Energy-Water Central Region Needs-Assessment Workshop

Summary Report

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Results compiled from notes taken by:
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1. Introduction

The Energy-Water Central Region Needs-Assessment Workshop was held November 14-16, 2005, in Kansas City, MO. The workshop is one of three regional workshops (see Figure 1) being held to assess the problems and needs associated with energy and water interdependencies. These workshops are part of a National Energy-Water Roadmap process that is intended to develop a strategy and prioritization of needs and potential solutions for the Department of Energy. Additional information regarding the Energy-Water Nexus and Roadmapping process can be found at www.sandia.gov/energy-water.

Figure 1. Delineation of states for the three regional needs-assessment workshops.

Each of the three regional needs-assessment workshops are intended to solicit issues, needs, concerns, and ideas from users and stakeholders with diverse backgrounds, expertise, perspectives, organizational affiliation, and demographics. Seven categories of user/stakeholder participants were identified for invitation to the workshops:

1) Energy/Power/Utilities (energy mineral extraction, fossil & bio-fuels production, electric power generation)
2) Water Utilities/Water Managers/Water Planners
3) Environmental/Ecological
4) Regulatory/Policy
5) Economics & Economic Development
6) Other Use Sectors (Ag, irrigation districts, mining, industrial)
7) Special Interests, Tribal, State Government associations

Nearly 70 participants representing 14 of the 15 central-region states were present at the workshop. In addition, several representatives from the Executive Committee and national labs also participated in the workshop.

2. Workshop Overview

The workshop began with introductions and a statement from Senator Peter Domenici, Chairman of the Senate Energy and Natural Resources Committee. In his statement, Senator Demenici conveyed the importance of these workshops and the roadmapping process to address problems and needs associated with energy and water interdependencies. An overview presentation (Clifford Ho, Sandia) and a keynote presentation (Robert Goldstein, Electric Power Research Institute) were then presented to set the stage and provide relevant background information regarding the interdependencies of energy and water. The Senator's statement and both presentations are available at the following web site: www.sandia.gov/energy-water/central.htm.

Following the opening presentations, participants were divided into four groups, and the lead facilitator (Conrad Mulligan) provided ground rules and instructions for the participants prior to the breakout sessions. Each group was created to have equal representation from each of the categories of invited participants (utilities, regulatory/policy, environmental, etc.). The formation of the four smaller groups was intended to promote discussion, participation, and coverage within subsequent breakout sessions.

For the remainder of the first day, each breakout group focused on problems and issues associated with energy (Session 1) and water supplies (Session 2). The breakout groups reconvened at the end of the first day and a representative from each group highlighted their findings from Sessions 1 and 2. On the second day, the breakout groups focused on the identification of needs (Session 3) associated with the problems and issues identified on the first day. The final breakout session (Session 4) on the second day allowed participants to suggest opportunities and potential solutions to address the identified needs. At the end of the second day, a representative from each breakout group summarized the major findings for Sessions 3 and 4. A list of participants belonging to each breakout group is provided in Appendix A. Matrices and questions that were used by the facilitator to promote discussion in each breakout session are shown in Appendix B.

The progression of the breakout sessions was intended to identify the "big picture" problem areas first. Once these areas were discussed and identified, specific needs (requirements) associated with these problem areas could be identified. Finally, although the focus of the workshop was on needs and gaps, the participants were allowed to suggest potential solutions to address the identified needs in the last session. An example of the logic behind this process was given to the participants by the lead facilitator as follows:

- **Problem:** My grades and SAT scores are not good enough to get me into the college of my choice.

- **Need:** I need to improve my grades from a 'C' average to at least a 'B' average (Gap 1), and I need to improve my SAT score from a 1000 to a 1200 (Gap 2).

- **Solution:** I will…
  - Take an "Effective Study Habits" course (addresses Gap 1)
  - Enroll in an SAT review course (addresses Gap 2)
  - Stop watching too much TV (addresses both Gaps 1 and 2).

The next section summarizes results from the four breakout groups and sessions.

3. Results from Breakout Sessions

3.1. Sessions 1 and 2: Problem Identification for Energy and Water Supplies

In this first session, each breakout group focused on identifying water-related issues and problems associated with various energy supplies. A summary of water-related energy-supply problems highlighted at the end of the first day are shown in Table 1. The second breakout session focused on water supply, including quality, quantity, and competing uses/demands in the region. A summary of identified water-supply problems are summarized in Table 2 for each group. Additional details and discussions from each breakout group can be found in Appendices C – F.

Table 1. Summary of water-related problems for energy supplies from each breakout group for Session 1

Group	Water-Related Problems for Energy Supplies
A	• Water availability is currently impacting energy availability – Many states are seeing water shortages, especially of surface water from current drought, impacting power generation. Most states are seeing large declines in ground water levels, which are limiting water availability in all sectors, including future energy production and generation. New energy, like biofuels, will take significant amounts of water and demands can not be met. • Cost of Water will be a Limiting Factor in energy development – Rising costs of water will drive up future energy production costs. • Opportunity for Beneficial Use of Produced Water – Use of impaired water, especially produced water from oil and gas and CBNG, may be used for power generation. • Lack of Transmission Availability – Transmission limitations are limiting site locations for power plants. This is limiting

Group	Water-Related Problems for Energy Supplies
	siting of power plants in areas with water and transporting electricity to areas of low water. Transmission is severely limiting use of renewable energy, such as wind, that uses less water. • Lack of Long-term Energy Planning – Lack of long-term water planning in many regions is impacting energy planning. Appears eastern water rights states are doing less water planning and further behind on surface water and ground water availability in each state. Due to economic development issues, many states will not admit water limitations. • Lack of Surface and Groundwater modeling and understanding – No good consistent data on surface water and ground water availability. Monitoring of surface and ground water not keeping up with needs, therefore not making good decisions on water availability and water allocations. • Energy production, especially CBM and bioenergy, driving energy growth – Energy development in many areas requiring more electric power needs • Water reallocation problems – Hydro reservoir water being used for other issues, not necessarily hydro power, which limits electricity. ESA, recreation, and other uses cutting into water availability for energy.
B	• Conservation/efficiency/awareness/regulation – Water (reuse) – Conserve energy, conserve water – Training/education/awareness of the water-energy tie and need for conservation • Water management and planning – Proliferation of authorities to 'grab' water for local economic development – Local vs regional needs and concerns • Coal – Low-flow induced problems; IGCC (longer-term) concerns (more water consumption) – Sequestration of CO2; water intensity; future of coal-fired generation • Wind power – Will it fly? Transmission restraints. Siting. Will it displace water-thirsty generation? Farmers love leases. Good resource in region. • Ethanol/biodiesel – Massive growth. Water availability? Effluent concerns. Thirsty feedstocks. • Natural gas future – Is projected natural gas use realistic? Water supply concerns. • Hydropower – Siltation concerns. Approaching design lifetimes. Reduced flexibility due to competing demands.
C	• Cooling water availability – Efficiency of thermal cycle/capital v operating costs. – Cascading use … beneficial use for waste heat and water • Economics/Water value – What is the value of water? How do you value water in storage? – Water commodities market. – Haves vs haves not. • Integrated national/regional resource planning – Competition for limited resources. – Resource assessment/characterization. – Growth and grid assessment/characterization. • Social/regulatory – Infrastructure. Mandate to service. Broken supply—delivery processes.

Group	Water-Related Problems for Energy Supplies
	– Social contract. How does water planning get incorporated into energy planning – Legal. Who owns the water? Availability concerns. – Siting concerns/downriver demands.
D	• Competing uses – Lack of collaborative institutionalized strategies to address competing uses through technologies, conservation, policies. • Siting – Siting constraints due to water availability, proximity to fuel supply, transmission access, air quality needs. Water is just as important as other factors. • Cost of new technologies. – Risk of deployment. Who pays? • Ability to use poor or reclaimed water vs. fresh water in cooling towers. – Lack of technology/experience. – Availability of reclaimed or impaired waters. • Water availability. – Power generation needs water … where does this come from? • Integrating alternative generation into grid. – How to integrate intermittent sources.

Table 2. Summary of water-supply problems from each breakout group for Session 2

Group	Water Supply Problems
A	• Lack of Value of Water – People think of water as a right, unwilling to pay for clean water as require treatment to higher and higher quality. • Competing demands – Growth in other sectors- ag, industry, etc.- driving up water use and water needs • Water quality – Salinity, nutrients, organic load, major impacts on water quality. Will require significantly more energy for treatment in the future. Issues over water management, several federal and state agencies with hand in water management and allocations, especially in transboundary areas. Transboundary concerns include both surface and ground water problems. • Conservation Advocacy – – Lots of focus on demand side and not supply side conservation. Lots of conservation efforts focused on minimizing water withdrawal, not water consumption where focus should really be. • Lack of long-range water planning – Long range planning varies across region. Difficult to get different states and agencies to plan together. Leads to non-optimum regional water management and use. • Non-point source quality impacts – Difficulty in treating non-point sources. • Water Transfers
B	• Agricultural competing use – Move to irrigation – Switching from groundwater to surface water – Less runoff due to conservation and more intensive use … cuts recharge/streamflow returns – 40% consumption in ag … ag a good target for water for energy • Water withdrawal priorities – Set by states; state boundary issues constantly arising – Feds have some leverage through USCOE • Energy production competing use

Group	Water Supply Problems
	– Energy production growing faster than population – Central region virtually "exporting" water with energy (electricity and ethanol) • Urban competing use – Diversions within states to serve urban growth – Private developers mining water – Urban construction/building codes and impact on water use trends – Impacts/implications of decentralized water • Water relocation – Management practices moving water to places where it is difficult to access for energy use
C	• Utility/Industrial – Impacts from operational activities on water resources, i.e. Cooling water availability, air emissions impacting quality of water. – Permitted upstream industrial discharge impacting downstream cooling water users. • Ecosystem sustainability – In-stream flows; downstream effects; watershed management; acknowledgement and incorporation of externalities. • Equitable allocation of limited water supply – Legal issues … who controls the water. Who owns the water. What is the value of water? – Urban v rural divide.Competition for limited resources. – Eminent domain issues.
D	• How do we prioritize and assign uses to the limited water supply? – Some of the uses of water for agriculture and energy production could be provided for municipal groups, or industrial users. The point is that there is a general lack of integrated resource planning. • How do you correct the problems with modeling before you allocate water? – In many geographical areas, there is allocation where there is no modeling at all. • How do you overcome the issue of establishing a power plant? – Power plant siting needs 50 – 60 year supply of water for risk investment. You cannot always get water or property rights through permits for this amount of time. Further, the property rights could also involve inter and intra state jurisdictional issues with water supply. These are conflicting from one state to another.

