



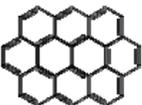
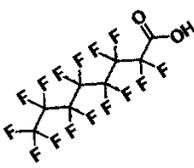
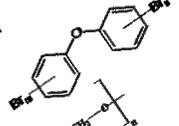

Adapted from: EPA Webinar Aug. 19, 2008  
Gulo R. Doherty, Duke Uni.

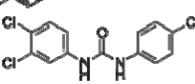
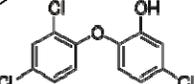
# MICROCONSTITUENTS ON THE REGULATION HORIZON

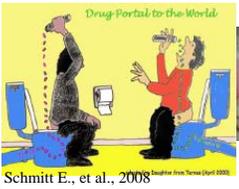
19<sup>th</sup> Annual  
Maryland Groundwater Symposium  
Simin Rezai, Ph.D.

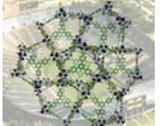
## PRESENTATION OUTLINE

- INTRODUCTION TO MICROCONSTITUENTS;
- SOME EXAMPLES;
- SOURCES;
- REGULATIONS; AND
- CONCLUSION







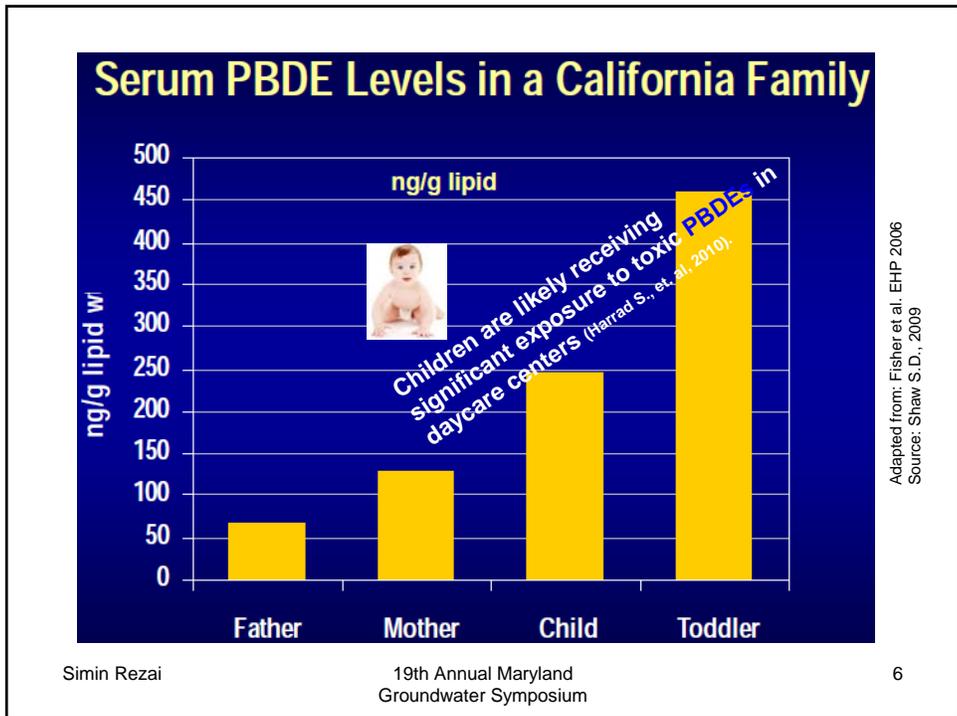
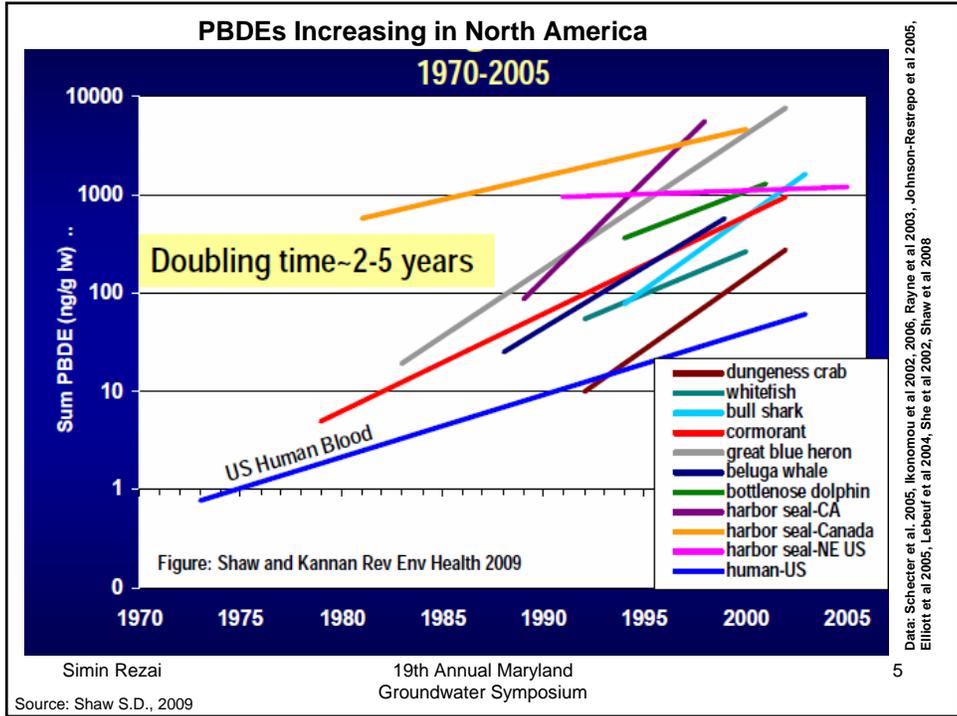

