





Fossil Energy: Carbon Management to Water Management Food Energy Water Nexus Workshop 7 October 2015

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Emissions reductions (GtCO₂)

Integrated Fossil Energy Solutions

Advanced Combustion Advanced Energy **Systems** Pressurized □ Gasification Turbines \Box O₂ membrane Chemical □ Supercritical CO₂ Direct Power Extraction looping USC Materials Efficiencies > 45%↓ Capital Cost by 50% \$10 - \$40/tonne CO₂ Captured Advanced Turbines 5 MWE Oxycombustion Pilot Near-zero GHGs Advanced CO₂ Capture Near-zero criteria pollutants CO₂ Storage and Compression Near-zero water usage Solvents Carbon Utilization Sorbents (EOR) Infrastructure (RCSPs Membranes Hybrid Geological Storage Monitoring, Verification □ Process Intensification and Accounting Cryogenic Capture

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Fossil

Energy

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Demonstration





Challenges in the Energy-Water System



Energy-Water Nexus: Why Now? Why DOE?

Six Strategic Pillars

- Optimize the freshwater efficiency of energy production, electricity generation, and end use technologies
- Optimize the energy efficiency of water management, treatment, distribution, and end use technologies
- Enhance the reliability and resilience of energy and water technologies
- Increase safe and productive use of nontraditional water sources through improved technology
- Promote responsible energy operations with respect to water quality, ecosystem, and seismic impacts
- Exploit productive synergies among water and energy system technologies



Download the full report at energy.gov/water-energy-tech-team



Water Research Opportunities





<u>Innovation Priorities</u>: Advancing cooling technologies, and applying novel water treatment and waste heat concepts to improve efficiency and reduce water use

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Power Plant Water Program Successes



Average US Coal Plant is 33% efficient at generating electricity, other 67% of heat from coal is waste heat, which is released from boiler in flue gas and dissipated to water from steam condenser.



Strategies for Brine Extraction

Producing clean water from briny water is a key challenge

- Cleaning produced waters from oil/gas development (Uncon.)
- Producing fresh water from saline aquifers during CO₂ sequestration (CO₂ Seq. FWP)
- Cleaning geothermal brines for use in 2G-RT process (SFIRE)



Key similarity of the applications is that the salt concentration (4%-20%) is above the ocean's salt concentration (3.5%), and hence above the concentration for which conventional RO membranes are designed and optimized



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Tools and Analysis for Water Management

Office of Program Performance and Benefits			
Performance Division	•	Specific power plant performance; Detailed water balances Plant and technology economics, integration of new technologies	
Benefits Division	•	Operational, economic, environmental, and social benefits modeling and analysis Ability to run and integrate models with EIA's National Energy Modeling System (NEMS)	Cost and Performance Baseline for Fossil Energy Plants Volume 1: Bituminous Coal and Natural Gas to Electricity Reviews 36: Secondar 2019 Reviews 2019 Beilews 2019 Beilews 2019 Beilews 2019
		Water Projects	() ënergy
	•	SOFC – minimize water use OH, PA, WV water use for shale oil/gas productio	Money HD Conserved Final Conserved Final Consumption
	•	RO process integration and optimization for prod water (oil & gas and carbon sequestration)	uced
	٠	Thermoelectric water use data	Levents application Section 2014



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Opportunity Spaces in Water for Energy



Opportunity Spaces in Energy for and from Water



