

# EERE Wind and Hydropower Technologies Program

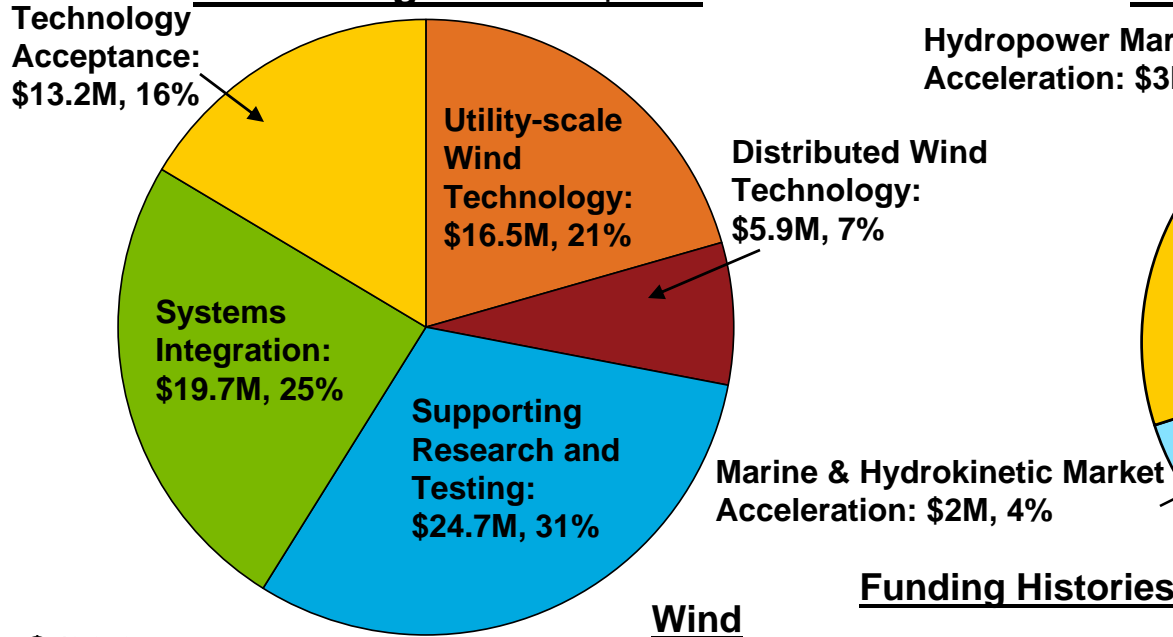
## Technology Review (Deep Dive) for Under Secretaries Johnson and Koonin

