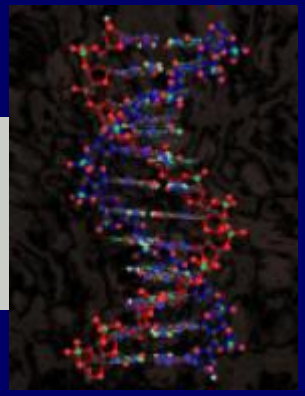
Green Chemistry Symposium
October 24, 2006

California Environmental Protection Agency
Department of Toxic Substances Control
Maureen Gorsen, Director

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

Michael P. Wilson, Ph.D, MPH
with Daniel A. Chia and Bryan C. Ehlers
mpwilson@berkeley.edu



Center for Occupational and Environmental Health

Est. 1978 (AB 3414)

Berkeley, Davis, San Francisco (northern California).

- Toxicology
- Epidemiology
- Industrial hygiene
- Environmental health policy
- Occupational and environmental medicine
- Occupational health nursing
- Ergonomics
- Labor occupational health education
- Continuing professional education

The UC Report:

- Fiscal sponsor: California Policy Research Center, UCOP
- Assesses problems and opportunities in chemicals policy
- Proposes broad policy goals

Commissioned January 2004 by:

- Byron Sher (Chair, SEQC)
- John Laird (Chair, ACESTM)

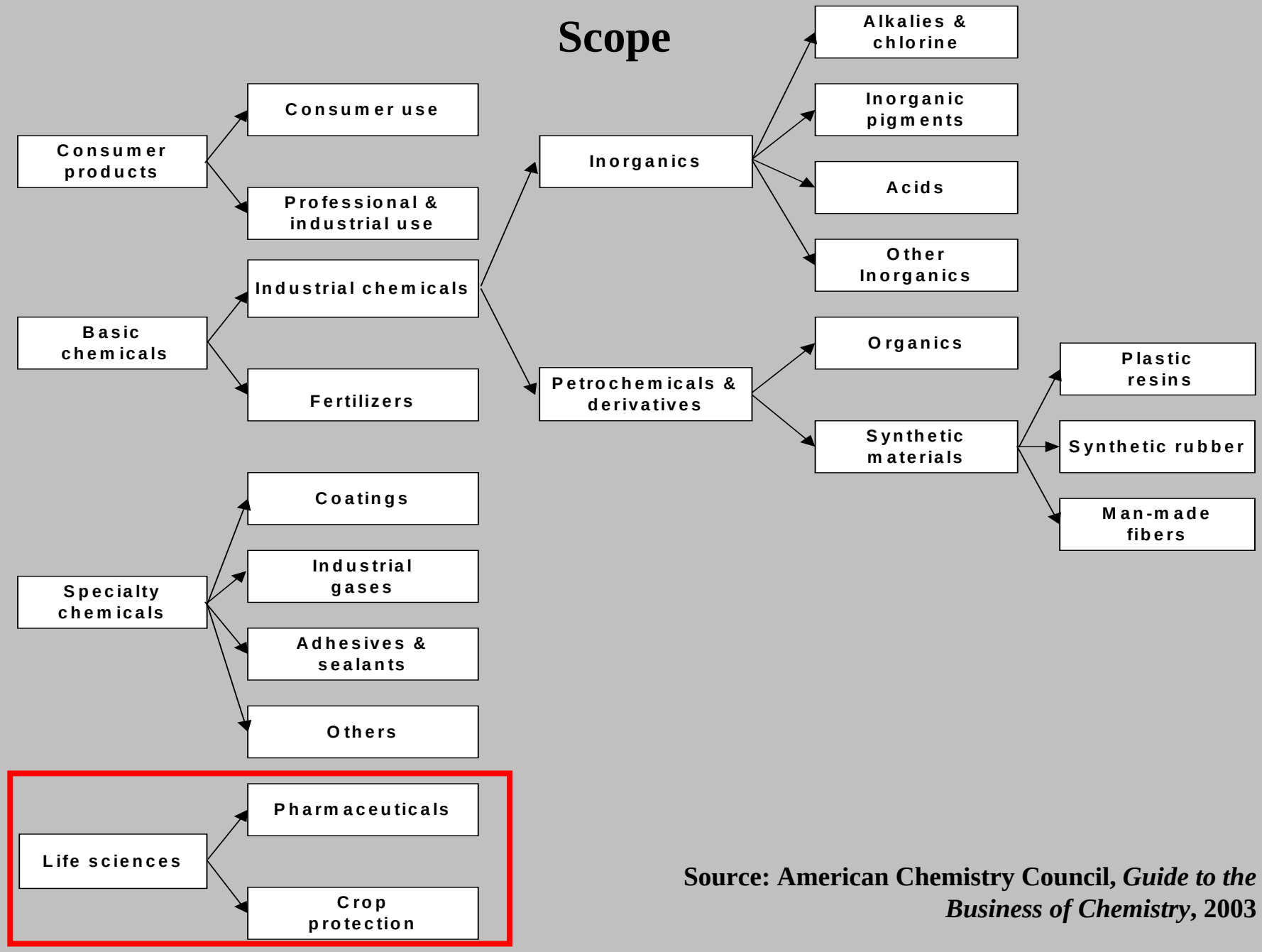
Released to Legislature March 14, 2006 to:

- Joseph Simitian (Chair, SEQC)
- Ira Ruskin (Chair, ACESTM)

Download etc:

http://coeh.berkeley.edu/news/06_wilson_policy.htm

Scope



Source: American Chemistry Council, *Guide to the Business of Chemistry*, 2003

Methods

- Literature review
- Key informant interviews
- Survey data from 37 electronics companies
- 35 conferences
- Presentations at 17 conferences
- Advisory Committee review

Advisory Committee Members

John R. Balmes, MD
School of Medicine, UC San Francisco

Carl F. Cranor, PhD
Department of Philosophy, UC Riverside

S. Katharine Hammond, PhD
School of Public Health, UC Berkeley

Bill E. Kastenberg, PhD
College of Engineering, UC Berkeley

Ann Keller, PhD
School of Public Health, UC Berkeley

Amy D. Kyle, PhD, MPH
School of Public Health, UC Berkeley

Geoff Lomax, DrPH
Department of Health Services

Timothy Malloy, JD
School of Law, UC Los Angeles

Thomas E. McKone, PhD
Lawrence Berkeley National Laboratory

Dara O'Rourke, PhD
College of Natural Resources, UC Berkeley

Julia Quint, PhD
Department of Health Services

Christine Rosen, PhD
Haas School of Business, UC Berkeley

David J. Vogel, PhD
Haas School of Business, UC Berkeley

Report's findings are similar to those of:

• National Academy of Sciences	1984
• U.S. General Accounting Office	1994
• Congressional Office of Technology Assessment	1995
• Environmental Defense	1997
• U.S. EPA	1998
• former EPA officials	2002
• RAND Science and Technology Institute	2003
• U.S. Government Accountability Office	2005
• National Academy of Sciences	2005

The challenge of chemicals policy: Hexane/acetone-induced neurological disease in the California vehicle repair industry.

Harrison et al. MMWR, Nov 16, 2001, Vol 50 #5

Accelerating Rotorod

Ladefoged et al. 1994. *Pharm and Tox*. 74:294-299.

