California's expected population growth, 1990-2050



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Environmental Policy in the European Union



- **Cosmetics: 2004**
- **Waste in Electrical and Electronic Equipment (WEEE): 2005**
- **Restriction on Hazardous Substances (RoHS): 2006**
- **Registration, Evaluation, Authorization, and Restriction of Chemicals (REACH): 2007**

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“G.E. Chief Points to ‘Green’ Handicap”

Financial Times
May 10, 2005
Stephanie Kirchgaessner in Washington

“...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.”



Jeffrey Immelt, Chairman and CEO (\$1.5 billion/yr Ecomagination)

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2006: Legislature

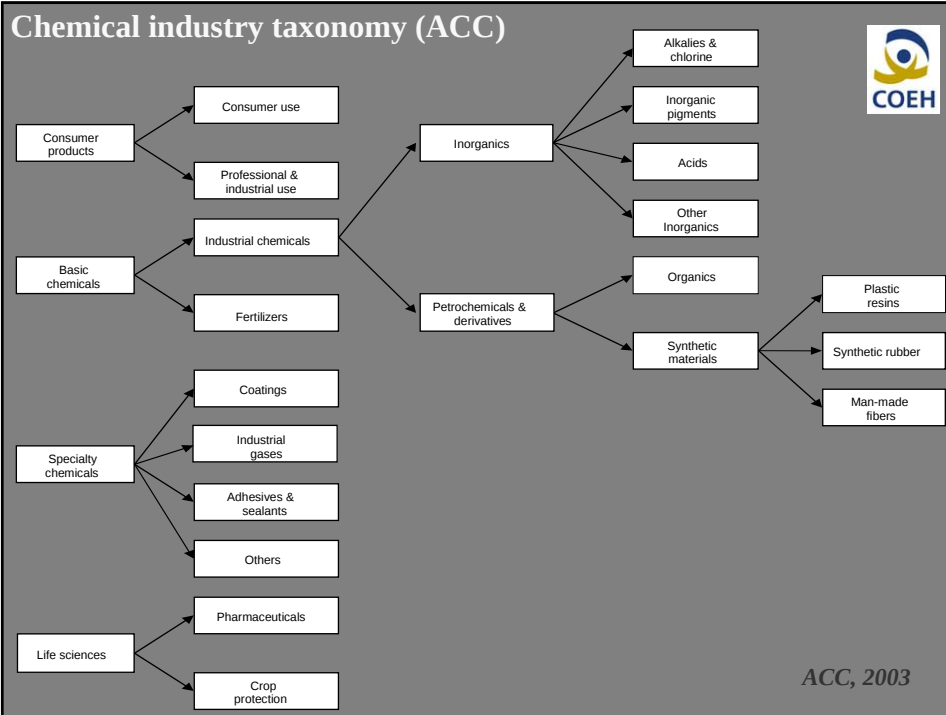
Green Chemistry in California:
A Framework for Leadership
in Chemicals Policy and
Innovation.

2008: Cal/EPA

Green Chemistry: Cornerstone
to a Sustainable California

127 UC faculty signatories
from seven campuses.

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- Total daily California sales of chemical products alone:
644 million pounds (2,700 tankers)
- Total daily U.S. chemical production and importation:
42 billion pounds (623,000 tankers)



Source: TSCA IUR and CA Air Resources Board



The workplace



Commercial products



Waste streams

Ecosystems: air, water,
food, soil



Global trade



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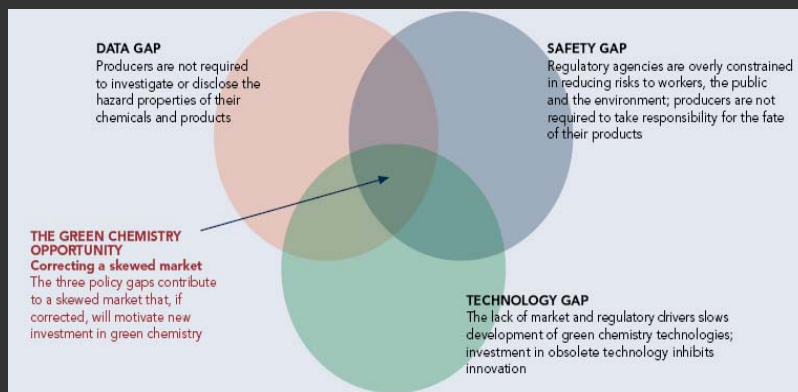
The federal Toxic Substances Control Act of 1976



- **Data Gap:**
 - TSCA does not require producers to generate health or environmental data for EPA or downstream users.
- **Safety Gap:**
 - TSCA has greatly constrained EPA's ability to assess and control chemical hazards.
- **Technology Gap:**
 - TSCA has dampened industry interest in green chemistry, as reflected in the market.