3.2. Sessions 3 and 4: Needs and Solutions Identification

The problems identified in Sessions 1 and 2 were prioritized within each group. The third and fourth breakout sessions focused on identifying needs and potential solutions, respectively, to address the prioritized problems from the first day. Table 3 summarizes the needs and potential solutions for the prioritized problems identified by each group. Additional details and "raw" notes from each breakout group can be found in Appendices C – F. Two key problems areas and associated needs that surfaced in each of the groups are summarized below:

- **Lack of water availability for energy production**
  - Need more efficient water-use technologies in energy production and extraction
  - Need to use impaired or other non-traditional water sources for cooling and energy production
  - Need better water recovery or re-use technologies
- **Lack of integrated water/energy planning and modeling**
  - Need better data (and database) and forecasting models
  - Need vision and planning from federal (DOE) agency
  - Need to integrate water managers in energy planning

Table 3. Summary of identified needs and potential solutions for prioritized problems from each group (Sessions 3 and 4).

Group	Problem	Needs	Solutions
A	Lack of Long-Term Energy and Water Planning	• States water agencies need seat at energy planning table • Need technical studies on basin-wide availability • States need to be involved in process of long range energy planning, including water agencies • States need to know how much energy they will have to meet in-state and out-of state • Need to Compare EIA projections with state projections • Energy planning needs to be much better coordinated among states within a region and with state water agencies (NT) • Power Plant needs water for up to 50 years – need good water data • Need information on water consumption for new technologies (NT) • Need a national gap analysis (figure out what we know and don't know) • Lack of universal best management practices • Cost is the limiting factor—we know what we want to do, but just don't have the resources • Need national review of state water plans and planning processes • Need greater interstate data sharing • Federal Department of Water to fund/oversee such studies • IOGCC as a model?	• Move water planners further up the transmission and permitting queue (currently, water planners generally only find out about energy project when they are well through the state's permitting process) • De-silo state agencies (agencies tend to focus only on their narrow areas of responsibility … there is often no 'big picture' at the state agency level) • Formalize communications (people within agencies tend not to talk to each other due to historical precedent, turf battles, etc.) • Looking to Federal or regional (multi-state) organizations to facilitate communication among/between agencies • Develop nationally suggested power plant needs by region report on a regular basis- ~5 year basis • Network in-state water mangers into energy planning activities • Site water plants next to power plants • Incentivize public/public and public/private partnerships (NT) • Develop National Gap analysis • Develop Best Management Practice standards– Uniform standards and development of models for groundwater and surface water modeling • Develop National review of state water plans • Share data on water efforts, monitoring, modeling • Use National Water Board (Interstate Oil and Gas Compact Commission) or Western States Water Council) model • Conduct feasibility Study of Water and energy coordination
	Lack of Water Availability for Energy Production	• Need to revisit definitions of waste, so that impaired or produced waters can be used; need to address the regulatory issues (NT) • Need improved efficiency and technologies to reduce consumptive use of water by power plants – More efficient turbines, hybrid cooling, combined cycles (Need Demos NT) • Need use of impaired or reduced quality water for cooling • Need to understand water rights issues • Need affordable water	• Develop policies to have power plants use impaired water • Provide incentives necessary for people to get involved from state, federal, etc. (loan guarantees) to develop and use more efficient technologies • Implement integrated gasification combined cycle (IGCC) power generation • Capture water from flue gas • Utilize water heat for coal drying
	Lack of Transmission Availability	• New transmission needed – no one knows how to do it or fund it – Need single average transmission rate in a region – new transmission everyone pays the	• Nationalize the grid; currently a state controlled issue • Investigate decentralized systems for improved security and reliability

Table 3. Summary of identified needs and potential solutions for prioritized problems

Group	Problem	Needs	Solutions
		same rate – Need DC line or high voltage to reduce losses – Find way to pay for transmission upgrades(NT) – Easier to move electrons than water; need ability to site power plants near available water supplies – Need better backbone system that connects other transmission • Security and reliability of system needs more transmission or other options	
B	Lack of Water Management and Planning for Energy	• National needs assessment of competing water values • Need a coordinated baseline of what water we have, where it is, what is the quality • Regional agreements within and across watersheds and aquifers to assemble, allow the data to be used • A model that shows how resources are being depleted—for whole region? – Uncertainty in data – need better data – Clear definitions – consumptive use, other – Where do you want to stabilize drawdown • Need investment in data gathering technology • Need forecasting/modeling of energy/water needs and use	• Develop clearinghouse for existing data from web sites (e.g., USGS) • Develop models for predicting future energy and water needs and use
	Competing Demands for Energy and Water	• Need to reduce irrigation to free up water for energy • Need models and tools for energy-system siting • Need forecasting/modeling of competition of other uses	• Provide incentives to reduce water use for irrigation • Develop necessary tools and models to better understand competing demands
	Lack of Water Availability for Energy Production	• Need generating technology that doesn't require cooling • Need cooling techniques that use less water • Less water-intensive mining/extraction technologies, i.e. oil shale • Need cheap ways to use/treat compromised water from extraction • Need energy efficiency measures	• Continue development of new cooling/thermal efficiency – Dry cooling – Groundloop cooling – Limestone cooling loops
C	Lack of Energy and Water Vision and Plan	• DOE needs to facilitate a vision that considers – Energy Security – Sustainable Infrastructure – Efficient Use of Resources – Ultimate protection of the Environment	• DOE should assemble an advisory group that can coordinate state-regional-national agencies
	Lack of Data Consistency and Availability	• Need a data structure and database that encompasses and links all water resources with users, crosses all civic boundaries, • Need quality assurance for data collection and analysis. • Need to identify who has this information, collect it and then disseminate it.	• Develop a state-maintained data base on energy and water. Use an assessment template –GIS application. Develop water-information template with 2-3 states as a pilot. • Develop inventory of data collection practices across the states

Table 3. Summary of identified needs and potential solutions for prioritized problems

Group	Problem	Needs	Solutions
	Lack of Water Availability for Energy Production	• Need to increase efficiency of cooling – Advanced cooling technologies for the greatest water use efficiency. – Substitute degraded water for fresh water. – Improve thermal conversion efficiency. • Need to close fuel cycle through ultimate storage and fuel reprocessing technology • Need to incorporate new reactor core technology to lead to higher thermal efficiencies • Public acceptance of perceived safety performance	• Develop and test cooling technologies and cooling strategies that would increase water use efficiency. – Applied Engineering R& D – Dry/ Hybrid systems – Utilization of degraded water • Develop and test generation technologies that would improve thermal efficiencies. – Materials development – Fluid dynamics – Applied engineering
D	Lack of Water Availability for Energy Generation	• Need advanced cooling technologies to site plants in water deficient regions • Need water recovery and re-use technologies and incentives • Need advanced treatment and detection technologies for all effluents – transfer of pollutants into water to detect once it gets to water • Need improved technology and flexibility on intake structures (all uses) • Need to continue R & D and demonstration to continue efforts focused on IGCC • Need to share risk of demonstration of the technology (and all new technologies)	• Fund demonstration projects in Indian country – Costs less, permits streamlined – Actors: Feds, tribes, and industry • Increase funding for basic science through R&D and demonstration (10-15 yr payoff) – Actors: Labs, utilities, universities, tech providers, federal & state governments, tribes • Market incentives – Tax credits, tax exempt bond financing, EEZ expanded to include energy – Actors: Federal, state, tribal government, industry • Conservation – Energy & Water – Incentives, requirement for federal funding
	Lack of Integrated Resource Planning and Modeling	• Need to increase awareness of need to integrate plans • From the ground up, include all stakeholders versus top-down (include tribes) • Need to standardize tools/terms • Integrate water/energy data bases (MAPS/GIS) • Institutionalize the process; combine science with needs • Need to figure out why tools that are there are not being used • Need to improve data collection	• Increase funding for standardized data collection, formatting analysis, model development, tool development. – Actors: USGS to lead, other stakeholder agencies • Develop national water and energy data base; standardized accessible web- based data – Actors: USGS takes the lead • Formalize the process to use the tools and data developed above, and involve all stakeholders in their implementation – Actors: Feds, permit writers, states, tech innovations, permitted entities
	New Power Generation Technologies	• Need to look at new technologies for energy generation in the long-term (e.g., integrate wind energy to produce hydrogen) • Need integrated technologies for energy and water • Need better storage technologies • Need production of electricity from low temperature waste heat • Need continued efforts to develop solar	• Reduce risk to utilities of advanced generation projects through cost shared R&D with DOE, USDA, DOI, BIA, etc. • Increase funding for public education to increase awareness of all technologies – Actors: Congress, public, environmental groups, utilities, regulators • Support Renewable Portfolio Standards to establish market opportunities for emerging renewables

4. Participant Feedback and Lessons Learned

Evaluation forms were distributed to each participant on the last day of the workshop to collect feedback regarding aspects of the workshop that either worked well or needed to be improved. Over half of the participants completed the evaluation forms. In addition, the organizers of the workshop held a "debriefing" at the end of the second day to discuss lessons learned and potential areas for improvement. A summary of the feedback and lessons learned is listed below:

What Worked Well:

- "Organization and flow of the meeting was excellent."
- Opening presentation and keynote presentation were useful.
- Breakout sessions worked well; facilitators did a good job.
- Having facilitators knowledgeable about the subject area was useful.
- Number of participants in each breakout and duration of each breakout was good.
- Designated note-taker was a good idea; freed up participants.
- Good mix of participants and "lively" informative discussions
- "Large knowledge pool"
- "The facility, especially the food, was good."
- The group lunches helped to continue discussions among the participants.