Schmitt E., et al., 2008

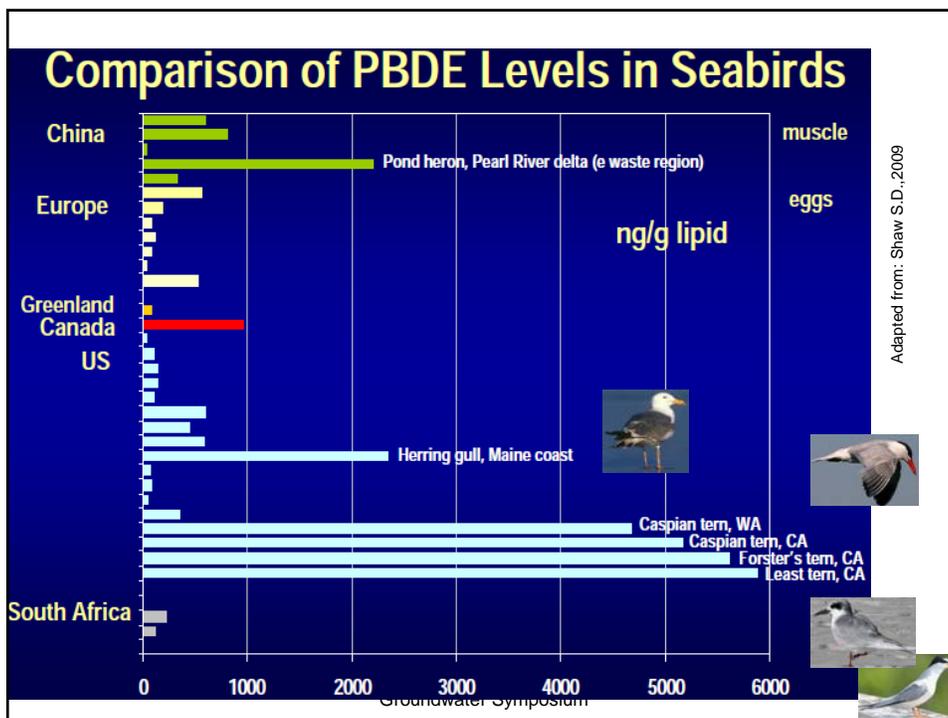
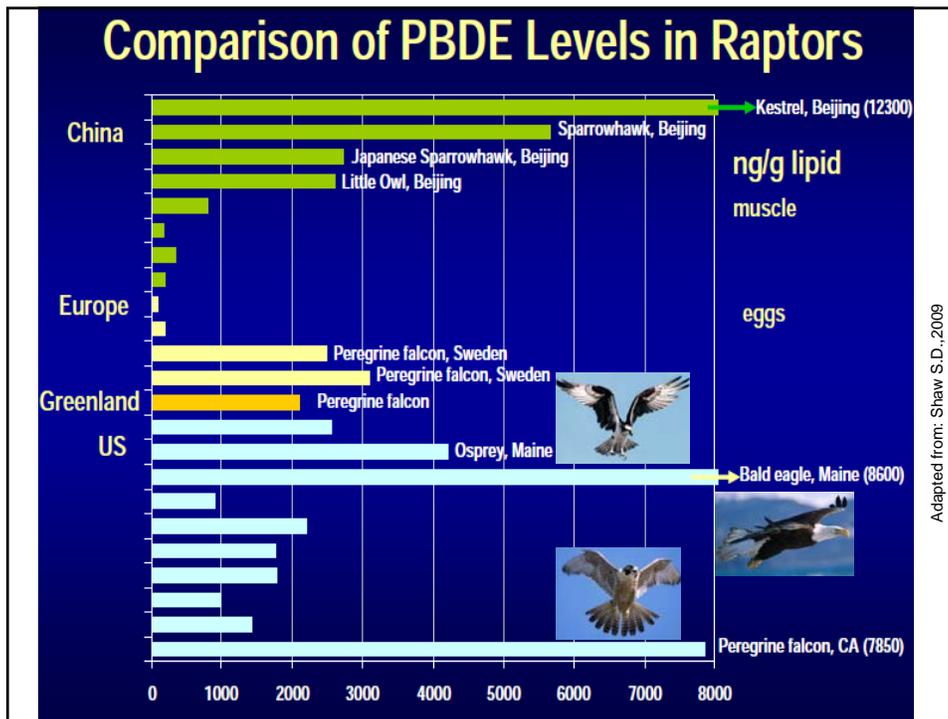
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