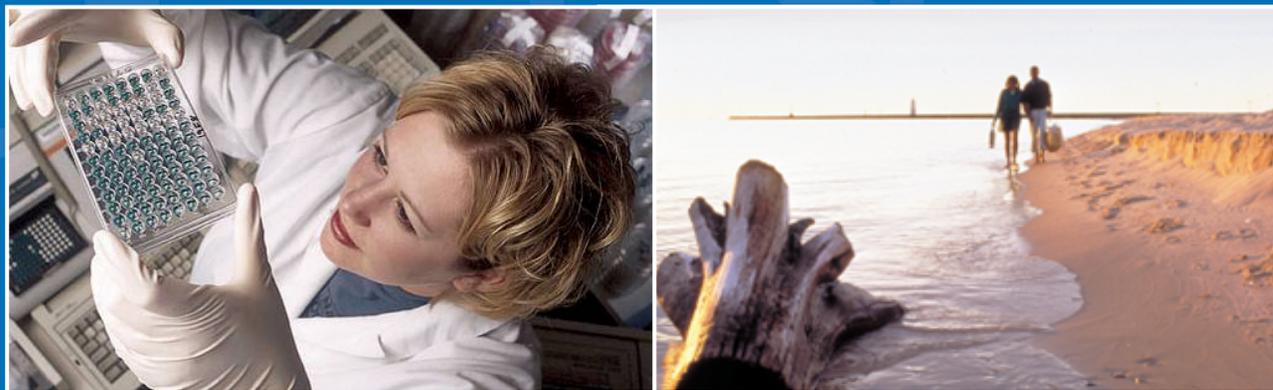


Strategic Research Directions: 2010 - 2014

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Overview

- Setting the Context
 - FY 2009 ORD Enacted Budget
 - ORD Budget Trends
 - Stimulus Funding
 - FY 2010 Status
- Exemplary Research Accomplishments
- Highlights of Strategic Research Directions and Products