Suggestions for Improvement:

- Discussions in breakout sessions were very broad; could narrow the issues to those that are most important for energy industry.
- Session 2 (water-supply issues) can be simplified since similar topics were discussed in session 1 (water-related energy-supply issues). Combine the two?
- A basic list of definitions of commonly used terms would be helpful for non-experts in either the energy or water areas.
- Facilitator should explain difference between water for energy and energy for water.
- Have hand-outs of all presentations available at the meeting.
- Need more representation at workshops from:
    - Power utilities
    - Oil companies
    - State energy regulatory and water-permitting agencies to answer many questions that arose in breakout sessions
    - Rural areas
    - Tribal nations
    - Environmental groups (e.g., EPA, DOI)
    - State and/or federally elected officials
    - National agencies (e.g., American Public Power Association, National Rural Electric Association, National Association of State Regulatory Commissions, Ground Water Protection Council)
- Have facilitator brainstorm ideas initially to "break the ice" in initial sessions
- Select group representative at beginning of sessions so they can be better prepared to present

- There are significant differences between Water Rights States and Riparian Rights States such that division among those states may have been a better way to divide the workshops (rather than Central, East, and West).
- "Dots on the ideas" prioritization approach can promote bandwagon affect; consider alternative prioritization strategy or limiting number of votes per topic.
- "It was difficult to focus on technical/scientific issues; discussions tended to delve more into policy and social issues." Need to focus on science and technology issues.
- Clarify in the workshop invitation that non-experts in water and energy are also welcome
- Identified "problems" need to be more specific so that specific (quantifiable) needs and solutions can be discussed
- Try to minimize the use of acronyms

5. Next Steps

Two more needs-assessment workshops will be held by January 2006 in the east and west regions of the country (see Figure 1). Following these needs-assessment workshops, the Executive Committee will evaluate the results and generate a gap analysis. Then, in April 2006, a Technology Approaches and Innovation Workshop will be held to allow technology providers to propose approaches and solutions to address the identified gaps and needs. Research priorities and an assessment of capabilities will then be conducted. A compilation of the results from the needs-assessment workshops, gap analysis, technology workshop, research prioritization, and capability assessment will then be documented in the final roadmap for DOE by September 2006. Figure 2 summarizes the entire roadmapping process.

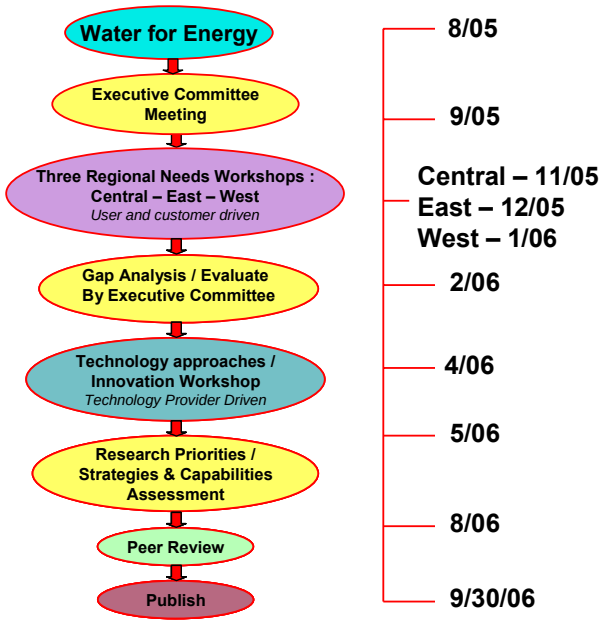

Figure 2. National Energy-Water Technology Roadmap process.

6. Acknowledgments

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Appendix A: List of Participants by Breakout Group

GROUP A		GROUP B	
Facilitator: Conrad Mulligan	**McNeil**	**Facilitator: Kevin DeGroat**	**McNeil**
Notetaker: Mike Hightower	**SNL**	**Notetaker: Ron Pate/Sandhya Rajan**	**SNL**
Dan Boyce	E Grand Forks Wtr & L	David E. Farnsworth	Great River Energy
Curtis Jabs	Basin Elec Power	David Michaud	We Energies
Edmund G. Archuleta	El Paso Water Utilities	Walter R. Aucott	USGS
Wayne Bossert	NW KS Groundwater	Diane Coe	KS Water Office
Kurt Pfeifle	Mid Dakota Rural Wtr	Derek Winstanley	Survey
Mike Mathis	OK Water Res Bd	Jesse Kharbanda	Env Law & Policy Ctr
Floyd Gilzow	Mo Dept Nat'l Res.	Earl Smith	AK Natl Res Comm.
Mirka Della Cava	LBNL	Marilyn O'Leary (floater)	Utton Center
Jeff Hoffmann	NETL	Stefan Finsterle	LBNL
Charles Lord	OK Corp. Commission	Brandon L. Kane	Welte, Suelthaus
Mike Parker	Exxon Mobil	Alan L. Dostal	NE Public Power
David P:ierce	Washburn Univ.	Bill Adams	Flowserve
Anthony Hunter Hunter	Washburn Univ.	Charles Groat	UT, Austin
Ho, Cliff (floater)	SNL	Joseph Hughes	US ACE

GROUP C		GROUP D	
Facilitator: Jack Whittier	**McNeil**	**Facilitator: Scott Haase**	**McNeil**
Notetaker: Terry Wilson	**SNL**	**Notetaker: Jaci Hernandez**	**SNL**
Eric Hixson	Cen NE PP&I	John Shultz	Basic Electric Power Coop
Jim Ploger	KS Corp Comm.	Linda Riley	KS City Power & Light
Robert G. Abboud	RGS Labs	Randall Beavers	Des Moines Water Works
Dave Koland	Garrison Diversion	Lane Letourneau	KS Div Water Res
Dan Titerle	San Antonio Water	P. K. Tudor	Del-Co Water Co.
Bhasker Dave	Nalco Co.	Mary E. West	City of Moberly
Cody L. Knutson	Nat Drought Mitig	Bill Michael	Haz Mgmt Systems
Ahmad K. Hilaly	Archer Daniels Midland	David M. Traster	Foulston Siefkin LLP
John Gasper	ANL	Rebecca Kidder	Cheyenne River Sioux
Roger Taylor	NREL	Terry Sullivan	BNL
Robert Goldstein	EPRI	Marie Garcia	SNL
John C. Peck	U of Kansas, Law	Tom Feeley	NETL
Carl Vansant	HCI Publications	Dan Stepan	Energy & Env. Res Center
Bill Bryson	GWPC	Tom Bohl	TX Attorney General's office
David French	Utton Center	Bob Walters	Cheyenne River Sioux
James E McMahon	LBNL		
John Merson (floater)	SNL		

Appendix B: Matrices and Questions Used in Each Breakout Session

BREAKOUT SESSION #1 MATRIX: Problem Area- Water for Energy Supply						
Energy Supply Activity	**Water-related Issues, Problems, Concerns**					
	0-10 years	**Trend (↑↔↓)**	**Certainty/ Confidence**	**10+ years**	**Trend (↑↔↓)**	**Certainty/ Confidence**
Extraction						
Fuel production						
Electricity production						
Renewable sources						
Other						

What are/will be the primary water-related concerns impacting…

- Extraction of oil, natural gases, coal?
- Production and refining of fuels (oil- or biomass-based)?
- Electric power generation (including both hydropower supply and thermal plant cooling)?
- Renewable energy production?

Probe participants about water-related concerns, including…

- Cost of water.
- Absolute availability/Temporal and spatial availability.
- Quality.
- Regulatory prohibitions/restrictions.
- Competing demands.

What is the trend for each of these limiting factors? Are they growing in importance (that is, are they becoming more of a limiting factor to energy production)?

Is the cost/availability/competing uses of water inhibiting energy production or the planning for future energy projects? At what point will cost/availability/competing uses inhibit the ability of the energy sector to meet the needs of your state/region?

Of all the factors that will impact energy production in your state/region, where does water cost/availability/etc. rank? Will water be more of a limiting factor than other constraints?

BREAKOUT SESSION #2 MATRIX: Problem Area, Water Supply. (2 hours allotted)								
Water for …	**Issues, Problems, Concerns in/on …**							
	Surface water	**Trend (↑↔↓)**	**Groundwater**	**Trend (↑↔↓)**	**Economic develop-ment/diver-sification**	**Trend (↑↔↓)**	**Environment [1]**	**Trend (↑↔↓)**
Urban use[2]								
Agricultural use								
Energy production								
Electricity generation								
Recreational use								

[1] Environment to include ESA concerns, ecological remediation, maintenance/enhancement of in-stream flows, etc.
[2] Urban use to include water provided for industrial use

What are the primary issues, problems, or concerns related to the impacts on surface water from urban/municipal use? Ag use? Energy production?

- In the near-term?
- In the long-term?
- What is the trend?
- What is your confidence level in this?

What are the primary issues, problems, or concerns related to the impacts on ground water from municipal use? Ag use? Energy production?

- In the near-term?
- In the long-term?
- What is the trend?
- What is your confidence level in this?

BREAKOUT SESSION #3 MATRIX: Needs and Gaps to Assure and Sustain Water for Energy. (3 hours allotted)		
To address …	**We Need …**	
	Near-Term (0-10 years)	**Long-Term (10+ years)**
Water for Energy Priority Problem 1		
Water for Energy Priority Problem 2		
Water for Energy Priority Problem 3		
Water for Energy Priority Problem 4		

Focusing on the highest priority Problems identified on Day One …

What do you need to address the priority Problems your region/state is likely to experience in the next 10 years?

Do you need improved technologies? If so, what is the delta or modification necessary? How much better do technologies need to be? Do you need better understanding or knowledge? If so, what in particular do you need to understand?

If the problem doesn't exist today, but is projected to exist in 10 years, what will be the cause of the problem? What will you need to address the problem? How much better must a technology/process/knowledge be to address the future Problem?

BREAKOUT SESSION #4 MATRIX: Solutions, Approaches, Innovations. (2 hours allotted)				
To address …	**We should investigate the following…**			
	Solution, approach, or innovation	**Payoff timeframe**	**Actor(s)**	**Risk/ Reward**
Water for Energy Priority Need 1				
Water for Energy Priority Need 2				
Water for Energy Priority Need 3				
Water for Energy Priority Need 4				

What opportunities or options do you see for addressing the priority Problems and Needs/Gaps raised over the past two days? What innovations and approaches are most needed and of highest priority to assure an adequate supply of water for energy? What are the major impediments, investment risks vs. rewards, and leverage opportunities?

Are there opportunities to be found in:

- Technology research, development, demonstration, and commercialization?
- Economic and market-based approaches?
- Policy and regulatory changes/additions?
- Educational outreach to public, policy-makers, others?
- Efficiency gains?
- Other areas/approaches?

For each innovation/approach/opportunity, what organizations are most appropriate to lead the development/implementation?

What are the relative roles, challenges, and opportunities for technology improvements vs. public policy/regulation vs. market economics vs. public priorities, attitudes and behaviors re: improving energy and water supplies and use efficiencies?

Are there any 'showstopper' regulations, legislation, policies, etc. that might reduce the ability of even the perfect technology/application to meet the need/solve the problem?