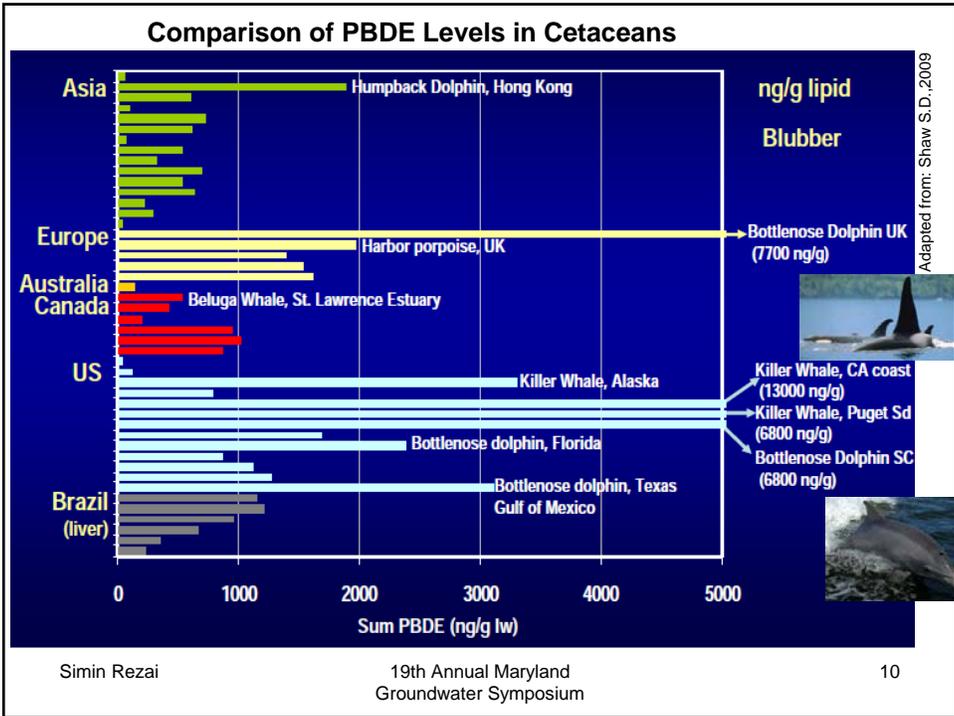
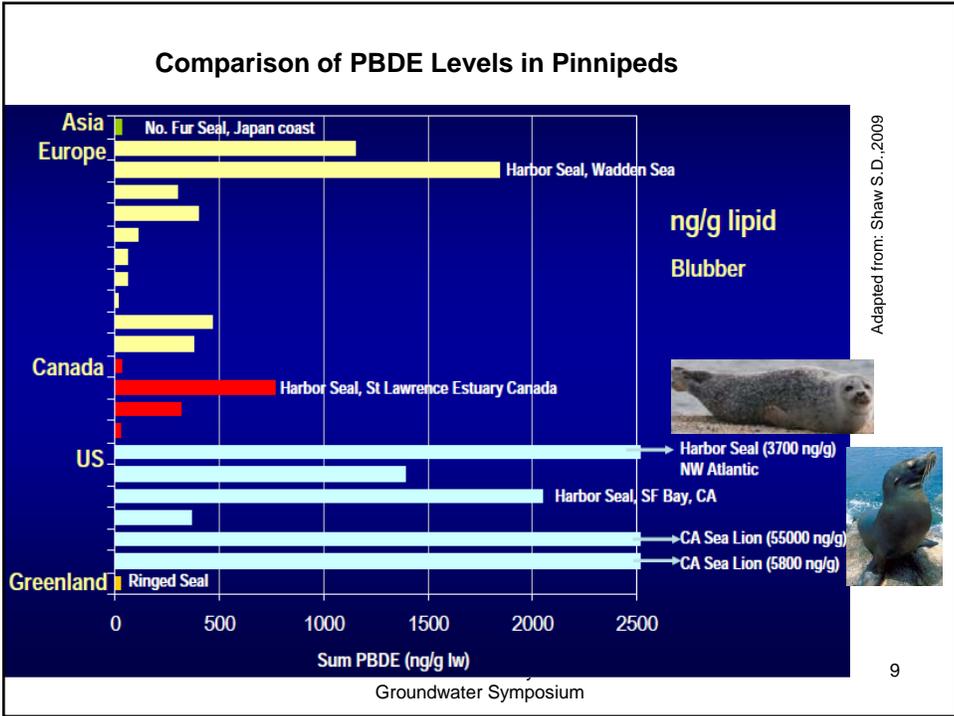
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2