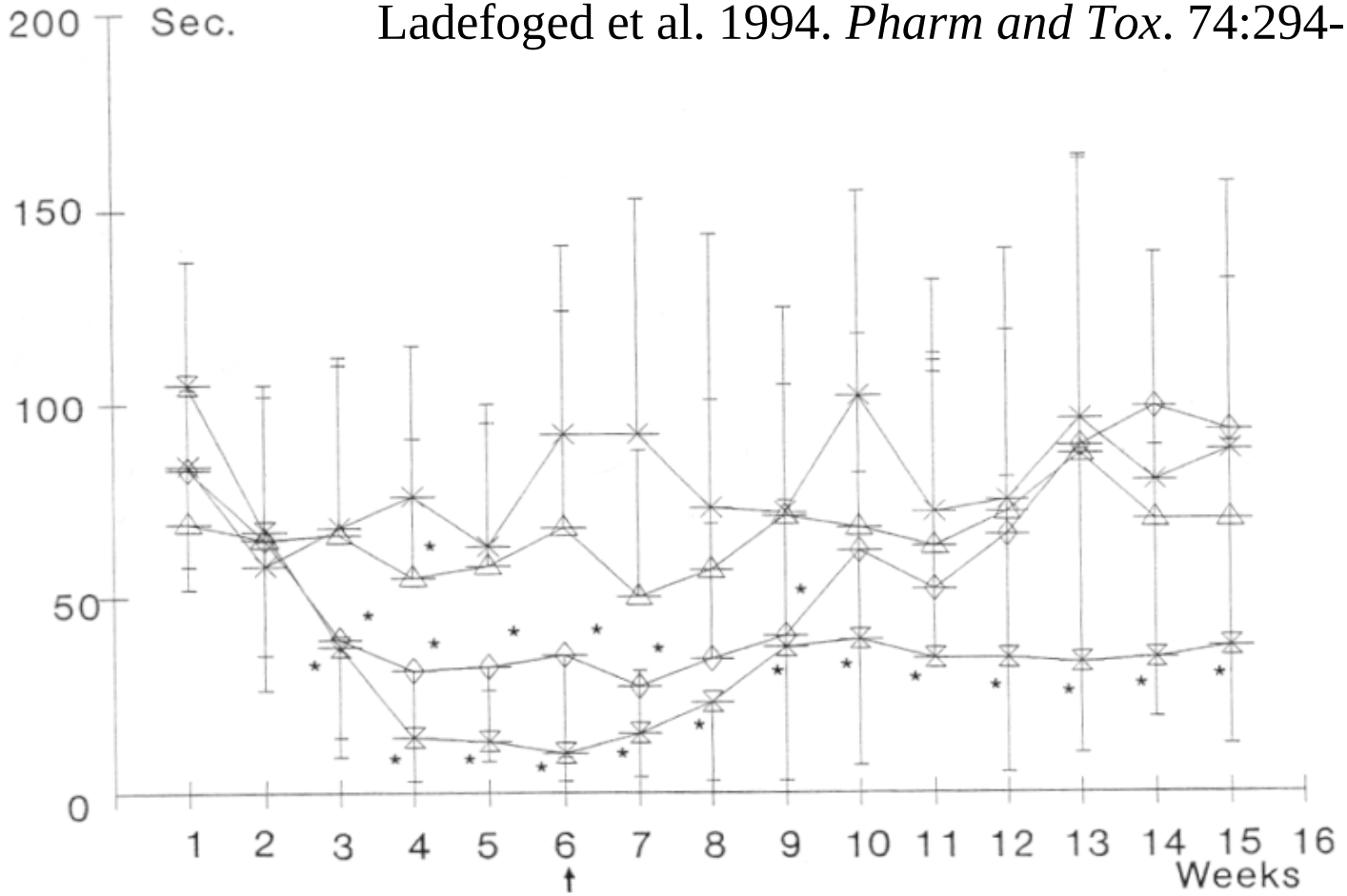
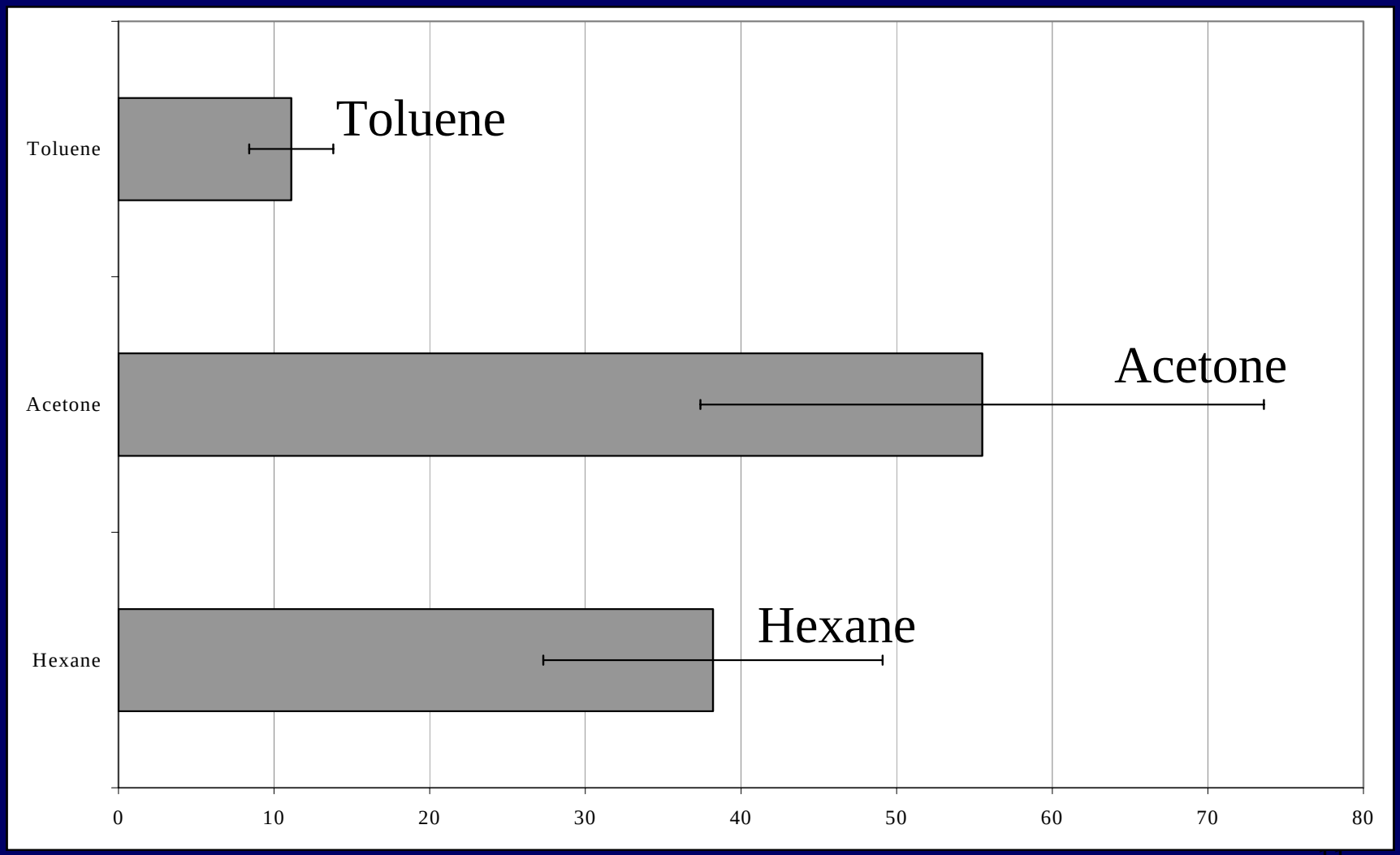


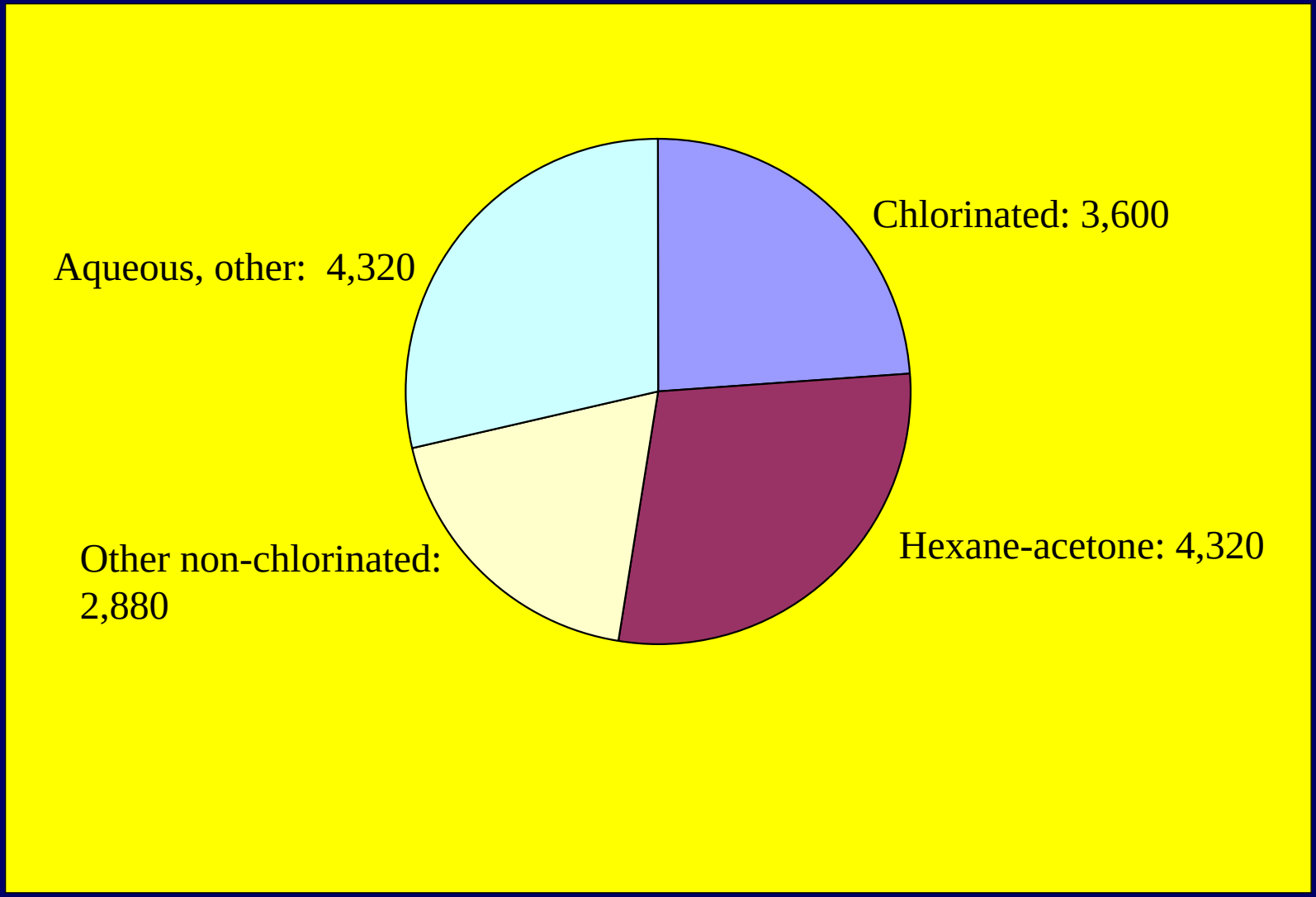
Fig. 3. Accelerating rotarod score (mean seconds before the rat falls of ±S.D.) of male rats treated with 2,5-hexanedione (0.5%), acetone (0.5%) or 2,5-hexanedione (0.5%)+acetone (0.5%) in the drinking water for 6 weeks followed by a 10-week dose-free period. The arrow indicates the end of treatment. *: $P<0.05$. Control —×—, 2,5-hexanedione —◇—, acetone —△—, 2,5-hexanedione+acetone —▽—.