Megan McCluer, Program Manager

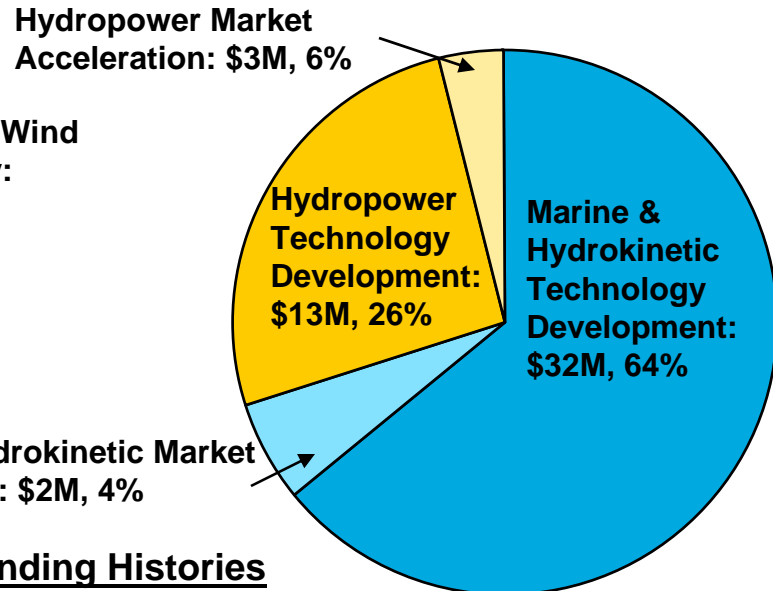
September 4, 2009

# Wind and Water Budgets

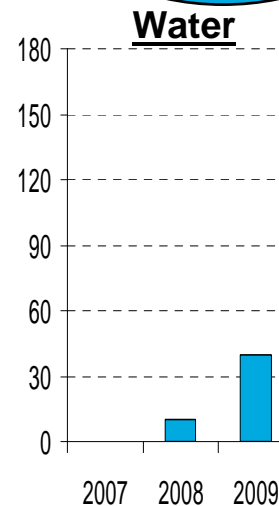
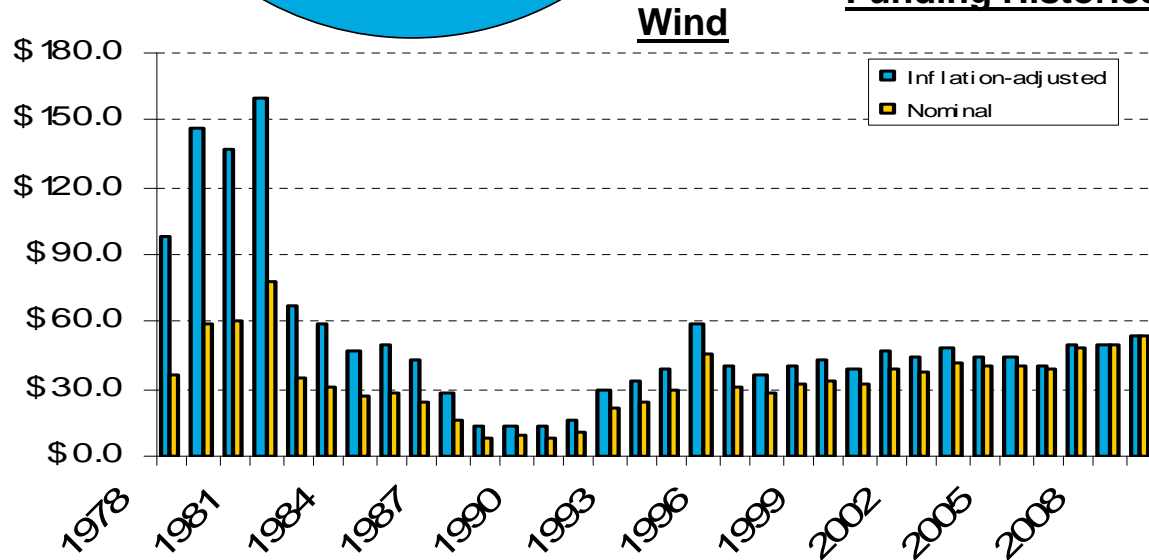
## Wind Budget FY10: \$80M



## Water Budget FY10: \$50M



## Funding Histories



<b>WHTP CDPs for 2009: \$21M</b>
<b>14 wind projects: \$14M</b>
<b>8 water projects: \$7M</b>

**National Laboratories**
**Federal Agencies**
**University Partnerships**
**Industry**

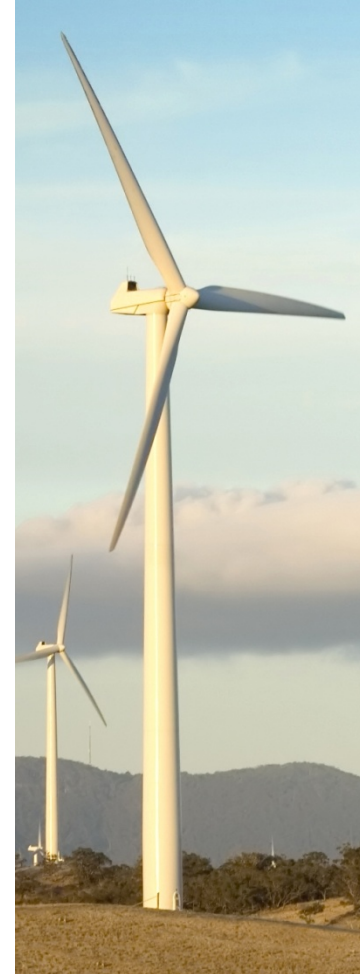
National Renewable Energy Laboratory	Federal Energy Regulatory Commission	National Marine Renewable Energy Centers	MOU on collaboration with 6 major wind turbine manufacturers
Sandia National Laboratories	Mineral Managements Service	(U-Hawaii, U-Washington, Oregon State University)	GE: helped develop 1.5MW turbine; most widely-installed design in U.S.
Oak Ridge National Laboratory	National Park Service	Large Blade Test Facilities in Massachusetts, Texas	Clipper: helped develop innovative 2.5MW Liberty turbine
Pacific Northwest National Laboratory	National Oceanic and Atmospheric Administration	(U-Mass. Amherst, MIT)	Gearbox Reliability Collaborative to improve wind turbine reliability
Idaho National Laboratory	U.S. Fish and Wildlife Service	University research consortia: U-Maine, U-Minnesota, Illinois Institute of Technology	Verdant Power: tidal current turbine improvements
Lawrence Berkeley National Laboratory	U.S. Environmental Protection Agency	20% Wind FOA: multiple university partners	TPI Composites: manufacturing process improvements
Lawrence Livermore National Laboratory	Army Corps of Engineers	Wind for Schools: multiple university partners	EPRI: fish-friendly turbine design
Los Alamos National Laboratory	Department of Defense	Advanced Water Power FOA: multiple university partners	Pacific Energy Ventures: siting protocols for marine energy projects
Argonne National Laboratory	Federal Aviation Administration		Multiple FOA award winners for wind, water topics