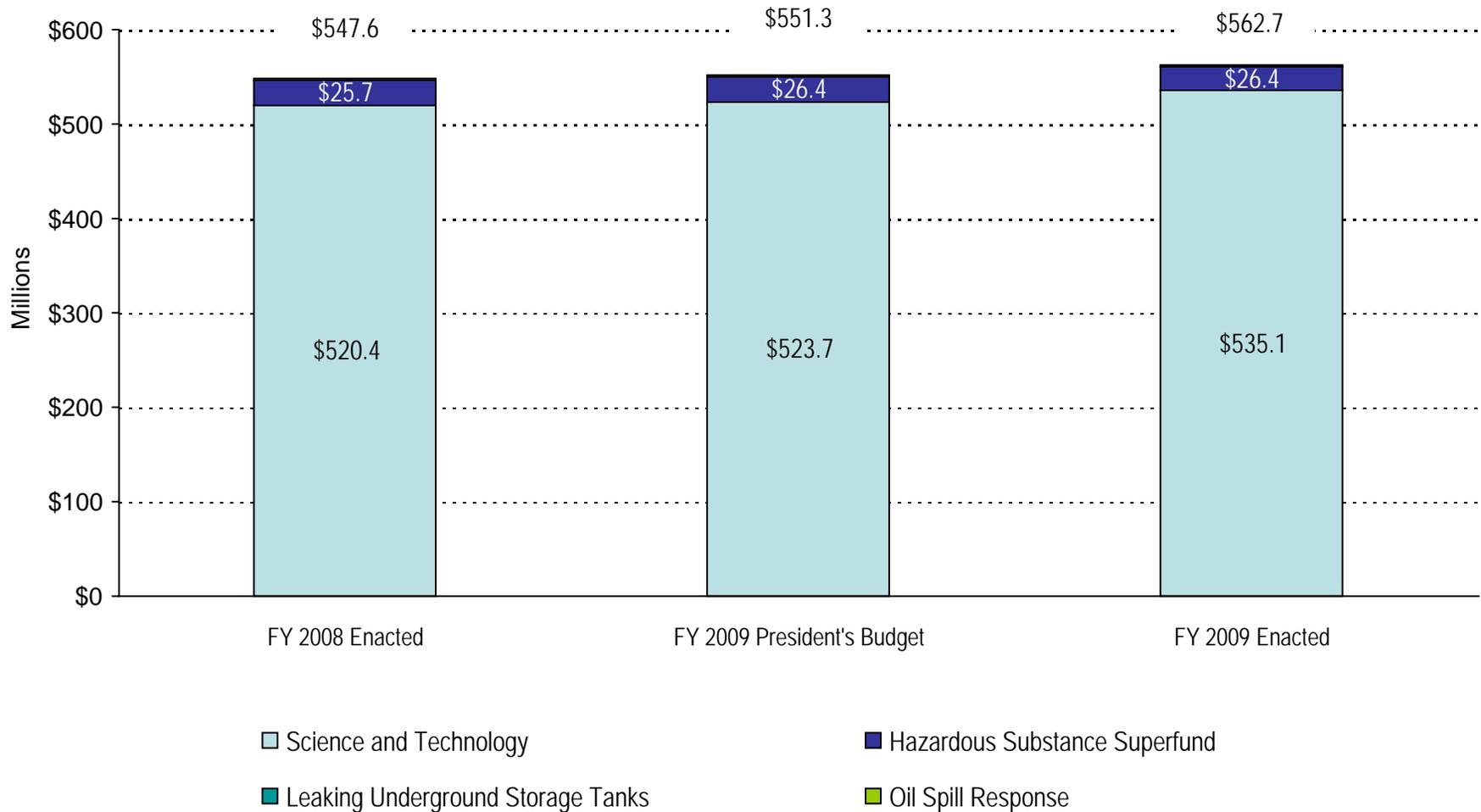


FY 2009 Enacted Budget

(Relative to the FY 2009 President's Budget Request)

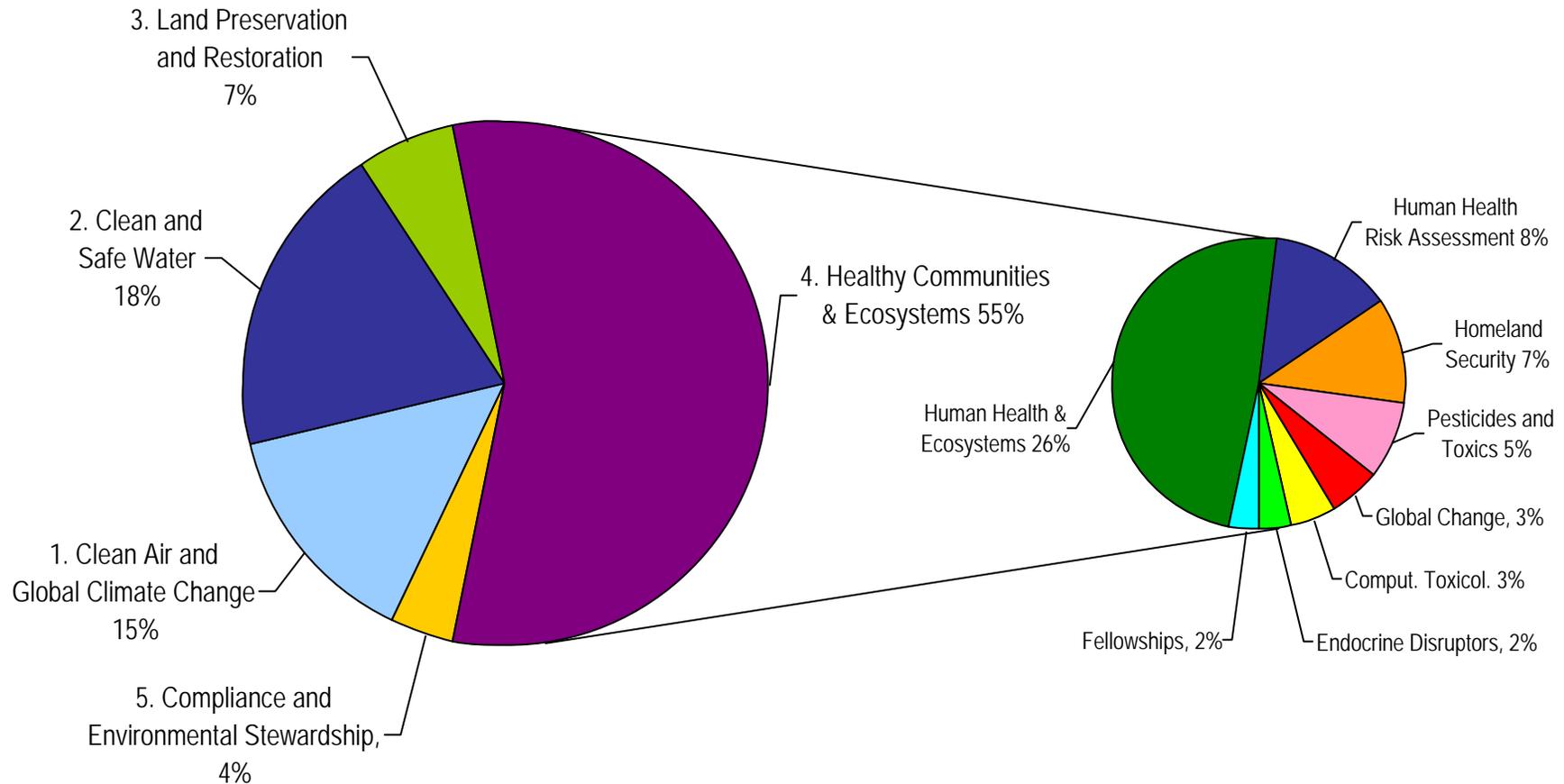
- Drinking Water (Carbon Sequestration) + \$ 2.0M
- Water Quality (Urban Storm Water Runoff) + \$ 2.0M
- Endocrine Disrupting Compounds + \$ 1.5M
- Global Change (GHG Mitigation and Adaptation Strategies) + \$ 2.0M
- Human Health and Ecosystems + \$ 8.6M
 - TIME/LTM + \$ 0.7M
 - Nanotechnology Research Roadmap + \$ 1.6M
 - Ecosystems + \$ 3.2M
 - Human Health + \$ 3.1M
- Fellowships + \$ 1.0M
- Earmarks + \$ 4.5M
 - Consortium for Plant Biotechnology + \$ 0.8M
 - AWWRF + \$ 1.7M
 - WERF + \$ 2.0M
- Homeland Security - \$12.6M
 - Includes FY 2009 Biodefense Amendment (\$10.6M)

