Hazardous Waste, Vulnerable Populations and Human Health.

Why We Need a Superfund Research Program

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Humans Have Been Accumulating Waste for Millennia

In great piles

The Pyramids at Giza

…and in small

Kitchen Midden, Aleutian Islands

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But What's New is What is in our Waste Today

No longer just sand and seashells…
Now the products and by-products of the chemical revolution

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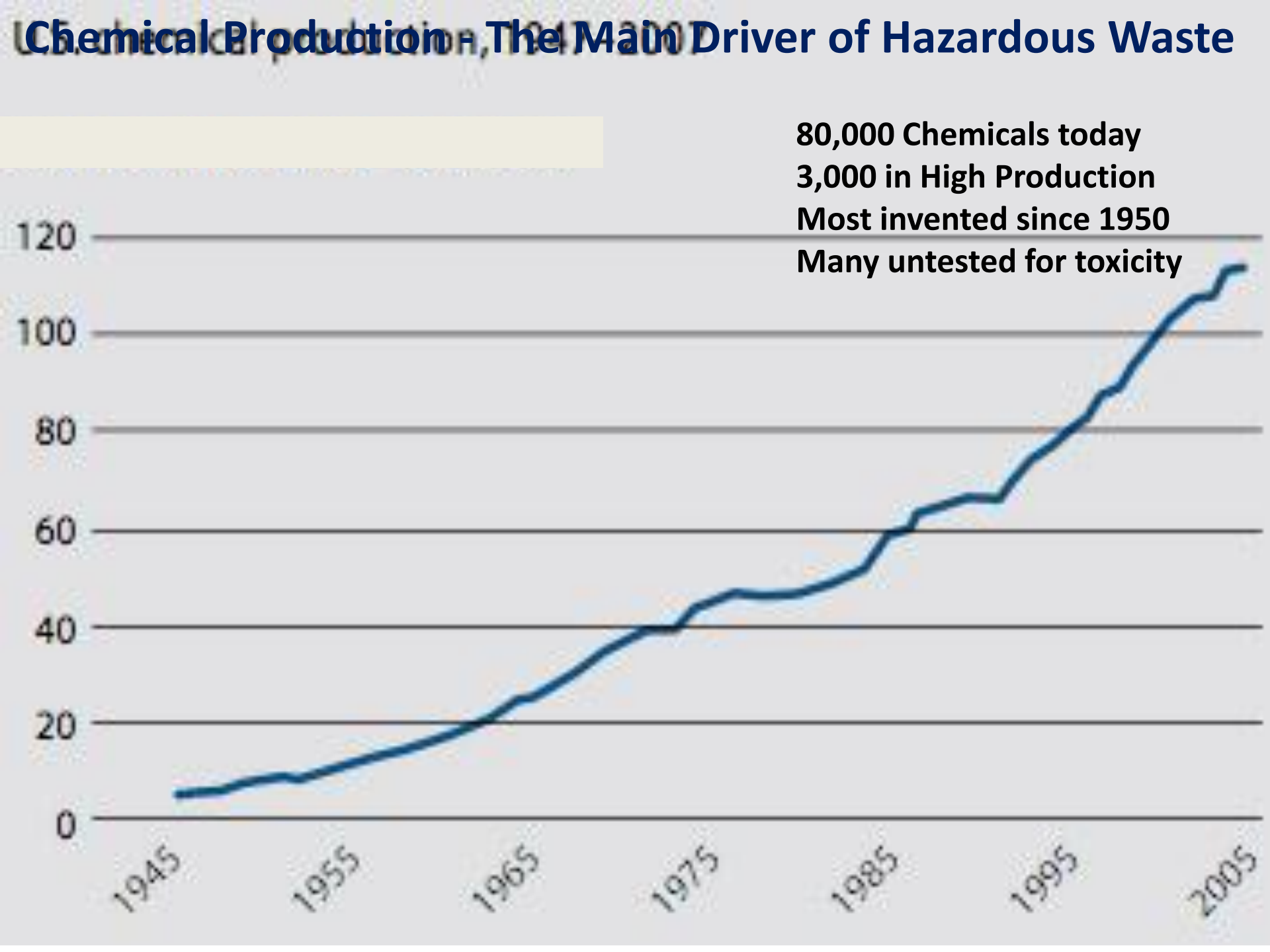
Chemical Production – The Main Driver of Hazardous Waste



Current Magnitude of the US Hazardous Waste Problem

- More than 15,000 hazardous waste sites
- 1,157 on National Priorities List (NPL)
- 346 have been cleaned up and delisted
- 49 new sites are proposed
- Many more on state Superfund lists

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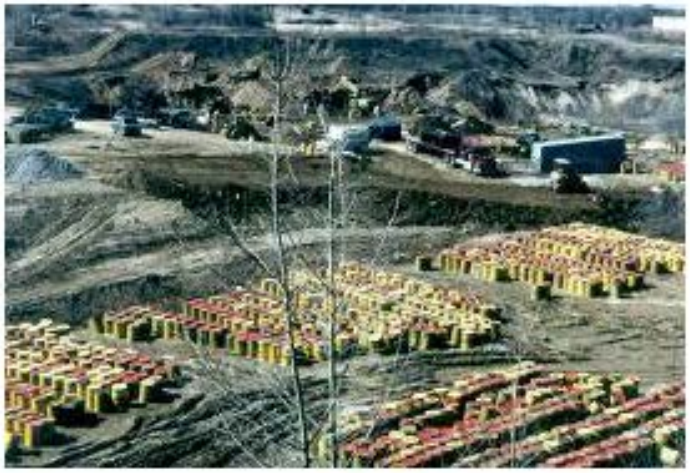
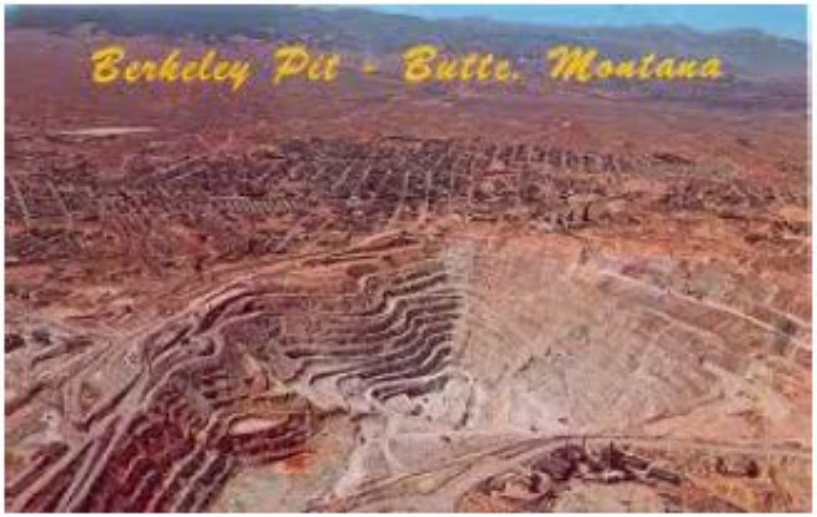
Images of US Superfund Sites





