Regional Effort to Deploy Clean Coal Technologies

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Abstract

The Southern States Energy Board's (SSEB) "Regional Effort to Deploy Clean Coal Technologies" program began on June 1, 2003, and was completed on January 31, 2009. The project proved beneficial in providing state decision-makers with information that assisted them in removing barriers or implementing incentives to deploy clean coal technologies. This was accomplished through two specific tasks: (1) domestic energy security and diversity; and (2) the energy-water interface.

Milestones accomplished during the project period are listed below.

- Presentations to Annual Meetings of SSEB Members, Associate Member Meetings, and the Gasification Technologies Council.
- Energy: Water reports
    - o *Regional Efforts to Deploy Clean Coal Technologies: Impacts and Implications for Water Supply and Quality*. June 2004.
    - o *Energy-Water Interface Challenges: Coal Bed Methane and Mine Pool Water Characterization in the Southern States Region.* 2004.
    - o *Freshwater Availability and Constraints on Thermoelectric Power Generation in the Southeast U.S.* June 2008
- Blackwater Interactive Tabletop Exercise- Decatur, Georgia April 2007
- Blackwater Report: *Blackwater: Energy and Water Interdependency Issues: Best Practices and Lessons Learned*. August 2007.
- Blackwater Report: *BLACKWATER: Energy Water Interdependency Issues REPORT SUMMARY.* April 2008.

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Executive Summary

The Southern States Energy Board's "Regional Effort to Deploy Clean Coal Technologies" program began in 2003, and was completed on January 31, 2009. The project has proven beneficial in providing state decision-makers with information that assisted them in removing barriers or implementing incentives to deploy clean coal technologies. This was accomplished through two specific tasks: (1) domestic energy security and diversity; and (2) the energy-water interface.

SSEB has helped its members, Associate Members, and the southern regional planners better understand and employ fossil fuels in the critical energy supply sector that is vital to economic vitality and a robust quality of life in the South. Clean coal technologies and advanced power systems hold the key to continued operation of the coal capacity of the southern region in an environmentally responsible manner. Not only has the regulatory and legal framework evolved over this project life, but technological improvements in the deployment of clean coal have been enabled partially through the work of this regional effort.

Interstate and intrastate conflicts over water quality, use, and supply have increasingly troubled state officials and environmental groups from across the South. These conflicts include contemplated inter-basin transfers of water to cities, water pricing systems that penalize smaller communities undergoing economic development, and threats to in-stream quality caused by water withdrawals whose impacts cross state lines. An interstate compact to resolve the Apalachicola/Chattahoochee/Flint River Basin dispute among Georgia, Florida, and Alabama has proven to be a serious undertaking. Groundwater shortages in northeastern Mississippi, central and southern Florida, and the Cumberland Plateau in Tennessee are becoming more severe. If unrestrained and competitive exploitation is allowed to take place in these and similar areas of the region, consequential environmental impacts will alter the region's freshwater resources as well as escalate disputes over access to this vital element of economic growth.

On June 1, 2003, the SSEB and the United States Department of Energy (DOE) entered into a cooperative agreement, instrument number DE-FC26-03NT41717, to establish a regional effort to deploy clean coal technologies. The program has been built on the knowledge and expertise derived from SSEB's existing committees, the Committee on Coal and Advanced Power Systems and the Electric Utility Task Force. Additionally, SSEB entered into subcontracts with the University of Tennessee's Energy, Environment and Resources Center in Knoxville, Tennessee, and Augusta Systems, Incorporated in Morgantown, West Virginia, to accomplish the research goals of the program and to provide the program with a broad, regional perspective.

Electricity production requires reliable, abundant, and predictable sources of water. The SSEB/DOE program provides a forum for discussion of current and emerging water issues that could impact electricity generation in the United States.

The Regional Effort to Deploy Clean Coal Technologies program was organized into two tasks. Task 1.0 focuses on removing barriers or implementing incentives to deploy clean coal technologies in the southern region. Task 2.0 examines the interface between energy and water and the challenges associated with meeting future regional energy demands.

Deliverables

TASK 1: Five (5) deliverables were produced for the subtasks, including:

1. Briefing Packet prepared and reviewed by SSEB's Committee on Coal and Advanced Power Systems and by the Task Force on Electric Utility Restructuring;

2. Briefing sessions (with Briefing Packets) delivered to member Governors at SGA's and SSEB's annual meetings;

3. Briefing sessions (with Briefing Packets) delivered to member State legislators at Southern Legislative Conference annual meetings;

4. Briefing sessions (with Briefing Packets) delivered to member State Regulators and the Interstate Technology Regulatory Committee (ITRC) Working Group;

5. SSEB's participation and State Regulators' participation in Gasification Technologies Council environmental workshops; and

Also, assistance to Governors' offices, State legislators and State regulators, were provided upon request during the duration of this agreement.

All of these deliverables have been provided through a variety of meetings, conferences, discussions, workshops, and written material developed through this program.

TASK 2: Deliverables developed for subtasks include:

1. Briefing packet prepared and reviewed by SSEB's Committee on Coal and Advanced Power Systems and by the Southern Water Supply Roundtable;

2. Summary assessment on the energy-water interface for the Southern region;

3. Summary Report for member Governors, State regulators, and other policy makers on TMDL's implications for coal resource development in the Southern region;

4. Briefing sessions (with Summary Report) delivered to member Governors at the SGA's and SSEB's annual meetings;

5. Briefing sessions (with Summary Report) delivered to member State legislators at the Southern Legislative Conference annual meetings;

6. A visual representation of plant siting patterns and the juxtaposition of impaired or limited opportunity waters;

7. A report assessing the likely availability of freshwater for electricity generation in the SSEB region's states identifies constraints to the region and determines the impact to advanced energy technology deployment;

8. A tabletop exercise plan and scenario for a 1-day workshop; and

9. An issues Report based on the findings of current practice and from the 1-day workshop, outlining broad issues confronting local officials and others in the time of an emergency event affecting energy-related water quality and availability.

Also, assistance to Governors' offices, State legislators and State regulators, were provided upon request during the duration of this agreement.

All of these deliverables have been provided through a variety of meetings, conferences, discussions, workshops, and written material developed through this program.

Experimental

No experimental methods were utilized to conduct the research for the SSEB/DOE Regional Effort to Deploy Clean Coal Technologies program.

Results and Discussion

Task 1.0: Removing Barriers or Implementing Incentives to Deploy Clean Coal Technologies in the Southern Region

SSEB regularly provided southern governors, state legislators, and state regulators with the identification of barriers and incentives to deploy clean coal technologies in the southern region throughout the program period. To accomplish this task, SSEB utilized the membership of its Committee on Clean Coal and Energy Technologies Collaboration (formerly the Committee on Coal and Advanced Power Systems) and the Electric Utility Task Force (formerly the Task Force on Electric Utility Restructuring). Information provided to the Committee and Task Force assisted state officials in recommending policies and positions that provided incentives and/or removed barriers to future deployments of clean coal technologies.

Subtasks under this work element centered upon three areas of importance to SSEB's leadership including fossil fuels in a restructured electricity market; fuel diversity and energy security; and emerging clean coal issues. In addition, SSEB continued its work with the Gasification Technologies Council on environmental workshops.

Subtask 1.1: Fossil Fuels in a Restructured Electricity Market

SSEB worked with State decisions-makers to identify aspects of regional wholesale electricity markets and newly emerging regional transmission organizations (RTOs) that could have positive or negative impacts upon the future development of coal resources within the southern region.

Southern States Energy Board has participated in numerous workshops, presentations, conferences, and other venues to describe and explore the complexities of the regional electricity markets, electric system reliability issues, transmission organizations, and other transmission-related issues and their impacts upon the future development of coal resources within the southern region. These conversations also explored the dynamics of coal development in a world of renewable energy development and the potential for portfolio

standards, alternative energy tax credits within the context of a robust state energy planning process.

Examples of this interaction include presentations and discussions with groups such as:

- North American Regulatory Utility Commissioners Electric Utility Council (2008);
- 2008 Bonbright Conference to utility commissioners in the southern states (2008);
- Energy Policy Leadership Summit, utility commissioners' discussions of relevant planning issues (2008);
- Georgia legislative committee on Energy (March 2008);
- West Virginia Energy Committee;
- PJM Board on interconnection issues (September 2006);
- Arkansas legislative committee on energy (2009);
- Virginia Energy and Sustainability Conference (2007);
- *Modernizing the Grid in the Southeast* to Modernizing the Grid Southeast Summit in Nashville, Tennessee August 2006; and
- *Modernizing the Grid in the Southeast: Regional Electrical Transmission and Distribution Issues* to the National Academies of Science Electric Utility Restructuring Task Force (February 2008).

SSEB, through its Electric Utility Restructuring Task Force, submitted extensive comments to DOE on the issues of electricity restructuring and related issues in 2004 and 2005.

Subtask 1.2: Fuel Diversity and Energy Security

SSEB worked with State decision-makers to assess the role of fuel diversity and clean coal technologies in regional adequacy requirements. FERC included resource adequacy requirements as an element of its Standard Market Design Notice of Proposed Rulemaking (NOPR).

SSEB worked with private sector participants who plan, finance, and construct energy production facilities to assess the role of fuel diversity and clean coal technologies in their planning processes within the southern region.

From a quarterly technical progress report early in the program, the following comments were provided to state decision makers.