### Perfluorinated Chemicals

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11

\*C1=CC=C(C=C1)C(=O)OCCO\*

**PET**

Cc1ccc(O)c(C)c1

**BPA**

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12

**PAH**



From Wikipedia

**Sources**



Guillermo R. Di., 2010

**And oil spill**



P.C. Baumann et al., 2002

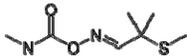
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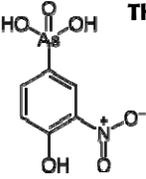
13

**PESTICIDES**

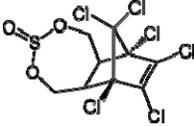
**The effect of arsenic in drinking water on IQ**

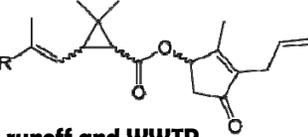



Wikipedia: Arsenic




*Lactobacillus acidophilus*





**The insecticide, found in runoff and WWTP effluent in the Sacramento area, ended up in two urban creeks.**

**Even 10 to 20 ppt of pyrethroid can kill *Hyaella azteca*.**  
(WE&T, May 2010)

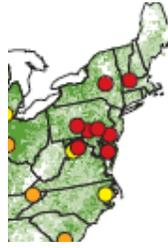


Pictures from Wikipedia

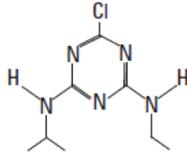
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14



### ATRAZINE

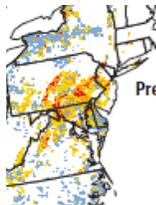


**Atrazine detection frequency**

- low (<10 percent)
- medium (10 – 25 percent)
- high (> 25 percent)

**Atrazine use**

- low
- medium
- high



**Predicted frequency of detections, as a percentage of shallow wells**

- < 25
- 25 – 50
- > 50 – 75
- > 75
- No prediction — areas have less than 50 percent agricultural land use

**Atrazine has been shown to affect reproduction of fish**  
EPA Release May 2010

**EPA has proposed a new permit requirement.**  
June 2010

**September 2010: EPA presents and seeks peer review of its evaluation of atrazine**

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15

### DREAMS OF SELF-SUFFICIENCY

**The unconventional, tricky and expensive has become conventional.**  
(The Economist, March 13, 2010)

**One nation over gas**  
US shale-gas resources



**The technology of spill clean up has not kept pace with the drilling technology**

**Penalizing carbon emissions would benefit natural gas at the expense of dirtier fuels.**

**EPA issued voluntary information requests to nine natural gas service companies regarding Fracking (9/9/10)**

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16

### Pipe dreams in PA

Kobell R., Bay Journal Dec. 2009



The technique to extract the gas has damaged streams, water supplies and Pennsylvania's famous forests.