Types of Superfund Sites

- Landfills and former industrial properties –70% - *"Some are abandoned, some are illegal, and a few are both illegal and abandoned"*
- Waste recycling facilities
- Mines and smelters
- Military facilities – 1,855
- Nuclear facilities - 500

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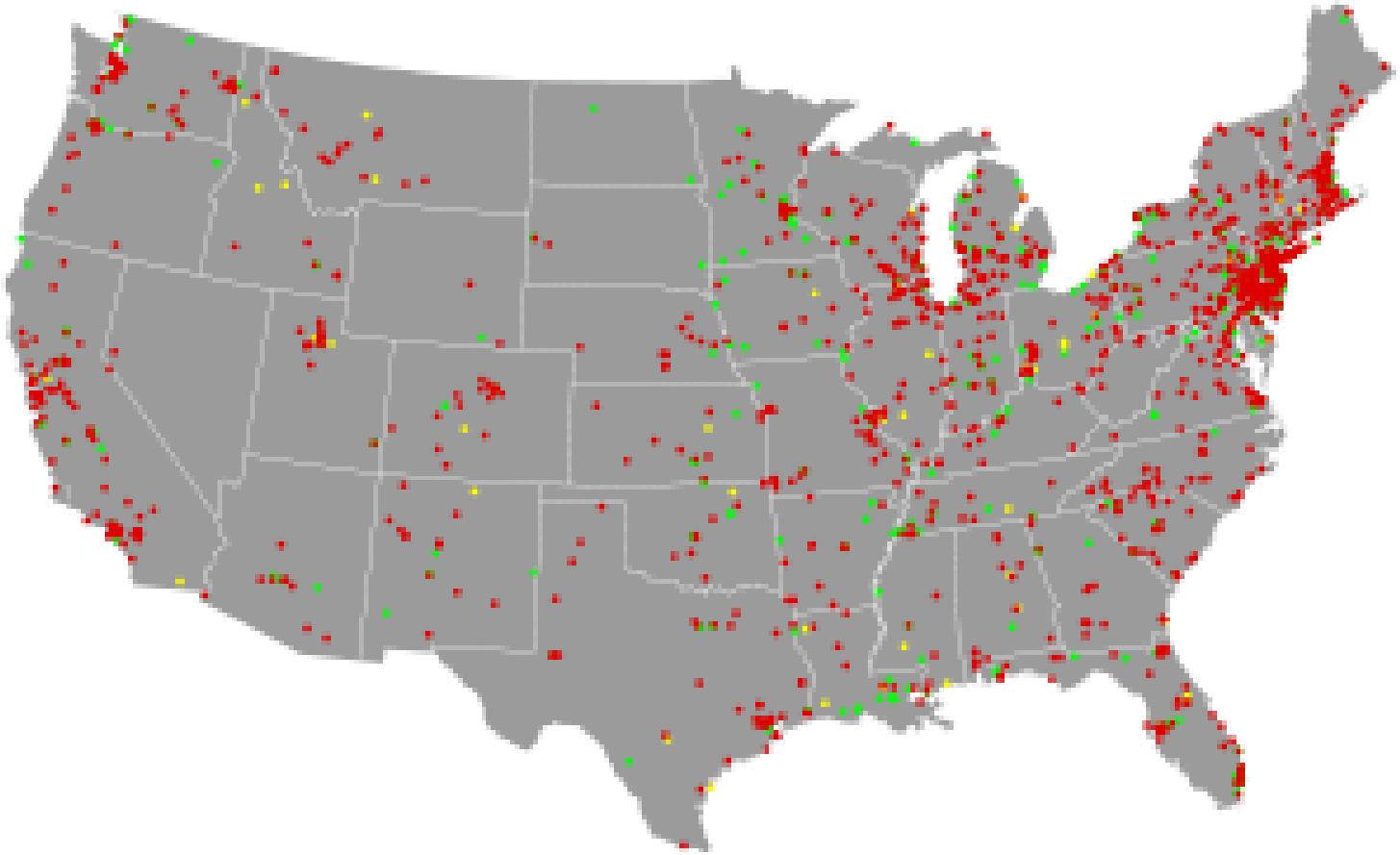
Federal Superfund Sites - 2010



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Environmental Contamination at Superfund Sites

- Contamination of soil
- Contamination of ground water
- Contamination of surface waters – lakes and rivers
- Airborne toxic releases
- Fire, which can produce toxic combustion products
- Explosion

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Populations at Risk of Exposure to Hazardous Waste Sites

- 11 million people in the U.S. live within 1 mile of a federal Superfund site
- Thousands of hazardous waste workers

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Hazardous Waste Workers

Populations at Risk of Exposure to Hazardous Waste Sites

- 11 million people in the U.S. live within 1 mile of a federal Superfund site
- Thousands of hazardous waste workers
- Disproportionate exposure of minority populations – *environmental injustice*