> *"State and federal initiatives to restructure the electric utility market have impacted the coal industry. Under rules proposed by the Federal Energy Regulatory Commission (FERC) in 2002 to implement retail access, resource planning adequacy reviews set out a five year planning horizon, and tended to reflect the preference of short-lead-time gas generation projects. World events, coupled with rapid increases in the price of natural gas, have resulted in a renewed interest in coal utilization. Clean coal technologies provide an attractive option for diversifying the current fuel mix for power generation.*
>
> *Just about one half of the states have adopted enabling legislation or issued a regulatory order to implement retail access of electricity. States on the extreme west coast and east coast were the first to restructure the electric utility industry.*

The degree to which there is true customer choice in the states that have restructured the electric utility industry is question. Several of these states have rate caps or some other type of controls on rates so that the true market has yet to be in play.

SSEB noted that the member states of the Southern States Energy Board Texas, Maryland and Virginia have retail access either currently available to all or some customers. Arkansas and Oklahoma have either delayed the restructuring process or the implementation of retail access. In West Virginia, legislation authorized the Public Service Commission to develop a restructuring plan but the Legislature and the Governor have not approved the plan. The WV legislature has yet to resolve the tax issues of the PSC's plan and no activity as occurred since early in 2001. The remaining SSEB member states are not actively pursuing restructuring. Those states are Alabama, Florida, Georgia, Kentucky, Louisiana, Mississippi, Missouri, North Carolina, South Carolina, and Tennessee.

SSEB compiled information showing that about one half of the states have adopted enabling legislation or issued a regulatory order to implement retail access of electricity. SSEB briefed state legislators on electricity restructuring issues and clean coal technologies during annual meeting of the Southern Legislative Conference."

Subtask 1.3: Emerging Clean Coal Issues

SSEB distributed information on emerging clean coal technologies to state regulators and legislatures and provided regular briefings on regional efforts to deploy clean coal technologies and on the Energy-Water Interface in meeting future energy demands in the southern region. Beginning in August 2003, project managers delivered annual presentations to the Board, its Associate Members (AM) and Utility Advisory Committee (UAC), legislators and regulators on the NETL-sponsored Water-for-Energy program and distributed information on emerging clean coal technologies. Table 1 summarizes the dates and locations for both the SSEB Annual Meeting (including briefings to governors, legislators and state policy-makers) and the SSEB Annual Briefing to Legislative Members (held in conjunction with the Southern Legislative Conference's Annual Meeting). It is important to note that the UAC discontinued in 2004 and presentations to this committee ended in 2004. Meetings of the Associate Member briefings also are shown in the table.

Table 1. SSEB Annual Meeting and Annual Briefing to Legislative Members Dates and Locations. These presentations provided state regulators and legislators with information on emerging clean coal technologies and the implications of the energy:water interface in meeting future energy demands in the Southern region.

SSEB Annual Meeting *(Board, Legislators, Regulators, AM, UAC)*		
Date	**Meeting Title**	**Location**
September 20, 22, 2003	SSEB 43rd Annual Meeting	Charleston, WV
September 11-13, 2004	SSEB 44th Annual Meeting	Richmond, VA
August 27-29, 2005	SSEB 45th Annual Meeting	Greensboro, GA
July 14-17, 2006	SSEB 46th Annual Meeting	New Orleans, LA
August 24-27, 2007	SSEB 47th Annual Meeting	Biloxi, MS
August 8-11, 2008	SSEB 48th Annual Meeting	White Sulphur Springs, WV
SSEB Annual Briefing to Legislative Members *(Legislators, Regulators, AM, UAC)*		
Date	**Meeting Title**	**Location**
August 10, 2003	SSEB Annual Briefing to Legislative Members	Fort Worth, TX
August 15, 2004	SSEB Annual Briefing to Legislative Members	Richmond, VA
July 30, 2005	SSEB Annual Briefing to Legislative Members	Mobile, AL
July 29, 2006	SSEB Annual Briefing to Legislative Members	Louisville, KY
July 14, 2007	SSEB Annual Briefing to Legislative Members	Williamsburg, VA
July 11, 2008	SSEB Annual Briefing to Legislative Members	Oklahoma City, OK
SSEB Annual Briefing to Associate Members		
Date	**Meeting Title**	**Location**
February 23, 2004	SSEB Associate & Utility Member Meeting	Washington, DC
February 25, 2005	SSEB Associate & Utility Member Meeting	Washington, DC
March 6, 2006	SSEB Associate & Utility Member Meeting	Washington, DC
February 26, 2007	SSEB Associate & Utility Member Meeting	Washington, DC
February 25, 2008	SSEB Associate & Utility Member Meeting	Washington, DC

SSEB assisted in identifying model laws and/or regulations that can provide incentives or remove barriers to the deployment of emerging clean coal technologies.

At the Southern States Energy Board Winter Meeting in 2005, SSEB members and associates discussed implications of the pending mercury rule and its relationship to clean coal technologies. During the meeting, the Board set up an ongoing task of monitoring the anticipated mercury rule and its impact on coal and clean coal technologies in the southern states.

The 2003 Energy Policy Act authorized Federal loan guarantees for designated coal gasification projects. A majority of the financial incentives related to biomass and coal gasification technology implementation within the region are supported by Federal legislation, including the Energy and Water Appropriations Bill and Department of Energy's Clean Coal Power Initiative.

In January 2004 EPA proposed the Utility Mercury Reductions Rule for controlling mercury emissions from power plants. The Utility Mercury Reductions Rule proposal, in combination with the Interstate Air Quality Rule proposal, creates a multi-pollutant strategy to improve air quality throughout the U.S.

The Utility Mercury Reductions rule would permanently cap emissions from coal-fired power plants. EPA proposed two alternatives for controlling mercury. One approach would require

power plants to install maximum achievable control technology. A second approach proposed by EPA would create a market-based "cap and trade" program. States may choose to adopt the cap-and-trade program to achieve and maintain the necessary emission budgets.

On March 15, 2005, EPA issued its long-awaited rule limiting mercury emissions from coal-fired power plants. The regulatory approach creates a cap-and-trade program for mercury that will be implemented in two phases: the first phase cap is 38 tons beginning in 2010, with a final cap set at 15 tons beginning in 2018.

In conjunction with this program, SSEB was involved in discussions about these issues with a variety of stakeholders and key decision-makers.

Subtask 1.4: Gasification Technologies Environmental Workshops

SSEB assisted NETL and the Gasification Technologies Council in promoting gasification technologies in the Southern region and in organizing the participation of state and local stakeholders in gasification environmental workshops. SSEB provided support in disseminating the information presented at gasification environmental workshops to members of the SSEB and state government regulators within the southern region.

The Southern States Energy Board participated in periodic Gasification technologies Council meetings and assisted the Gas Technology Institute (GTI) in organizing its workshop and plant tours. SSEB also arranged participation of state regulatory officials in the workshops sponsored by the Gasification Technologies Council, the U.S. Department of Energy, the U.S. Environmental Protection Agency, Southern States Energy Board and the National Association of Regulatory Utility Commissioners to acquaint state officials and others with gasification technologies.

Private industry leaders have contributed to clean coal technology research and development from Chevron/Texaco's study of mercury reduction of syngas to the GTI's research of feedstock conversion, product-gas clean-up, and the use of gaseous fuels in fuel cells and turbine engines. SSEB monitored the development of the next generation of gasification technologies and progress of the Administration's FutureGen research facility (gasification technology capable of capturing CO2 emissions for long-term sequestration). Workshops included one in Indianapolis, Indiana June 8-9, 2004; Knoxville, Tennessee April 12-13, 2005; and presentation on capturing CO2 in IGCC at the Gasification Technologies Council meeting in Tampa, Florida March 2-3, 2006.

The Southern States Energy Board also assisted the Gasification Technologies Council in organizing Wabash plant tour in Indianapolis, Indiana during its June 2004 workshop.

Task 2.0: The Energy-Water Interface and Challenges Associated with Meeting Future Energy Demands in the Southern Region

SSEB worked with the Southern Water Supply Roundtable (SWSR) and the Task Force on Electric Utility Restructuring (EUR) to address issues related to the energy-water interface. SWSR and EUR provide unique regional forums to:

- Inform decision-makers on the interdependence of energy security and water availability.

- Develop valuable data on water supply and exchanging information on water use in a regional setting.
- Assess the role of water in siting new and repowered generating capacity.
- Evaluate innovative water use programs, such as produced water from Eastern coal bed methane and mine pool water from underground coal mines.
- Assess energy impacts that may result from emerging Total Maximum Daily Load (TMDL) regulations and trading programs.

Working with various stakeholder groups, SSEB has developed several reports during the contract period covering issues of energy supply and water usage. The June 2004 report *Regional Efforts to Deploy Clean Coal Technologies: Impacts and Implications for Water Supply and Quality* and the June 2008 report *Freshwater Availability and Constraints on Thermoelectric Power Generation in the Southeast U.S.* both address these and other issues surrounding the energy-water interface and challenges facing the southern region in ensuring adequate electrical generation in the future. Results of these reports have been widely distributed among the stakeholders in the South and discussed at stakeholder meetings. The report *Energy-Water Interface Challenges: Coal Bed Methane and Mine Pool Water Characterization in the Southern States Region* was released in 2004.

In addition, in April, 2007, SSEB coordinated a tabletop exercise with water, energy and emergency management professionals exploring responses during crises as energy facilities are impacted by weather events, leading to interruption of energy supply to water and waste water treatment facilities and other infrastructure impacts. The subsequent report and outreach at stakeholder meetings provided the results of that workshop and helped educate key stakeholders about the issues facing water, energy and emergency service providers during a crisis.