Objective: Reduce cost of energy and increase U.S. market share (green jobs and economic revitalization) of wind and water power technologies

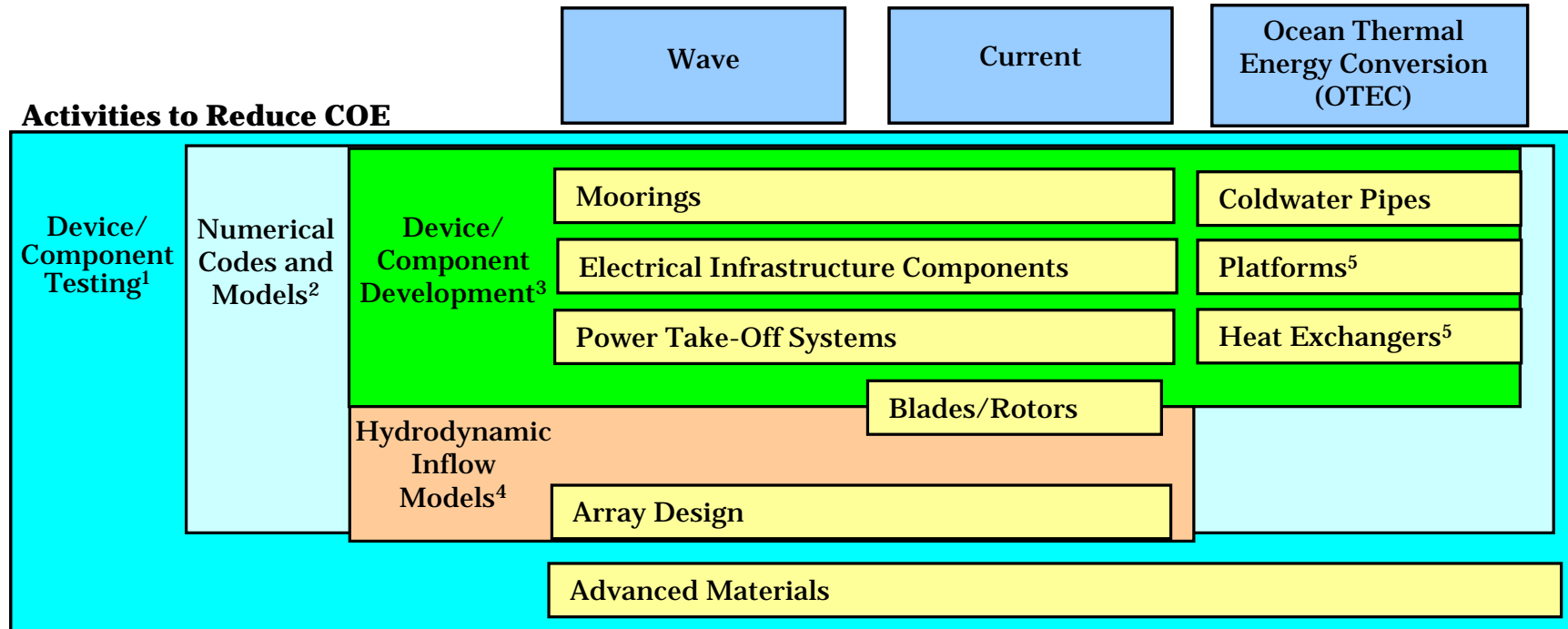
Technology	Near-term targets	Long-term targets	Technical goals
Land-based wind	Cost of Energy: \$0.039/kWh by 2009	Cost of Energy: \$0.036/kWh by 2012	Improve energy capture from rotors; improve gearbox reliability; develop advanced controls to improve performance
Offshore wind	(Program restarted in 2009)	Cost of Energy: \$0.070/kWh by 2014	Adaptation to marine environment; larger rotors; cost effective foundation structures; specialized installation vessels
Marine and hydrokinetic energy	Complete draft Multi- Year Program Plan in FY 2009.	Test 5 devices by 2012.	Establish baseline COE per resource type; identify key component cost drivers; establish figures of merit to compare design approaches
Conventional hydropower	Complete draft Multi- Year Program Plan in FY 2009.	Conduct 80 incremental feasibility studies by 2012.	Demonstrate fish friendly turbine technology; develop tools to maximize system-wide efficiency; quantify hydropower's value in integrating variable generation

