

Water Research and Technology: The Federal Government's Role

Kelly H. Carnes

May 17, 2011

Water is Everywhere

- Drinking water and sanitation
- Agriculture
- Health
- Energy
- Economic development
- Industrial development
- National security

Global Water Crisis Now

- Water use growing twice the rate of population increase
- 1 billion without access to safe drinking water
- 2.6 billion without basic sanitation
- 1.4 billion live in river basins where water use exceeds recharge levels
- Developing countries:
 - 70% industrial waste dumped untreated into waters
 - 80% sewage discharged untreated into rivers, lakes, coastal areas
- 60% of European cities with 100,000+ people using ground water faster than it can be replenished

Water Catastrophe Tomorrow

Economic and population growth...

- Water withdrawals predicted to increase 50% by 2025 in developing countries; 18% in developed world
- By 2025, 1.8 billion people could be water scarce; 2/3 of world population could be water stressed
- With expected population increases, food demand may increase 50% by 2030; world water will have to support agricultural systems to feed 2.7 billion more people

Water Needs:

Energy, Economic Security, National Security

- **Water/Energy Nexus**
 - As biofuels use increases, more water for energy crops
 - CSP water use
- **Economic Security**
 - Key industries are water reliant (food, beverages, chemicals, pharmaceuticals, semiconductors)
- **National Security**
 - Lever in geopolitics
 - Lack of water for drinking/food could led to civil unrest/political instability
 - Water prime target for terrorism

Water is Big Business

- 3rd largest industry on Earth (\$550 billion)
- Investment funds specializing in water sector; \$130 million in in 33 deals in 2009
- 75% of U.S. urban water infrastructure needs to be replaced—hundreds of billions of dollars
- Developing countries—India, China, Saudi Arabia—need to spend hundreds of billions for new water infrastructure
- Singapore vision to become global hydro-hub for business, investment, R&D
 - \$40 million investment (biomimetic membranes for desalination, electrochemical desalination, sensors)
 - 70 water-related companies already located there

Market Opportunities: *Target rich environment for innovation*

- Innovation of different kinds and at different scales:
 - Desalination
 - Large-scale water treatment
 - Oil spill and hydro-fracking cleanup
 - Small community and village size water treatment
 - Home water purification
 - Water collection and harvesting
 - Waste water recycling
 - Personal point-of-use systems
 - Sensors and monitoring

Markets:

Something Needed at Every Scale

- OTEC
 - 2 MW plant could generate power and produce million gallons of fresh water daily from seawater
 - Cold water aquaculture/chilled soil agriculture for food
- Swales and green roofs for storm water management
- Hollow-fiber membranes for point of use systems
- Smart water grid

Markets:

Something Needed at Every Scale

- Nano-silver antibacterial agent
- ARPA-E \$2 million carbon-nanotube project for industrial scale reverse osmosis membranes for desalination/wastewater reuse
 - Drop-in replacements
 - Ten-fold increase in permeability
 - 39%-50% energy savings, saving 290 TWh over ten years
 - 90% reduced membrane use
 - 10%-23% reduction in capital costs for new plants
 - Reducing the cost of water by as much as 40%
- Water attracting/water repelling nano-based films for water harvesting from air

U.S. Government Role

- 19 Federal agencies with water-related responsibilities
- No coordinated water program
- Federal spending on R&D not commensurate with the challenges

Federal Agency Water Responsibilities

Department of Commerce: NOAA

- Ocean, coastal and marine management, monitoring and research

Environmental Protection Agency

- Safe drinking water, watershed and coastal water protection

Department of Agriculture

- Watershed protection and restoration, water rights, water quality, hydrology, ground water, wetlands, water efficiency

National Science Foundation

- Water sustainability and climate

Department of the Interior

- Wetlands, fisheries, water resources data, water resource management, surface water science

Federal Agency Water Responsibilities

Department of Defense

- Water resources management and planning
- Water desalination

Agency for International Development

- Water in the developing world

Department of Energy

- Water power technology, energy-related water issues

EX-IM Bank

- Financing for water infrastructure

Federal Agency Water Responsibilities

Trade and Development Agency

- Funding for water and wastewater treatment

NASA

- Water sustainability, monitoring climate change effects

Centers for Disease Control and Prevention

- Safe water

Department of Homeland Security/FEMA

- Water system security
- Water during disaster

Peace Corps

- Water and sanitation, water resource engineering

Department of Commerce: NOAA

Wide ranging research, including:

- Office for Oceanic and Atmospheric Research
 - Ocean Acidification
 - Gulf of Mexico Ecosystem
- Great Lakes Environmental Research Laboratory
 - Water quality monitoring and modeling
- Earth Systems Research Laboratory
 - Hydrometeorology Testbed
 - Western Water Assessment
- Florida Keys National Marine Sanctuary
- Global Climate Programs
- Center for Sponsored Coastal Research

EPA Research Goals/Themes

Water Quality Integrity

- Aquatic life guidelines
- Biological assessment approaches to bio-criteria and aquatic life uses
- Nutrient criteria
- Recreational water criteria for pathogens/pathogen indicators
- Emerging contaminants

Watershed Management

- Impaired and vulnerable resources
- Threats and causes of impairment for effective decision-making
- Ways to reduce impairment and vulnerability

Source Control and Management

- Infrastructure

EPA National Risk Management Laboratory

Aging Drinking Water Infrastructure

- Condition assessment, system rehab, monitoring, control, infrastructure

Aging Wastewater Infrastructure

- Condition assessment, system rehab, treatment technologies

Watershed Management

- Pollutant transport, management strategies, decision support systems

Drinking Water Treatment Technologies

- Distribution systems, water treatment, contaminants

Non-point Source Characterization and Control

- Water quality restoration/protection, storm water runoff

Source Water Production

- Monitoring, use of geospatial data for mapping, planning, monitoring

Distribution Systems Water Quality

- Treatment, pipe materials

Department of Agriculture

Water Availability and Water Management

- Research focus areas include developing methods to reuse degraded water, increase water use efficiency and water availability to mitigate impacts of drought.
- Objectives include:
 - quantifying and predicting the impact of conservation practices and their net cumulative benefits within watersheds
 - technology and strategies to restore stream corridors and reduce soil erosion and sedimentation
 - technology and strategies to reduce the transport of nutrients, pathogens, and pharmaceutically active compounds to enhance water quality

National Science Foundation

Water Sustainability and Climate Program

- Interactions between water system and climate change, land use, built environment, and ecosystem function
- Impact of climate change and human activity on water budgets, water quality, ecosystems, chemical transport
- Theoretical frameworks and models for adaptive management of water resources
- Built water systems and governance systems to meet diverse needs
- ***Integrative program:*** biological sciences, engineering, geosciences, and social sciences
- Water systems studied in their entirety



USGS/Department of Interior State Water Resources Research Program

- 54 Water Resources Research Institutes
- 50 States, DC, Puerto Rico, U.S. Virgin Islands, Guam
- Located at land-grant or governor-designated universities
- Networked institutes
- Plans and conducts research to address state/regional water problems
- Promotes technology transfer
- Provides competitive grants under Water Resources Act
- Address entire spectrum of water issues
- *Proposed for elimination in FY 2012*

Interagency Collaboration: *Army Corps of Engineers, NOAA, USGS*

Memorandum Of Understanding to coordinate efforts in water management to provide the nation with critically needed water resources information and support for better and smarter water planning and management.

This effort will include:

- creation of high-resolution forecasts of water resources showing where water for drinking, industry and ecosystems will be available, and
- one-stop shopping through a database portal to support stakeholders in managing water resources

Office of Naval Research

Water Purification

- New concepts in desalination
- Development of new membranes
- Shipboard desalination research and technology demonstration

Open BAA Topics

- Materials for water desalination
- Shipboard desalination demonstration

USAID Crosscutting Water Program

U.S. Government Water Action Plan for Developing World

Water supply, sanitation, and hygiene

- Access to water systems hardware, behavior change, hygiene, and enabling environment (policies, public-private partnerships, etc.)

Water resource management

- Supply optimization, demand management (including water efficiency technologies), financing, drought and flood mitigation

Water productivity

- Water use efficiency in agriculture
- Climate change adaptation
- Reducing water pollution by industry
- Water use efficiency in cities

Disaster Risk Reduction

USAID

Development Innovation Ventures Grants

- Seed funds: development of innovations with cost-effective impact that can match the scale of microfinance
- Start-up/impact assessment financing: test impact of ideas for ability to scale
- Funding to transition to scale innovations
- Award ceiling \$350K

Potential Policy Solutions

- Create cross-cutting Federal water interagency initiative
- Increase research funding
- Cross-cutting research strategy
- Pilot projects
- Partnerships between business/aid community
- Lower regulatory barriers to innovation



Thank you!

Kelly H. Carnes

202.966.6610

kcarnes@techvision21.com