Subtask 2.1: Role of Water in Siting New and Repowered Generating Capacity

SSEB gathered information on the siting of new power plants and on plans to repower existing generating units.

SSEB assessed data on a continuing basis to determine if water availability (including drought conditions) or water quality issues are impeding the ability to site new coal-fired electricity generation in the region. Follow up (qualitative) interviews were conducted in cases where sponsors appeared to be unable to obtain water permits.

SSEB assessed data to determine if current and future water regulations, in particular 316(b) Phase II, is impeding the operation or repowering of power plants in the region.

SSEB disseminated data and assessments to member Governors, State legislators and State regulators.

As reported in June 2008, there are numerous constraints limiting the supply and availability of freshwater for use in thermoelectric generation. Within the southeastern region each state experiences its own constraints upon available freshwater resources. States are susceptible to freshwater shortages for a multitude of reasons including drought conditions, growing population, and increasing electrical and water demand. For purposes of this report, possible constraints affecting the region fall into one of four categories: hydrologic, societal, economic, and policy constraints.

Hydrologic constraints include ground water depletion; water quality degradation, including groundwater; surface water challenges and consumptive water uses; and desalination impacts. Economic constraints include the impacts of additional nuclear power plants; clean coal technology; developing liquid fuels from coal; ethanol production; the impacts of wind generation; and TMDL limits. Finally, policy constraints include the ongoing state water wars and stakeholder competition for the right to use water for their individual, sometimes directly competitive purposes.

In the earlier report, interviews and survey instruments were key to developing an understanding of stakeholder perceptions regarding the role of water in deployment of clean coal technologies within the region. The state agency survey contained 16 questions covering various aspects of siting and operational regulations; while the power producer survey contained 68 questions on a variety of operational topics related to siting decisions; water, environmental and economic factors affecting siting; and the status of decisions regarding the siting and operation of coal-fired power plants in the region. The following results are germane to the discussion:

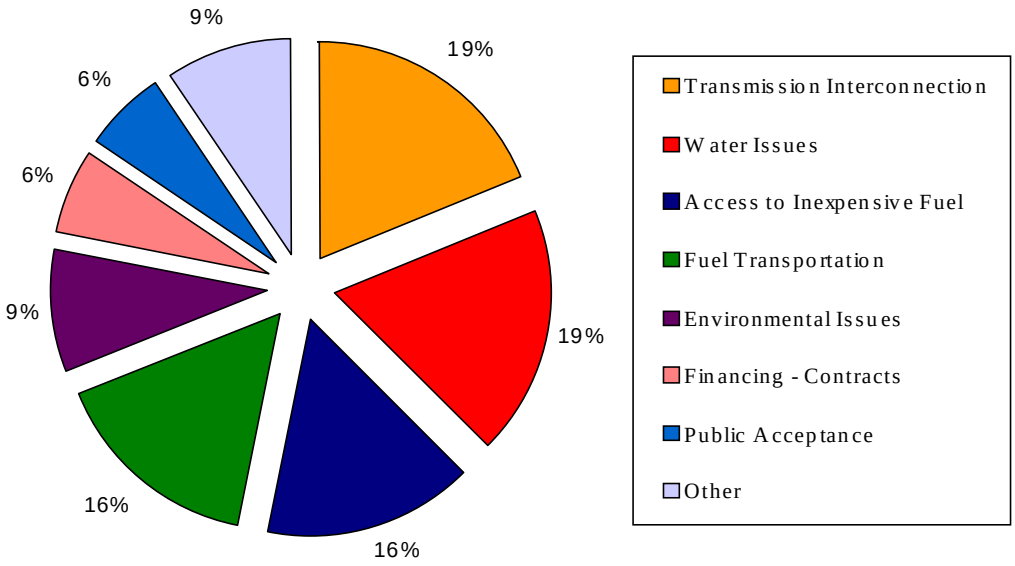

Figure 1. Most important criteria for siting coal plants.

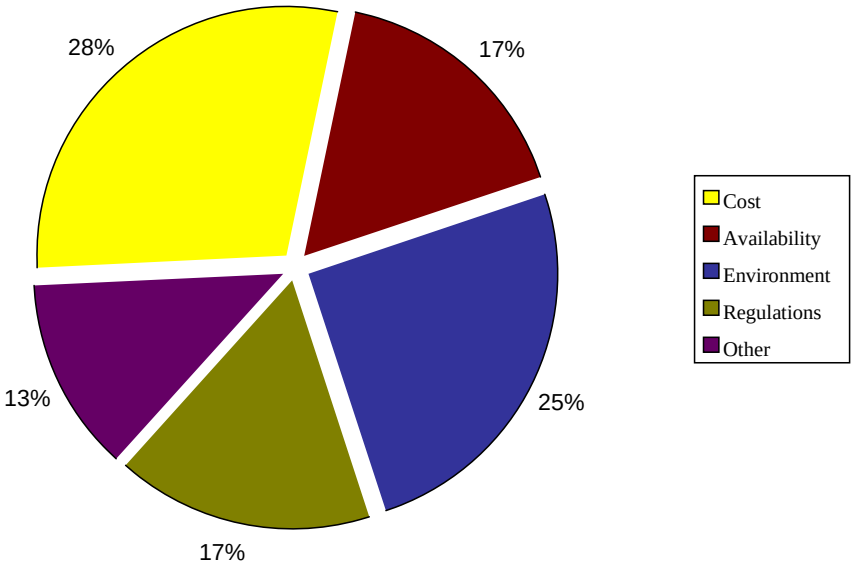

Figure 2. Factors that determine chosen fuel type.

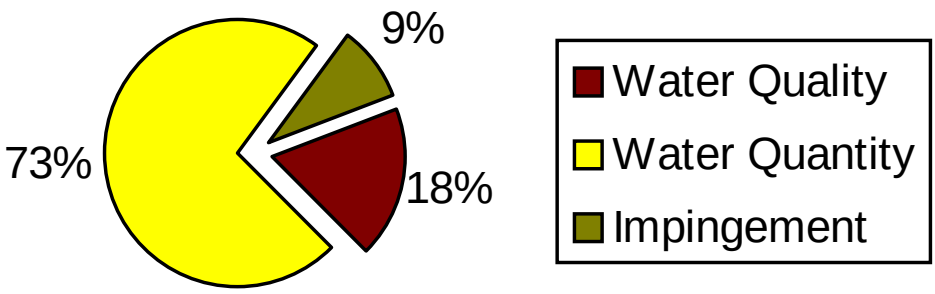

Figure 3. Role of local water issues in siting the power plant.

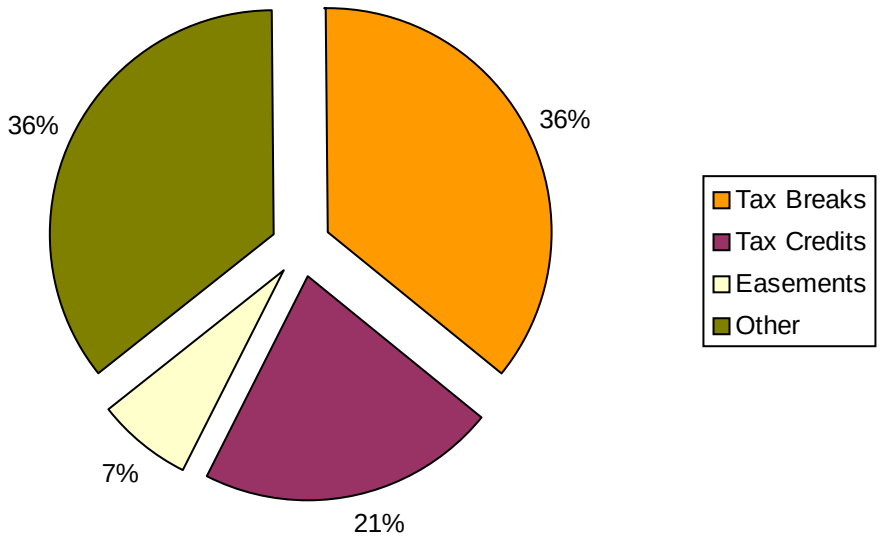

Figure 4. Economic incentives to use waste water.