The University of California, Berkeley

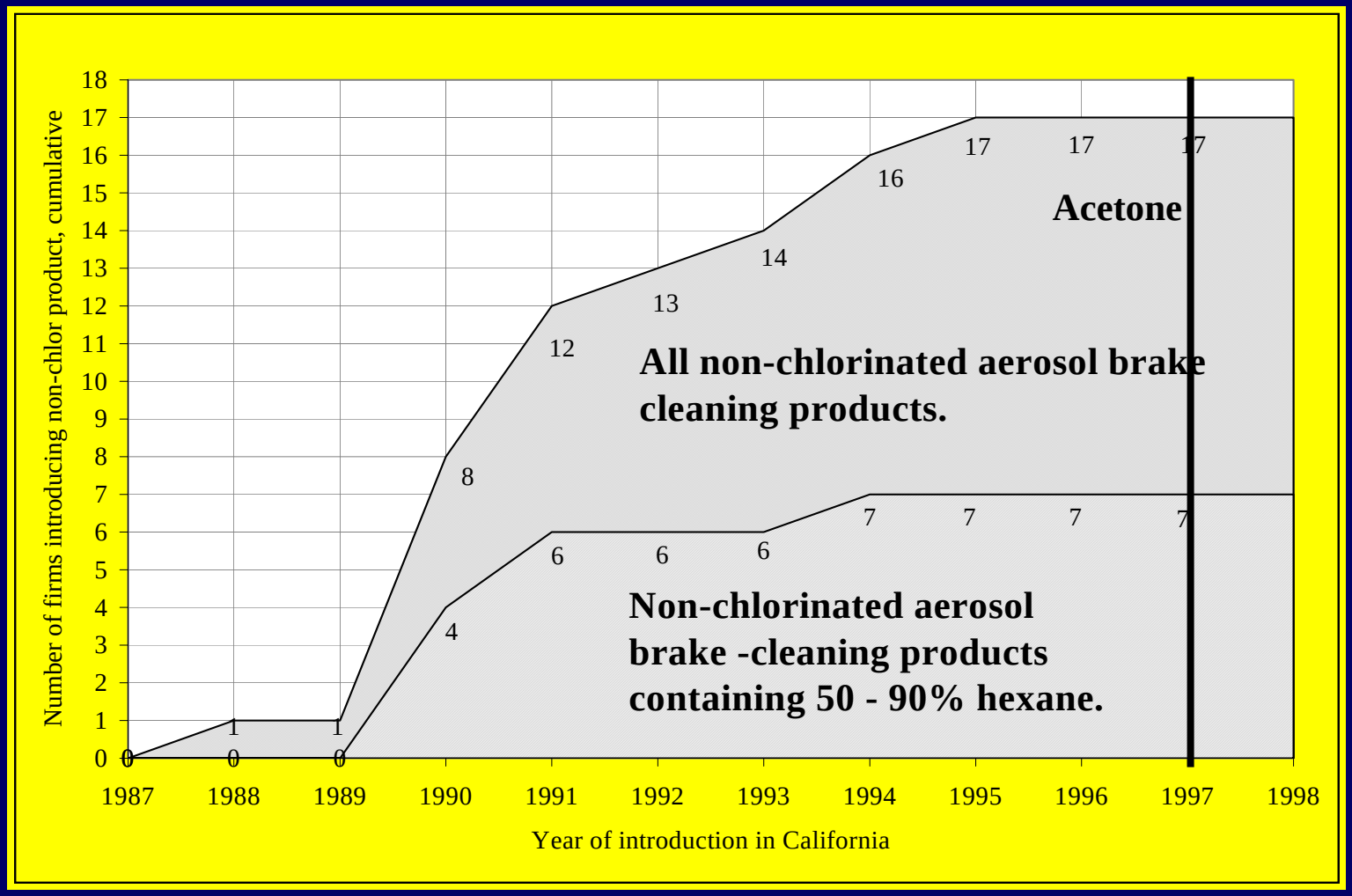
8h time-weighted average exposure concentration, mg/m^3



Solvent use in 14,400 California vehicle repair shop, 2001



1988: Introduction of hexane products in CA.
1997: Introduction of hexane-acetone blends.



Survey data for 17 companies, 90% of market.

Introduction of hexane-acetone blends, 1997:

An unintended consequence of exempting acetone from California VOC rules.

Introduction of hexane, 1988:

An unintended consequence of listing chlorine-contaminated oil as a hazardous waste.