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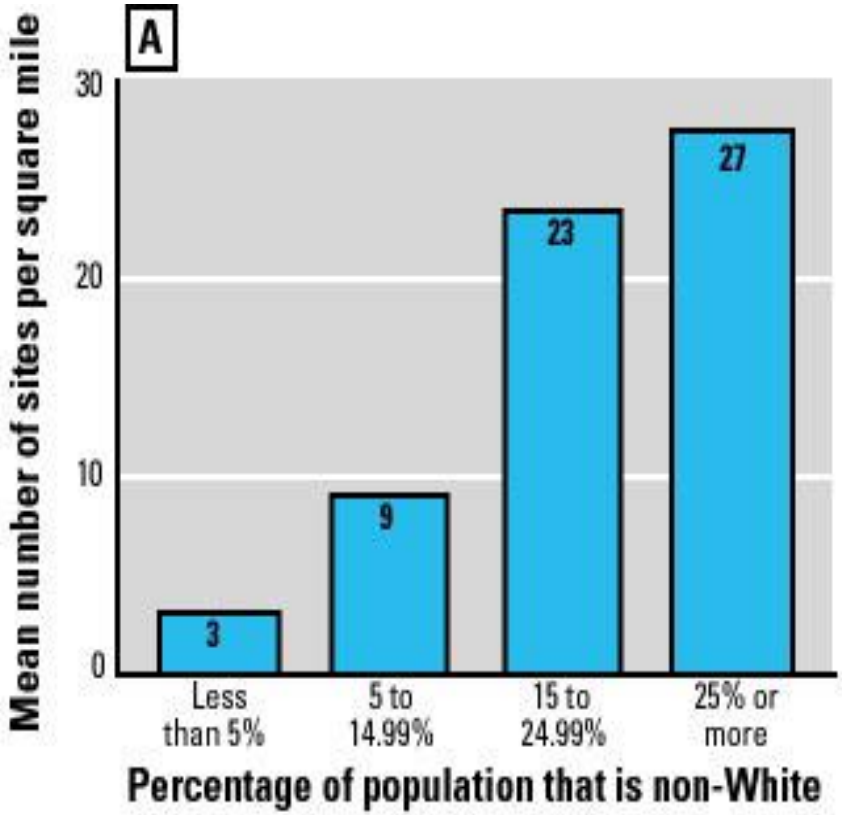
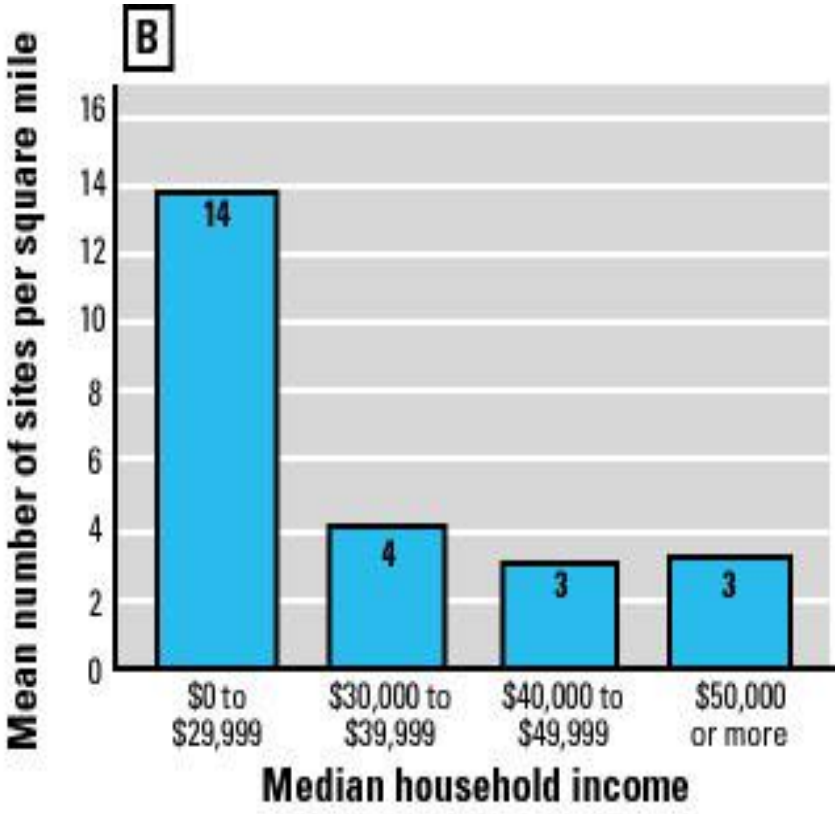
Toxic Waste Sites, Income and Race Massachusetts, 2002





Faber DR and Eric J. Krieg EJ. Unequal Exposure to Ecological Hazards: Environmental Injustices in the Commonwealth of Massachusetts. *Environ Health Perspectives* 2002.

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Environmental Injustice in Los Angeles