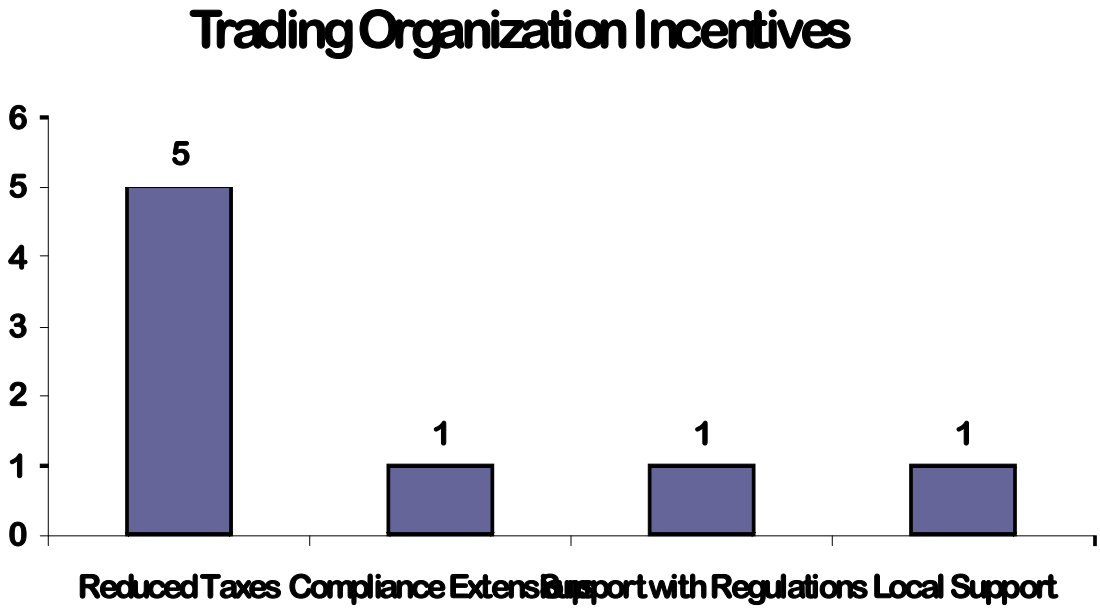

Figure 5. Trading Organization Incentives.

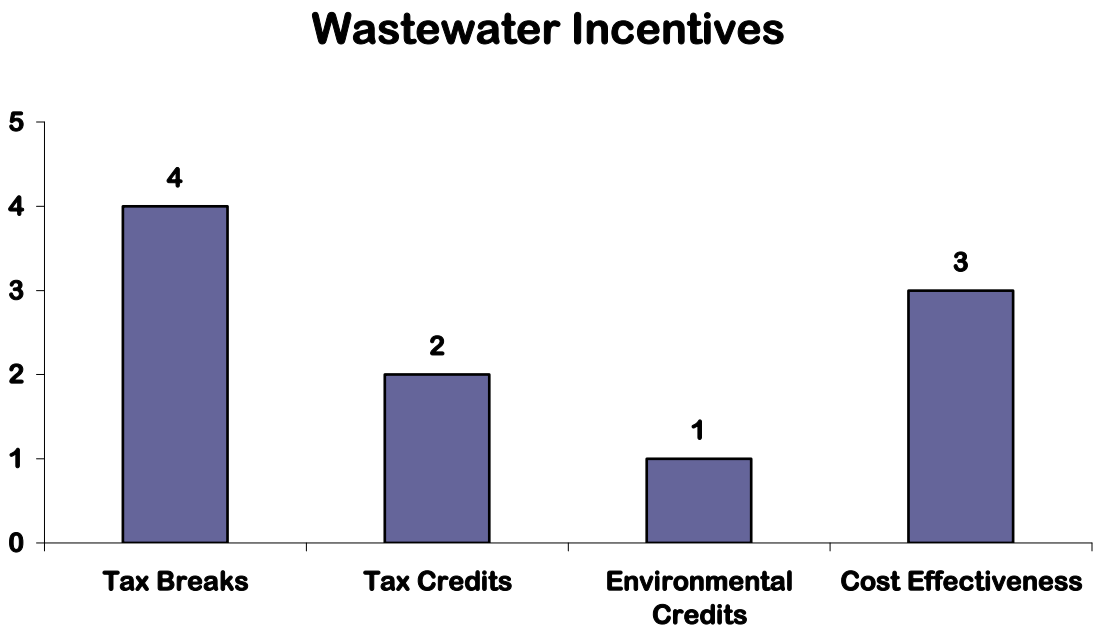

Figure 6. Waste Water Incentives.

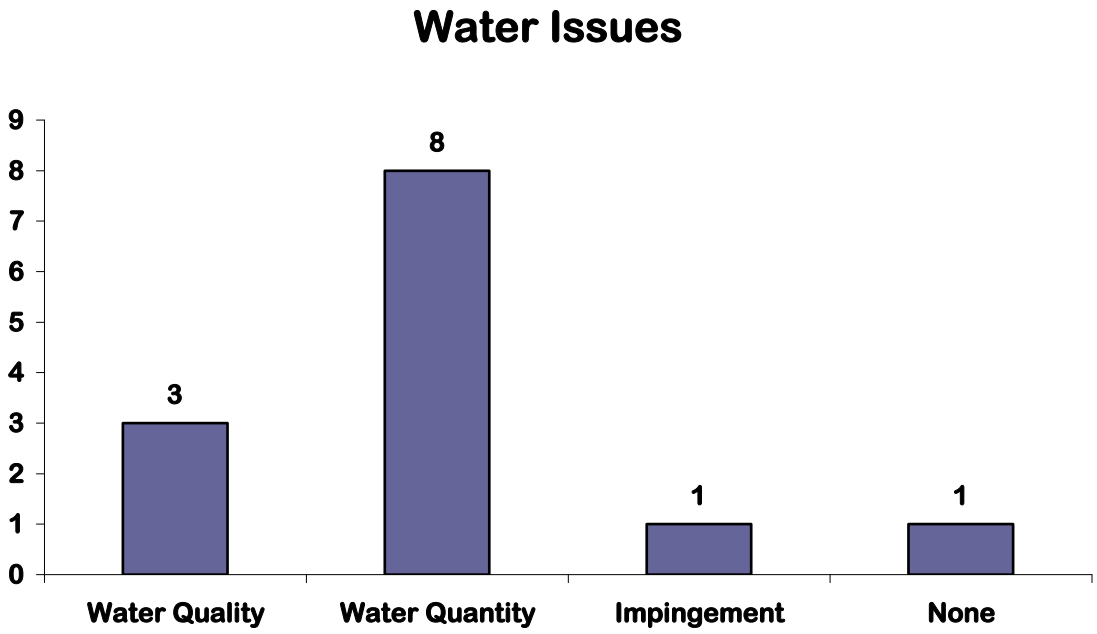

Figure 7. Water Issues.

Subtask 2.2: Clean Coal Technology and TMDL Policy Development

SSEB reviewed state programs being developed for total maximum daily load compliance [Section 303(d) of the U.S. Clean Water Act requires states to establish TMDLs for any stream that fails to meet federal water quality standards].

SSEB worked with the Southern Water Supply Roundtable and electric utilities in the region to assess potential impacts of state TMDL programs, in particular emerging credit trading programs, upon future development of coal resources and coal-fired power generation in the region.

SSEB provided member Governors, State legislators and State regulators with information on potential barriers and opportunities that TMDL programs, including water-credit trading programs, may impart upon coal-based electric power generation.

In this effort, discussions were held with stakeholders involved in the use of degraded water as a water resource in power production, as well as continued investigation into the effectiveness of current water trading programs. Several aspects of coal-fired power generation and production affecting implementation and enforcement of state TMDL programs were reviewed. Consideration was given to several alternatives to current methods of mitigating pollution sources, such as those relating to agricultural and other non-point sources of pollution.

The development of state TMDL programs has many implications for the siting of coal-fired power production facilities. Currently 40% of the nation's water bodies are impaired. Although many industrial and commercial applications require water withdrawals, thermoelectric withdrawals comprise 48% of the total water withdrawals in 2004 (totaling approximately 269 billion gallons per day. Approximately 3% of this total is lost through processes such as cooling.)

Most SSEB member states have approved and developed TMDL programs, and are in various stages of implementing TMDLs for impaired watersheds TMDL programs will affect permitting and siting processes for coal-fired power plants in the future, as they do currently.

Most current permit holders are unaware of changes in state water permitting process and the TMDL program. Specific concerns for coal-fired power plants include temperature, pH, and the overall concentration of effluent at the point of emission (e.g., mercury) whether through air deposition or water. While there is considerable debate over how much coal-fired power plants contribute to the problem of mercury deposition leading to impaired waters, regardless of the source of mercury in impaired waters, the very presence of this substance imposes a limiting factor on future permitting of new industrial facilities that emit mercury – including coal-fired power plants.

TMDL programs involve citizen input before finalization. Efforts to include local stakeholders in the process of development, implementation, monitoring, and evaluation of TMDL programs provide a more holistic approach to watershed management. Incorporating local imperatives is key to establishing successful TMDL programs and has also provided one principal incentive for the growth of non-conventional, non-regulatory means of compliances – including pollutant trading and the use of best management practices (BMPs).

Total Maximum Daily Load Programs

The 2004 report explored the relationship between coal-fired power producers in general (including CCTs) and development of state TMDL programs, including a brief summary of some innovative TMDL programs within SSEB states. Also highlighted were emerging issues concerning the implementation of state TMDL programs that affect coal-fired power production in general, as well as CCT processes.

The map - *Southern States Coal-fired Power Plants and 303(d) Listed Waters* - depicts major watersheds in the region, and identifies four major variables of concern to our discussion. These are: 1) 303(d) listed ("impaired") waters as identified by states using criteria established by the U.S. EPA under the federal Clean Water Act; 2) a further breakdown of principal contaminants under which these streams are listed (i.e., sediment, temperature, mercury, metals – the last three of particular relevance to electric power production); 3) counties in SSEB states; and 4) counties in the SSEB region is which coal-fired power plants are located.

The map shows that several counties with coal fired plants are located on 303(d) listed streams; especially parts of Arkansas, Louisiana, Missouri, Florida, Oklahoma, Texas, and West Virginia. Temperature (heat) as a pollutant is a problem throughout the region, especially in parts of Missouri and North Carolina.