ORD Budget by Appropriation Account



Enacted FY 2009 Budget for ORD by EPA Strategic Goal

(dollars in millions, all appropriation accounts)



Comparison of FY 2009 Enacted Budget to FY 2009 President's Budget

ORD Program/Project	FY 2008 Enacted ¹		FY 2009 President's Budget ¹		FY 2009 Enacted ^{1,3}		Change from FY 09 Pres. Bud. to FY 09 En.	
	\$M	FTE	\$M	FTE	\$M	FTE	\$M	FTE
Clean Air	\$78.9	236.2	\$80.6	236.4	\$80.5	269.5	\$0.0	+33.1
Drinking Water	\$47.6	207.2	\$45.3	190.2	\$46.9	190.2	+\$1.6	0.0
Water Quality	\$56.0	239.4	\$56.2	236.8	\$59.3	236.8	+\$3.1	0.0
Land Preservation and Restoration	\$32.0	141.3	\$35.5	154.7	\$35.7	154.7	+\$0.2	0.0
Homeland Security	\$33.4	50.9	\$50.2 ²	57.5	\$37.0	57.5	-\$13.2	0.0
Human Health Risk Assessment	\$42.7	182.1	\$42.6	178.6	\$42.7	178.6	+\$0.1	0.0
Computational Toxicology	411.5	34.3	\$14.9	32.7	\$15.2	32.7	+\$0.3	0.0
Endocrine Disruptors	\$10.2	54.4	\$9.5	50.1	\$11.5	50.1	+\$2.0	0.0
Global Change	\$18.1	32.6	\$16.4	32.2	\$17.9	35.5	+\$1.5	+3.3
Human Health & Ecosystems	\$154.2	497.0	\$144.7	478.3	\$153.8	484.9	+\$9.0	+6.6
Pesticides and Toxics	\$25.5	126.3	\$26.6	137.4	\$26.9	137.4	+\$0.4	0.0
Fellowships	\$9.7	2.7	\$8.9	2.6	\$9.7	2.6	+\$0.8	0.0
Sustainability	23.5	76.2	\$20.0	70.8	\$21.2	70.8	+\$1.3	0.0
Congressional Earmarks	\$4.2	0.0	N.A.	N.A.	\$4.5	0.0	+\$4.5	0.0
Total	\$547.6	1,880.6	\$551.3	1,858.3	\$562.7	1,901.3	+\$11.5	+43.0

¹ Totals may not add due to rounding.

² This includes \$10.6M related to the FY 2009 Homeland Security Amendment.

³ FY 2009 Enacted includes adjustments such as payroll and funding of the Small Business Innovation Research Program.