Appendix C: "Raw" Notes from Group "A"

Day 1 – Session 1 -
Problem Areas - Energy Supply

Water for Energy Supply
Extraction

- Oil and gas production driving electricity needs in north
  - 2.7 % growth/yr for next 15 years
- CO2 injection for enhanced oil recovery driving electricity needs
  - MO sees uncertainty in growth
- CBM produced water big issue
- Ethanol, biodeisel plants driving electricity needs
- Oil and gas extraction driving groundwater quality issues KS, OK, NM, TX
- Transportation of coal requires new railroads
- Illinois, MO has high sulfur coal that might be usable
  - If move to gasification might be able to be used
  - May increase water use and mine water in Illinois and MO
  - Water quality and treatment needs to protect ground water
- Pumping during mining may cause regional groundwater issues
  - Especially is in future for of this coal is more readily used
- CBM water in relatively good quality but low quantity in OK
  - Has little impact on aquifers
  - May become water for use for industrial applications with some treatment – regulatory limits on use of this water, currently regulatory disincentive, KS
  - ND power company looked at quantity and collection of CBM water and seemed infeasible

Fuel Production and Refining

- Ethanol – corn needs lots of water
  - Refining plant (30 mgy- use 350 acft/yr) use not as big a driver as water for grain growth for plant
- MN – permitting issues on water needs and water discharge
  - Water law drivers for allocating water- private investment in water intensive industries discouraged –(Info fo
- KS, groundwater basins have now new allocations, but potential projects for two new power plants
  - Will have to buy other water rights
- Consumptive use for ethanol not examined
  - Energy policy driving needs for ethanol
  - May need technologies that use less water
- Synfuels production will require more water and more energy

- Questions of future water use in oil sands and oil shales
- Some talk of new refineries – but water not necessarily issue but energy might be

Electricity Production

- MO , drought on MO River, operations, EPA regulations, causing major issues on current power plants
    - Causing derating of plants due to low flows and high temperature
    - EPA science issues on temp limits
- ND wants more water on MO river held upstream
    - Issues of river management to meet all user needs
- TX water withdrawal issues and water management districts showing long-term water problems for all areas
- WY buying water for power plants from irrigation
    - Can have negative impact on economy
- Power companies
    - Air and then water major considerations for plant location
    - MO growth in areas without surface water, so compete with municipalities for ground water
    - Looking at alternate water sources – municipal waste ater
    - OK hydropower pools can be reallocated for other uses, including thermoelectric plants – putting hydropower at risk and issues of compensation
    - WY due to lack of water going to dry cooling plant, reduces efficiency and increases capital costs by ~15%
- Cost of water is driving economic considerations and user costs for energy
- Competing demands for water
- OK – no water compacts with tribes, will be big concern about water availability
    - Issue in ND,
    - Ticking time bomb
    - Energy Policy act encourages tribal energy operations
- Load shedding and interruptible rates for water companies to provide lower rates
- ESA, ecological issues driving river management – reduces power,
    - Still drought big driver
    - ESA drivers not well science-based
    - Environmental studies can take up to 10 years, value of recreation relative to power also and issue – (Whiter River Study – MO, Oklahoma – non-native trout fisheries created by hydro need to be maintained)
- IGCC not ready for low rank coal
    - Needs more development – no guaranties from vendors
    - High sodium lignite a problem
    - Has potential for lower water
    - Need demo plants of large scale near term
- Water Availability a big Issue
    - Need better surface water understanding and understanding of droughts needed
    - Need better Groundwater understanding
    - Need much better data base on water issues and availability
- Issues of Water rights States and Riparian Rights states

    - Will impact water availability and siting of plants
    - This will lead to water wars
- Siting
    - Power plants next to water plants
- Account for real-time market for power and how does that impact power generation – combine fuel, transmission, water system approach
    - Regulatory issues of transmission, use corridors and upgrade transmission, need more lines
    - Real-time cost structure does not meet current requirements
    - Transmission is big issue

Renewable Sources

- Wind is good, but
    - Need firm electrons
    - Lack of transmission capability
    - Species interactions
- Geothermal heat pumps
    - Losing interest
- MO, 25% of heating is from wood
- Issue of removal of hydro power plants
    - Remove from service, and remove plants
    - Low head hydropower still a possibility (OK, few percent, MN, ND, upgrades and possible few new plants)
    - Ecological issues a problem
- Waste heat to energy from waste compressor station heat in MN and ND
- Solar too expensive
- Pumped storage in OK and MO – may have peaking application
    - Costs and environmental big issues

Other

- Need data base on crop – energy and water use for trading purposes
    - Issue on how big to draw the box for the system
    - Genetic crops
- Reduce consumptive use and increase value added for water use
    - Some energy approaches will not meet this
- Hydrogen from water
    - Big issue is infrastructure

Ranking

Transmission capabilities
Riparian
Understanding of water availability

Day 1 – Session 2 -
Problem Areas - Water Supply

Urban

- Water rights
- Competing demands
- Water transfers
    - Legal and physical
    - Who decides best use

- Water quality
    - Salinity, nutrients, sedimentation, degradation byproducts, and natural organic load, nitrates,
    - Jurisdiction control by different state, federal, tribal, entities
    - Different directions by different agencies- lack of coordinated policies
    - Non-point source problems
        - Farmers, livestock, surface runoff,
        - Stormwater runoff,
        - Septic tanks
        - Abandoned wells, unplugged oil and gas wells
- Water Management
    - No one in charge
    - Lots of federal agencies, but no one in control
    - States have jurisdiction over water, no way to manage well currently
    -
- Water Quantity
    - Jurisdiction control state, tribal, federal
    - Need for conservation, improved efficiency
    - Overapproriation of rivers
    - Droughts
        - Impact water availability and plant operation
        - Determination of major users for the water
        - Population growth

- Infrastructure needs
    - Costs,
    - Federal government pulled away from infrastructure development

- Lack of value of water
    - Society thinks water should be free
    - Public understanding and education
    - Reservoir storage vs. free river costs
- Declining Ground water levels
    - Lack of metering- this is needed for any advanced management
    - Absolutely essential in the future
- Lack of long range planning
    - Rate driven focuses on short term management
    - Not ready for drought cycles
- Urban growth

    - Driving more need for water
    - Water reuse is bigger issue
        - who owns the water
        - downstream users want return flows
- Discharge issues and instream flows
    - Mixing zones, what are damages allowed
- Biological considerations force minimum stream flows
    - Makes less water available
    - Can impact existing plants
- Invasive species
    - Zebra mussels on intake structures

<u>Energy Use Impacts on water</u>

Oil and gas

- Whole lot of issues with oil and gas production
- Water quality damage from abandoned oil and gas
-

Power Plants

- Spatial availability of water
- Commercial development of IGCC
- Wet scrubbers remove more GHC, but use more water
    - Need pretty clean water
- Hybrid cooling needs to be considered and may have some interest
    - Dry cooling really impacts power on hot days
- Intake structures and efficiencies
- Most plants going to zero discharge
    - Much more consumption of water
- CO2 scrubbing will require more energy and more water
    - CO2 sequestration possible up to 200 miles and with IGCC makes it possible
    - GE Transport reactor looks good, not ERGE

<u>Societal Needs</u>

- Treating water to too high a quality
- Public health standards driving water treatment , lack of concept of risk
- Never consider cost
- No supply side conservation-

<u>Economic Development</u>

- Water options needs to be looked at by consumptive use
- People will not fess up to watr shortage needs

<u>Ag</u>

- Declining groundwater levels across all states
- Pumping water with natural gas is about uneconomic
- Increasing challenges to meet non-point source controls
    - More concentrated agriculture

  - EPA beginning to focus on non-pint source
  - Change in way farm – less fertilizers, less pesticides, buffer strips –
- Expect will be moving to regulated industry that have not had before
  - Will see point polluters paying farmers for cleanup

Group A Energy Supply Issues - Ranked Concerns

Water availability is currently impacting energy availability -

Many states are seeing water shortages, especially of surface water from current drought, impacting power generation. Most states are seeing large declines in ground water levels, which are limiting water availability in all sectors, including future energy production and generation. New energy, like biofuels, will take significant amounts of water and demands can not be met.

Cost of Water will be a Limiting Factor in energy development -

Rising costs of water will drive up future energy production costs.

Opportunity for Beneficial Use of Produced Water –

Use of impaired water, especially produced water from oil and gas and CBNG, may be used for power generation.

Lack of Transmission Availability

Transmission limitations are limiting site locations for power plants. This is limiting siting of power plants in areas with water and transporting electricity to areas of low water. Transmission is severely limiting use of renewable energy, such as wind, that uses less water.

Lack of Long-term Energy Planning

Lack of long-term water planning in many regions is impacting energy planning. Appears eastern water rights states are doing less water planning and further behind on surface water and ground water availability in each state. Due to economic development issues, many states will not admit water limitations.

Lack of Surface and Groundwater modeling and understanding

No good consistent data on surface water and ground water availability. Monitoring of surface and ground water not keeping up with needs, therefore not making good decisions on water availability and water allocations.

Energy production, especially CBM and bioenergy, driving energy growth –

Energy development in many areas requiring more electric power needs

Water reallocation problems

Hydro reservoir water being used for other issues, not necessarily hydro power, which limits electricity. ESA, recreation, and other uses cutting into water availability for energy.

Group A Water Supply Issues - Ranked Concerns

Lack of Value of Water-

People think of water as a right, unwilling to pay for clean water as require treatment to higher and higher quality.

Competing demands-

Growth in other sectors- ag, industry, etc.- driving up water use and water needs

Water quality

Salinity, nutrients, organic load, major impacts on water quality. Will require significantly more energy for treatment in the future. Issues over water management, several federal and state agencies with hand in water management and allocations, especially in transboundary areas. Transboundary concerns include both surface and ground water problems.

Conservation Advocacy –

Lots of focus on demand side and not supply side conservation. Lots of conservation efforts focused on minimizing water withdrawal, not water consumption where focus should really be.

Lack of long-range water planning

Long range planning varies across region. Difficult to get different states and agencies to plan together. Leads to non-optimum regional water management and use.