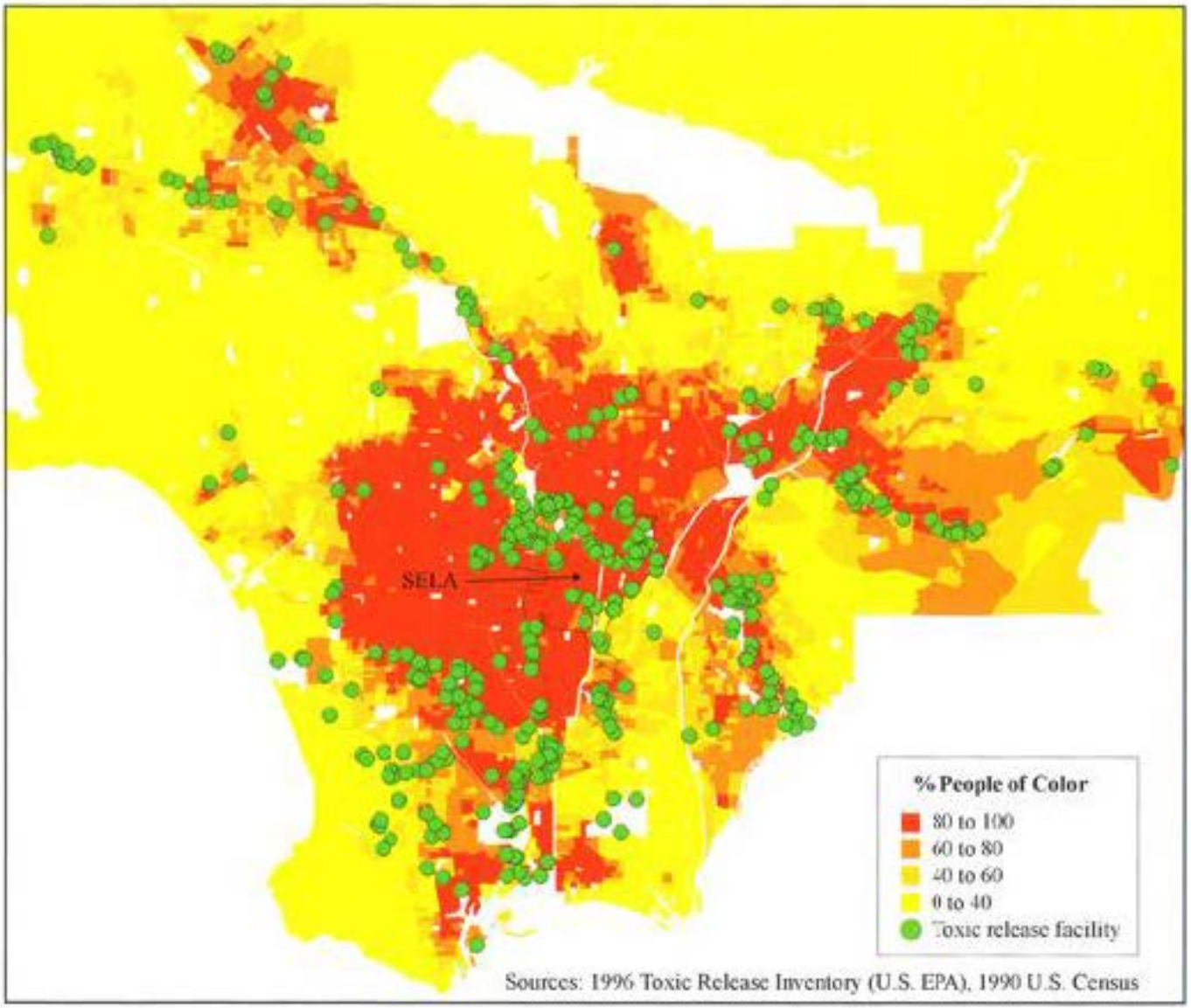

Figure 1.1: People of Color and Toxic Release Facilities in Los Angeles County

Populations at Risk of Exposure to Hazardous Waste Sites

- 11 million people in the U.S. live within 1 mile of a federal Superfund site
- Thousands of hazardous waste workers
- Disproportionate exposure of minority populations – *environmental injustice*
- 3 to 4 million American children live within 1 mile of a federal Superfund site

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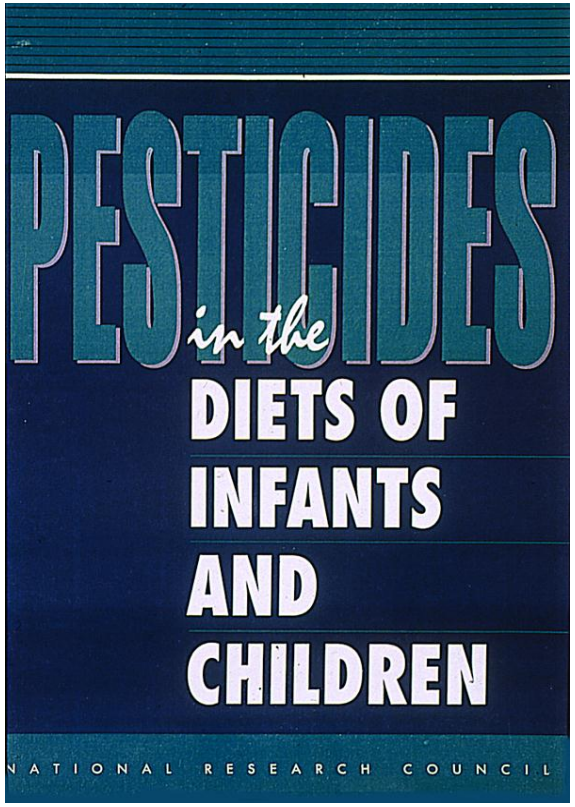
Infants and Children are Uniquely Sensitive to Toxic Chemicals



- Greater exposure pound-for-pound
- Diminished ability to detoxify and excrete many chemical toxins
- Heightened biological vulnerability, e.g., thalidomide, DES
- More years of future life

"Children are not Little Adults"

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First Public Recognition of Hazardous Waste Love Canal, 1976-79

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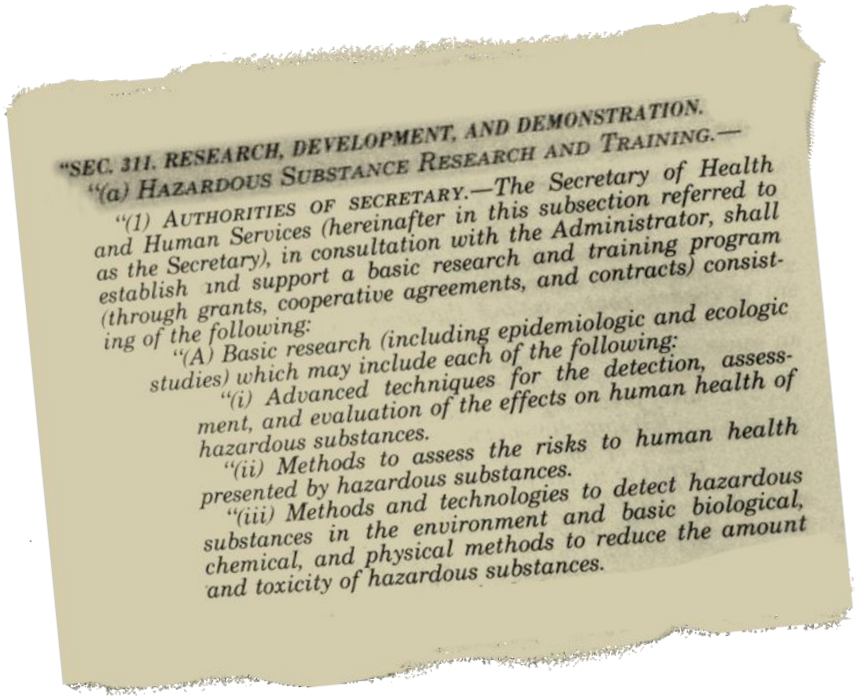
Valley of the Drums
Near Louisville, KY, 1979

Superfund Legislation

- Triggered by Love Canal and Valley of the Drums
- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980
- Superfund Amendments and Reauthorization Act (SARA) of 1986



"SEC. 311. RESEARCH, DEVELOPMENT, AND DEMONSTRATION.

"(a) HAZARDOUS SUBSTANCE RESEARCH AND TRAINING.—

"(1) AUTHORITIES OF SECRETARY.—The Secretary of Health and Human Services (hereinafter in this subsection referred to as the Secretary), in consultation with the Administrator, shall establish and support a basic research and training program (through grants, cooperative agreements, and contracts) consisting of the following:

"(A) Basic research (including epidemiologic and ecologic studies) which may include each of the following:

"(i) Advanced techniques for the detection, assessment, and evaluation of the effects on human health of hazardous substances.

"(ii) Methods to assess the risks to human health presented by hazardous substances.

"(iii) Methods and technologies to detect hazardous substances in the environment and basic biological, chemical, and physical methods to reduce the amount and toxicity of hazardous substances.

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Division of Labor under Superfund - Three Federal Agencies

- Listing, clean-up and remediation of hazardous waste sites – EPA
- Health assessments of populations living near hazardous waste sites with special emphasis on children – ATSDR
- Highly interdisciplinary research and training – NIEHS/SRP

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The Mission of the SRP Program

A university-based research program that:

- Advances society's understanding of human health risks of hazardous substances - Biomedical
- Develops innovative technologies for the prevention of such exposures – Engineering, Earth Science and Ecology
- Trains the next generation of scientists; *and*
- Translates results into applied research that can inform the risk assessment and guide remediation

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The Ultimate Goal of SRP is the Protection of Human Health

Triumphs of SRP

- Arsenic
- PCBs
- Benzene
- Innovative remediation technologies – poplars, fungi, grasses and bacteria

None of these triumphs could have been achieved without a university-based interdisciplinary research program that brings together biomedical research with engineering, earth science and ecology

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Superfund in the Future

An increasing focus on global health

The export of toxic chemicals and hazardous processes from the industrially developed to the developing nations of the world has the potential to profoundly change patterns of morbidity and mortality around the world.