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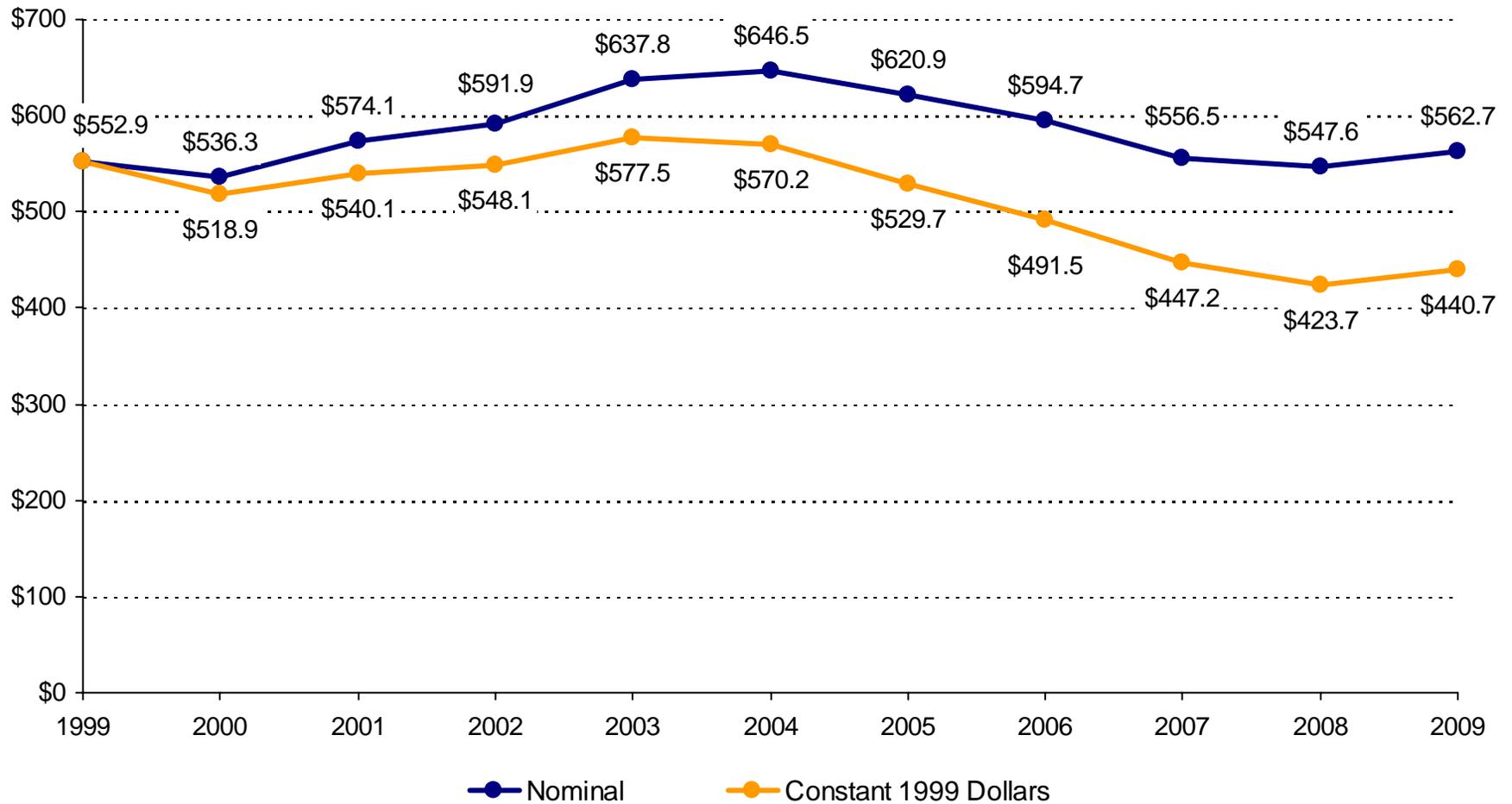
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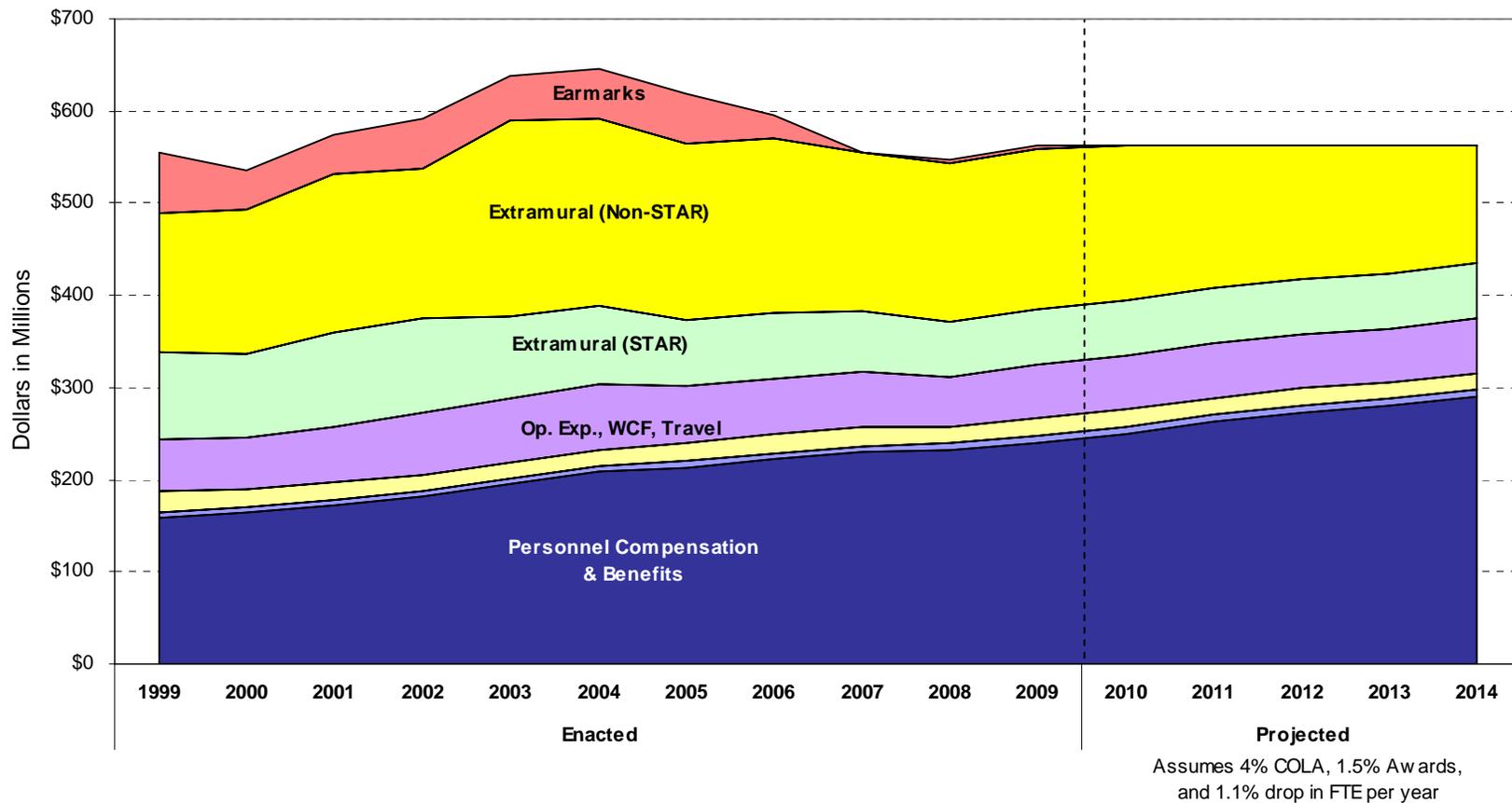
³ FY 2009 Enacted includes adjustments such as payroll and funding of the Small Business Innovation Research Program.