TMDL Issues Related to Coal-Fired Power Production

The development of state TMDL programs depicted in the map has many implications for the siting of coal-fired power production facilities. Currently 40% of the nation's water bodies are impaired. Although many industrial and commercial applications require water withdrawals, thermoelectric withdrawals comprise 48% of the total water withdrawals in 2004 (totaling approximately 269 billion gallons per day.

The formula used to determine a TMDL by state regulators is:

Wasteload Allocation (From Point Source)	**+**	Load Allocation (From Non-point source)	**+**	Margin of Safety

Most SSEB member states have approved and developed TMDL programs, and are in various stages of implementing TMDLs for impaired watersheds. TMDL programs will affect permitting and siting processes for coal-fired power plants in the future, as they do currently.

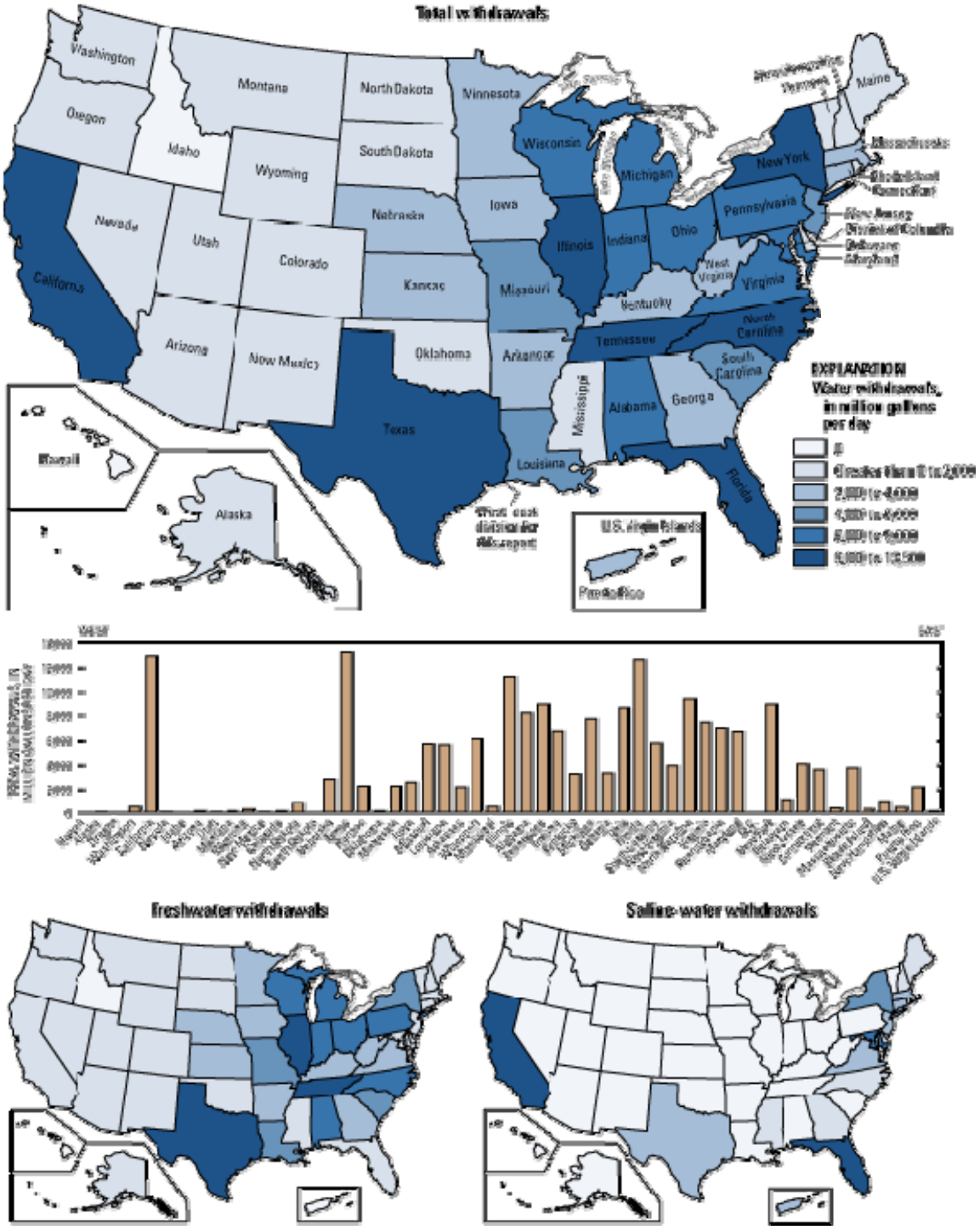

Figure 8. Total Water Withdrawal Data 1950-2000.
Source: http://water.usgs.gov/pubs/circ/2004/circ1268/htdocs/figure12.html

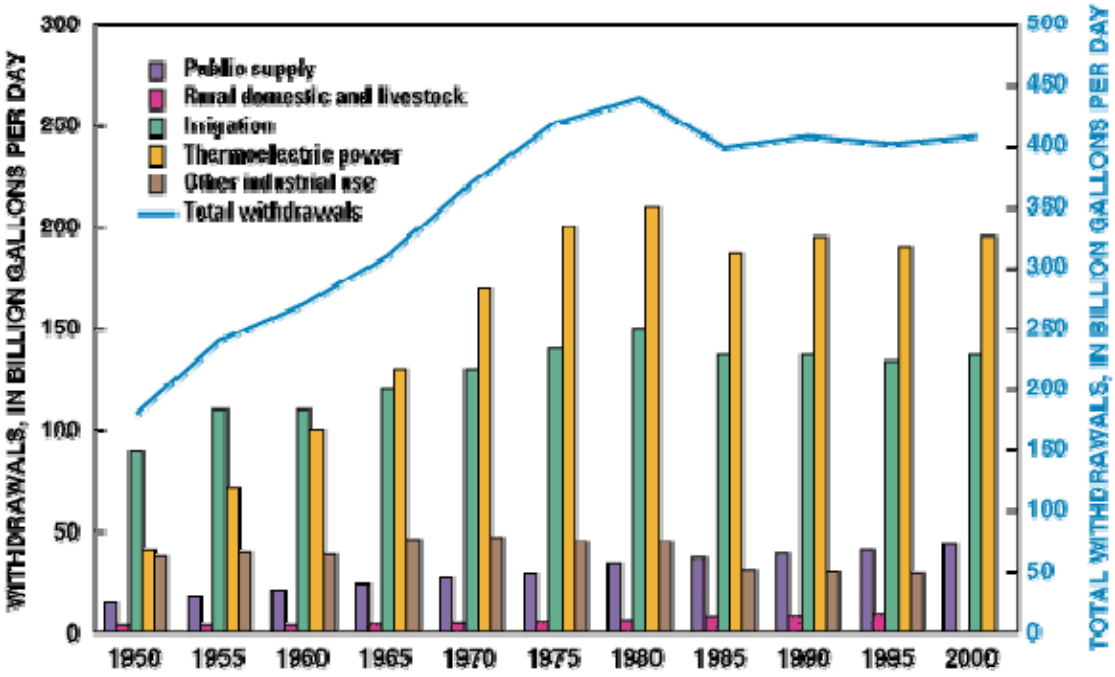

Figure 9. Trends in total water withdrawals by water-use category, 1950-2000.
Source: http://water.usgs.gov/pubs/circ/2004/circ1268/htdocs/figure14.html

Table 2. SSEB TMDL Websites and Contacts.

State	EPA Region	State Agency	Bureau/Division/ Office	Contact Person	Contact Phone/Address	Website
AL	Four	Department of Environmental Management	Division of Water	Chris Johnson clj@adem.state.al.us	(334) 271-7827 P.O. Box 1463 Montgomery, AL 36130-1463	http://www.adem.state.al.us/WaterDivision/WQuality/WQMainInfo.htm
AR	Six	Department of Environmental Quality	Water Division, Water Quality Planning Branch	Bob Singleton singleton@adeq.state.ar.us	(501) 682-0660 1 State Plaza Drive P.O. Box 8913 Little Rock, AR 72219-8913	http://www.adeq.state.ar.us/water/tmdls/default.htm
FL	Four	Department of Environmental Protection	Watershed Assessment Section	Jan Mandrup-Poulsen jan.mandrup-poulsen@dep.state.fl.us	(850) 245-8448 2600 Blair Stone Road Mail Station 3555 Tallahassee, FL 32399-2400	http://www.dep.state.fl.us/water/tmdl/index.htm
GA	Four	Department of Natural Resources	Water Protection Branch, TMDL Implementation Office	Vince Williams Vince_williams@mail.dnr.state.ga.us	(404) 675-1752 4220 International Parkway Suite 101 Atlanta, GA 30354	http://www.dnr.state.ga.us/dnr/environ
KY	Four	Natural Resources and Environmental Protection Cabinet	Division of Water	Johnny Gonzales Johnny.gonzales@ky.gov	(502) 564-3410 ext. 431 14 Reilly Road Frankfort, KY 40601	http://www.water.ky.gov/sww/tmdl/default.htm
LA	Six	Department of Environmental Quality	Office of Environmental Assessment Technology, TMDL Program	Barbara Romanowsky Barbara.romanowsky@la.gov tmdl@deq.state.la.us	(225) 219-3557 P.O. Box 4314 Baton Rouge, LA 70821-4314	http://deq.la.gov/technology/tmdl/
MD	Three	Department of the Environment	Water Programs	Melissa Chatham mchatham@mde.state.md.us	(410) 537-3937 1800 Washington Boulevard Baltimore, MD 21230	http://www.mde.state.md.us/Programs/WaterPrograms/TMDL/index.asp
MS	Four	Department of Environmental Quality	Office of Pollution Control, Surface Waters Division	Greg Jackson Greg_jackson@deq.state.ms.us	(601) 961-5098 P.O. Box 10385 Jackson, MS 39289-0385	http://www.deq.state.ms.us/newweb/homepages.nsf