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CORE POLICY WEAKNESSES





Data Gap is key to new markets.

; To make informed purchasing decisions about chemicals, buyers need four pieces of information:

Function	Price
Performance	Hazards

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How buyers operate in the chemicals market under TSCA:

Function	Price
Performance	

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To assess & prioritize chemical hazards, state agencies need at least four pieces of information:

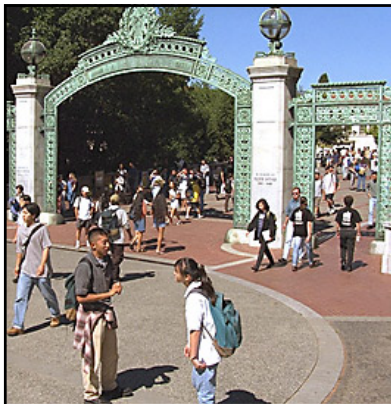
Identity	Sales volume
Uses	Hazards

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Information available to state agencies under TSCA:

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Reflecting the chemicals market
under TSCA...

The chemistry curriculum does not
require an understanding of:

- toxicology
- ecotoxicology
- exposure
- principles of green chemistry.

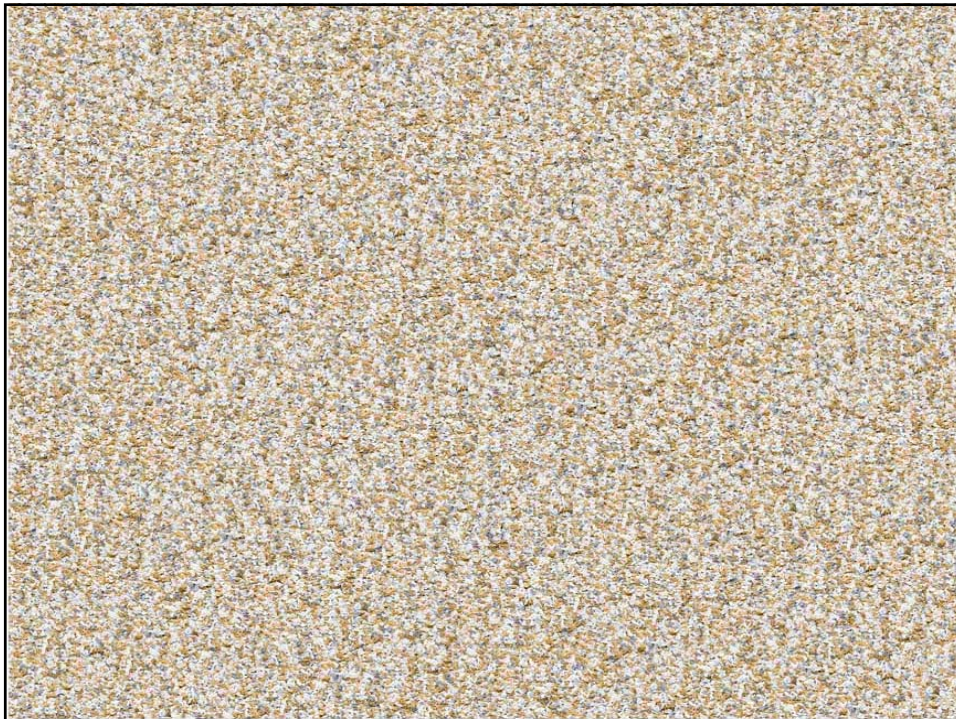
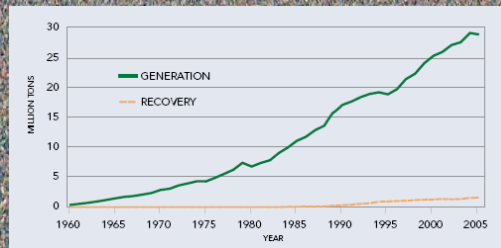
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Consequence: Producer and consumer
externalities