ORD Budget Trend

(enacted budget, includes earmarks, dollars in millions)



ORD Budget by Type of Spending





American Recovery and Reinvestment Act (ARRA) of 2009

• State and Tribal Assistance Grants (STAG)		+\$6.30B
– Clean Water SRF	+\$4.00B	
– Drinking Water SRF	+\$2.00B	
– Diesel Emission Reductions Act	+\$0.30B	
• Other Appropriations		+\$0.92B
– Brownfields	+\$0.10B	
– Superfund Remedial Clean-up Program	+\$0.60B	
– Leaking Underground Storage Tank	+\$0.20B	
– Inspector General	+\$0.02B	



FY 2010 Budget Status

- FY 2010 President's Budget Press Conference April 27, 2009*
- EPA Press Conference April 27, 2009*
- FY 2010 Appropriations Committee Hearings
 - House Appropriations Committee Hearing May 6, 2009
 - Senate Environment and Public Works Committee Hearing May 12, 2009
 - Senate Appropriations Committee Hearing May 13, 2009

* Tentative



Exemplary Research Accomplishments

Office of Research and Development

Research Accomplishments

- **Homeland Security**
 - Determined the efficacy of decontaminating toxic industrial chemicals and chemical warfare agents on building materials using chlorine dioxide fumigant and liquid oxidants
 - Developed a model for reducing security risks in drinking water systems (Threat Ensemble Vulnerability Assessment model)
- **Drinking Water**
 - Developed analytical methods for microbial pathogens, emerging chemical contaminants, and arsenic bioavailability
 - Tested and verified treatment technologies for control of arsenic, particularly for small systems