Chemical management over the last 30 years

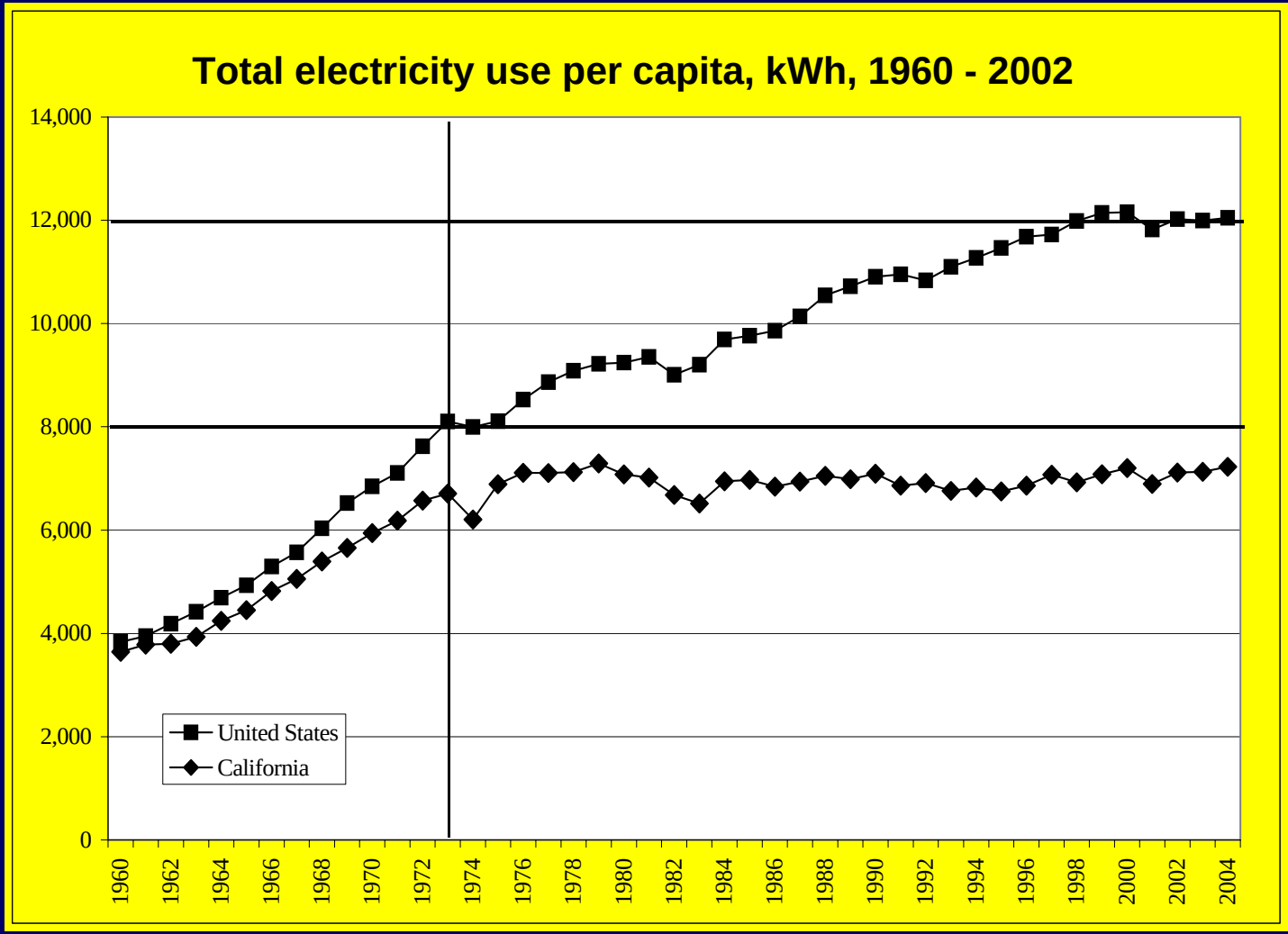
Stage 1: Disposal and dilution

Stage 2: Waste treatment and pollution control

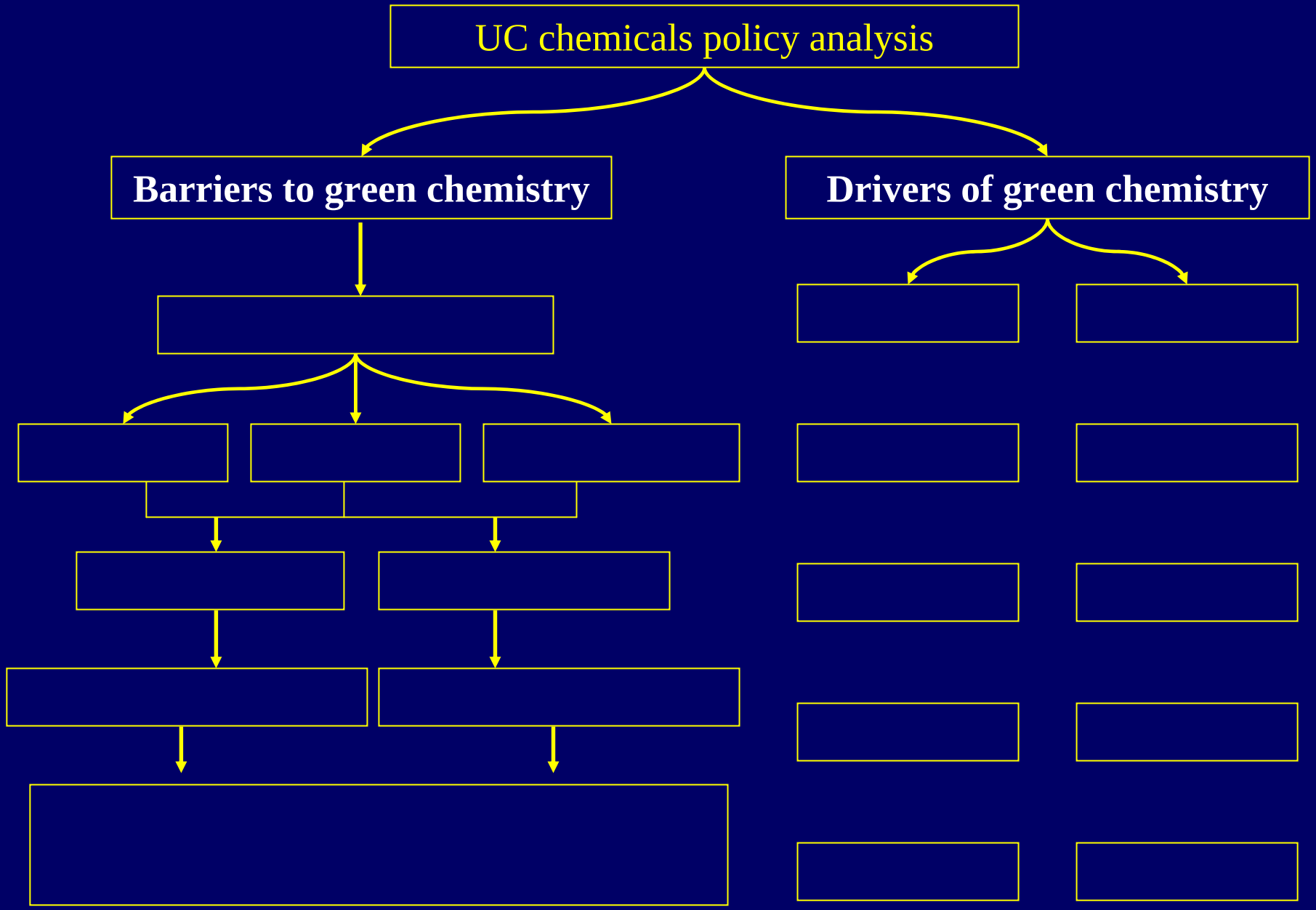
Stage 3: Toxics policy (chemical-by-chemical approaches)

Stage 4: Chemicals policy (chemical design, markets, life cycles)

UC report: A systems approach to public policy is needed to produce enduring changes, including in the chemical sector. Example: electricity use.



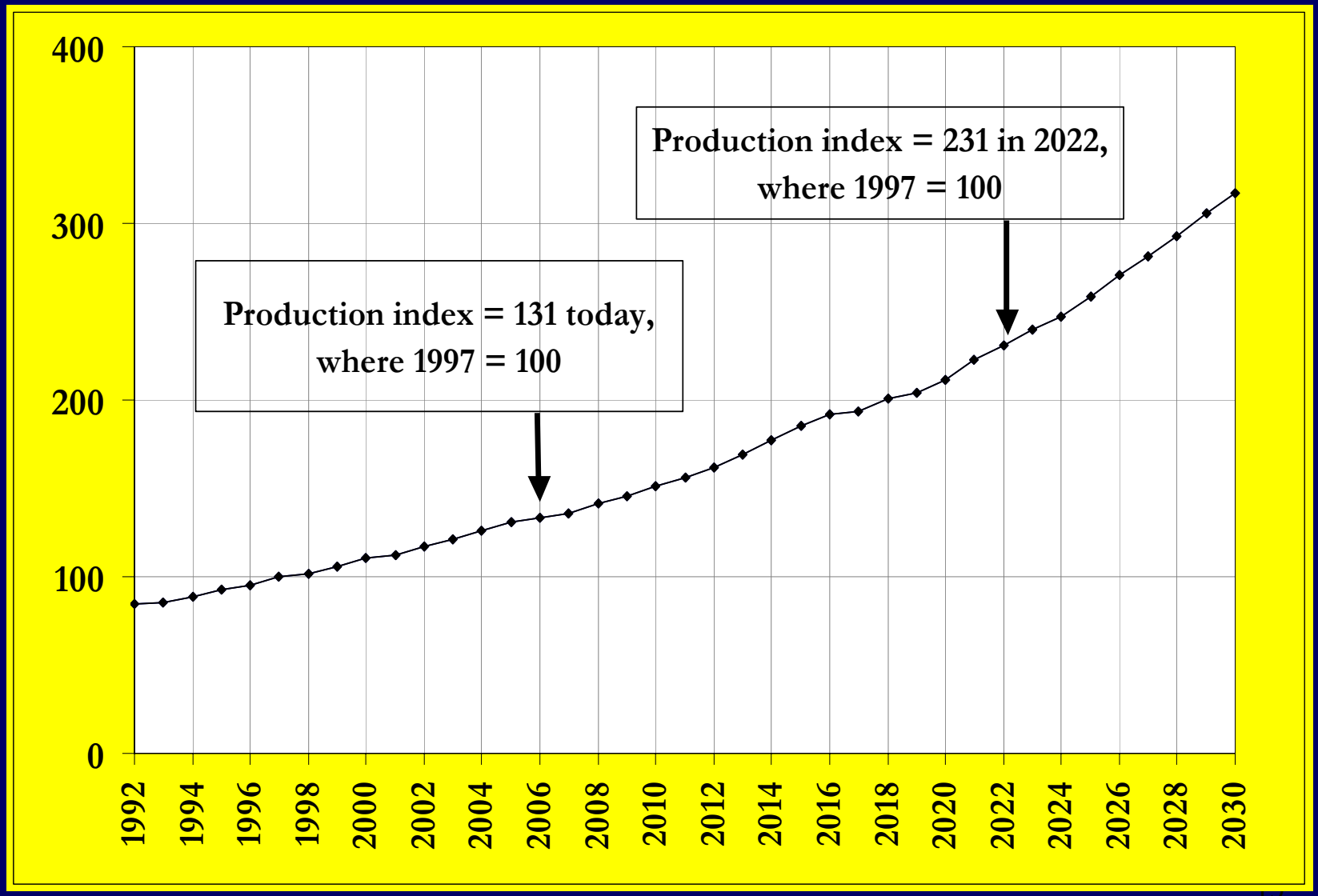
Courtesy John Wilson, CA Energy Commission


UC chemicals policy analysis
Barriers to green chemistry
Drivers of green chemistry