State	EPA Region	State Agency	Bureau/Division/ Office	Contact Person	Contact Phone/Address	Website
MO	Seven	Department of Natural Resources	Water Protection and Soil Conservation Division	Ann Crawford Ann.crawford@dnr.mo.gov	(573) 751-5827 P.O. Box 176 Jefferson City, MO 65102	http://www.dnr.state.mo.us/wpscd/wpcp/wpc-tmdl.htm
NC	Four	Department of Environment and Natural Resources	Division of Water Quality	Michelle Woolfolk Michelle.woolfolk@ncmail.net	(919) 733-5083 ext. 505 P.O. Box 29535 1617 Mail Service Center Raleigh, NC 27699-1617	http://h20.enr.state.nc.us/tmdl
OK	Six	Department of Environmental Quality	Water Quality Division	Steve Webb Steve.webb@deq.state.ok.us	(405) 702-8100 P.O. Box 1677 Oklahoma City, OK 73101-1677	http://www.deq.state.ok.us/WQDnew/tmdl/index.html
TN	Four	Department of Environment and Conservation	Division of Water Pollution Control, Water Management Section	Sherry Wang Sherry.wang@state.tn.us	(615) 532-0656 7th Floor, L&C Annex 401 Church Street Nashville, TN 37243-1534	http://www.state.tn.us/environment/wpc/tmdl
SC	Four	Department of Health and Environmental Control	Environmental Quality Control, Bureau of Water	Kathy Stecker steckemk@dhec.sc.gov	(803) 898-4011 2600 Bull Street Columbia, SC 29201	http://www.scdhec.gov/water
TX	Six	Natural Resource and Conservation Commission	Office of Environmental Policy, Analysis, and Assessment	Faith Hambleton fhamblet@tceq.state.tx.us	(512) 239-1908 ext. 4600 P.O. Box 13087 Austin, TX 78711-3087	http://www.tnrcc.state.tx.us/water/quality/tmdl/
VA	Three	Department of Environmental Quality	Office of Water Quality Programs	Charles Martin chmartin@deq.state.va.us	(804) 698-4462 P.O. Box 10009 Richmond, VA 23240-0009	http://www.deq.state.va.us/tmdl/
WV	Three	Department of Environmental Protection	Division of Water Resources	Jim Laine jlaine@wvdep.org	1201 Greenbrier Street Charleston, WV 25311	http://www.wvdep.org/item.cfm?ssid=11+sslid=188

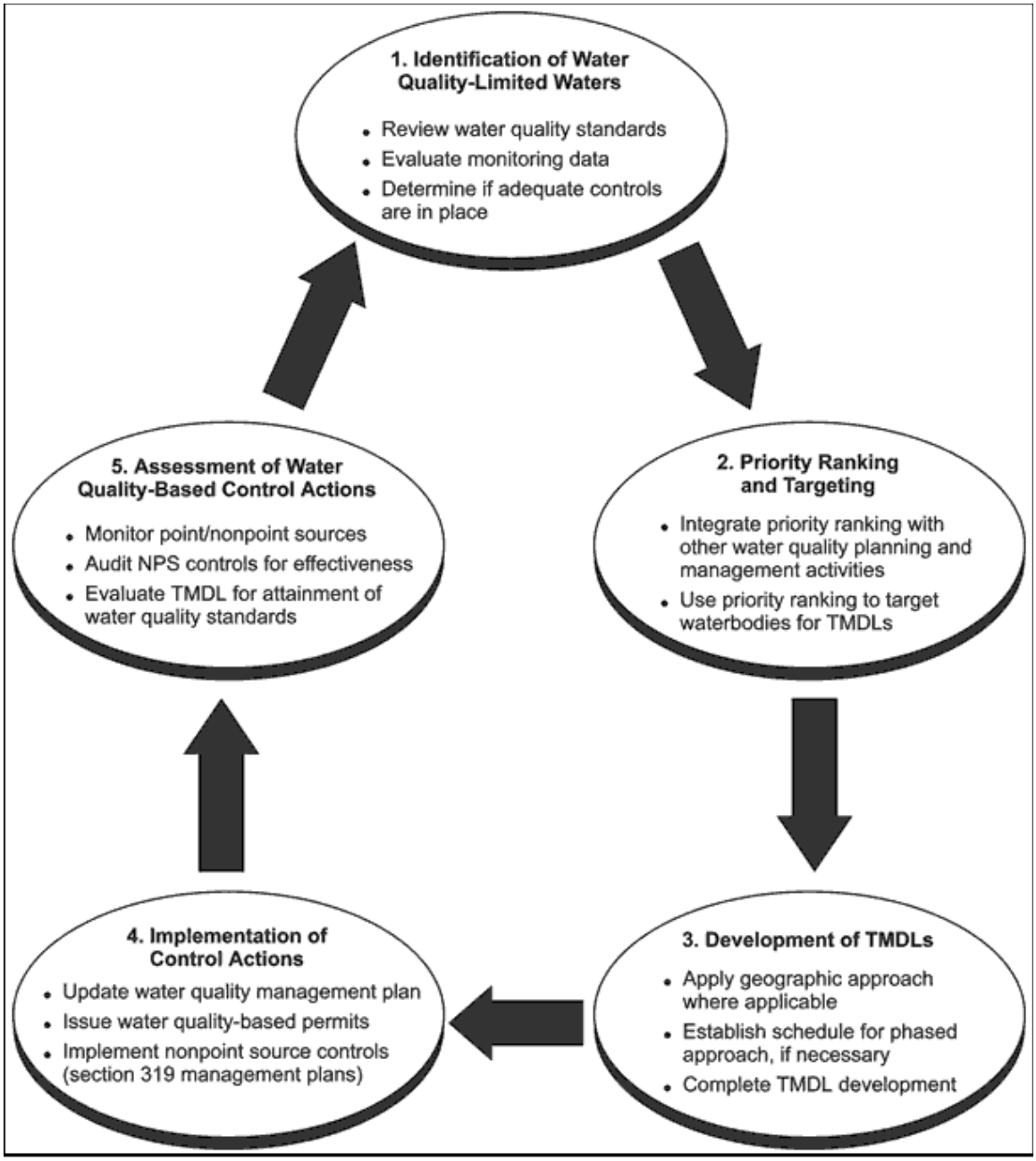

Figure 10. General elements of the water quality-based approach (adapted from USEPA, 1991).

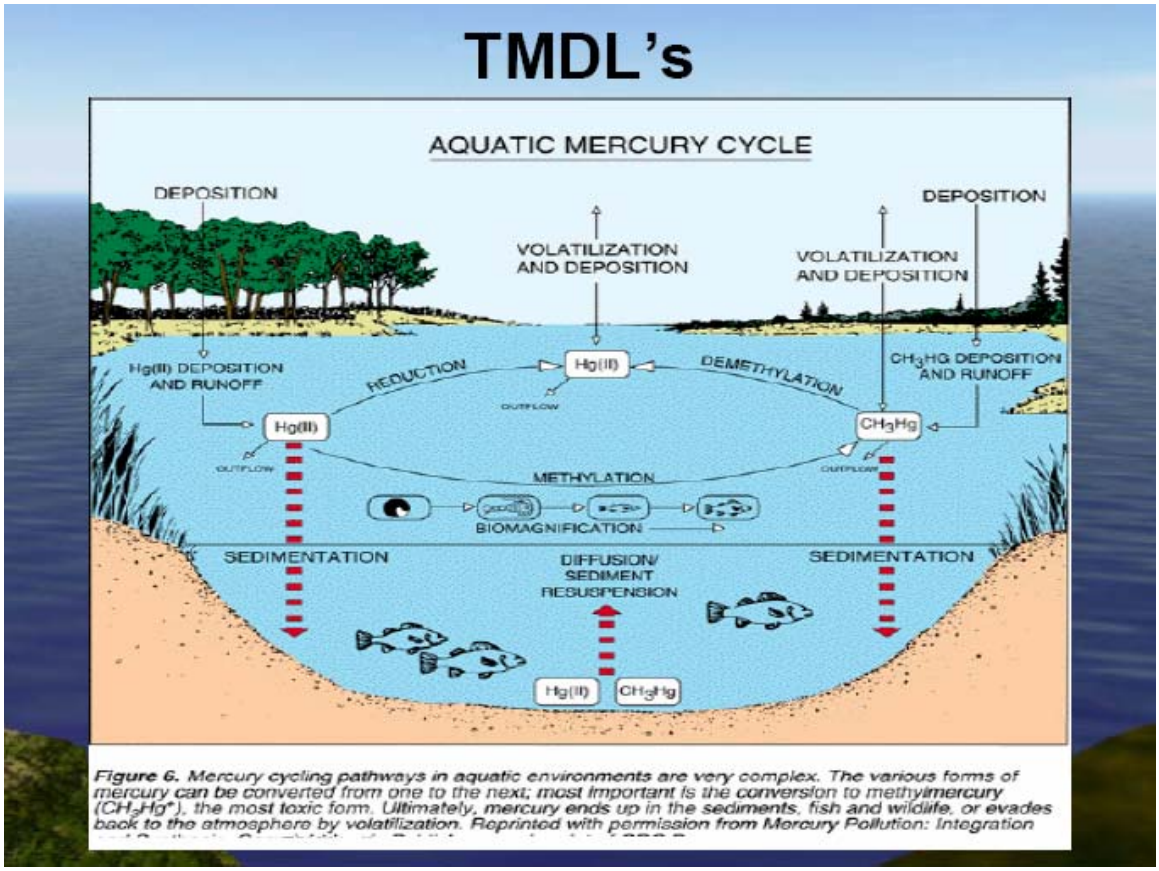

Figure 11. Aquatic Mercury Cycle Diagram.
Source: http://www.netl.doe.gov/coalpower/environment/pubs/Ron%20Hix%20Water%20Tutorial_1.pdf

Subtask 2.3: CBM and Mine Pool Water Resources

SSEB worked with member States, and utilized information developed by the Interstate Oil and Gas Compact Commission (IOGCC) and NETL, to characterize coal bed methane (CBM) water resources in the region (Note: In September 2002 IOGCC and NETL conducted a national stakeholders forum on CBM).