**Goal: Reduce cost of energy by increasing performance and reliability while reducing manufacturing cost of wind turbines**

- **Increased Performance (Energy Capture)**
  - **Advanced towers:** taller towers and advanced designs
    - Impact: 11% increase in energy production
  - **Blades/Rotors:** improved designs and materials; active and passive controls; variable diameter; blade performance testing
    - Impact: 25% increase in energy production; 3% capital cost reduction
  - **Performance:** develop robust control systems and sensors
    - Impact: 5% increase in energy production
  - **Power conversion:** permanent-magnet generator designs; improved power electronics
    - Impact: 4% increase in energy production
  
- **Reliability**
  - **Drivetrains:** reliability database; direct drive generators; gearbox design code validation
    - Impact: 4% increase in energy production; 6% capital cost reduction
  - **Blades:** reliability database; inspection validation; effects of manufacturing defects; analysis validation
    - Impact: 25% increase in energy production; 3% capital cost reduction
  
- **Manufacturing**
  - Create process improvements to lower component costs;
    - Impact: 13% capital cost reduction
  
- **Offshore Turbines:**
  - Design codes and specialized components for marine environment
  - Low-cost offshore foundations
  - Installation/maintenance vessels
  - Advanced designs for ultra-large turbines

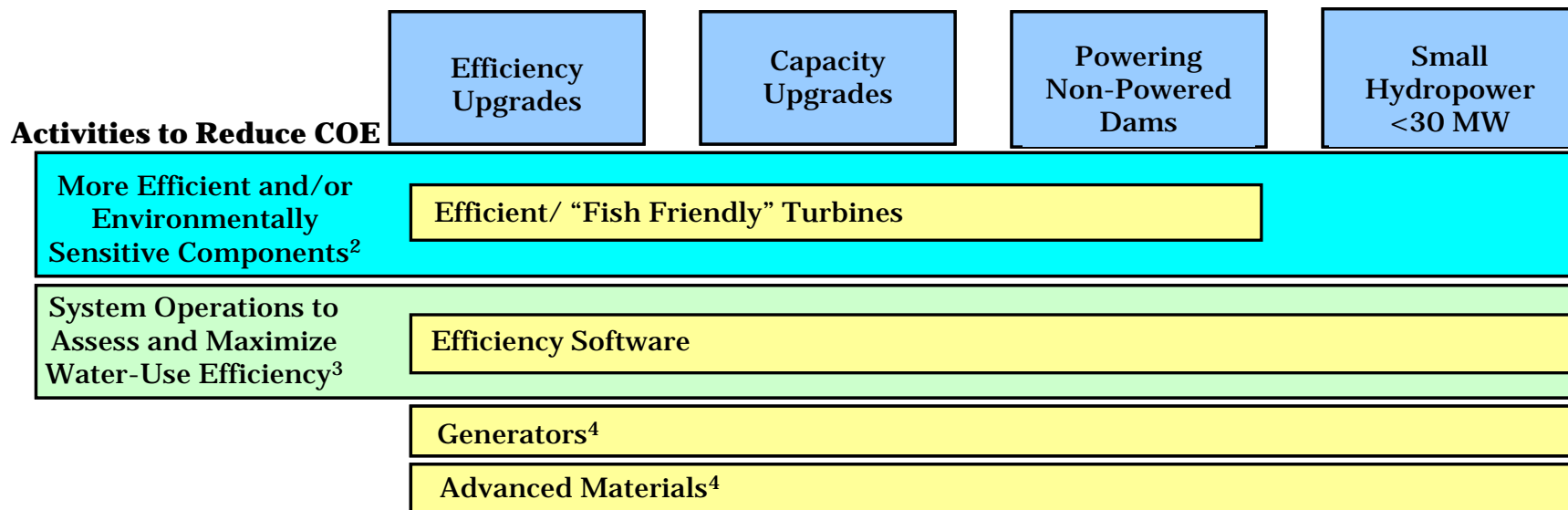


## Marine and Hydrokinetics: Improve technologies and establish baseline data



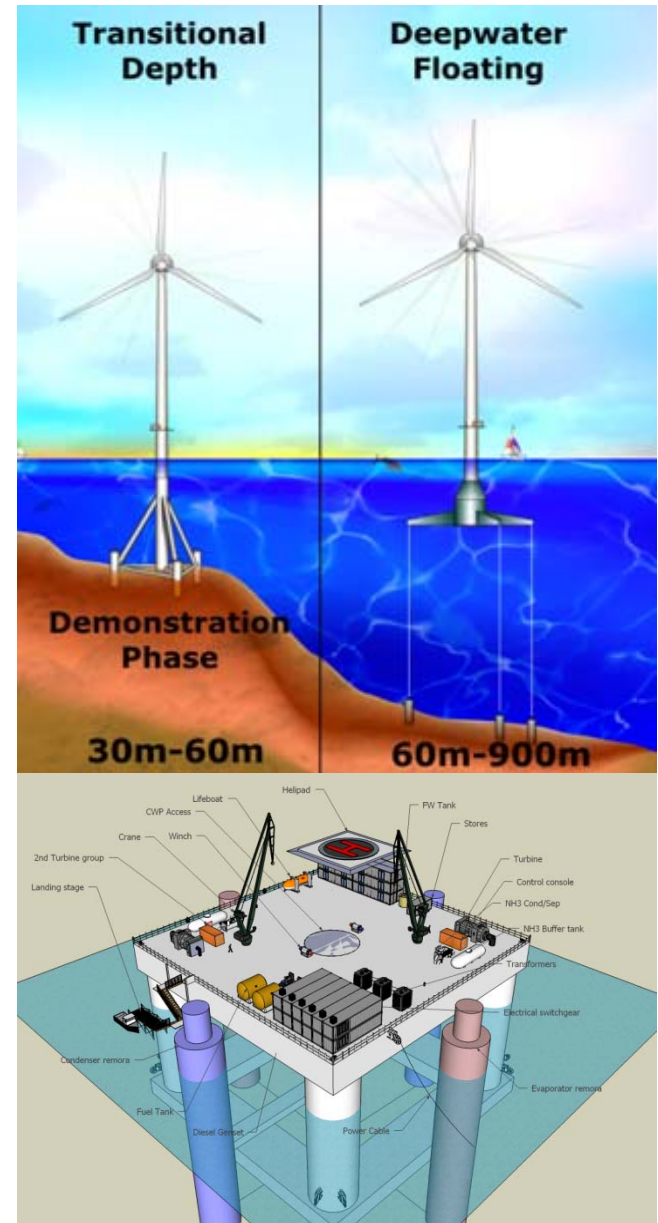
1. Support testing through the establishment of open-water test facilities, development of National Marine Renewable Energy Centers, and launch of device testing program
2. Develop codes and models through National Laboratory Partnerships to improve device design
3. Support device/component development through industry, university and National Laboratory partnerships
4. Develop hydrodynamic inflow models through National Laboratory partnerships