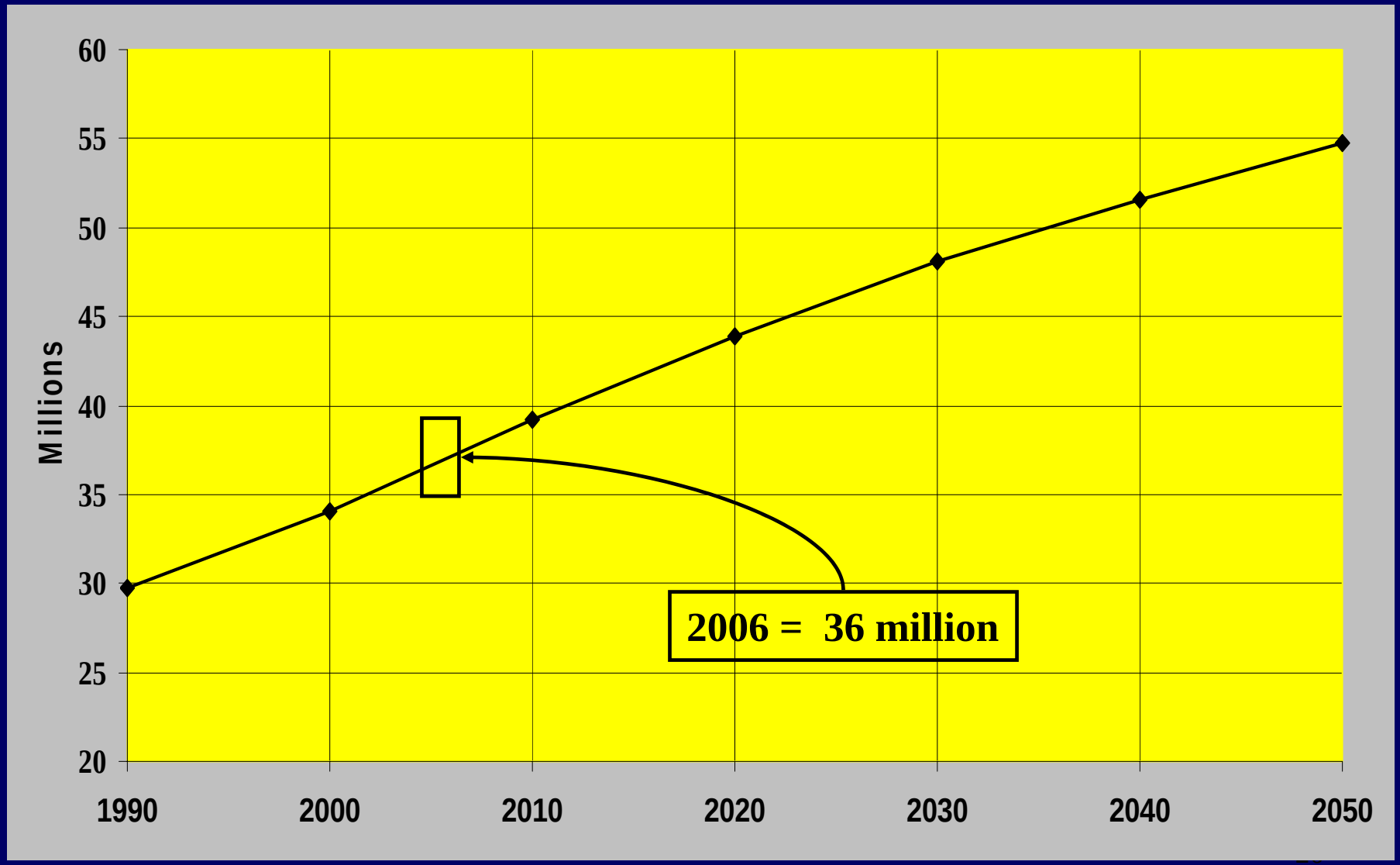
GREEN CHEMISTRY

- From a policy perspective,
- green chemistry links solutions to chemical problems…
- with new business & investment opportunities.

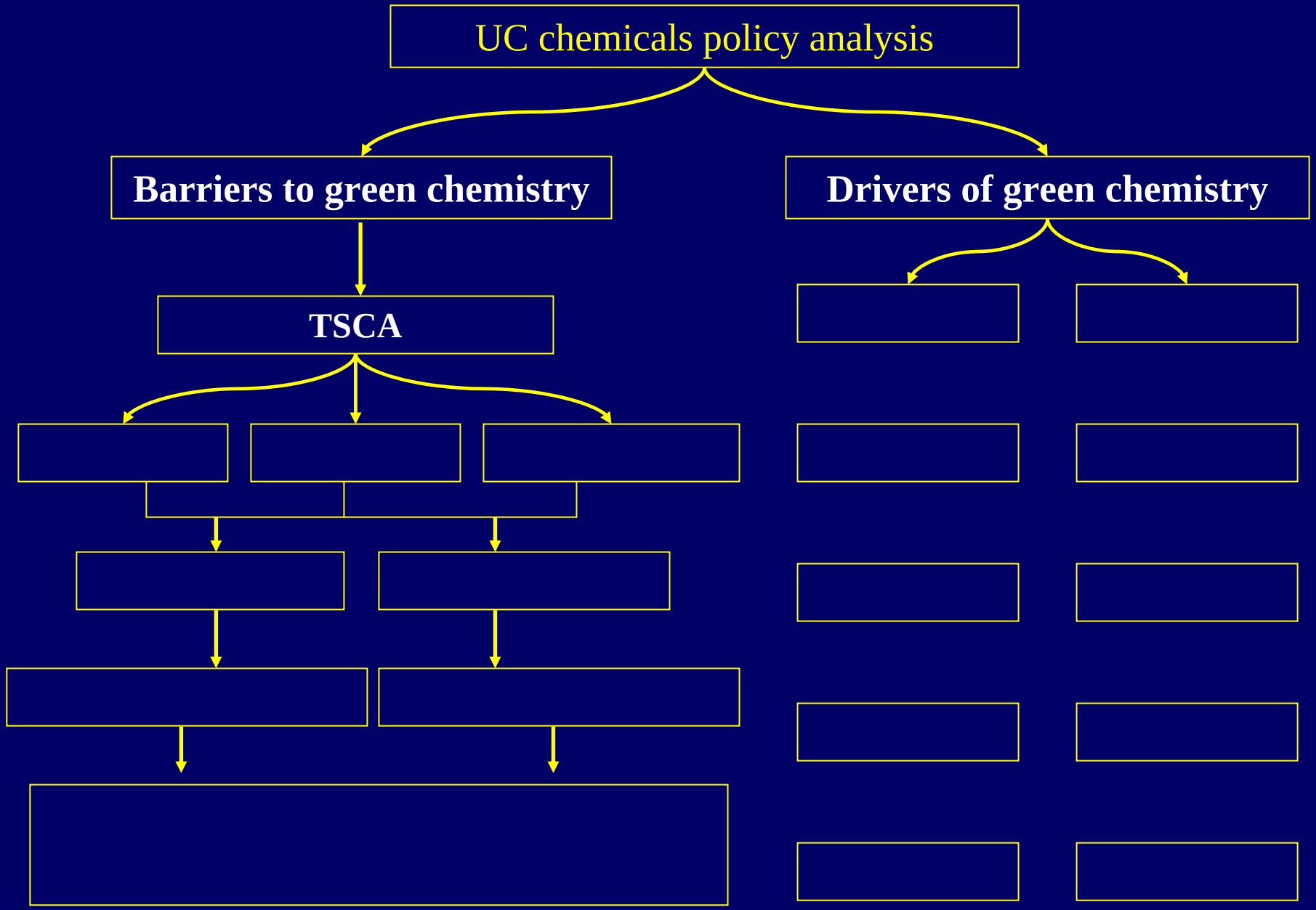
Global chemical production is expected to double every 25-years.



California's expected population growth, 1990-2050



Source: California Dept of Finance, CA pop. trends, 1990 – 2050


UC chemicals policy analysis
Barriers to green chemistry
Drivers of green chemistry
TSCA

The federal Toxic Substances Control Act of 1979.

- Data Gap:
  - TSCA does not require producers to generate chemical hazard data for EPA or downstream users.

- Safety Gap:
  - TSCA has constrained government's ability to assess and control chemical hazards.

- Technology Gap:
  - TSCA has dampened private sector interest in green chemistry, which is reflected in research and education.

Implications of the Data and Safety Gaps 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 relative 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 costs and liabilities that result from using hazardous chemicals.

Example 1. Data Gap

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

Function	**Price**
Performance	**Hazards**

Hazard information (e.g. toxicity) is essentially absent.

Function	**Price**
Performance	

Example 2. Data Gap

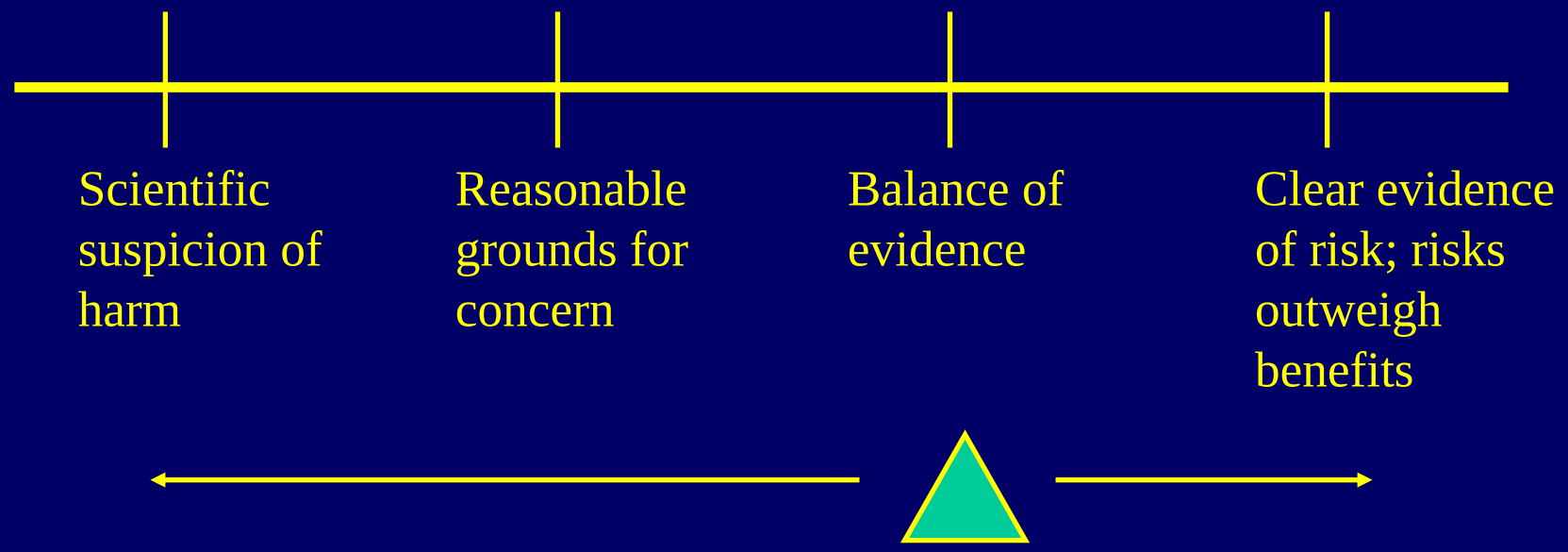
To assess & prioritize chemical hazards, state agencies need at least four pieces of information:

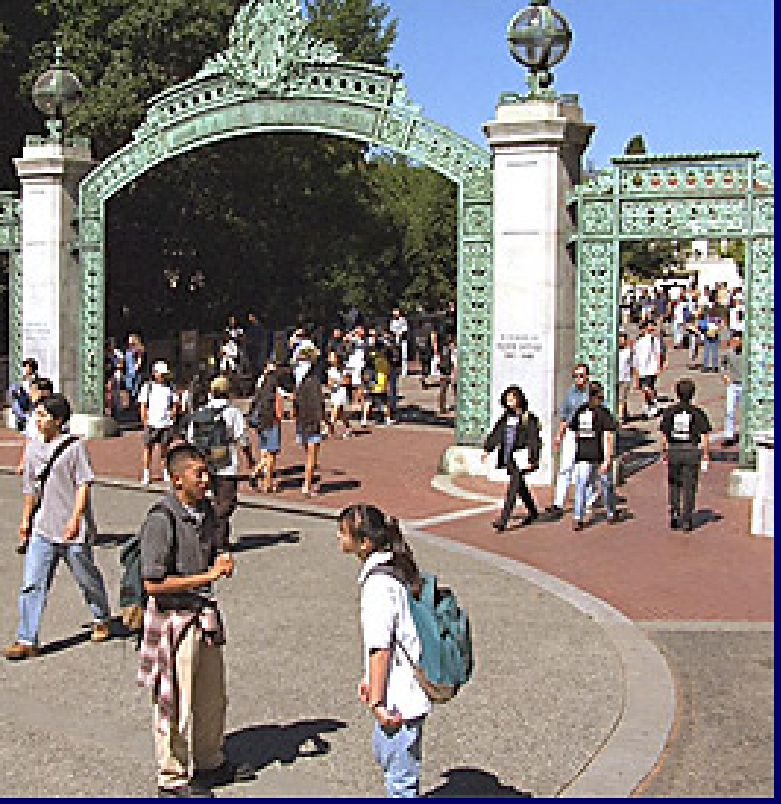
Identity	**Sales volume**
Uses	**Hazards**

This information is routinely unavailable to agencies.

Example 3. Safety Gap

Government carries the burden of proving risk, yet producers are under no obligation to provide the information necessary for government to do so = a logical paralysis.





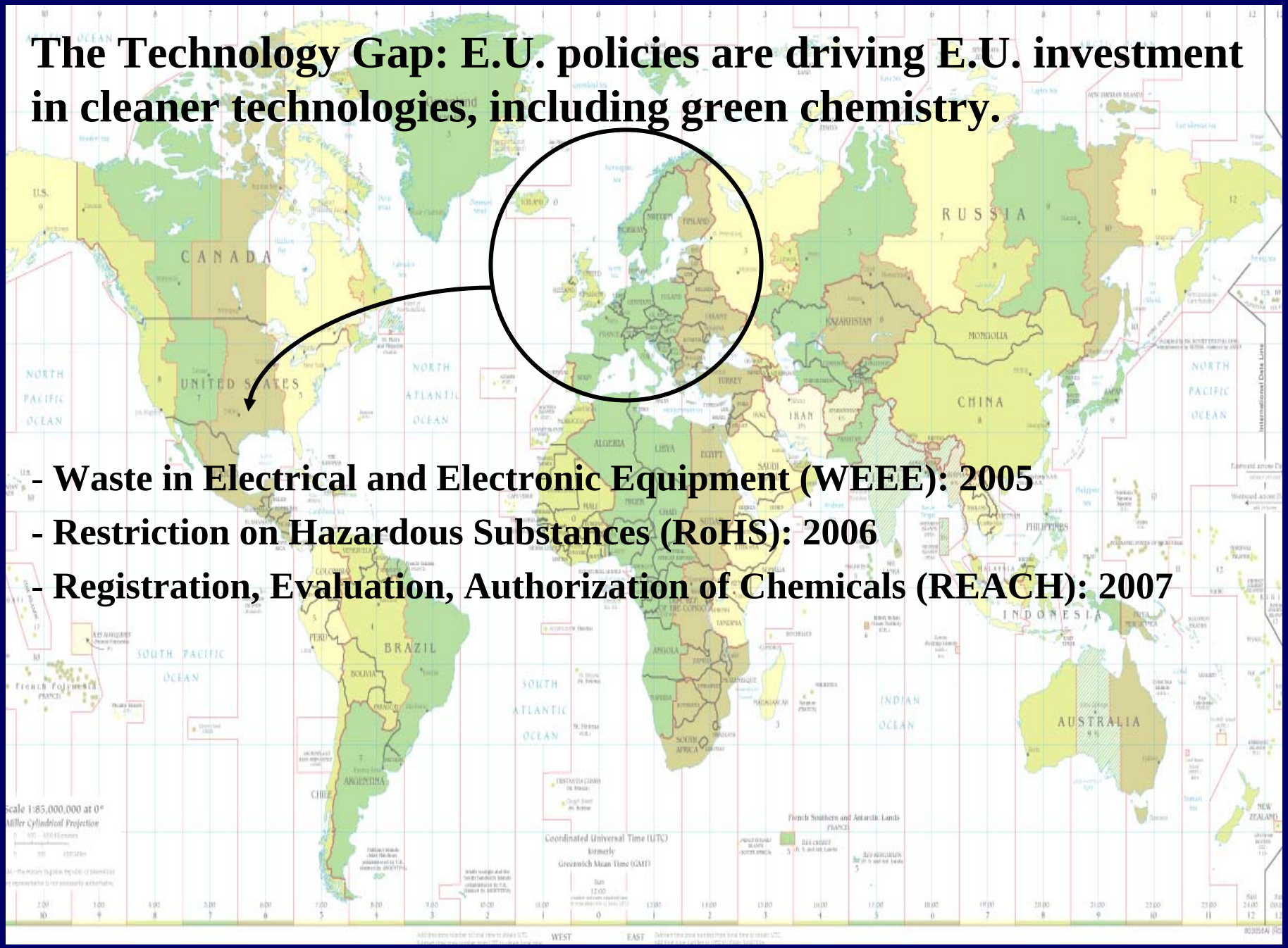
University teaching and research in chemistry reflect conditions in the chemicals market.

Example 4. Technology Gap.

With very few exceptions, one can earn a Ph.D in chemistry in the U.S. without demonstrating a basic understanding of toxicology…

…or the principles of green chemistry.

The Technology Gap: E.U. policies are driving E.U. investment in cleaner technologies, including green chemistry.



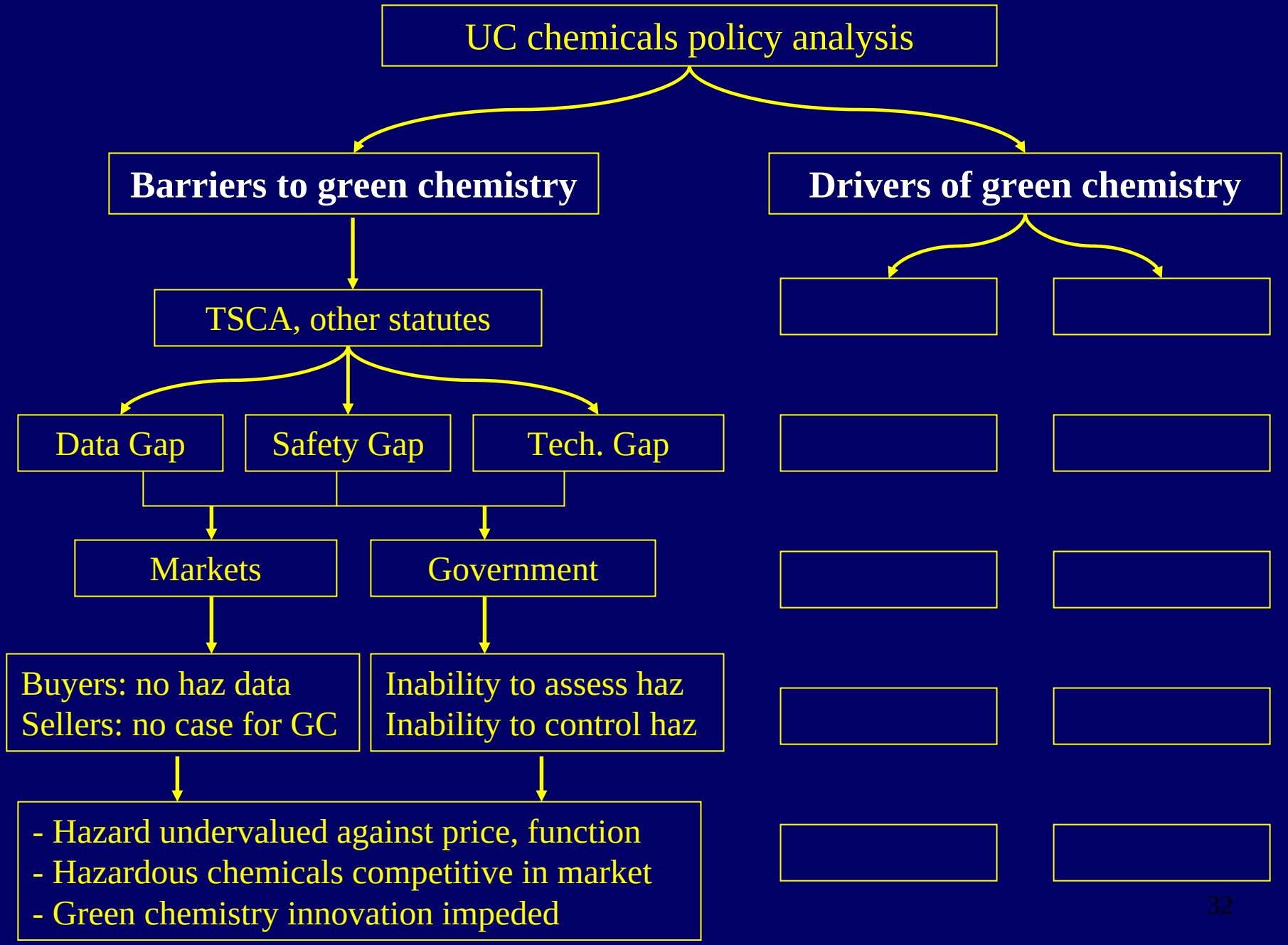
- Waste in Electrical and Electronic Equipment (WEEE): 2005
- Restriction on Hazardous Substances (RoHS): 2006
- Registration, Evaluation, Authorization of Chemicals (REACH): 2007