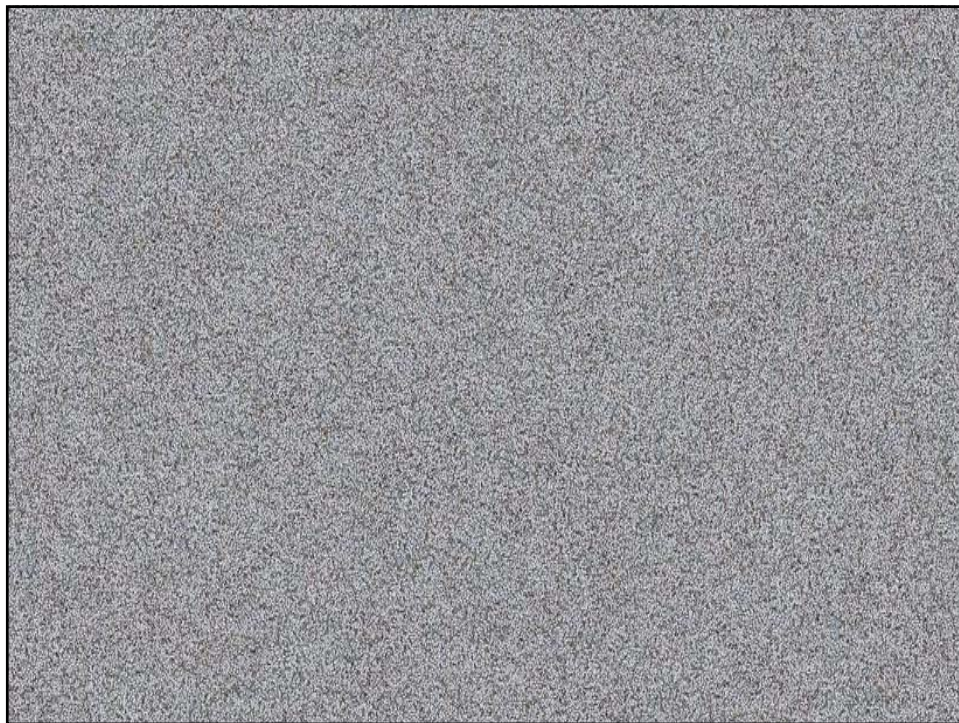
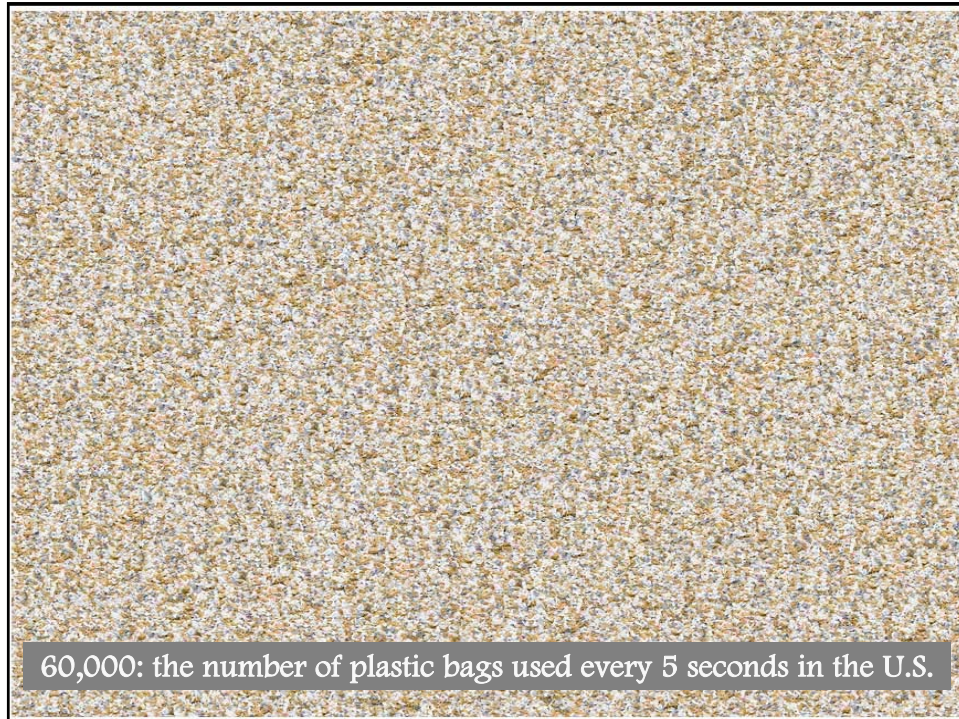
Graphic arts courtesy of Chris Jordan www.chrisjordan.com