Non-point source quality impacts –

Difficulty in treating non-point sources. Driving

Water Transfers -

Group A – Session 3 - Needs

Needs Assessment

Long Range Planning Technology Needs

- States need to be involved in process of long range energy planning, including water agencies
- States need to know how much energy they will have to meet in-state and out-of state
- States water agencies need seat at energy planning table
- Need to Compare EIA projections with state projections
- Energy planning needs to be much better coordinated among states within a region and with state water agencies (NT)
- Power Plant needs water for up to 50 years – need good water data
    - Technical studies needed for more data on surface water and ground water studies (NT)

  - State water agencies do this in cooperation with USGS, COE, (NT)
  - Broad regional gaps in groundwater data and modeling
  - Water is on the critical path for energy development now!
  - Aquifer storage and recovery needs more technical studies since is being considered as new water supply (NT)
  - Reduced costs of logging would help improve water information
  - Will need new people, all water people are old and ready to retire, need new people in this area (NT)
- Site water plants next to power plants
  - Public/public and public/private partnerships need to be incentivized (NT)
  - Plus power pants with water plants for synergies
  - Need some regulatory support
  - Materials, processes, lower costs, of waste water for cooling needed (Mankato MN with Calpine an example)
- Need information on water consumption for new technologies (NT)
- Comparative regulations

Water availability is impacting energy

- Water rights issues are driving water use
- Power plants want affordable water
- Need to require more efficiency – need reduced consumptive use technologies
  - More efficient turbines, hybrid cooling (Need Demos NT)
    - Incentives necessary for people to get involved from state, federal, etc. (loan guarantees)
  - Need info on flue gas water removal
  - Need technologies that enable reduced consumptive use of water

Use of impaired or reduced quality water for cooling

- Suggestion that use water of impaired quality if technology and cost are there as done in KS (NT)
  - Impacts overall efficiency of power plant
  - Need to shift best water for public health concerns – policy shift may be required to make cost not only driver
  - Policies to have power plants use impaired water
- Definitions of produced water, waste definitions, need to address the regulatory issues (NT)

Transmission

- Transmission lines a state controlled issue
- New transmission needed – no one knows how to do it or fund it
  - Single average transmission rate in a region – new transmission everyone pays the same rate
  - Nationalize the grid
    - DC line or high voltage to reduce losses
  - Find way to pay for transmission upgrades(NT)
  - Easier to move electrons than water
  - Better backbone system that connects other transmission

- Security and reliability of system needs more transmission or other options
    - Decentralized systems are another option that needs to be looked
- Transmission is major national issue, should pursue multiple options (NT)
- May make renewables more readily available- today renewables replace natural gas

Siting

- Need way to model the options, move fuel, move water, move electrons, so can make good decisions (NT)
    - Need to look at the benefits of an integrated system
    - Need to be able to show integrated benefits of system from reliability, and security at a national level

Technology Science and Technology Needs

- Wind –
    - need better ways to bring wind into system
    - Risks of wind is a problem
    - Need better prediction approaches to bring into use and more effective(NT)
- Coal –
    - Want to keep base load at constant capacity
    - Need to get better demos (cost performance data for utilities) and incentives to participate in IGCC research (fully fund NETL)
    - Coal to liquid – coal to gas (reliability and security issue)
- Ethanol
    - Improve ethanol processing science
    - Science to move to cellulose ethanol

Cost of Water

- Look at 'replacement' cost of water
    - Marginal cost of water – cost of new water for sustainable development
- Least cost alternative methodology
- Social benefit of water will be an issue

Competing Demands Science and Technology Needs

- Urban Use
    - Use of brackish water for turf grasses, to offset fresh water use
    - Conservation highly localized
    - Conservation cuts into revenues of city- therefore need more incentives to enhance conservation
    - National program on energy and water conservation
    - National program on water pricing

- Ag use
    - Reduced water use is looking at ag
    - Need effort to develop crops that use less water

  - Best management practices that reduce consumptive use need to be implemented and should be implemented
  - Use it or lose it water rights is a big problem

- Ecosystem use
  - Endangered species issues must be considered in water development for energy
  - Must define drivers better, both quantity and quality
  - Better science definition of minimum needs
  - Include broad group in developing the science

Session 4 - Solutions:

Getting a seat at the table:

Regional efforts for electric utility, energy, and air and water managers, department of commerce, to coordinate regional energy supply upgrades

Would allow ability to compare growth evaluations

See where regional growth outside state

Rework issue of waste:

ECOS may need to be involved

Rework this possibility

Nomenclature shift

Basin-wide Water Availability

National Gap analysis

Best Management Practice standards– Uniform standards and development of models for groundwater and surface water modeling

National review of state water plans

Share data on water efforts, monitoring, modeling

National Water Board (Interstate Oil and Gas Compact Commission) or Western States Water Council) model

Feasibility Study of Water and energy coordination

Network in state water mangers into energy planning activities

Develop national suggested power plant needs by region report on a regular basis- ~5 year basis

Group A, Day One, Problems

"Priority" Problem Flipchart Transcription, Summary Presentation

- **PRIORITY ENERGY SUPPLY PROBLEMS**
  - Water availability
  - Cost of water as a limiting factor
  - Beneficial use of produced water
    - Clean Water Act
    - Contaminant removal
    - Use in agriculture
  - Transmission availability
  - Long-term energy planning
    - Water rights boundaries
  - Groundwater understanding
  - Surface water hydrology models
  - CBM water
  - Water re-allocation
    - Hydropower facilities

- **PRIORITY WATER SUPPLY PROBLEMS**
  - Lack of value of water
  - Competing demands
  - Quality
    - Salinity
    - Nutrients
    - Organic Load
    - Jurisdictional issues
    - Transboundary issues
  - Conservation
    - Demand v Supply-side
  - Non-point source quality impacts
  - Water transfers
    - Legal and physical
  - Lack of long-range planning

Problem Flipchart Transcription, Energy Supply

EXTRACTION

- **CBM WATER—**(2 VOTES) –Near-term
- **CARBON EXTRACTION FOR ENHANCED OIL RECOVERY—**Long-term
  - Additional electric demand for pipeline compressors
- **WATER QUALITY PROTECTION** (1 VOTE)—Near-term
  - Broadly regional concern—contamination of groundwater
  - MO not likely an issue, but uncertain due to lack of data
- **TREATMENT OF DISCHARGED WATERS**
  - Mine-aquifer interactions—Long-term
- **REGIONAL AQUIFER DRAWDOWN—**Long-term
  - Site/facility specific concerns—Near-term
- **BENEFICIAL USE OF PRODUCED WATERS** (4 VOTES)
  - CWA problem—Near-term
  - TSS from CBM?—Near-term
  - ARCO using produced waters for ag in Bakersfield
  - Customer acceptance of produced/impaired water use—Long-term

ELECTRICITY PRODUCTION

- **WATER AVAILABILITY (5 VOTES)**
  - MO
    - Limited draws due to USCOE
    - 90 degree rule (some cheating to keep generating facilities running)
    - Lowflow/water temperature
    - Increasing groundwater withdrawals for electricity generation—Near-term problem
      - Population/load growth centers don't match surface water availability
    - Increased use of wastewater for cooling (fraction % savings)
  - ND
    - Problems similar to MO
  - TX
    - Rule of capture state
    - Agricultural use declining over time—Long-term problem
    - Cost of water an increasing issue/factor **(4 votes)**
    - Increase in load shedding activities
  - WY
    - Facilities buying water from irrigators due to drought—Near-term problem, Long-term uncertainty
    - Moving toward dry cooling
    - Air permitting first concern for new plants; water supply second concern
  - OK

        - Hyro reservoir water can be reallocated, impacting generating capacity—Near-term small problem, Long-term could be large problem **(3 votes)**
        - Question over compensation to state?
        - Tribal compacts or lack thereof add to uncertainty – Regional timebomb vis a vis water planning
- **ENVIRONMENTAL RELEASE ISSUES (2 VOTES)**
    - Temporal mismatches—Near-term problem
    - Lack of scientific basis for volume/timing of releases
        - Move water planners further up the transmission and permitting queue (currently, water planners generally only find out about energy project when they are well through the state's permitting process)
- **TECHNOLOGY ISSUES**
    - IGCC not ready for primetime—Near-term need for demonstration plant
        - Can't handle sub-bit coal
        - Plants not readily available
        - Agglomeration issues
- **GROUNDWATER UNDERSTANDING**—Local understanding to be addressed near-term; regional understanding to be addressed in long-term **(3 votes)**
        - Yields, recharge, water quality, flow, volume
- **SURFACE WATER HYDROLOGY MODELS (3 VOTES)**
        - Are they accurate?
        - Do they account appropriately for droughts?
- **ACCOUNT FOR REAL-TIME MARKET IN WATER/ENERGY POLICY DEVELOPMENT** (significant disconnect between the two right now)
- **ELECTRICITY PLANNING HAMSTRUNG BY T&D LIMITS AND LACK OF CARRYING CAPACITY**

FUEL PRODUCTION

- **ETHANOL PRODUCTION DEPENDENT UPON RAIN**
- **WATER AVAILABILITY—NEAR-TERM PROBLEM (3 VOTES)**
    - DNR rulings/KS ETOH producers buying water for plant
- **DISCHARGE ISSUES**—Near-term problem **(1 vote)**
- **CONSUMPTIVE USE DRIVEN UP BY VALUE-ADDED PROCESSES (1 VOTE)**
    - Increment use impacts not examined
- **ETHANOL**
    - What impact of 7.5 billion gallons per year production? **(1 vote)**
    - Need 350 ac/ft of water per year to produce 30 million gallons
    - Examine alternative, less water-intensive feedstocks
- **COAL-TO-LIQUIDS—**
    - Thirsty, electricity-hungry process, so potential future impacts need to be examined in the Near-term
- **OIL SHALES/TAR SANDS**
    - Thirsty processes; impacts need to be examined in the Near-term

RENEWABLES/OTHER

- **TRANSMISSION AVAILABILITY (8 VOTES)**
- **"FIRM" ELECTRONS**
  - Intermittency of renewable resources
- **SPECIES INTERACTIONS**
- **WOOD-HEAT HYDROLOGY**
  - 20% of rural MO uses wood heat
- **DAM REMOVAL CONCERNS**
  - Impacts of taking dams out of service?
- **LOW-HEAD HYDRO**
  - Peaking power?
- **REDEVELOPING OLD HYDRO**
  - Institutional issues
  - Are past reports still valid?
- **WASTE HEAT/RECYCLING—NEAR-TERM ISSUE**
  - 13 sites generating 5.7 MW of electricity from waste heat
- **ATMOSPHERIC MANIPULATION/SNOWPACK AUGMENTATION**
- **WATER RIGHT/RIPARIAN RIGHT BOUNDARIES (4 VOTES)**
  - Impacts on LT energy planning
- **WATER EXCHANGES**
- **SITING CONSIDERATIONS**
- **PUMP AND STORE**
  - Peaking power?
  - Cost and environmental concerns (USCOE)
- **AGRICULTURE—ENERGY AND WATER INTENSITY DATA NEEDED**
- **CROP ENGINEERING TO REDUCE WATER CONSUMPTION**
- **LOCALIZED ENERGY EXHAUSTION SHIFTING WATER CONSUMPTION**
- **REDUCE CONSUMPTIVE USE AND INCREASE VALUE-ADDED PROCESSES/PRODUCTS**