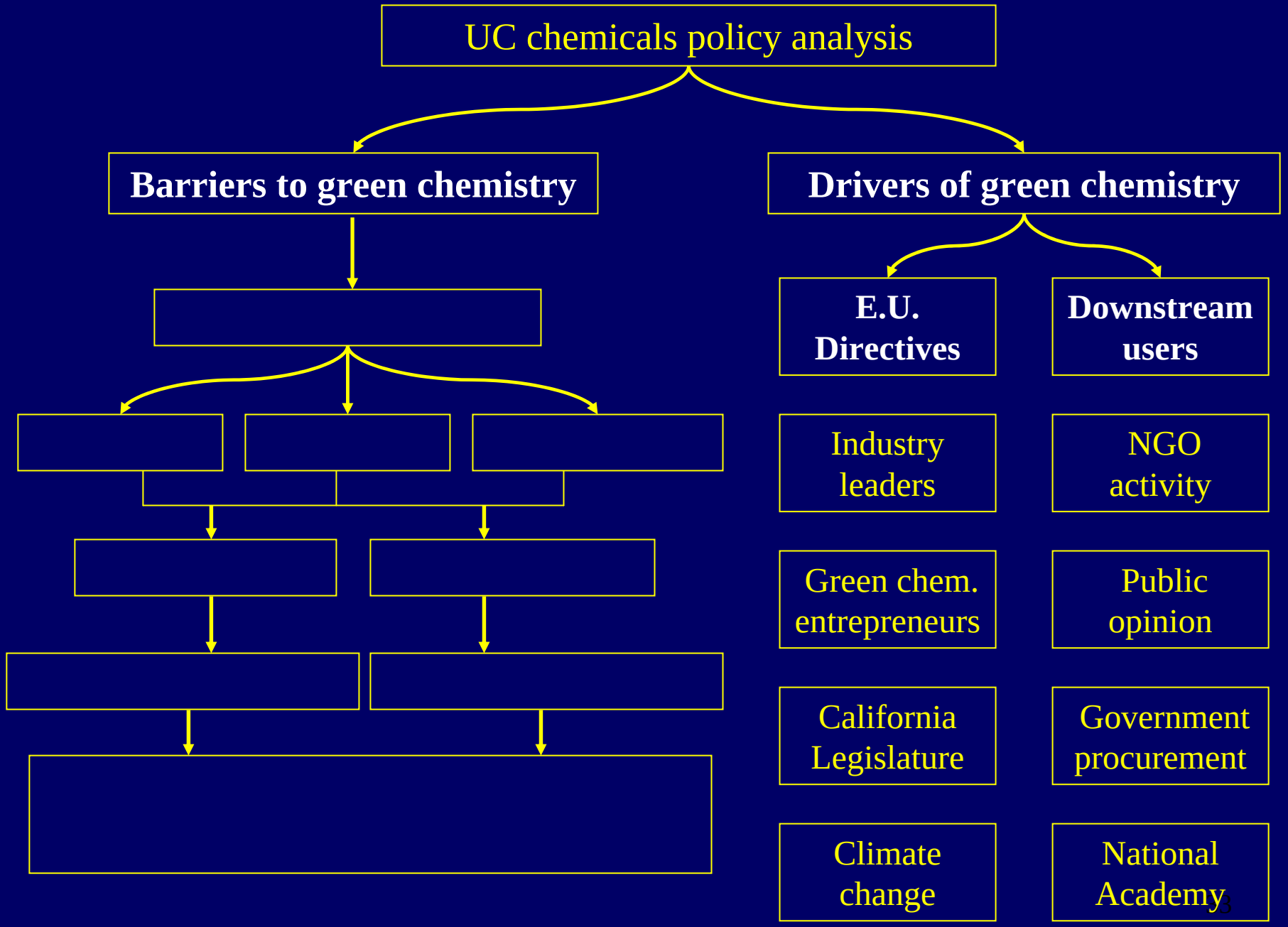
“G.E. Chief Points to ‘Green’ Handicap”

Financial Times
May 10, 2005
Stephanie Kirchgaessner in Washington

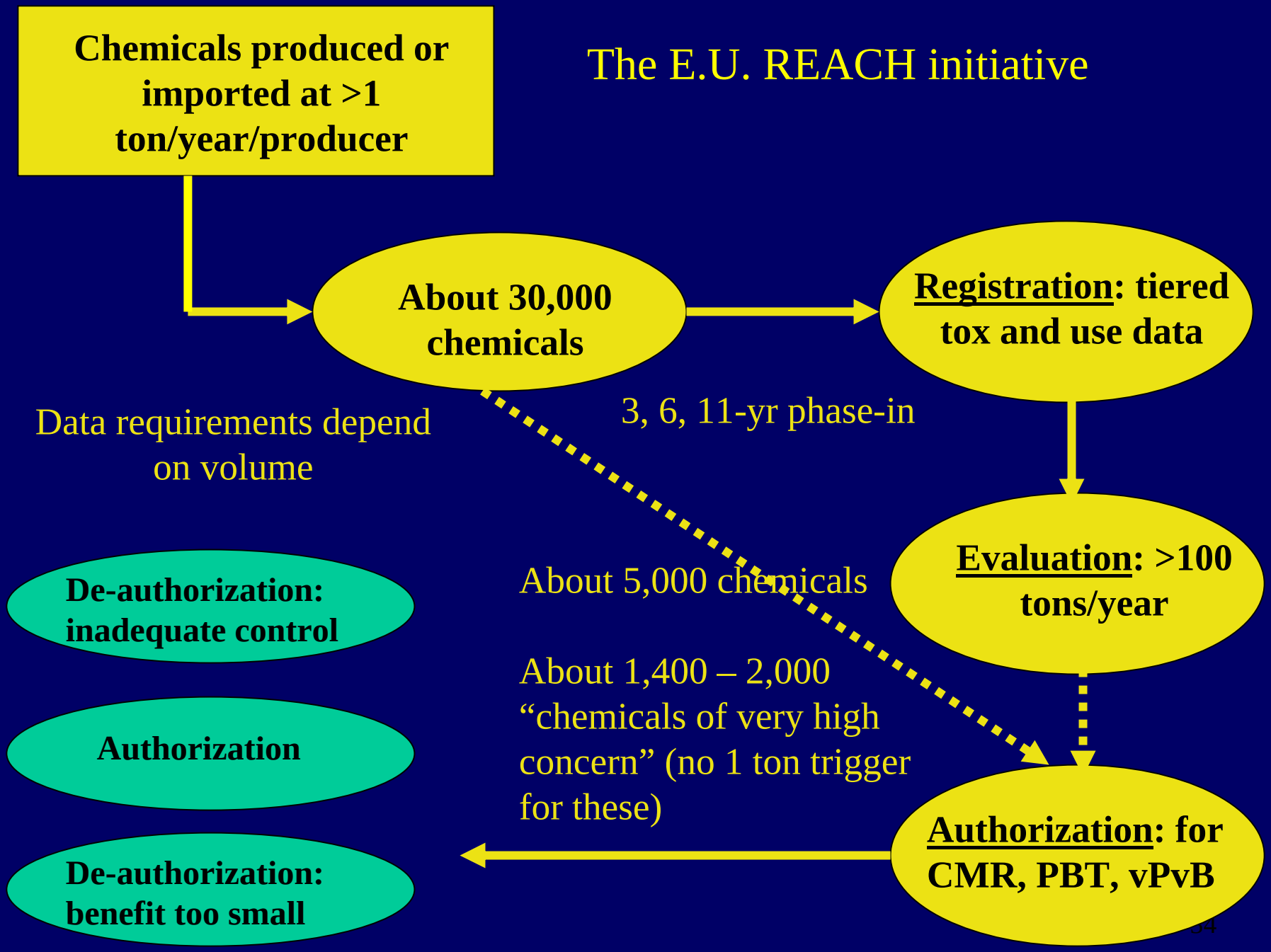
“…the deregulatory agenda favored by the U.S. business community – particularly on environmental issues – is not providing American companies with a competitive advantage over their European counterparts.”

Jeffrey Immelt, Chairman and CEO (Ecomagination)


UC chemicals policy analysis
Barriers to green chemistry
Drivers of green chemistry
TSCA, other statutes
Data Gap
Safety Gap
Tech. Gap
Markets
Government
Buyers: no haz data
Sellers: no case for GC
Inability to assess haz
Inability to control haz
- Hazard undervalued against price, function
- Hazardous chemicals competitive in market
- Green chemistry innovation impeded


UC chemicals policy analysis
Barriers to green chemistry
Drivers of green chemistry
E.U. Directives
Downstream users
Industry leaders
NGO activity
Green chem. entrepreneurs
Public opinion
California Legislature
Government procurement
Climate change
National Academy

The E.U. REACH initiative



Some downstream users…

are demanding that suppliers fill toxicity data gaps.