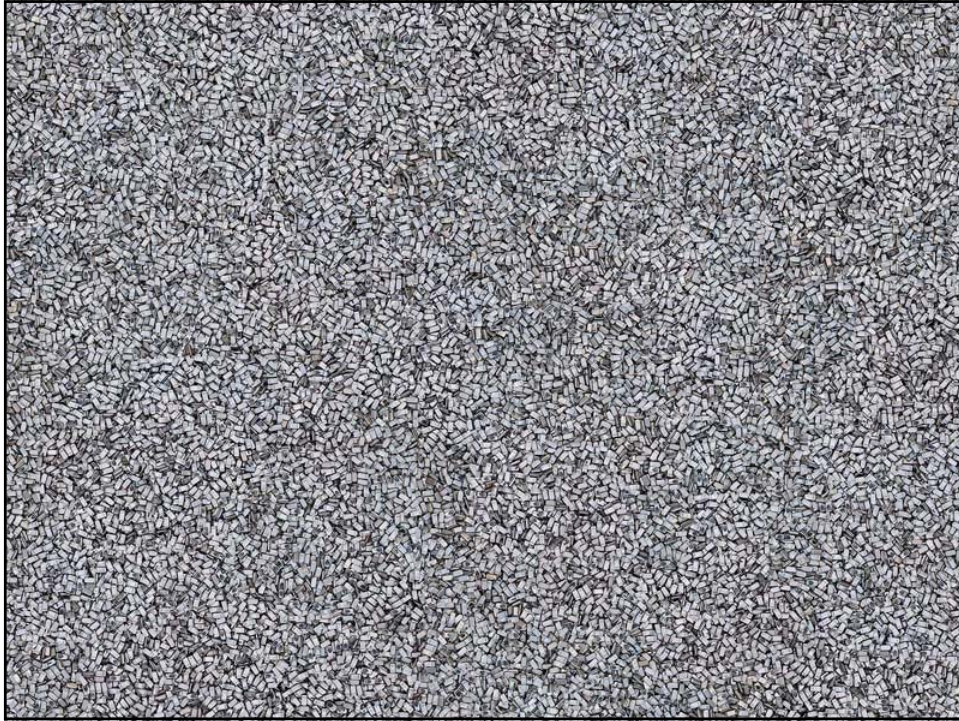


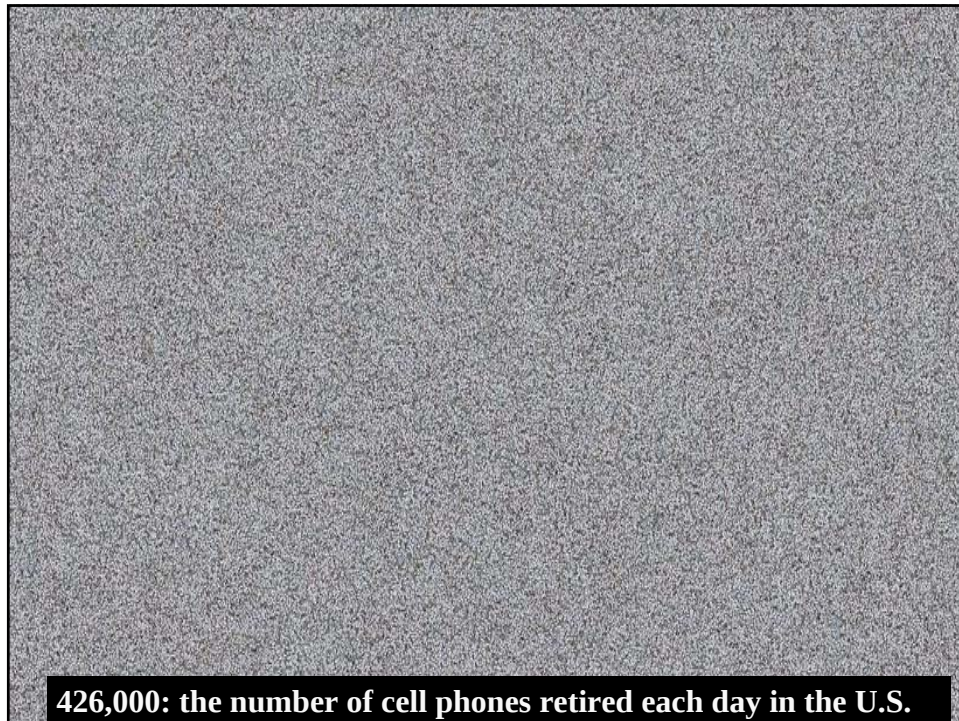
Two million plastic beverage bottles are discarded every five seconds in the U.S. ~ about 3% are recycled.