SSEB worked with member States, private companies and NETL to identify information sources and to characterize mine pool water (MPW) resources in the region.

SSEB conducted a qualitative assessment of the region's potential for utilizing degraded CBM and MPW water resources in energy production and electricity generation (Note: SSEB will consult with NETL to determine if the scope of this task should be expanded to include a regional/national stakeholder forum on MPW).

SSEB provided information on CBM and MPW water resource opportunities to member Governors, State legislators and State regulators.

Mine pool water is another degraded water resource that may provide an alternative to additional withdrawals for plant cooling. Mine water can be processed to remove contaminants

such as heavy metals prior to use as cooling resource and can then be released directly back to the mine pool or into the water body (in an open-cycle, or once-through cycle) or can preclude the need for withdrawals by cooling through other innovative measures. In order for mine pool water to be useful as an alternative, a sufficient amount of available water must be sustained over the life of the plant operation. Rough estimates of the volumes necessary to sustain plant operations are 365 million gallons per day for at least 50 years – for a total of over 7 trillion gallons. Mine pool water use can also be used downstream of the source pool.

A report entitled *Energy-Water Interface Challenges: Coal Bed Methane and Mine Pool Water Characterization in the Southern States Region* was a result of this work.

Subtask 2.4: Utilization of Other Degraded Water Resources

SSEB worked with member States, private companies and NETL to identify regional opportunities for utilizing other degraded water resources (e.g., treated municipal wastewater or industrial water discharges) in conjunction with emerging clean coal technologies.

SSEB assisted in identifying model laws and/or regulations that can provide incentives or remove barriers to clean coal technologies that utilize degraded water.

The states of Alabama, Arkansas, Kentucky, Louisiana, Missouri, Oklahoma, Tennessee, Texas, Virginia, and West Virginia are producers of coaled methane. Coaled methane water information for two of the southern states could be found, namely Alabama and Louisiana. Based upon the information provided, it can be estimated that the gas versus produced water rate can range from 0.704 to 1.963 thousand cubic feet / barrel (mcf/bbl).

It seems as though awareness of the danger of abandoned mine land (AML) water after the 2002 Pennsylvania miners' incident has stimulated the investigation of AML water pools in the region of West Virginia and Pennsylvania. In addition, the neighboring state of Kentucky is active in utilizing AML water to supplement municipal water supplies.

If we consider the annual production from the CBM operations in Alabama, approximately 2,481 million gallons of water per year, then that resource would be able to provide cooling water with 2% recirculation capacity for a 400 MW power plant for one year. If transportation costs to move local water from all of the CBM producing wells in the State of Alabama is considered, then the use of the water source is not economically feasible. If we consider the current volume of AML storage in the West Virginia/Pennsylvania region, the water can supply cooling water with 2% circulation capacity to about three 400 MW power plants for 30 years and cooling water with 30% capacity to one 400 MW power plant for 5 years.

Water generated from CBM production is typically placed in on-site holding ponds or re-injected into the well to enhance CBM production. Coalbed methane water information for two of the southern states could be found, namely Alabama and Louisiana. Based upon the information provided, it can be estimated that the gas versus produced water rate can range from 0.704 to 1.963 thousand cubic feet/barrel (mcf/bbl).

Mine pool water, considered a hazardous waste, isolated from underground sources of drinking water by being placed in lined holding ponds or reservoirs. MPW will tend to have higher concentrations of sulfate and dissolved metals.

As an example of water volume, the West Virginia Geological and Economic Survey (WVGES) estimates that there are at least 10,000 – 15,000 abandoned underground mines in West Virginia, and data on the number of underground mines and total volume of water in the mine pools is not well developed. The National Mineland Reclamation Center (NMRC) at West Virginia University (WVU) is conducting a four-year effort to map the underground mines and their associated mine pools in the northern coal field of West Virginia. To date, the NMRC has mapped 130 underground coal mines in both Pennsylvania and West Virginia and has estimated the combined storage volume of these mines to be 250 billion gallons.

A 2003 $7 million project, funded mostly by the state Department of Environmental Protection and the Pennsylvania Infrastructure Investment Authority (PENNVEST) treats and pumps acid water from a mine extending across the border from West Virginia to Pennsylvania. The water eventually will be used for the Longview coal fired power plant's cooling system (located in Morgantown, West Virginia), which will require about 7,000 gallons per minute.

The following is provided as an availability/usage comparison of coalbed methane water versus mine pool water using the information collected and assessed during this task. In Alabama, the CBM produced water of 2,481 million gallons per year cannot support either a 10% or 15% recirculation water capacity whereas the mine pool water in Pennsylvania/West Virginia totaling **o**ver 250 billion gallons of water can support a 10% recirculating water capacity for 20 years and 15% capacity for 15 years.

Subtask 2.5: Regional Assessment

SSEB reviewed NETL's report "Estimating Freshwater Needs to Meet 2025 Electricity Generating Capacity Forecasts" and conduct a regional follow-up to the reported findings. SSEB will survey the likely availability of freshwater for electricity generation in the SSEB region's states. In an effort to build upon the national assessment's hydrological conclusions or extrapolations, SSEB focused on: 1) distinctly regional hydrological constraints (e.g., drought, in-stream flow demands) that are likely to impinge upon water availability for power generation; 2) societal/economic constraints (e.g., water rights and administration issues arising from competing regional water uses); and, 3) other issues that are likely to function as policy constraints – even if not yet fully recognized as such by the power generating community – e.g., transboundary water conflicts, water quality issues.

Thermoelectric power plants – coal, oil, natural gas and nuclear-fueled power generators – require vast quantities of water for steam generation and cooling. For example, a 500-MW coal-fired power plant burns approximately 250 tons per hour of coal while using over 12 million gallons of water per hour for cooling turbine exhaust. As both regional population and economic development continue to grow, the demand for energy and viable water sources will too continue to increase. This growth will inevitably increase the amount of water used by thermoelectric generation plants. The EIA's latest forecast estimates U.S. thermoelectric generating capacity will grow from approximately 709 GW in 2005 to 862 GW in 2030. A large portion of this growth in demand is projected to occur in the southeastern region of the United States.

According to the U.S. Census Bureau, the southeast is the fastest-growing region in the nation. The Southeastern Energy Efficiency Alliance found that in 2001, over 511 thousand privately-owned housing permits were issued to residents of the southeastern region - or 31% of the nation's total permits given to all regions that year. Along with growing population, the region has a growing energy demand. The Federal Energy Regulatory Commission found that the

southeast has the highest per capita electricity consumption of any region in the nation. Three southeastern states – Florida, Tennessee and Texas – are among the largest total (i.e., freshwater and saline water) withdrawers of water for thermoelectric power generation. Texas leads the nation in total withdrawals for this purpose (in 2000, 14.9 million acre-feet per year).

It is evident that the southeast's current rate of growth will impose additional energy demands for the region. Accompanying the certainty of this growth, many questions will arise surrounding available supply and probable demands for the water necessary to support the process of thermoelectric generation. Current and future water-related issues and constraints will impact the availability and efficiency of water sources. In addition, environmental regulations and requirements, regional hydrological constraints (including the possibility of climate change and variability – e.g., periodic drought), and societal and economic restrictions (e.g., siting issues, costs) are sure to challenge the freshwater availability and operation of thermoelectric generation projects.

Subtask 2.6: Update of Impaired and Limited Water Resources

SSEB updated information collected earlier on impaired waters and areas of limited opportunity for energy development within the member states. This information was compared to historic power plant siting patterns to provide a visual representation of regional constraints.

Subtask 2.7: Survey State Environmental Regulators

SSEB conducted a survey of state environmental regulators regarding the role of water availability in energy facility permitting and siting processes. From these contacts SSEB determined the constraints to the region and determined the impact to advanced energy technology deployment.

In development of the 2004 report, SSEB developed an extensive survey on state environmental regulators and other stakeholders regarding the role of water availability in energy facility permitting and siting processes. The survey was also designed to gauge: (1) role of water quality and quantity issues in siting of coal-fired power plants; (2) design choices in regards to clean coal technologies and wastewater use for cooling; (3) issues relevant to development/participation in pollution trading schemes; and (4) *a list of GIS mapping ideas* to depict relevant aspects of water pollution and water supply problems, including, e.g., map showing heat effluents percent by state; layered map of coal-fired power plants (permitted/operating, permitted/in-progress, permitted/denied, and so on; reported impingement problems; chronically low flow watersheds by state.