Problem Flipchart Transcription, Water Supply

- **INTERAGENCY PROBLEMS**
  - Lack of coordinated action
  - Conflicting demands
- **NON-POINT SOURCE**
  - Quality Impacts
    - Phosphates
    - Pathogens
    - Nitrates
    - Pesticides
    - Urban stormwater
    - Septic tanks
- **LACK OF VALUE OF WATER**
- **PUBLIC UNDERSTANDING AND EDUCATION ABOUT WATER**
- **RESERVOIR V RIVER SOURCE**
- **DECLINING GROUNDWATER LEVELS—REGIONAL NEAR-TERM PROBLEM**
- **METERING**
  - KS yes, others no
  - OK meters surface water
- **DROUGHT CYCLES**
  - Impacts on availability
  - Population growth
- **LACK OF LONG-RANGE REGIONAL PLANNING**
  - No human capital to get it done
  - Drought cycle availability
  - Force into regionalization
  - MO no planning; KS, OK, TX, MN, SD, and ND do planning
- **FEDERAL ROLE IN REPLACING DETERIORATING INFRASTRUCTURE**
- **TOO MANY COOKS/NO ONE IN CHARGE**
- **INTER-ORGANIZATIONAL ISSUES**
  - Sturgeon: 2x pulse bad for all
  - Need cooperative management
- **INVASIVE SPECIES**
  - Intake blocks
  - Mussels eat nutrients—beneficial side effect
- **QUALITY (1 VOTE)**
  - Abandoned water wells
  - 10k oil/gas wells unplugged **(1 vote)**
    - Aquifer mixing
    - Lack of oversight
    - Lack of financial security (firms abandoning wells)
- **GROWTH (POPULATION**
  - Additional stresses; quality problems
  - Additional requirements for water

- **RECLAMATION**
  - Who owns reclaimed water?
  - Lack of inclusion in modeling/planning
- **DISCHARGE REGULATIONS**
  - Inc. draws
- **IN-STREAM FLOWS**
  - Mixing zone (EPA point source)
  - Biological approach (less water available)
- **PUBLIC HEALTH STANDARDS**
  - Cost v use (treatment)—Near- and long-term problem
  - Consumer confidence reporting
- **CONSERVATION (4 VOTES)**
  - Demand v supply side
  - Definition (differs among groups)
- **COMPETING DEMANDS (6 VOTES)**
- **OWNERSHIP/RIGHTS PROBLEMS (1 VOTE)**
- **WHO DECIDES BEST USE? (1 VOTE)**
- **WATER TRANSFERS (3 VOTES)**
  - Legal and physical (people to water; water to people)
- **QUALITY (6 VOTES)**
  - Salinity
  - Nutrients
  - Sedimentation
  - Natural organic load
  - Jurisdictional issues
  - International issues
- **QUANTITY**
  - State/Federal/Tribal jurisdictions complicate quantity side of argument
- **INFRASTRUCTURE/COST/FINANCING (1 VOTE)**
- **CONSERVATION (LACK THEREOF)**

COMPETING USE—AGRICULTURE

- **AR**
  - Rice growth and groundwater depletion
- **REGIONAL DEPLETION OF GROUNDWATER DUE TO AG**
- **COST OF PUMPING**
  - Farmers switching crops to lower pumping expenses
- **STRUCTURE OF FARM BILL**
  - Encourages increased water consumption
- **DISCHARGE QUALITY BAR RISING**
- **CONCENTRATION OF AGRICULTURE**
  - More efficient use of inputs
  - Economic cost of buffers (MN studies)
- **NEED FOR TRADING SYSTEM (2 VOTES)**
- **CULTURE OF FARMING**

  - Use water until someone tells you to stop
- **UNINTENDED CONSEQUENCES**
  - Streamflow impacts from terracing
- **SHIFT FROM AG USE TO MUNI USE (REFLECTED IN PLANNING)**
- **LIVESTOCK CAN BE USED TO VALUE WATER**
  - Better quality cows come from better quality water

COMPETING USE—ENERGY

- **SPATIAL AVAILABILITY PROBLEM (2 VOTES)**
  - Water no where the facilities are/utilities would like them to be
- **IGCC (1 VOTE)**
- **SCRUBBERS**
  - Dry v wet
    - Wet better, but consumes significant volume of water
- **DRY COOLING**
  - Efficiency drops, but so does water consumption
  - Hybrid cooling?
- **INTAKE ISSUES**
  - Positioning/fouling
- **CO2 SCRUBBING**
  - Consumes 30% of the plant's output to run equipment … more scrubbing, more powerplants to meet same external demand
- **CLOSED LOOP COOLING**
  - Water consumption penalty … draws less, but consumes it all

COMPETING USE—RECREATION

- **LACK OF WATER IN RESERVOIRS DUE TO DROUGHT**
- **DISSOLVED O2 LEVELS BELOW DAMS**

COMPETING USE—ECONOMIC DEVELOPMENT

- **WATER TRANSFER REGULATIONS ONEROUS (EX: LIMITING DAIRY EXPANSION IN KS)**
- **SPATIAL AVAILABILITY PROBLEMS (WATER NOT WHERE INDUSTRY WANTS IT)**
- **INCREASING CONSUMPTIVE USE WRT LONG-TERM SUPPLY**
- **TOURISM IMPACTS IN MO**
- **NO LONG-RANGE PLANNING OR PUBLIC EXPOSURE**
- **CAN DO LONG-RANGE PLANNING, BUT NEED BUY-IN**

Group A, Day Two, Needs

"Priority" Problem-Need Flipchart Transcription

- **PRIORITY PROBLEM: SEAT AT THE ENERGY PLANNING TABLE**
  - Move water planners further up the transmission and permitting queue (currently, water planners generally only find out about energy project when they are well through the state's permitting process)
  - De-silo state agencies (agencies tend to focus only on their narrow areas of responsibility … there is often no 'big picture' at the state agency level)
  - Formalize communications (people within agencies tend not to talk to each other due to historical precedent, turf battles, etc.)
  - Looking to Federal or regional (multi-state) organizations to facilitate communication among/between agencies
- **PRIORITY PROBLEM: REEXAMINE THE DEFINITION OF WASTE TO FACILITATE BENEFICIAL USE**
  - Oil industry reticent to have RCRA definitions reexamined
    - Categorical exemption something they don't want to see taken away
  - Role of ECOS?
  - Complicated by CERCLA-RCRA-SDWA interactions
  - "What is hazardous?"
    - Need shift in nomenclature at Federal and state levels
- **PRIORITY PROBLEM: TECHNICAL STUDIES OF BASIN-WIDE WATER AVAILABILITY**
  - Need a national gap analysis (figure out what we know and don't know)
  - Lack of universal best management practices
  - No driver besides the rare and very specific Supreme Court decision
  - Cost is the limiting factor—we know what we want to do, but just don't have the resources
  - Need national review of state water plans and planning processes
  - Need greater interstate data sharing
  - Federal Department of Water to fund/oversee such studies
  - IOGCC as a model?
- **PRIORITY PROBLEM: ELECTRON INTERSTATE**
  - Enables low cost power to move to high-cost areas
  - Some research on higher-capacity transmission lines to overcome problem today, but insufficient
  - Allows power plants to be sited where produced/reclaimed water can be used, thus freeing additional freshwater
  - Reliability—Security R&D
- **PRIORITY PROBLEM: EFFICIENCY**
  - Efficiency **(6 votes)**
    - Reduction in ag consumptive use key to freeing water
    - Increase power/energy plant efficiency
  - Co-location of electricity/ethanol plants

"Rough" Flipchart Transcriptions

- **PROBLEM: Fossil Energy Production Technologies**
  - Need cost-performance data for competing technologies
  - Advanced ethanol production research
    - Yeast breeding=greater yields=more ethanol for same water consumption
    - Move to less thirsty ethanol feedstocks
  - Re-examine coal-to-liquid and coal-to-gas processes to improve economics and overall national energy reliability
- **PROBLEM: Competing Demands**
  - Urban
    - Expand use of saline/highly saline waters on urban greenery (parks, golf courses, etc.)
    - Conservation efforts highly localized and not widespread—conservation cuts into revenue of communities, who rely on water utilities and sales as income stream
    - Rebates for appliances at national level to encourage conservation
    - Xeriscaping
  - Agriculture **(2 votes)**
    - Crop research (may cut consumption by 15%); long-term research
    - Improve management practices (rice crop consumption can be cut by 20%)
    - Overcome culture of farming
    - Develop cash crops that are salt-tolerant
  - Ecosystem/ESA
    - Definition-driven (need cooperation between state and Fed agencies)
    - Actual in-stream needs require research
      - Double-edged sword—may lock-up currently available water supplies if need is determined to be greater than currently supplied
    - Needs to be science-driven **(2 votes)**
      - Science doesn't always provide answers
    - All players need access to science
- **PROBLEM: Transmission**
  - Need single average transmission rate in region
    - Cities lose/rural wins **– Long-term activity**
  - Electron Interstate **(8 votes) – Long-term activity**
    - Enables low cost power to move to high-cost areas
    - Some research on higher-capacity transmission lines to overcome problem today, but insufficient
    - Allows power plants to be sited where produced/reclaimed water can be used, thus freeing additional freshwater
  - Reliability—Security R&D
  - Need greater public understanding of production—transmission trade-offs **– Near-term activity**
  - Move to higher voltages to limit line losses – **Near-term activity**

- Educate public about renewables and the role they play/their integration into the grid
- Renewables integration—**Near-term activity**
  - Generation management
  - Better/more accurate ways to forecast wind