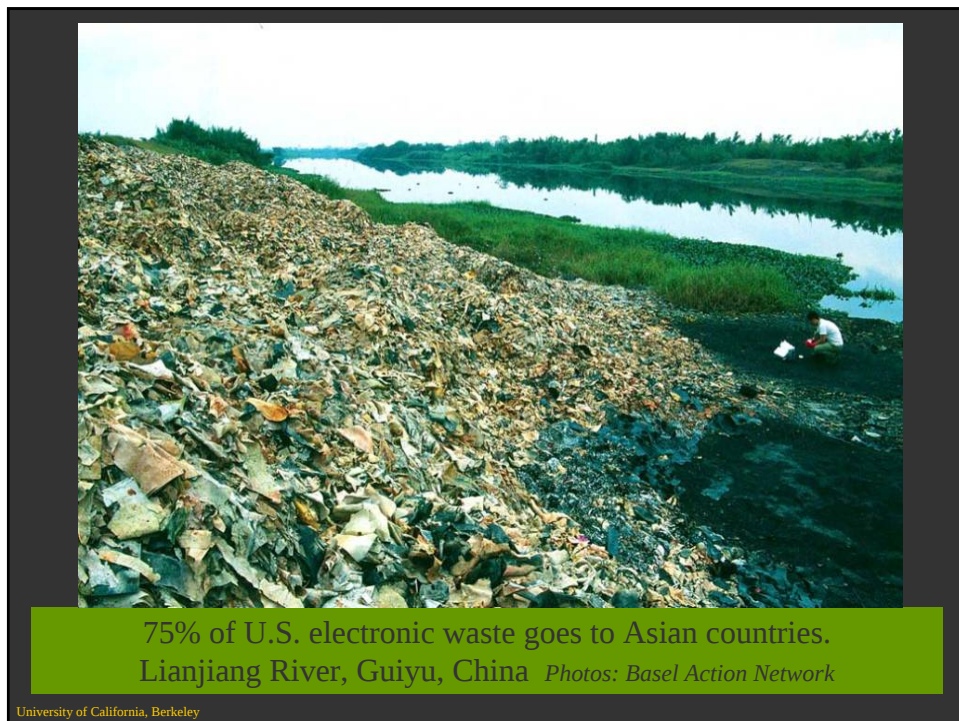








426,000: the number of cell phones retired each day in the U.S.



**75% of U.S. electronic waste goes to Asian countries.
Lianjiang River, Guiyu, China** *Photos: Basel Action Network*

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50 million tons of e-waste are discarded annually
(5% of global solid waste) Guiyu, China

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Consequence: HAZARDOUS WASTE



California DTSC estimates that 61 of 85 of the state's largest hazardous waste sites are leaking into groundwater. Of 51 sites inspected for groundwater intrusion, 94% were found to present, "a major threat to human health or the environment."

Consequence: OCCUPATIONAL DISEASE

Our estimate of annual CA morbidity and mortality attributable to occupational chemical exposures (p. 18):

- 4,400 deaths (~0.03% of CA workforce).
- 208,000 cases of deadly chronic disease in 2004 (~1.3% of CA workforce).