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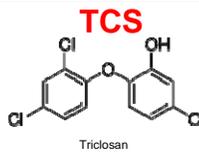
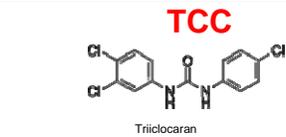
**Chesapeake Bay watershed loses 100 acres of forests a day**  
 (Agriculture is Forest Service and the Conservation Fund)

**God isn't making any more land. He quit that a long time ago.**  
 Rep. Levdonsky



- Arsenic at almost 10 times
- Lead at 21 times
- Chromium at more than double
- Butanone, acetone, carbon disulfide and strontium

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The chemicals have been detected in 75 percent of the U.S. population, and have been found in 60 percent of U.S. waterways



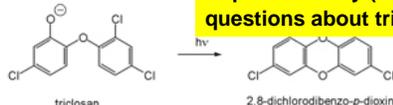
Mississippi River



Lake Pepin



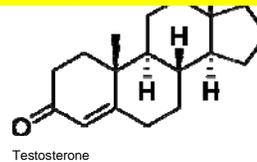
Pictures courtesy of Wikipedia



McNeill Research Group, May 2010  
 University of Minnesota • Department of Chemistry

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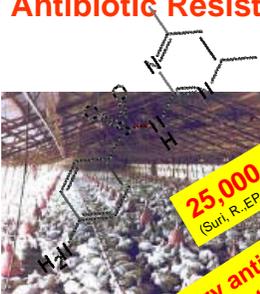
Rep. Ed Markey (D-Mass.) pushes EPA and the FDA for answers to questions about triclosan and triclocarban (1/5/2010).



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18

### Antibiotic Resistance Bacteria



**25,000 tons/yr antibiotics**  
(Suri, R. EPA Webinar, February 9, 2010)

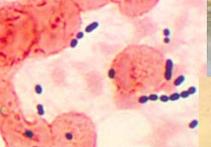


**Antibiotic in all six CAFO nearby wells water** (Batt et al., 2006)

**Veterinary antibiotics account for about half of all antibiotics used in the US** (Qiang et al., 2006)



**Monensin found in trace amount in drinking water**  
WSS Water Brochure



From Wikipedia

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19

### Mercury



From: EPA

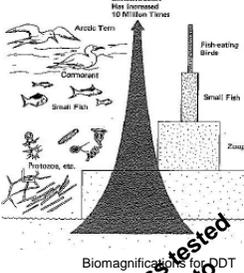
**Dentists are the largest polluter of mercury to wastewater** (Watchdog Group, 6/1/2010)



### PCB

### DIOXINS

### DDT



Biomagnifications for DDT

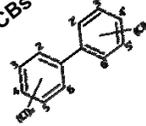
Organism	DDT Concentration (parts per million)
Water	0.00002
Planktonic Algae	0.04
Zooplankton	0.20
Small Fish	2.0
Fish-eating Birds	20.00

**Ten out of 11 largemouth bass tested high enough in methyl mercury to cause damage to children and women of childbearing age** (Julia Scott, July 2010).

**Fish containing potentially harmful levels of toxic chemicals like mercury and PCBs are widespread** (WE&A, March 2010)



From: USGS



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20

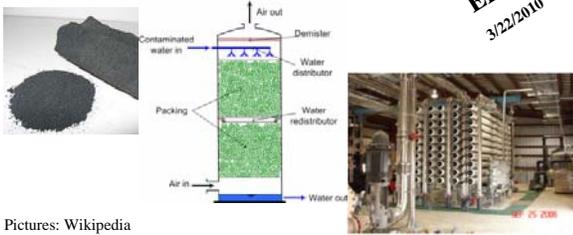
ClC=CCl  
**PCE**  
**Cancer Risk**

ClC(Cl)=CCl  
**TCE**

**Groundwater plume containing TCE**




**EPA called for a tightening of DWSs for PCE**  
3/22/2010



Pictures: Wikipedia

- **Swelling Glass**
- **Nanoparticles made out of gold and palladium** (Wong M., June 2010)
- **Injecting oxidizing chemicals into the groundwater**