Especially in poor countries

And most especially in children in poor countries

Global Magnitude of the Hazardous Waste Problem

- Toxic pollution affects the health of more than 100 million people, shortening their productive life spans by 12.7 years on average *

- 20% of deaths in the developing world are attributable to environmental pollution+

*Blacksmith Institute
+ WHO & World Bank

Examples of the Global Spread of Toxic Chemicals

- Bhopal – Methyl Isocyanate
- Lead in Gasoline
- Asbestos
- Export of “banned” pesticides
- Export of hazardous wastes – E-waste

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Photo - Courtesy : Pablo Bartholomew

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The International Spread of Lead in Gasoline

- Lead was first added to gasoline in 1922
- By the 1970s, almost all gasoline produced worldwide contained lead
- In the USA alone, peak annual consumption was almost 100,000 tons (mid-1970s)
- A disaster for public health
- Removal of lead from gasoline has reduced lead levels, raised mean IQ and yielded great economic benefits - $200 billion estimated benefit in each annual birth cohort born since 1980 in the US alone

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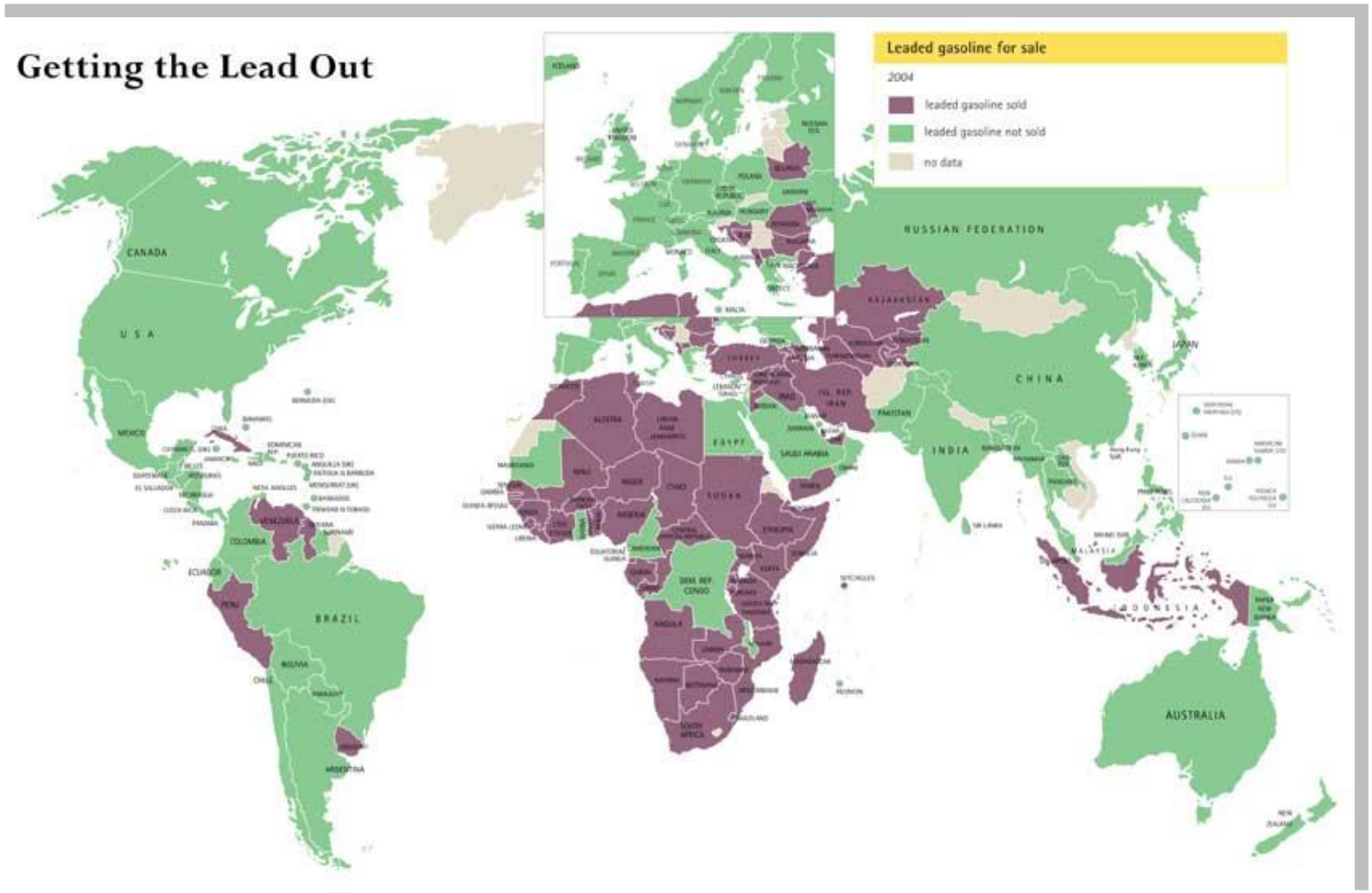
Getting the Lead Out



Lead: IQ Alert

The International Export of Asbestos

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ASBESTOS

Asbestos Causes Multiple Diseases

- Lung Cancer
- Malignant Mesothelioma
- Asbestosis
- Other Malignancies
  - Larynx
  - Ovary
  - GI (probably)

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Asbestos Disease Burden

- Currently 125 million people are exposed asbestos in workplaces around the world
- 100,000 workers die each year from asbestos-related diseases
- Forecast a total of 5 million to 10 million deaths from asbestos-related cancers by 2030
- By 2020, deaths from asbestos-related cancers could exceed 1 million in developing nations