- **PROBLEM: Water Availability Impacting Energy Availability**
  - Efficiency **(6 votes)**
    - Reduction in ag consumptive use key to freeing water (state/local water agencies/organization activity)—**Near-term/Long-term activity**
      - Irrigate fewer acres
      - Cultivate less water intensive crops
    - Increase power/energy plant efficiency (DOE/industry/state activity)—**Near-term activity**
      - Improved turbine blades (6-15% increase in generation possible)
      - Hybrid cooling
      - Higher efficiency turbines
      - IGCC/NGCC
      - Need state and federal incentives to mitigate risk
    - Capture water from flue gas (DOE/industry activity)
    - Utilize water heat for coal drying (DOE/industry activity)
    - Co-location of electricity/ethanol plants
- **PROBLEM: Long-Range Planning**
  - Need water seat at energy planning table **(5 votes)**—**Near-term activity**
    - Need knowledge of new energy plans
  - Need EIA/State planning consistency— **Near-term activity**
  - Rational energy planning— **Near-term activity**
    - No state oversight
  - Need assured long-term water supplies for energy (state and utility activity)
  - Need technical studies on basin-wide availability **(7 votes)**—(State, USGS, USCOE, local organization activity)—**Near-term activities**
    - Area gaps/spatial gaps
    - Understanding of drought vulnerability
    - Ogallala aquifer information OK in KS
    - Know results, but not causes
  - Need greater local understanding of aquifer storage and recovery (BoR, AWWARF, state activity)
  - Need the type of understanding of water aquifers that we have of oil reservoirs
  - Need low-cost well characterization testing equipment
  - Need funding—already know what to do and how to do it
  - Need new people in the pipeline **(2 votes)—Near-term activity**
    - Agencies facing 30% retirement in the next 5 years
  - Co-siting of energy production facilities to improve water efficiency/reuse—**Long-term activity**
    - New ownership/operation models (state/federal/private sector partnerships)
    - Incentives to mitigate early adopter risk

  - Understanding of future water-for-energy consumption—**Near-term activity**
    - Net water use shifts
  - Need energy companies to identify potential energy sites
    - Cost-share data collection (states/utilities)
  - Need comparison of regulations at national/regional scales
  - Salt cedar/vadose zone issues—find beneficial use of salt cedar
- **PROBLEM: Greater Beneficial Use of Produced/Impaired Waters**
  - Need public policy to overcome human nature (take the easy/cheap way out)
    - "True" cost of water problem
  - Revisit definition of "waste" or "hazardous waste"—(GWPC, states, Feds activity)—**(5 votes)**
    - Improve body of scientific knowledge
    - Increase role of science in regulatory policy
  - Regulation hurdles **(1 vote)**
    - RCRA
    - Potash/iodine examples
  - Shift best water for human health uses
  - Encourage shift to use of impaired/process waters in powerplants (esp. in dry, arid areas) **(1 vote)**
  - Goodwin, KS co-siting and secondary use example
- **PROBLEM: Value/Cost of Water**
  - Need replacement cost calculations
  - Apply least-cost alternative methodology
  - Need to measure scarcity to develop cost
  - Replacement rates/marginal cost

Appendix D: "Raw" Notes from Group "B"

Group B Breakout Session 1: Energy Problem Identification

Initial questions and answers re/ scope of roadmap… regional vs national
Introductions of who is in group… lab people vs. others
Policy and Legal/regulatory = Utton Economics/Policy = LBNL

Outputs available to participants? Maybe for distribution and feedback from participants? Maybe post on web site? Group would like opportunity to review and provide feedback comments. Need to figure out a way to do this.

Introductions around table. Mix of power and water planners, utilities, and related supply industries.

Fuel production topic…
NE PACT mandate for ethanol and biofuels … growing energy crops, developing new facitilies, etc.
Big use of groundwater… demand will grow

e.g., Ethanol plant using waste heat from coal-fired lignite plant…860 acre feet for plant with power generation using its waste heat, also ethanol fuel – 1000 acre feet per year in addition to 13,000 AF per year for power plants using Missouri river water… 13000 ac-ft water per year use pumped 7-miles from river… 14 % increase in water usage being looked at. Also conversion of coal using german process… would use 1000 ac-ft water per year.

Many more examples out there…
3 major contractors… ADM, Cargill, Staley
Water demand for irrigation (fuel feedstocks) as well as for fuel processing irrigation for ethanol fuel feedstocks—how much is irrigated vs. dryland farming
Biodiesel also emerging as growth area… water demands probably similar to ethanol, but not sure. How much? 0-10?

Impact assessement needed to look at biofuel energy production and distribution vs. spatial/geographical region where water supply impacts will vary…water availability will be issue in many areas… quality of water is also issue… water used for fuel processing needs treatment before use… process outflow will go to evaporation ponds or re-use… will not be discharged back to surface flows effluent flow from ethanol plants may be a problem?

Where is greatest water use in biofuels production? Depends on process used (wet vs. dry) Usually involves mix of technologies.

Alternative production for ethanol and biodiesel and their demands for water quantity and quality… Coal bed methane… poor quality water produced… high mineral content in some cases… discharge problem… recovery opportunity

Local solution of water supply management… Water authorities being developed (eg Illinois) to control water resource use… have authority independent of state.

Ethanol institutional—retaining reliable supplies emergence of water authorities to control water—15-20 in IL—challenge to manage supply

Institutional issues depend on what state being looked at. (dream catcher issue)

Rural water districts provide water for communities taken from river.

Big issue is water supply planning and management (dream catcher)

www.kansasenergy.org is good source of information

Fuel production and economic development… is driving water districts and control of water resources.
Oil and gas production involves produced water management… and the need for water reinjection to maintain reservoir pressure… this is increasing need… productive use of produced water. LA, TX, KS—reinjection sensitive to cost of oil/water and also the availability of water
Bringing capped off wells back on line is increasing with increased prices for O&G. Will depend on water availability… in KS most water used for Ag in areas where O&G is produced.

Irrigation water for biofuel feedstocks…information on geographical distribution is related to water availability.

New refineries? Permitting is a big problem, which has restricted expansion of refinery facilities in more geographically diverse locations i.e. out of hurricane areas. Despite no new refineries, refinery capacity has increased over the years through improved operations… air permitting and hazardous outputs bigger issue than water.
Co-firing of waste biomass and energy crops
Movement toward waste fiber gas-fired biomass power generation? Some moves in this direction… forest thinning, saw grass augmentation of coal-fired,

Competition between irrigated crop production for energy vs food production?
Prices for energy production trump commodity food production? Interaction of commodity prices and alternative fuel prices determines the market.

Water impact on both.
In short term, a high degree of certainty that more biofuel production facilities will be built…
E85 fuel use on increase… car manufacturers supporting this move.

Power production Topic:

Low flows and high temperatures have been big problem for cooling water

- poor quality at intakes
- struggles with USACE operations
- lots of uncertainty
- temperature at intakes
- heat driving demand … up as generation capability was down
- Platte and Lake McConaghy?
    - 7 temperature excursions during drought
    - Tapping groundwater
    - Battle to maintain capacity

Coal plants

Two in WI--Big Stone and Powder River basin, MO river watershed

- new plants difficult to obtain
- once-through cooling not a future option on MO river… too much water demand required with that technology

In Arkansas… Use of storage … demands on storage changed over years that impact power supply… more use for environmental and recreational uses… stored water availability for power vs. guarantee of river flow for power… no legal basis for guarantee in Arkansas

Future power production based on natural gas is potential problem… NG may not be there, and/or may cost too much… reality may be need to use coal or gasified fuel based on coal

Total water demand for all purposes vs. priorities among uses vs. power production

Consistent inventory of energy/water demand is missing… total and where energy needs to fit.

Cost of energy is big problem and US competitiveness
Don't have facilities and policies
LNG imports, facilities to handle and transport
High costs for NG and LNG will drive industry overseas… must deal with these high costs… is big political problem… hard decisions have not been made over the years.
Governmental and environmental restraints and barriers… for water supply and energy supply
Water angle… Not in my backyard by the east and west coasts pushing plants and energy infrastructure to the middle of country along with the environmental and water issues
e.g. DoD desire to strategically site of fuel production in middle US areas is example-low water areas?
Even in areas with a lot of water—eg WI, there are rivers that won't support once-through cooling, constraints are broader than quantity of water

Difficulty in building reservoirs to support energy production even in water rich areas.

If natural gas is not the future what is?-coal, more water use
Failure to deal with NG and LNG issues will drive increased need for limited water supplies for dealing with use of coal and biofuels.

Coal gasification and IGCC is rising trend and will require more water. One output is CO2 being used for oil field enhanced recovery.

Will be big increase over next 10 years… dealing with NG and LNG problem will have less impact (environmental and water) than the Coal gasification, biofuel production, IGCC, etc.

Even water rich areas are being forced to look for alternatives to once pass-through plant cooling. Reservoir construction also limited due to environmental, land-use, and economic barriers.

Nuclear… if plants are not renewed or life-extended, will have implication for water for electricity

- licensing likely
- new capacity… air cooled and gas cooled
- future of standard design/PBR 10 years
- Energy bill initiatives are critical and must be effective, or it will not happen
- Greater heat dissipation requirement with nukes

Withdrawal vs. consumption… power cooling consumption will go up in future
Overall withdrawals also likely to go up with increased consumption due to increased generation capacity needed. Is complex and site-specific issue… including constaints on allowed withdrawal quantities.

37.7 gal/kwh for water withdrawal
0.1 vs. 1.1 for consumption not an easy calculation need to model or know site specification

Future use of once-through cooling very limited.

Water temp criteria used to regulate river availability vs. needs for cooling… need review/study at national level
Water recycles on closed loop—use it continually once it is withdrawn—make up water technology

Economic issue re/ power plant siting away from water supplies… energy cost associated with conveyance of water to plant site. And use of impaired water for cooling… cost of any treatment required.

Pass-through costs related to fuel/energy… driving prices for power to customers
Fuel price volatility will shape costs in future… will impact water usage… Increased water demand will occur with increased cost of O&G energy
Will drive coal, nuclear, and renewables…
Re/ renewables…wind and solar cannot satisfy baseload needs, but sync well with peak load times of day, which can help decrease demand for natural gas
Transmission system availability is issue with wind… improvements occurring here

Renewables connection to water? Does not need water… improves water demand situation.
Lack of access to resource data on wind because much of it is proprietary.

Large scale solar… some for PV Central vs. distributed 10+ years timeframe
Siting issues re/ wind. Is uncertainty for wind Wind resource data lacking for doing economic assessments… data generated by companies is held as proprietary. Makes policy making more difficult… uncertainty in establishing good Renewable Portfolio Standards (RPS)
Those who naturally oppose transmission lines can prefer wind turbines… spatial distribution of wind resource variations is technical issue for load-following and power/use management… how well can grid accommodate? Intermittencies?

Biomass power generation… numerous pilot plants for range of biofuels
-switchgrass
-waste fuels
- efficiencies?
- size vs. performance?
- CHP

Combined Heat & Power (CHP)… energy recovery to make energy & water go further
Impact can be less water use
Where will it go?
How much? How can we make it easier to do?
Rising trend
Challenge is finding situations where it can be done.

Low temp heat recovery for productive use is a challenge/limitation.