Research Accomplishments (2)

- **Water Quality**
 - Completed and implementing a Critical Path Science Plan to support recreational water criteria development
 - Conducted research devoted to linking watershed impairments to contaminant sources and land use practices
- **Ecosystem Services**
 - Inventorying, mapping, and modeling ecosystem services nationwide, working with the National Geographic Society to disseminate ecosystem service maps
 - Conducting Community-Based Demonstration Projects: Midwestern Landscapes, Tampa Bay, Willamette River, and Coastal Carolina



Research Accomplishments (3)

- **Human Health**
 - Developed exposure tools and protocols to characterize exposure in specific environments (e.g., homes, daycare, playgrounds)
 - Provided information on life stage susceptibility and vulnerability to environmental exposures
- **Human Health Risk Assessment**
 - Initiated interagency or external peer review for 16 IRIS assessments and posted 5 final assessments in 2008
 - Completed Integrated Science Assessments (health and eco) for SO_x and NO_x, and completed first external review draft of PM ISA

Research Accomplishments (4)

- **Computational Toxicology**
 - Completed Phase I of ToxCast, profiling over 300 well-characterized chemicals (primarily pesticides), building forecasting models, and publishing papers
 - Released ACToR (Aggregated Computational Toxicology Resource) website, a collection of over 200 sources of publicly available data on environmental chemicals
- **Endocrine Disruptors**
 - Completed research in developing assays for Tier 1 of the Agency's Endocrine Disruptors Screening Program
 - Led a multidisciplinary effort to characterize the environmental impact of hormones (natural and synthetic) from concentrated animal feeding operations

Research Accomplishments (5)

- **Safe Pesticides and Products**
 - Developed novel methods to detect pest resistance to GM crops, e.g., remote sensing, methods for genetic characterization, and exposure monitoring protocols
 - Developed ecological models to support pesticide assessments
- **Economics and Decision Sciences**
 - Developed and evaluated market systems with both a price ceiling and price floor for use in environmental trading programs, finding that a symmetric safety valve may be superior to a price ceiling
 - Developed additional valuation tools, including the observation that adults will pay twice as much to protect their children from mortality risks from pesticides in food as they would pay to protect themselves



Research Accomplishments (6)

- **Science and Technology for Sustainability**
 - Analyzed strengths and weaknesses of life-cycle analysis tools for assessing environmental impacts of biofuels production
 - Sponsored the 5th annual National Sustainable Design Expo
- **Global Change**
 - Completed two major Synthesis and Assessment Products for the U.S. Climate Change Science Program
 - Adaptation Options for Climate-Sensitive Ecosystems
 - Effects of Climate Change on Human Health and Welfare
 - Completed an assessment of the potential impacts of climate change on regional U.S. air quality, with a particular focus on ground-level ozone



Research Accomplishments (7)

- **Clean Air**
 - Found that reduction in ambient particulate matter from 1980-2000 resulted in nearly a half-year of increased life expectancy
 - Concluded that roadway “emissions” (especially particulate matter, or PM) constitute a significant exposure burden with increasing links to multiple health outcomes (e.g., coarse PM studies suggest cardiac outcomes)
- **Land**
 - Developed and applied technologies to provide cost effective solutions to organic and inorganic contamination in ground water (including mining sites)
 - Published reports on the characterization of, and metal availability in, coal combustion residue



Research Accomplishments (8)

- **Nanotechnology**
 - Developed EPA Nanomaterial Research Strategy
 - Leveraging interagency and international research on the implications of nanomaterials
 - Carbon nanotubes with the National Institute of Environmental Health Sciences (NIEHS) and the National Institute for Occupational Safety and Health (NIOSH)
 - Silver with the Consumer Product Safety Commission (CPSC) and NIOSH
 - Carbon tubes and fullerenes, cerium oxide, iron, silver, and titanium oxide with the Organization for Economic Cooperation and Development (OECD)



Research Accomplishments (9)

- **Global Earth Observation System of Systems /
Advanced Monitoring Initiative**
 - Deployed AIRNow-International and advanced a broader air quality (AQ) information “system of systems” to improve local AQ management and promote international awareness of global AQ problems
 - Used land-use tools to map projected Lyme Disease risk vs. future development patterns in Wisconsin, Maryland, Pennsylvania, and New York to indicate where integrated pest management may help in reducing disease transmission