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O=C(OCC1=CC=CC=C1)C(=O)OCC1=CC=CC=C1  
**PHTHALATES**

CCCCN+(CCCC)CCCC  
**DBP**







**Possible NDMA Sources**

**The feminizing capacity of some phthalates makes them true 'gender benders'**

Elizabeth Salter-Green, director of CHEM Trust

**NDMA**

CC1=CC=CC=C1N1=CC=CC=C1

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**NANO-ANYTHING**

**NANOPARTICLE**

**Functionalized vs. Pristine**

**A gram of nanoparticle material** → 

**Nanosilver Socks**  
(WERF, Fall 2008)

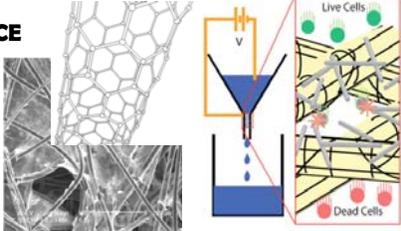
**Removal Contaminant from water, e.g. TCE**  
(Yan W.)

**Palladium and Platinum nanoparticles for ammonia oxidation**  
(Chinthaginjala J.K., June 2010)

**Carbon Nanotube**

**Concerns for WWTP processes**  
e.g. **Nitrifiers** (WERF, Fall 2008)

**SEVERIOUS LACK OF INFORMATION**



Cui Y., 2010

**EPA is working with OECD**

- **Green Nanotechnology**
- **Renewable Energy**



Pictures: Wikipedia

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23

**TREATMENT**

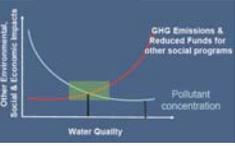
**Three AOPs:**

**PAC & GAC**









Source, Stinson B., 2008

**LECA**

**HiPOx®: California's strict regulations for water reuse destruction of most trace PPCPs and EDCs** (L. LeBrun, et al. WEF09).

**Vetiver for WW treatment**  
(Michigan Technological Uni.)



**Fern *Pteris vittata* for removing toxic metals**  
(Perdue Uni.)

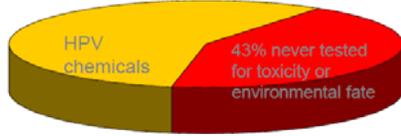


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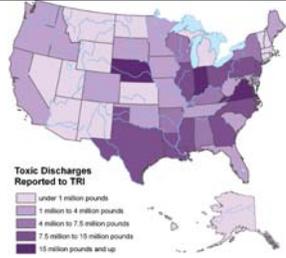
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24

**1976 TSCA, EPA bears the burden of proof**



J. Drewes, WERF Research Forum, 2008



Dutzik, et al., Fall 2009

84,000 chemicals in commercial use (EPA)  
 About 20 percent are secret, 15% are HPV  
 The secrecy is a barrier to environmental control  
 95 percent of new chemicals requested some secrecy  
 About 1000 chemicals introduced annually

**Pollution Controls at the End of the Pipe**  
**Switch to Safer Alternatives**

**Green Chemistry**

**REACH**  
**April 29, 2010, ToxRefDB**  
**EPA Opens Access to Chemical**  
**Information**  
**CCL3**  
**UMCR3**

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**PRODUCT STEWARDSHIP**



The Economist, March 31, 2010



From BBC

**Maine: EPR law, which could in principle cover any product.**



**The EU: manufacturers to dispose of packaging, electronics and vehicles.**

**CRADLE-TO-CRADLE**

**Maryland Drug Stewardship Program (HB 648)**



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26

## CONCLUSION:



Take, Make, Waste



"To waste, to destroy our natural resources, to skin and exhaust the land **instead of using it so as to increase its usefulness, will result in undermining in the days of our children** the very prosperity which we ought by right to hand down to them amplified and developed." --President Theodore Roosevelt, in his seventh annual message, Dec. 3, 1907



### Chesapeake Bay watershed loses 100 acres of forests a day

(Agriculture's Forest Service and the Conservation Fund)

10% impervious watershed cover ~ sensitive aquatic insects decline as much as one third (Cuffney T, June 2010)



Lessen from EU:  
- 20/20/20 GOAL  
- REACH



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27

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28