Kaiser, Consorta, S.C. Johnson, Catholic Health Care, Alta Bates, Shaw, Herman-Miller etc.

30 hospitals, 432 medical office buildings, growing.

1) Why focus on hazard?

2) What are the barriers to green chemistry?

3) How can California address these barriers?

UC chemicals policy analysis

Barriers to green chemistry

Drivers of green chemistry

Recommendations

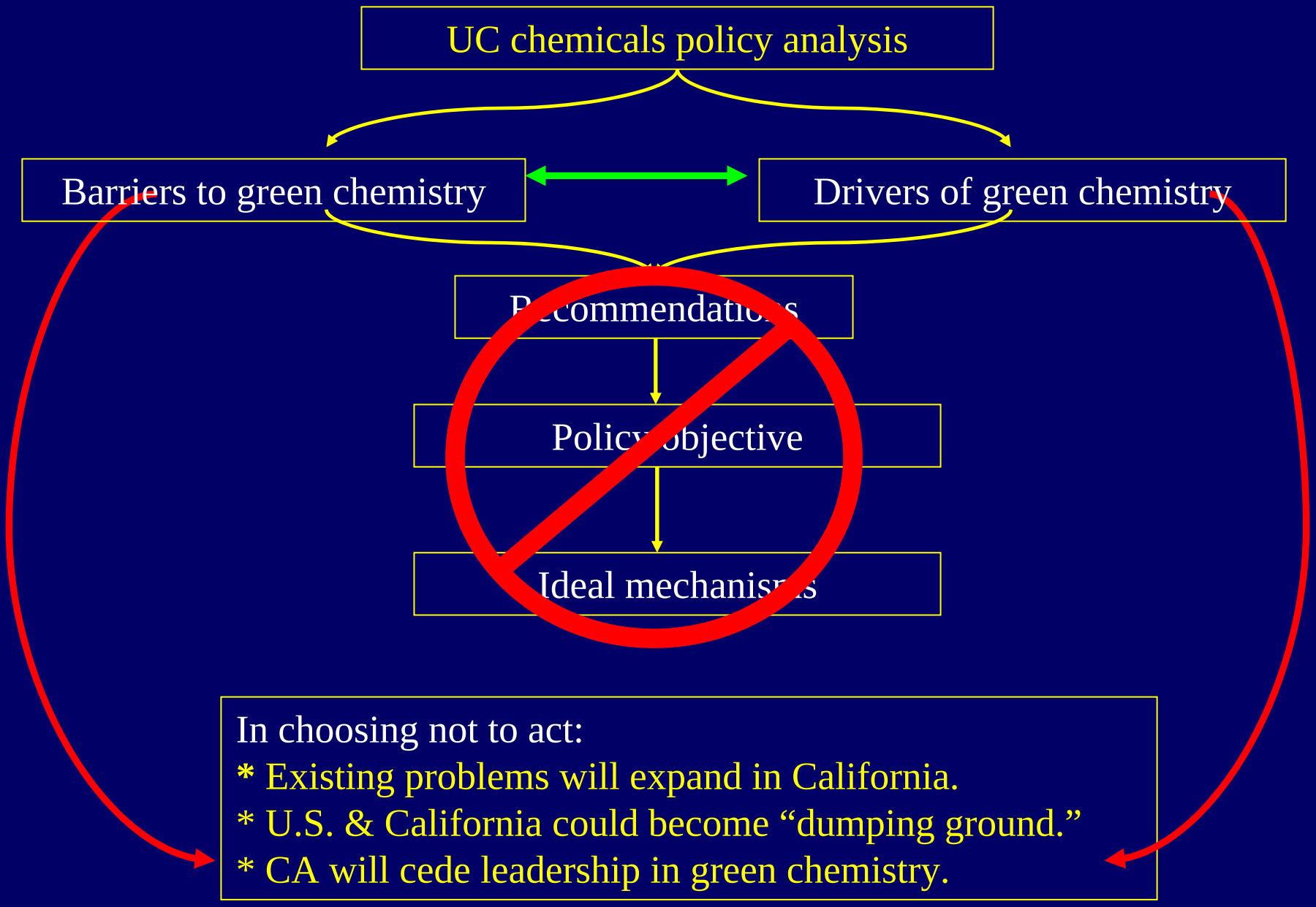
Policy objectives**:**

Close the Data, Safety & Technology Gaps:

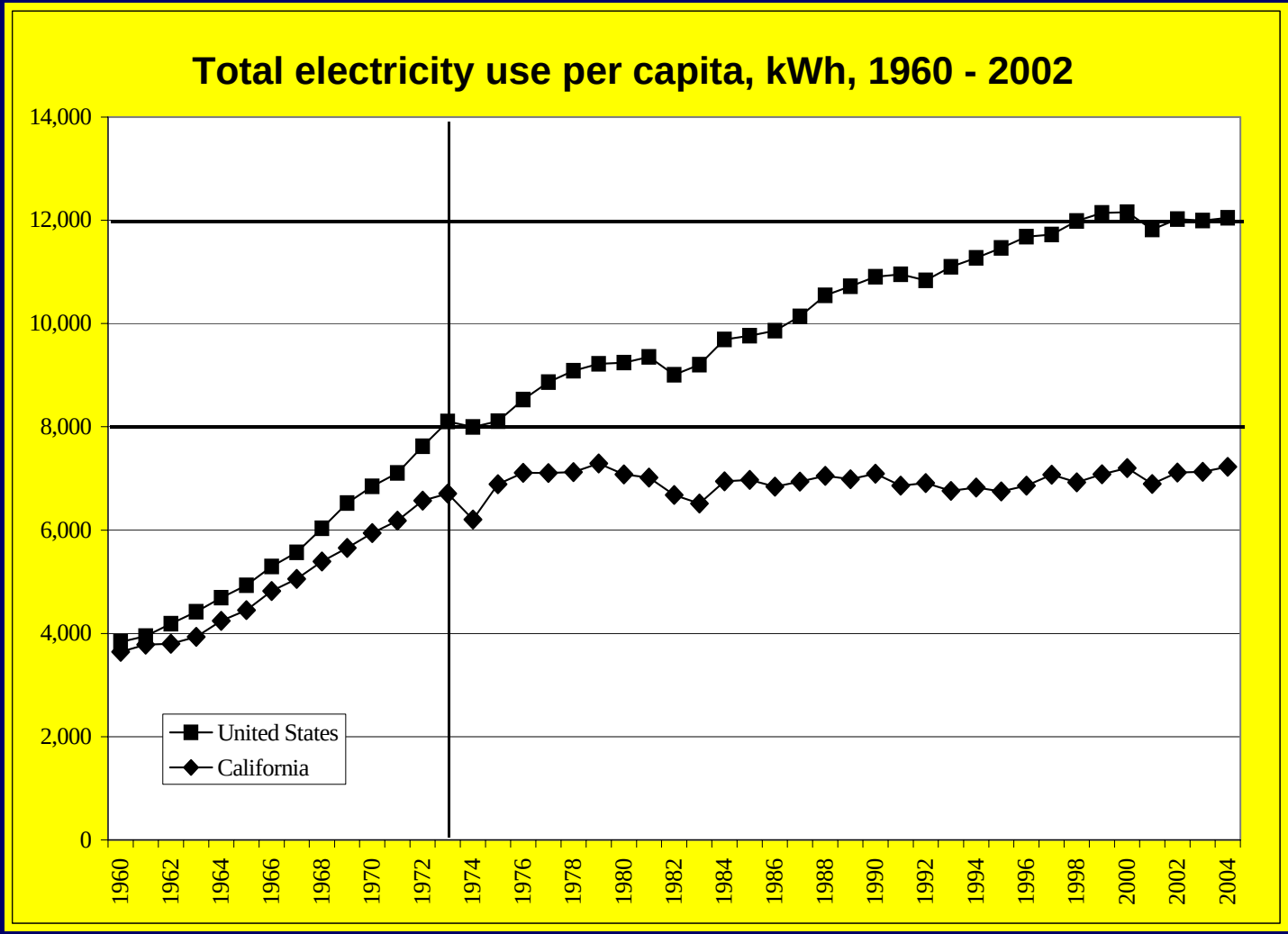
* Improve the flow of information in the chemicals market.
* Improve government capacity to act.
* Implement other incentives for green chemistry.

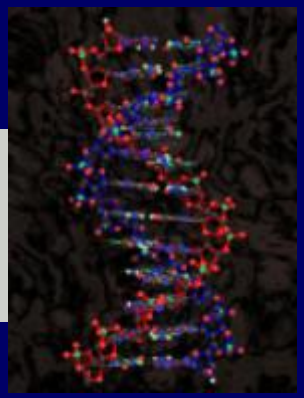
Issues, models, mechanisms:

* Leverage market forces.
* Address chemical life cycle.
* Place least demands on government.
* Motivate technology innovation and diffusion, etc.


UC chemicals policy analysis
Barriers to green chemistry
Drivers of green chemistry
Recommendations
Policy objective
Ideal mechanisms
In choosing not to act:
* Existing problems will expand in California.
* U.S. & California could become “dumping ground.”
* CA will cede leadership in green chemistry.

A properly functioning chemicals market will motivate investment in green chemistry, which will solve public environmental health problems and stimulate new growth.



Courtesy John Wilson, CA Energy Commission

Thank you!