For the survey, respondents included state agencies including state Public Service Commission's as well as state departments of environmental quality or environmental resource management. Survey recipients from industry included utilities, and generating facilities that used coal in power production processes.

The generating facility survey included any entity in the region that used coal for the production of electric power, regardless of whether that power is generated by the entity for on-site consumption, or distribution and sale to off-site users. These industries were included in the survey sample because: 1) the manufacturing processes they employ use coal for production of power, and entail the same coal and water resources demands for power production as is the case for commercial power producers; and, 2) these above-mentioned users comprise a majority of the coal-for-power users in Southern States Energy Board states.

While the study area in this report was limited to SSEB states, it must be noted that many producers have multiple power-generating facilities within – as well as outside – the region. Among the ten (10) companies that we identified for the study that have multiple power generating facilities located within SSEB states, one survey was sent to the one facility located within the SSEB region – it was sent to the individual identified through telephone contact as being the person primarily responsible for siting power generating facilities.

The state agency survey contained a total of 16 questions covering various aspects of siting and operational regulations; while the power producer survey contained 68 questions on a variety of operational topics related to siting decisions; water, environmental and economic factors affecting siting; and, the status of decisions regarding the siting and operation of coal-fired power plants in the region.

Subtask 2.8: Outreach and Education

SSEB compiled information from Tasks 1.0 & 3.0 into a report format that will be suitable for distribution to local government officials, regional NGOs, state regulators, and state legislative and executive leadership of the SSEB Board and member states. SSEB conducted educational briefings for its legislative and executive membership and staff, state regulators, and state energy offices.

Numerous meetings, presentations, discussions have been held in conjunction with this activity, in a multitude of formats that engaged federal and state regulatory officials; utility officials; state energy and environmental officials; legislators; governors; industry representatives; and other stakeholders in an attempt to fully expand the understandings of the stakeholders about the issues addressed in this work.

Subtask 2.9: Energy and Potable Water

SSEB, in conjunction with other stakeholders, sponsored a highly interactive tabletop exercise in April, 2007 at which water, energy and emergency management professionals came together to explore responses each sector should make in times of crisis as energy facilities are impacted by weather events, leading to interruption of energy supply to water and waste water treatment facilities and other infrastructure impacts. Some 90 representatives of electric and gas utilities; water and watershed management; state energy, environmental and emergency response officials; the U.S. Army Corps of Engineers; Federal Emergency Management Agency; and national water management associations met to review best practices and explore solutions to a scenario that included a series of tornadoes that moved through the city of Decatur, Georgia, up through the Atlanta region over a 24 hour period. Representatives from 12 SSEB states participated in the event.

The exercise included presentations on the basics of the electricity supply system, water and waste-water systems and emergency local and state energy assurance guidelines. Participants were briefed on the issues and challenges faced by agencies and private organizations during response and coordination efforts. Real situations explored included how electric utilities respond to a tornado watch at 3:00 a.m. and when do backup generators go online at the water utility?

The Blackwater exercise helped participants explore these issues in great details, resulting in a better coordinated, better prepared response team ready to react when the next weather event

occurs. Participants were also briefed on the issues and challenges faced by local, state and federal agencies and private organizations during response and coordination efforts. Geographical information was presented in map form which included water and wastewater treatment plants in the southeast; key pipelines from the Gulf of Mexico through the mid-Atlantic; and the electric infrastructure, including major generating facilities and voltage lines. This information was key to the interactive process of the tabletop exercise in helping participants visualize the impacts of the weather events. The following Summary Table describes actions to improve energy:water relationships and responses to critical situations.

Table 3. actions to improve energy:water relationships and responses to critical situations.

Issue	Response / Organization
Need for backup fuel supply to operate backup generators	**-Increase backup fuel supply at waste-water facility and other related facilities**
Need improved telecommunication infrastructure	**-Explore use of wireless, Wireless Priority Service (WPS) and GETs cards (providing land line priority service)** **-Explore Telecommunications Service Priority (TSP) program**
Language barrier issues exist within public communications, especially in metropolitan areas with large immigrant population	**-Use language banks to help real-time communications** **-Use language banks and professional translations to develop brochures and educational tools for various languages** **-Public announcements must be made in multiple languages and on the media that reaches most people**
Public communications should be thorough and simple for the public to understand	**-Public must be provided basic information and advice following disruption to services** **-Coordinating agencies need access to basic information such as NOAA weather information** **-Inform public about their pets and how to care/ evacuate them if needed**

Issue	Response / Organization
Planning processes and agency coordination is inefficient or ineffective	**-Utilities should provide leadership and offer full response plans** **-Develop MOUs and MOAs with various entities so the legal framework is available when emergency needs arise** **-Use ongoing briefings including representatives from key players in disaster response (highway patrol, National Guard, municipalities, utilities, health agencies)** **-Develop continual coordination and training processes among agencies such as FEMA, US Army Corps of Engineers, Governors' Office, utilities** **-Designate and develop an 'Incident Commander' system (such as that in the National Response Plan)** **-Water as crucial to fire protection must be considered in recovery plans** **-Develop priority assessment tool similar to US Army Corps of Engineers for decision-making: life-saving; life sustaining; other.** **-Ensure highway patrol coordinates highway openings to clear way for emergency vehicles, fire and police responders or other critical infrastructure issues**
Need for crossover credentials and other inter-jurisdictional issues	**-Develop processes for inter-agency, inter-state regulations and procedures to allow access to critical areas. State emergency officials to coordinate this process overview.**
Need for common language regarding infrastructure basics	**-Develop 'dictionary' of common terms that everyone involved in infrastructure 'rescue' is familiar with** **-Continue to have ongoing educational activities for those from various agencies to be briefed on basics of various aspects of infrastructure**
Some issues are better dealt with at the policy level	**-Review zoning requirements regarding mandatory access to at least one community shelter in each residential manufactured home park** **-Develop a system of 'route-critical' petroleum stations with backup electrical power so they can continue to pump fuel for emergency care** **-Review water:wastewater facility designs with respect to flooding and other similar disasters** **-Develop system of identification for 'critical' customers (such as financial center or telecommunications center) who will likely be responding to weather-related crises**

Issue	Response / Organization
Public Awareness and Education	**-Promote public awareness of their responsibility in emergency situations and to prepare a minimum-self sufficiency 'kit'**
Training & Preparation	**-Review and continually monitor status of emergency infrastructure communications and response capabilities including emergency generators at public locations (fire stations, e.g.)** **-Develop ongoing, routine coordination group meetings for discussion, training, organization of effective multi-state response**
Organizational Actions (based on workshop exercise)	**-Promote additional energy and water emergency drills and exercises** **-Develop dedicated staff to manage Emergency Operations Personnel** **-Add water representatives to team of key personnel involved in emergency management functions** **-conduct table-top exercises locally** **-review energy assurance plans for local applicability and need for updates** **-develop outreach plan** **-upgrade UPS for SCADA** **-Introduce local ordinances requiring hospitals to have roof-top water reserve tanks.**

Conclusions

The Southern States Energy Board's "Regional Effort to Deploy Clean Coal Technologies" program began on June 1, 2003, and was completed on January 31, 2009. The project proved beneficial in providing state decision-makers with information that assisted them in removing barriers or implementing incentives to deploy clean coal technologies. This was accomplished through two specific tasks: (1) domestic energy security and diversity; and (2) the energy-water interface.

Milestones accomplished during the project period are listed below.

- Presentations to Annual Meetings of SSEB Members, Associate Member Meetings, and the Gasification Technologies Council.
- Energy: Water reports
    - o *Regional Efforts to Deploy Clean Coal Technologies: Impacts and Implications for Water Supply and Quality*. June 2004.
    - o *Energy-Water Interface Challenges: Coal Bed Methane and Mine Pool Water Characterization in the Southern States Region.* 2004.
    - o *Freshwater Availability and Constraints on Thermoelectric Power Generation in the Southeast U.S.* June 2008
- Blackwater Interactive Tabletop Exercise- Decatur, Georgia April 2007

- Blackwater Report: *Blackwater: Energy and Water Interdependency Issues: Best Practices and Lessons Learned*. August 2007.
- Blackwater Report: *BLACKWATER: Energy Water Interdependency Issues REPORT SUMMARY.* April 2008.

References

References for the report are provided throughout the documents.

List of Acronyms and Abbreviations

AM	Associate Members (SSEB committee)
AML	Abandoned Mine Land
BMP	Best Management Practice
CBM	Coalbed Methane
CCT	Clean Coal Technology
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
EUR	Electric Utility Restructuring Task Force (SSEB committee)
FERC	Federal Energy Regulatory Commission
GTI	Gas Technology Institute
IOGCC	Interstate Oil and Gas Compact Commission
ITRC	Interstate Technology Regulatory Committee
MPW	Mine Pool Water
NETL	National Energy Technology Laboratory
NMRC	National Mineland Reclamation Center
NOPR	Notice of Proposed Rulemaking
PENNVEST	Pennsylvania Infrastructure Investment Authority
RTO	Regional Transmission Organization
SSEB	Southern States Energy Board
TMDL	Total Daily Maximum Load
UAC	Utility Advisory Committee (SSEB committee)
WVGES	West Virginia Geological and Economic Survey
WVU	West Virginia University

Appendices

Appendices are not provided for this report.