No Small Thing

Getting Nanodevelopment Right the First Time

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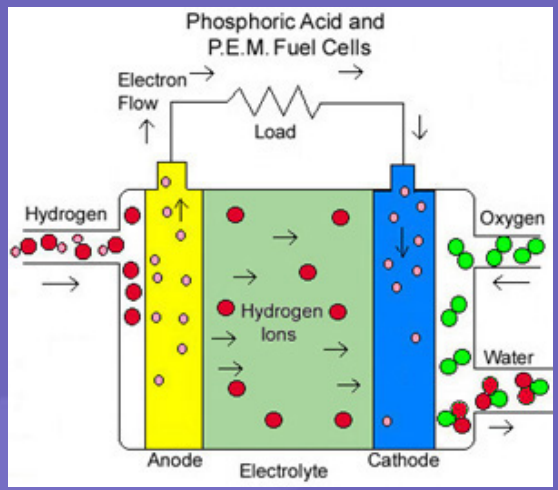
ENVIRONMENTAL DEFENSE

finding the ways that work

Our Hopes for Nanotech: Environmental Benefits

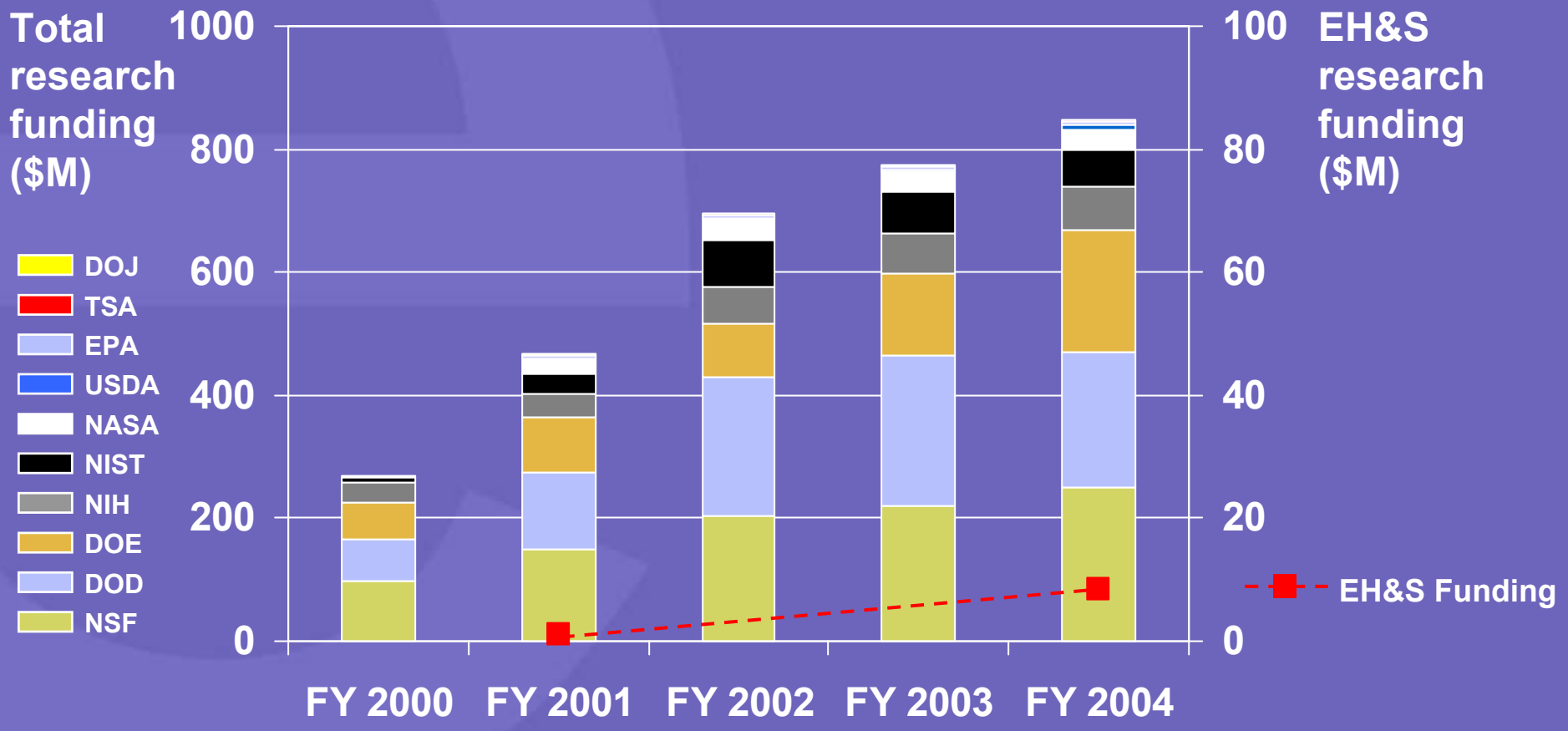


What We Want to Avoid: The "Wow- to-Yuck" Trajectory

Technology	Promise	Problem
Asbestos	Insulator, fire retardant	Lung disease; carcinogen
DDT	Mosquito and malaria control	Persistent, bioaccumulative, toxic;
Leaded gas	Engine improvements	Persistent, bioaccumulative, toxic; Carcinogen; developmental toxin
PCBs	Insulator, fire retardant	Persistent, bioaccumulative, toxic; Probable human carcinogen; Multiple other probable toxic effects
CFCs	Refrigerant, aerosol	Ozone depletion
GMOs	Improved crop yields	Public backlash; inadequate controls

Can we get it right the first time with nanotech?

Why It's Uncertain: Not Enough Implications Research



Source: National Science Foundation, National Science and Technology Council

Preliminary Studies Raise Concerns

Mobility

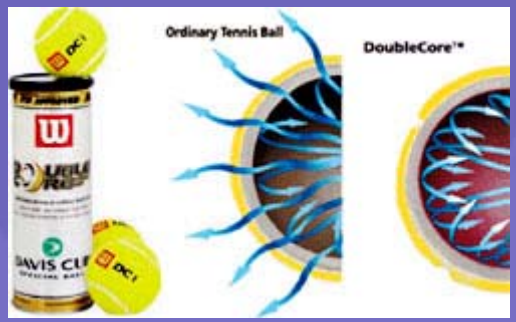
- Through groundwater?
- Bioaccumulation?
- Across cell membranes?
- Across blood-brain barrier?
- Across placenta?

Toxicity

- Lung granulomas?
- Brain lipid peroxidation?
- Aquatic toxicity?
- Cytotoxicity?

Testing needed to properly identify hazards, assess risks, and develop proper safety standards and control protocols

Marketplace Presence Creates Urgency



Is Our Current Regulatory System Up to the Task?

Breadth of applications

- Consumer products
- Personal care/cosmetics
- Medical applications
- Coatings
- Electronics
- Catalysts

Multitude of federal agencies

- Occupational Safety and Health Administration (OSHA)
- Environmental Protection Agency (EPA)
- Food and Drug Administration (FDA)
- Consumer Product Safety Commission (CPSC)

Will OSHA Protect Workers?

- Particulates Not Otherwise Regulated ("Nuisance Dusts")
  - Inhalation standard based on 30-year old science, mass-based