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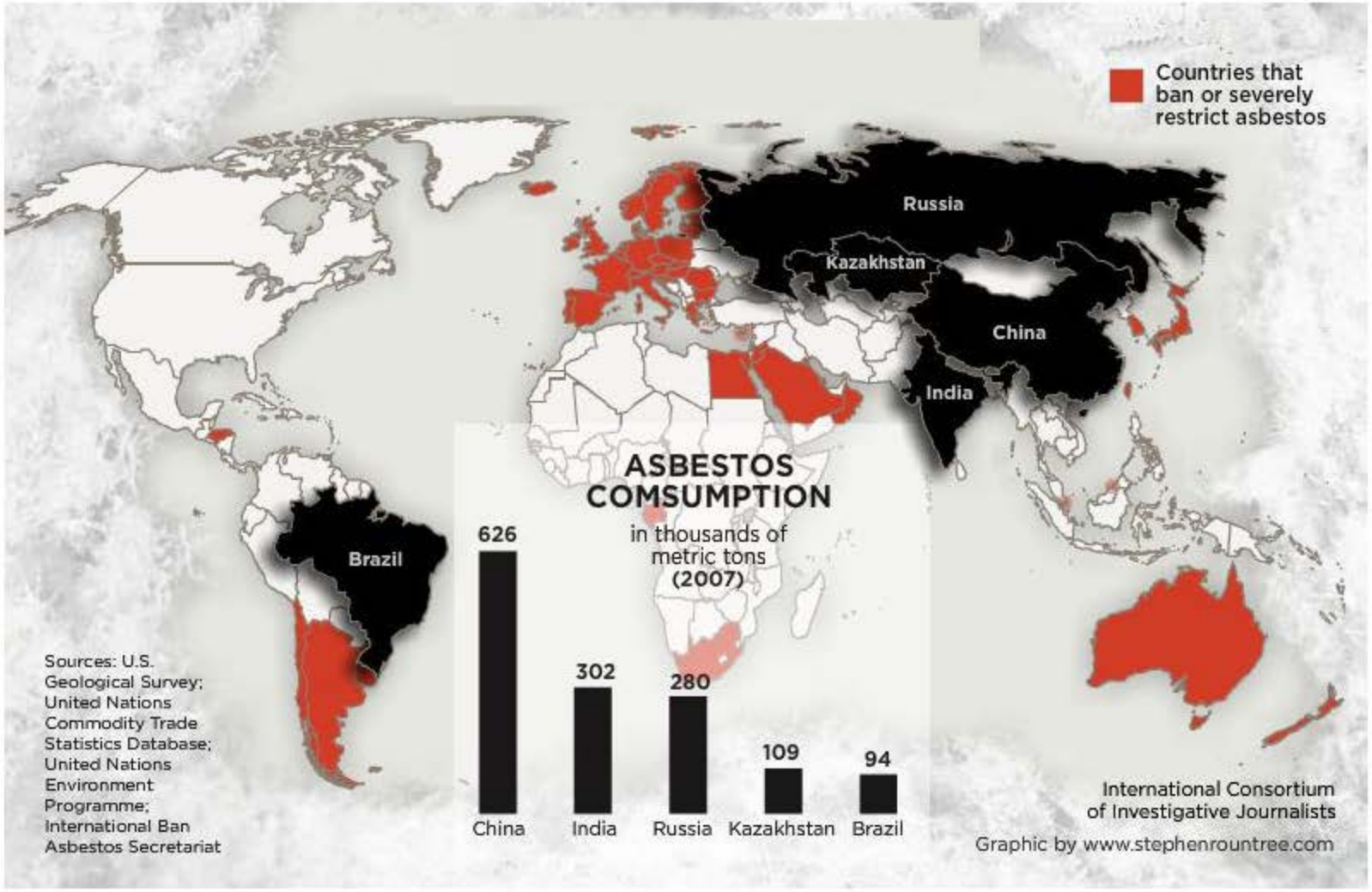
Trends in World Production of Asbestos

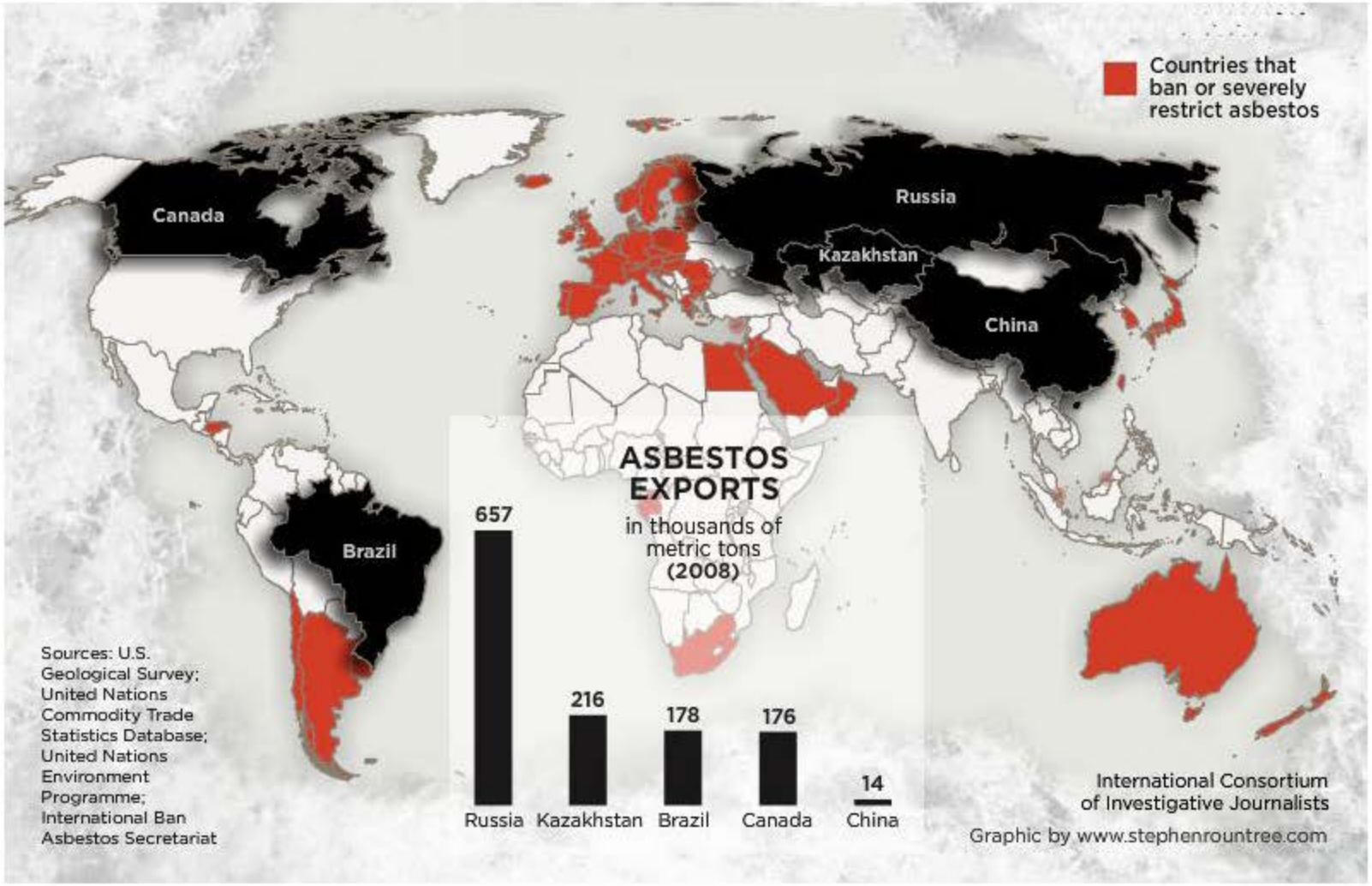
Year	Production (tons)
1963	2,922,000
1973	4,614,000
1978	5,159,000
1983	4,276,000
1988	4,323,000
1993	2,650,000
1994	2,410,000
1995	2,308,300 (a)
1996	2,140,000 (a)