5. No proposals were received for these areas under recent solicitations. OTEC activities are currently limited to coldwater pipes.

**Conventional Hydropower:** Increase incremental<sup>1</sup> generation



1. Incremental hydropower includes efficiency upgrades, capacity upgrades, powering non-powered dams and small hydropower <30 MW
2. Support industry to design more efficient and "fish friendly" turbines
3. Develop system operations to assess and maximize water-use efficiency
4. Program did not receive proposals under its Lab Call in the area of advanced materials, so no activities are currently funded. Program is not currently funding activities on generators.

- Advanced turbine materials:
  - Inexpensive carbon fiber
  - Superconducting cables
  - Smart materials
  - Better permanent magnets
- Inexpensive deepwater foundations for offshore wind
- Cost-competitive and reliable pilot-scale Ocean Thermal Energy Conversion plant
- Fish friendly turbines
- Small hydropower turbines and generators
- Optimized designs for wave and current energy devices





<b>Market Barrier</b>	<b>DOE Solution</b>
Lack of transmission capacity keeps wind energy from markets	Work with grid planners to enable large-scale wind integration
Environmental, siting, and social concerns may limit deployment	Environmental studies and Wind Powering America objectively address siting and social issues
Multiple barriers to offshore wind deployment: environmental, regulatory, public acceptance, etc.	Developing offshore wind technology; work with other federal agencies on regulatory and environmental issues
Lack of data on conventional and marine & hydrokinetic resource potential	Develop comprehensive quantitative assessments of water power resource types
Water power siting and permitting is expensive and time consuming	Understand and reduce impacts; collaborate with regulators and stakeholders to streamline siting.
Hydropower's ancillary grid services undervalued	Create modeling tools to quantify and maximize benefits of hydropower