Highlights of Strategic Research Directions and Products

Strategic Directions and Products

- **Homeland Security:** Responding to an attack on a water distribution system—computer modeling tools to contain the spread of contamination, locate the source, decontaminate infrastructure, and treat contaminated water
 - **Products:** Training modules and manuals to enhance the use of computer modeling tools and a report comparing the efficacies of various decontamination protocols and technologies for drinking water and wastewater systems
- **Drinking Water:** Risk assessment and risk management across the engineered water cycle (source-to-tap) with increased emphasis on water distribution/infrastructure systems and underground sources of drinking water
 - **Products:** Models, laboratory studies, and field investigations of distribution systems (to manage biofilms, nitrification, solids accumulation, lead and copper release, and disinfection byproducts) incorporating water/energy efficiency; studies on the geologic sequestration of CO₂

Strategic Directions and Products (2)

- **Water Quality:** Continued research and technical support for the Office of Water's recreational water quality criteria revisions
 - **Products:** Report on the most critical sources, as well as fate and transport processes, that affect concentrations of pathogenic and fecal indicators (bacteria, viruses, protozoa) in recreational waters
- **Ecosystem Services:** Modeling key interactions among services, ecological production functions, scenarios, and tipping points
 - **Products:** Scenario-based tools to proactively manage ecosystem service risks associated with: (1) reactive nitrogen, (2) biofuels development, (3) loss of services due to wetland conversion, and (4) contributing to the Millennium Assessment "II."

Strategic Directions and Products (3)

- **Human Health:** Apply methods and models in community settings, working collaboratively with EPA Regions, the National Children’s Study, and the Centers for Disease Control and Prevention
 - **Products:** New child-specific and aging-specific exposure factor findings to be incorporated into ORD’s Exposure Factors Handbook
- **Human Health Risk Assessment:** Move towards next-generation risk assessment by implementing EPA’s “Strategic Plan for Evaluating the Toxicity of Chemicals” (2009)
 - **Products:** Methods for the use of new data (e.g., computational toxicology data) in risk assessment and improve cumulative risk methods by considering vulnerability, nonchemical stressors, and background risk factors

Strategic Directions and Products (4)

- **Computational Toxicology:** Develop and verify predictive bioactivity profiles through ToxCast Phase II, with the goal of providing a tool to EPA Programs to prioritize toxicity testing
 - Products: Develop profiles for pharmaceutical agents that have failed in human clinical trials due to safety issues; start pilot studies with selected nanomaterials
- **Endocrine Disruptors:** Determine extent of impact of endocrine disruptors on humans, wildlife, and the environment
 - Products: New methods to evaluate environmental samples for endocrine activity and determine potential impacts on fish/human health; training modules for EPA Programs/Regions, States, and Tribes

Strategic Directions and Products (5)

- **Safe Pesticides and Products:** Develop methods, models, and data to prioritize testing requirements, enhance interpretation of data, and develop data to inform decisions on requested chemicals
 - **Products:** Multidisciplinary research on the toxicity, environmental pathways, and fate of perfluorocarbons (PFCs)
- **Economics and Decision Sciences:** Examining the design of policies for pollution control using market mechanisms
 - **Products:** Protocols and methods to estimate ecological and human health benefits from pollution control, including evaluating the efficacy of benefits transfer and meta-analysis methods; improved quantitative treatments of uncertainty; and evaluations of market mechanisms coupled with other policies addressing tax and revenue impacts, technology and innovation, and other distributional concerns



Strategic Directions and Products (6)

- **Science and Technology for Sustainability:** Partner with EPA Programs and Regions to advance research to support sustainable biofuels production, focusing on current and next-generation feedstocks
 - **Products:** Criteria, indicators, and pilot studies to measure sustainable biofuels production (a coordinated effort across EPA and with other federal agencies)
- **Global Change:** Research and assessment of the environmental implications of alternative strategies for mitigating greenhouse gas emissions
 - **Products:** Reports on the co-benefits of various mitigation strategies and the potential for unanticipated negative impacts



Strategic Directions and Products (7)

- **Clean Air:** Use a multi-pollutant approach coordinated with the Global Change Research Program to assess the impacts of climate change on air quality and human health
 - **Products:** Studies examining NAAQS outcomes within the multi-pollutant air environment, contributing to the Climate Change / Air Quality Assessment, “Effects of Global Change on Air Quality in the United States” (2012)
- **Land:** Assessment of vapor intrusion into buildings
 - **Products:** Reports on vapor intrusion modeling and engineering factors to determine approaches for screening and remediation