- PELs for only 193 of 2,800 HPV chemicals (~7%)
- 8,300 chemicals produced or imported > 10,000 lbs/year
- PELs: U.S. 453 (~5%)
CA 688 (~8%)
- MDs board-certified in Occ Med: 0.2% of U.S. physicians
- DOSH inspectors: < 200 for 16.5 million workers (~1/83,000)
- HESIS staff: 3



OCCUPATIONAL DISEASE

FIGURE 1. DISEASE CASES AND COSTS ATTRIBUTABLE TO CHEMICAL EXPOSURES IN THE WORKPLACE, CALIFORNIA 2004

	Cases			Costs (\$millions)	
	Disease	Hospitalizations	Deaths	Direct medical	Indirect
Cancer	113,999	8,700	3,845	\$617.2	\$620.5
COPD	42,606	1,145	361	\$42.6	\$42.8
Asthma	45,856	460	11	\$25.4	\$7.5
Pneumoconioses	1,710	171	132	\$15.3	\$21.0
Chronic renal failure	2,854	128	21	\$4.9	\$5.7
Parkinson's disease	699	27	37	\$1.1	\$1.3
Total	207,724	10,631	4,407	\$706.5	\$698.8
				TOTAL	\$1,405.3



Funding is easiest to justify when the outcome is highly visible (e.g. structure fires).

Funding is difficult to justify when the outcome is less visible (e.g. workplace diseases).

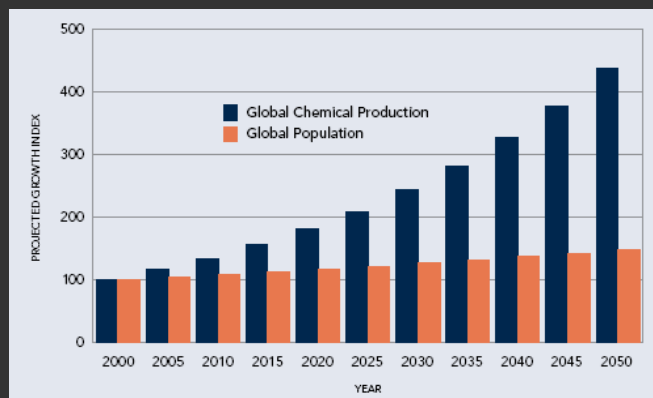


CHEMICALS in PEOPLE

TABLE 1. SELECTED EXAMPLES OF TOXIC SUBSTANCES FOUND IN UMBILICAL CORD BLOOD, BREAST MILK AND ADULT TISSUES

Contaminant	Examples of known sources	How people are exposed
<i>Volatile Organic Compounds</i>		
Naphthalene ¹⁰	Vehicle exhaust, deodorizers, paints, glues	Outdoor and indoor air, drinking water, workplaces
Perchloroethylene	Dry cleaning solvent, degreasing products	Treated clothing, proximity to dry cleaners, workplaces
Benzene	Gasoline, glues, detergents, vehicle exhaust	Outdoor air, workplaces
<i>Agricultural Products</i>		
Organophosphates	Pesticides, flea & tick pet products	Food, proximity to agriculture, field work, indoor air
Atrazine	Herbicide	Food, water, proximity to agriculture, field work
<i>Persistent Organic Pollutants</i>		
Polybrominated diphenyl ethers (PBDEs) ¹¹	Flame retardants in furniture and electronics	Food, indoor air and dust
Dioxins & Furans	Byproduct of waste incineration, paper mills, manufacturing	Food, outdoor air, drinking water
PFOA/PFOs ¹²	Non-stick and stain-resistant coatings	Consumer products, food, water, workplaces
<i>Plastics Components</i>		
Phthalates	Cosmetics, detergents, household cleaners, vinyl materials, lacquers	Skin contact, indoor air, food, soft plastics
Bisphenol A ¹³	Hard plastic containers, canned food linings	Food, water
<i>Heavy Metals</i>		
Cadmium	Batteries, fertilizer production, waste incineration, plastics, metal coatings	Food, air, water, workplaces
Lead	Paint, electronics, batteries, fossil fuels	Toys, food, soil, drinking water, workplaces

GLOBAL CHEMICAL PRODUCTION



The design of chemical products and processes to reduce and/or eliminate substances hazardous to human health and the environment.



- Links public and environmental health...
- with new business & investment opportunities.