(a) Chrysotile only.

Top 5 Asbestos Consumers



Top 5 Asbestos Exporters



Export of Toxic Pesticides

- 2001-2003, the US exported ~ 1.7 billion lbs of pesticide products
- Included were 27 million pounds of pesticides banned in the US
  - 500,000 pounds known or suspected carcinogens
- Endocrine disrupting pesticides were sent overseas at the rate of 100 tons a day

The Circle of Poison

- Every month, pesticides and herbicides banned in the US and Europe are sprayed on plants, trees and flowers in developing countries, putting health workers' children at risk.

- Every minute, someone in a developing country becomes a victim of pesticide poisoning.

- These same chemicals come back to the US and Europe on tomatoes, bananas and cut flowers, this closing the circle.

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E-Waste

- E-waste is that it is the fastest-growing component of the municipal waste stream worldwide
- In 20 years, developing nations will be discarding 400-700 million personal computers annually
- Developed nations will be throwing out 200-300 million a year

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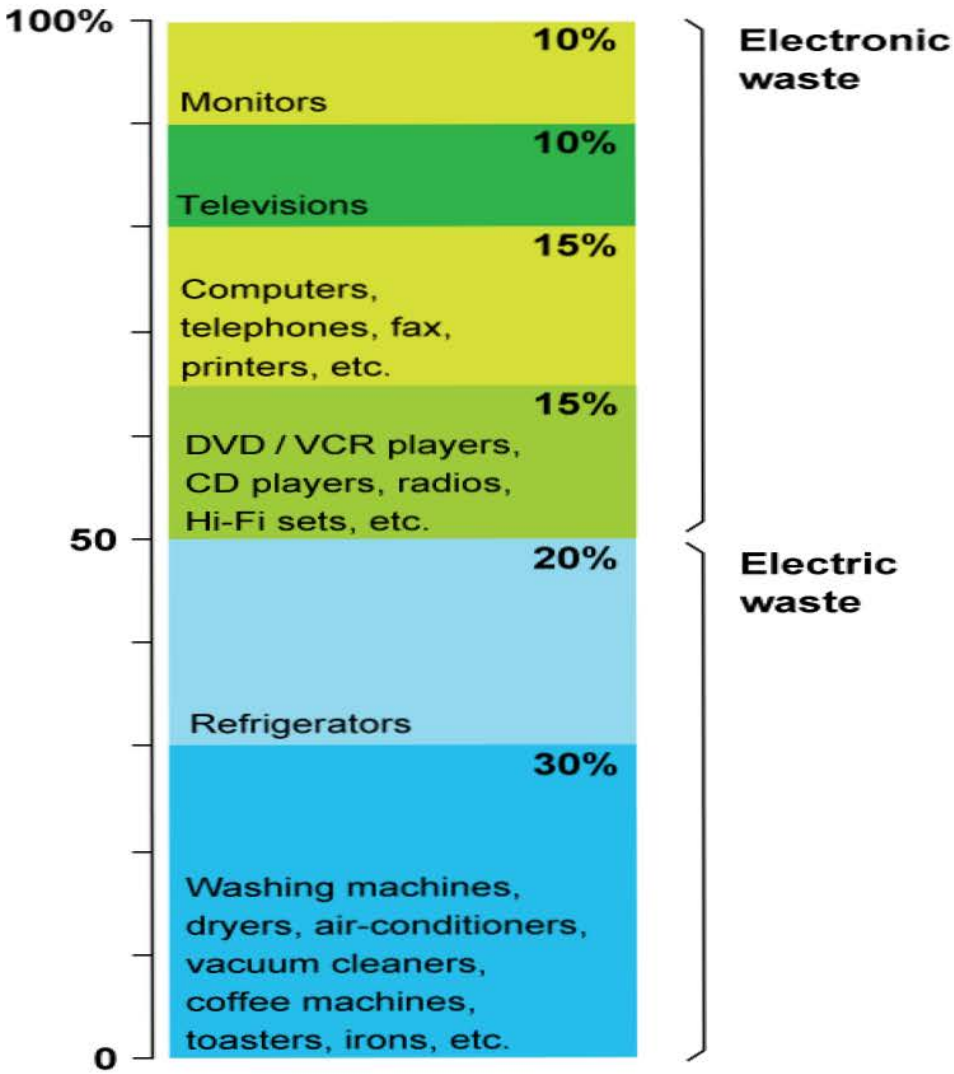
What is E-Waste?



Additional categories: lighting equipment (fluorescent tubes); toys, sports and recreational equipment; electric and electronic tools (drills, sewing machines, lawn mowers, etc); surveillance and control equipment; medical instruments; automatic ticket machines.