Strategic Directions and Products (8)

- **Nanotechnology:** Continue to focus on fate, transport, transformation, and exposure with regard to the five nanomaterial types (Ag, C, CeO, TiO₂, Fe)
 - **Products:** Studies to determine the major processes that govern environmental fate, transport, and transformation of the five nanomaterial types; source-to-dose exposure models
- **Global Earth Observation System of Systems / Advanced Monitoring Initiative:** Continue the use of new approaches to measurement and observational data, integrated with EPA science and technology, to improve environmental decision-making by EPA and its partners
 - **Products:** Link observation data and modeling, and partner to provide user-friendly visualizations (e.g., Google Earth's "Virtual Globe" technology) for advanced decision-support analyses and real-time adaptive management



Highlights in Response to the SAB Advisory on Strategic Research Directions (November 26, 2008)



EPA Response to the SAB Advisory: Cover Letter

- “At my confirmation hearing and in my communications with U.S. Environmental Protection Agency staff, I have emphasized that science must be the backbone of EPA programs.”
- “...I intend to rely heavily on the SAB to safeguard the integrity and quality of our science-based decisions.”
- “The SAB’s eight recommendations...are extremely helpful. We have reviewed these recommendations carefully and believe that in many areas we are already working toward the change in focus recommended by the SAB.”
- “At the same time, we recognize that more action will be needed to fully address the environmental challenges we face. Taking new action requires choices and trade-offs; we plan to engage the SAB as we navigate this more challenging part of the decision-making process.”
- “I share the Board’s interest in ensuring that ORD’s efforts are directed toward meeting our nation’s most important environmental challenges in an integrated, multidisciplinary way that draws on ORD’s unique expertise.”



EPA Response to the SAB Advisory: Enclosure

- *Broaden the interpretation of "land preservation"*
 - Addressing land-use issues concerning biofuels
 - Using scenario analysis to examine the effects of biofuels policy on a suite of six ecosystem services
 - Continuing important research on asbestos, vapor intrusion, and contaminated sediments
- *Broaden consideration of the life-cycle of new products and their globalization*
 - Using life-cycle analysis to study the global consequences of new technologies such as nanotechnology and biofuels

EPA Response to the SAB Advisory: Enclosure (2)

- *Expand the analysis of water infrastructures*
 - Shifting to a sustainable water quality and quantity approach
 - Evaluating the ecosystem-service outcomes implicit in water-policy decisions
 - Supporting the Aging Water Infrastructure initiative
- *Reinvigorate and modernize research on sensitive human and ecological populations including research involving chemical mixtures*
 - A number of research programs (e.g., safe pesticides and products, computational toxicology, ecosystem services) include projects designed to address susceptible human and ecological populations
 - Exploring how to move to a more integrated, multidisciplinary approach that addresses chemical contaminants

EPA Response to the SAB Advisory: Enclosure (3)

- *Improve the science foundation needed to respond to unexpected and emerging problems and environmental disasters*
 - Co-funded, with the National Science Foundation, the Center for the Environmental Implications of Nanotechnology
 - Developing an interagency research strategy on pharmaceuticals in the environment
- *Expand policy-relevant research on developing, testing, and evaluating new and innovative alternatives to conventional command-and-control regulation*
 - This line of research is closely aligned with the changing emphasis of our risk-management research program
 - Economics plays an important role in framing alternative approaches, as EPA needs to analyze the costs and benefits of different risk-management options



EPA Response to the SAB Advisory: Enclosure (4)

- *Improve dramatically the integration of economics and the decision and behavioral social sciences into research and policy development across the Agency*
 - ORD is partnering with EPA's National Center for Environmental Economics
 - Decision and behavioral sciences are currently under-represented as disciplines within EPA, so we will work with organizations such as the National Science Foundation to enhance our use of these skills
- *Continue to work on improving the effective communication of research results*
 - National Program Directors play critical communication roles; they facilitate end-to-end partnerships with both internal and external stakeholders
 - Internal efforts include leading routine seminars with EPA Programs and Regions, and participating in workgroups to develop regulations and guidance
 - External efforts include publications in the peer-reviewed literature and presentations at scientific and technical society meetings

Summary

- ORD's research program continues to significantly inform the environmental decision-making of EPA and others.
- To go from being a "good" organization to a "great" one, ORD is working with our partners to focus on what research it should be conducting and how it should be performing that research.
- As always, ORD looks forward to open and frank discussions with the SAB on the strategic directions for ORD's research program.