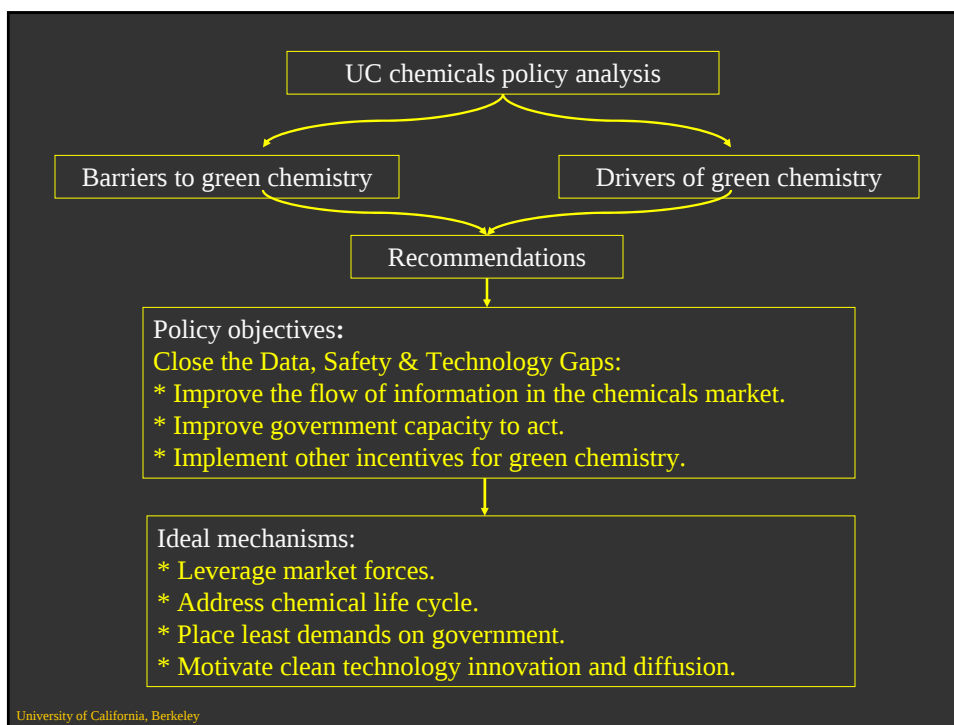
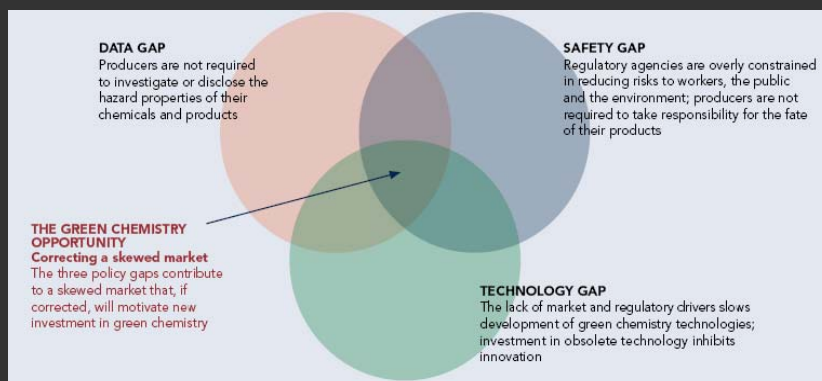
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Policy Solutions: Getting to Green Chemistry

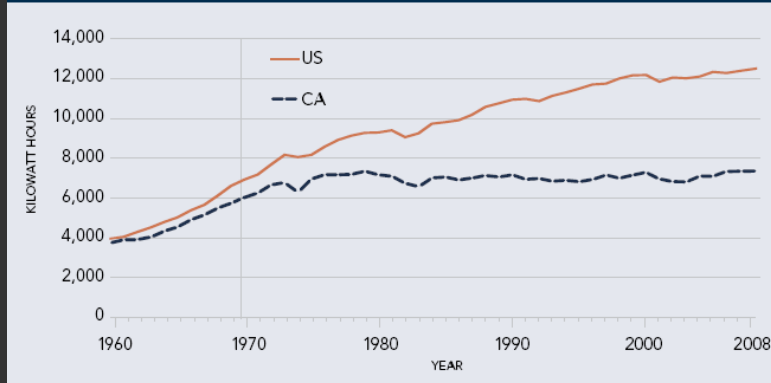
- Close the Data Gap: Generate Hazard Information
- Close the Safety Gap: Implement Responsive Regulatory Tools
- Close the Technology Gap: Foster Green Chemistry Directly

CHEMICALS POLICY FRAMEWORK



Effective Policy Interventions

FIGURE 2. PER CAPITA ELECTRICITY SALES (KWH/PERSON)



Source: California Energy Commission, 2007

As other nations decide to follow an E.U. or U.S. model, there is a role for the U.S. IH community.