  - New standards unlikely
- Essentially no dermal exposure standards
- Limits to personal protective equipment (PPE) approaches
  - Reduced efficiency of respirators in 100-300 nm range
  - NIOSH working on interim guidance
- How about HAZCOM?
  - MSDS for carbon nanotubes = MSDS for graphite

EPA: TSCA Complexities / Limitations

- When are nanomaterials “new” chemicals?
- Existing exemptions (e.g., weight threshold)
- No up-front data requirements for new chemicals
- Significant burden on EPA to require testing
- Poor basis for evaluating risk in absence of data on specific types of nanomaterials
- Nomenclature confusion

Our Goals: Better Risk Identification and Management *Up Front*

- More research on ESH implications
  - Increased federal funding
  - Increased testing prior to commercialization
  - Clearer understanding of risks
- Proactive management of risks
  - Interim risk management *in advance of* information
  - Appropriate risk management *in response to* information

Create a Roadmap for Trust and Progress

- Acknowledge nanomaterials are different
  - Risks cannot be inferred from bulk materials
- Commit to pre-manufacture testing
  - Ecological as well as human health
- Push for regulatory clarity / adequacy
- Embrace transparency
  - Labeling, MSDS language, nomenclature
- Adopt a lifecycle approach

Develop a Comprehensive Risk Management Approach (I)

- Facilitate hazard identification
  - Nomenclature
  - Test protocols
- Facilitate exposure evaluation
  - Develop measurement/monitoring methods
  - Address workplace / environment / products
  - Assess and track fate and transport

Develop a Comprehensive Risk Management Approach (II)

- Interim worker safety steps
  - Assume toxicity until shown otherwise
  - Worker training, industrial hygiene, PPE
  - Wastes treated as hazardous materials
- Interim environmental safety steps
  - Restrict dispersive uses until hazard and exposure/fate data available
  - Manufacturers assess and disclose lifecycle risk considerations