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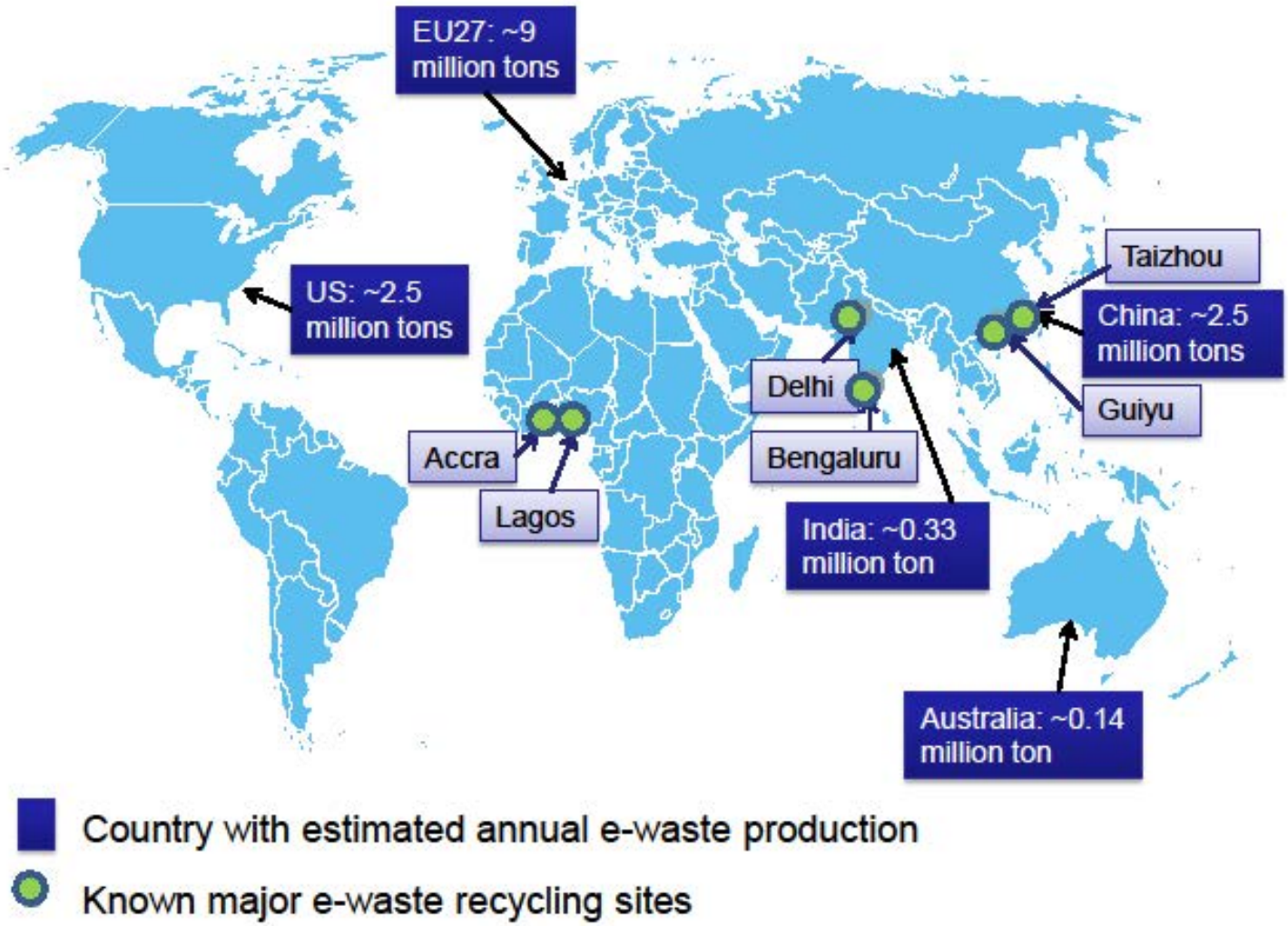

Aimin Chen, Kim N. Dietrich, Xia Huo, Shuk-mei Ho, Environmental Health Perspectives: Developmental Neurotoxicants in E-Waste: An Emerging Health Concern

Informal E-Waste Recycling

Wires pulled from electronics

Burned in open piles

=

dioxins

Others Pollutants

furans

=

ResaleableCopper

Circuit Boards

Treated with acids and cyanide

=

Pollute local water systems

=

Copper + Precious Metals

Burden of Disease Due to Hazardous Waste

- We developed a Disability Adjusted Life Year (DALY)-based estimate of the disease burden attributable to hazardous waste sites. We focused on three low and middle income countries (LMICs) - India, Indonesia, and the Philippines.
- We found that 8,629,750 persons are at risk of exposure to industrial pollutants at 373 hazardous waste sites in these three countries.
- In 2010 these exposures resulted in 960,456 DALYs, approximately 0.26% of the total DALYs in these countries.
- The disease burden from hazardous waste sites ranks just below that attributable to hypertensive heart disease and above the disease burden from malaria, hepatitis B, and hepatitis C.

Chatham-Stephens K et al.

In Closing

Four Heroes of the Superfund Program

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Dr David Rall

"It is our job as scientists to attempt, as best we can, to look into the future, see the changes ahead, and anticipate the side effects of these changes. But we know from past experiences that there are few important and useful discoveries that do not have some unanticipated, undesirable side effects. It is our responsibility to alert leaders in public policy and suggest to them how we might prevent or minimize any negative health consequences."

Dr. Barry Johnson

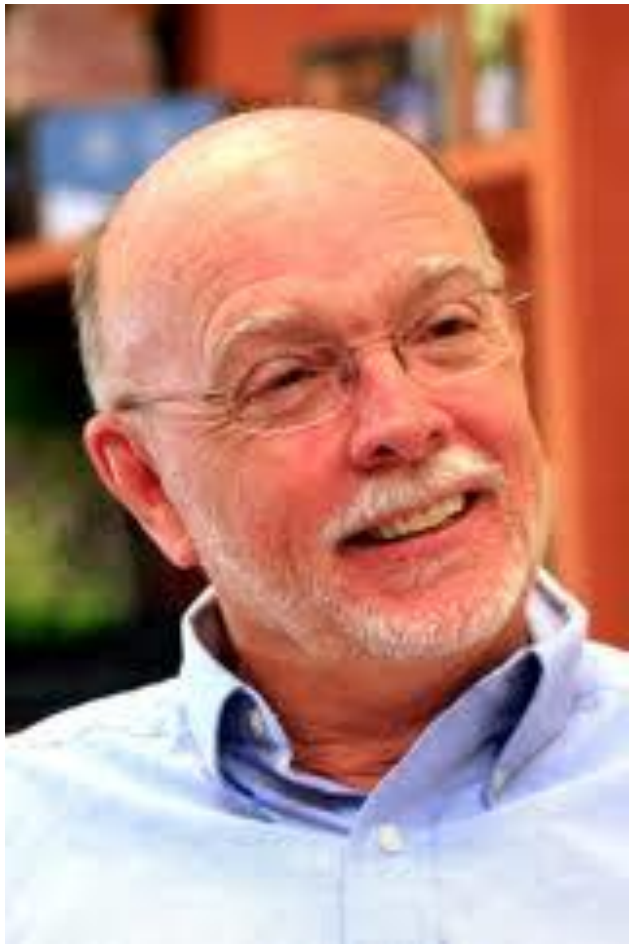
Director, ATSDR

Creator of the Pediatric Environmental Health Specialty units (PEHSUs)

Chip Hughes

Director, NIEHS Worker Education and Training Program

Bill Suk



Director, NIEHS Superfund Research Program

THANK YOU