E.U.: Governance

REACH, RoHS, WEEE:

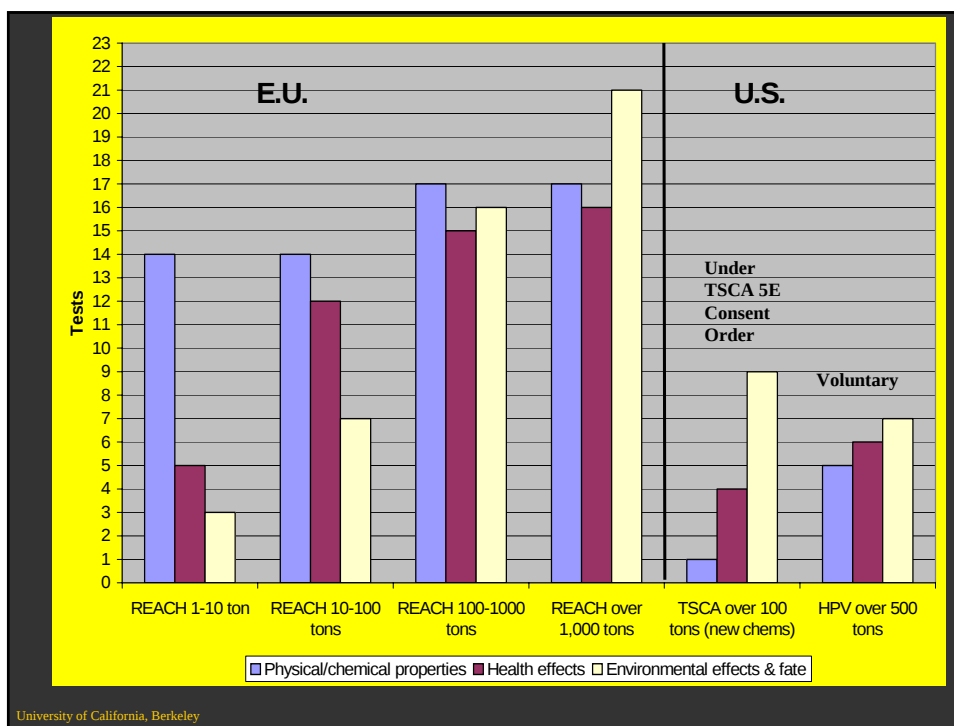
- Transparency
- Accountability
- Precaution

U.S.: Voluntary

• “Security and Prosperity Partnership:”

- HPV
- No transparency or accountability measures

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Thank you!



Michael P. Wilson, PhD, MPH
 Timothy F. Malloy, JD
 Megan Schwarzman, MD, MPH

UC Berkeley School of Public Health, UCLA School of Law
 UC Centers for Occupational & Environmental Health

“I do not believe that addressing this type of concern in the legislature on a chemical by chemical, product by product basis is the best or most effective way to make chemical policy in California.”

Signing Statement for Assembly Bill 1108

Close the Data Gap: Generate Hazard Information

- What
 - Submission of hazard and distribution information
- Who
 - Chemical producers and product manufacturers
- Why
 - Purchasers & users can choose safer products
 - Agencies can identify hazards





Hazard Traits

- Examples:
 - Induces cancer or birth defects
 - Affects endocrine, reproductive or immune system regulation
 - Toxic to fish, birds or animals
- Prioritize chemicals based on “hazard matrix”

Close the Safety Gap: Agency Responsibility

- Review new and existing chemicals
- Mandate use of safer feasible alternative where available
- Otherwise mandate appropriate controls



Regulatory Tools: Business Responsibility

- Periodically evaluate availability of inherently safer processes and chemicals
- Implement safer feasible alternatives
- Report results of evaluation
- Fee on industry required to administer

Close the Technology Gap

- Public Support for Research
- Education
- Technical Assistance
- Targeted Incentives