CHP with power plants combined with greenhouses is example

Hydrogen Central vs Distributed generation vs fuel type (Renewables or fossil)

Energy crops for distributed generation --Increase in use of local waste-fired power generation and/or fuel crop generation for small communities or facilities… anaerobic digestors for manure… improved water quality, reduced greenhouse emissions, less odor, less environmental impact

Market fragmentation (dream catcher topic)…
- net metering
- interconnects

Use of wind turbines to pump water for power plants… on-demand pumping for on-site storage

Geothermal… water circulation to get HDR systems… needs lots of water
Depleted systems in CA
Recharge with impaired water
Also has cooling demand

Heat engines with oil well production
Closed cycle

Oil shale production… future? Lots of water needed. 10+ Issues associated with water quality after use.

Coal slurry transport in pipelines use lots of water… but are in very limited use. Not seen as growth area. Uncertain future?

Water navigation … fuel delivery?
- uncertain
- may not be a big issue

Grouping & consolidating
Next prioritize 1-6
Ethanol, irrigation aspect, feedstock,
Irrigation is big Nebraska—big economic side effect

Agricultural Uses
Getting More value out of water used, which doesn't reduce amount consumed for water
- Less runoff due to conservation, actually cuts recharge rates
- More efficient use of water offset by more extensive use in agricultural sector.

Move to irrigation has moved demand from surface water to groundwater reliance
40,000 wells in AR, 1000 or more going in every year, this in an area with 50" or more of rainfall a year, based on an unsustainable draw on groundwater.
What do you need to do?
Conservation
Efficiency
Augmentation form irrigation projectxs
Demand on existing surface water
Huge increase that his groundwater declines, withdrawals from major rivers
Econ/Policy issues
Groundwater impacting wetlands and surface water – there is a correlation between the two.
Wetland/Habitat
Power prices and irrigation, makes surface water more attractive
New technology, sales, trends of use?
*References: Southern IL University Study 2005 to 2025
NRC Report and future of irrigated agriculture.

Agriculture
Water "relocation"/movement caused by different management practices, buying acres of water rights for power production.

Water quality – desalination is being used to make up for poor water quality of water compromised by ag uses, plus it gets more concentrated as quantity is reduced.

40% of water goes to agriculture, 40% to power in withdrawals, but ag is all consumed – it has the biggest saving potential. Save water for energy by saving it in agriculture.

Ag

States set water withdrawal priorities – how will states divide it up? State based boundary issues. Feds have some levers in terms of incentives, agency management like the USACE and the MO River basin. If you don't permit buying water rights in a state, for example, that closes that avenue for obtaining water for energy.

Energy Production

Energy production and its water will be exported – more growth in energy than in population in the Central region.

Energy production is increasing, can''t see conserving us out of problems

Water underlies cheap energy exports

Transmission and distribution to markets – wire, pipelines and other are behind exports.

Urban

As population grows we can't just conserve our way out of problems.

Energy Production

Power companies exporting electricity instead of agricultural products if they use water for power instead of agriculture – impacting farm economy, local distribution, impacts.

Urban

Diversions within state to sever urban growth – ND and TX examples.

Mining water for development (T. Boone Pickens example)

Urban planning/construction and water use – building codes and water, building practices and water (the luxury home and growth of water-using fixtures)

Decentralized water infrastructure – where is it going – grey water, storage, implications for vulnerability.

Urban

Aging infrastructure of urban water systems – lack of metering, infrastructure. Savings from improvements are going back to urban uses (sprawl) – it is not really saved for energy or other uses.

Drawdown on aquifers is a problem for cities that have moved to groundwater – subsidence, compromised quality and other issues. On the other hand those experiencing problems are shifting back to surface water, with its problems.

The more affluent we become, the more water amenities we want – although to date a lot of it has been offset by more efficient water appliances (low-flow) through regulation

The heavy rust belt industries and their water use continue to fade – not clear if there are any net savings, will it come back with new industries?

Summer peaks/demand increases power requirements, but takes more water too.

Quality issue – urban impact on water quality – runoff, treated water a higher proportion of available supply, boosts treatments downstream, may runoff faster and move away from availability

Urban

Shift from industrialized economy to service economy accentuates peak energy demand, and for water – seasonal and daily peaks.

Recreation

MO river basin competition – holding more in demands

Disproportionate influence

Much less market-based crosses to environment, driven by water level

Very impacted by politics – Federal operational plans are driven by interventions, very sensitive

Competing influence on water for energy

Misperception that it has no costs

Removal of reservoirs for recreation – ecosystem maintenance

Boundaries issues – recreation in my state is more important than other downstream uses outside my state.

Other

Sedimentation – water supply for all uses, and for power—design lives of reservoirs, reconditioning of dams and reservoirs to extend life.

Endangered Species problem

Plovers and sandbars, protected areas

Alternative habitats

Dam modifications/management – i.e. sturgeon and not being able to draw from cold bottom of reservoir

In-stream flow requirements – how much, timing, effectiveness

Coal Bed methane, production of comprised water, coal and natural gas—accelerating with technology and science…

Oil and Gas in the middle US, refinery location, security wise should it be in hurricane valley—In North Dakota where the corn stock mostly from dry land,,,what are the projections—overlay with water supply and water availability?

Power point cooling and access to surface water, keep driving demand up..
No water use technology, wind technology
Combined heat and power where the technology is going can we combine for efficiency
Distribution generation, we touched on barriers to it
How far is going to go in residential/commercial sectors\
Energy crops combine with biomass
Water navigation and fuel delivery point,
Oil shale we may want to combine with oil and gas extraction, longer term big issue, uses lots of water--One big ethanol issue—Ethanaol/Biodiesel

CBM
Emergence of water management and planning, proliferation of authorities, available for energy production
Home land security and energy consumption
2000 miles of pipes for the county—consumes energy,
Aid economic development
**Coal now, Integration gasification box circle
NG—price, LNG 10 years out
Hydropower—reservoir issue—the ability to use hydro power for peaking—can't peak in hydro—subplant hydro with something—in one case you are conserving water while you use a lot somewhere…
Buy water in daytime and they would replenish in the night…
The smaller plants are traditional peakers and they have gone out—
Less flexible—"solid base load"
Environmental and recreation issues—reservoir management—power is the only thing they pay attention to…run of river or other technologies—the KW got out of this earlier made people reject it..
Biomass power
Coal powering energy
Woodsy crops are very water intensive
Do we irrigating dry land?
Interest in forest spinning,
Refinery location Nimby LNG facilities
Infrastructure as a broad topic area
Moving to the center of the country with other people pushing it out of their backyards
Consistency in policies/incentives/regulations for water and energy—add awareness also
Market gets fractured because of
In ND cannot build transmission once in MN…
Between NE/KC/CO different policies
Emerging technologies don't do well in patchwork
Consistent supply demand projection and geographic projection related to water
INFORMATION—everyone working with similar information and knowledge
NUCLEAR PRESENT & FUTURE
Problem realizing what we have—more pronounced cooling demands than coal—hard to know—what to do—
HYDROGEN ISSUE—very uncertain—what you produce it from—nuclear, wind, --high temperature reactor in University of TX—output to water—where is it going and how fast…
GEOTHERMAL
Another potential water user
WIND
HEAT & POWER
SOLAR technology—thin films—distribution generation—on homes—low electricity rates in central—incentives in CA, NJ, NY
Climate change causes major policy –boost cost for coal, natural gas to coal—global climate change –one of the benefits of IGCC does not emit carbon—pushing neutral things like biofuel—sequestration

52% power in the country comes from coal—some conversion may be but the coal will be there…
Pick out important issues to carry forward…
Question—reducing demand/conservation/efficiency
Recover heat from different things in his plant—Farnsworth—
Do we have adequate modeling techniques to do recovery—new technologies—
Training education awareness…programs to encourage—energy implications of water use and water implications of energy use...
No energy water conservation effort—water reuse…
Priorities to be decided by group—cut at a combined list
21 topic areas
Which are priority problems for water for energy…

1. Ethanol/Biomass
2. 2. CBM
3. Water Management & Planning
4. Homeland Security
5. Coal
6. NG
7. Hydropower

8. Biomass

Group B Breakout Session 2: Water Problem Identification

Key issues/problem with irrigation/recreation/energy production/trends affect water available for future…
Future water availability—how much water do we have—in the Dreamcatcher section
Agricultural issues—is it surface/groundwater issues/environmental issues
In central area—varies by state—in AR surface water relying on precipitation—last 3 decades lot of 40,000 irrigation wells in delta—tremendous increase in the 40-50 inches rainfall—policy end—state issue but what do we need to do—importation of surface water to augment ground water demand—there are several projects AR to that—ground water demand on surface water sources—flood control, municipal –huge increase in agricultural water demand, both in surface and ground water and big groundwater demands—cuts across—all—economics, policy…does it impact the wetlands in Delta but does not know how much…not huge impact—fall and spring out of bank discharge—creek run dry by groundwater wells—NE—surface water tapped out—long drought—limited irrigation water—stopped drilling ground water wells—price of electricity affecting people—NE flat river—so dry—never flows—in Kansas same thing—forecast agriculture demand will go down in 2025—water rights are sold to developers—source SIU national water consumption forecast—2005-2025—done in 2003—NRC report suggested total water use stay same while it goes down in acres…it has affected in run offs in Kansas—combination of filter strips, to hold water on the land—it has affected water recharge for the high plains—great declines in the high plains—the western part—more than 40,000 wells in the southwestern part of the state—we have done conservation practices—more value with the water—than cutting back—not reducing the amount of water used or consumed—new

technologies doing this—decline is still there—we have problems coming in and going out—water relocation/movement caused by management practices—municipalities and private wells—coal fire plant expanded—sunflower—they have bought acreages to get irrigation water—put in a desal facility—water quality impacts magnified by water availability—lot more surface in eastern part—desal—part of it agriculture and part of it quality…agriculture—consumptive use calculated—agriculture 97% use in Kansas—allocation of water by state—agriculture is priority—federal govt. cannot get in water—create incentives only in the west—MO river basin—corp of engrs have divide water to various—so much consumptive use in agriculture we should conserve there—trying to get federal programs for efficiency—to reduce no. of acres to be watered—we this year—biggest potential because it is the biggest user—whoever wants water buys out the other—barriers to solution—state regulatory that doesnot make it easy for selling water rights—

Trends in energy production—

Based on projections energy production is going up and so will water—you cannot conserve –as population grows you cannot just conserve water—if one assumes energy use is going to rise—energy use/production and water will be exported…agricultural products exported—produce and sell—assuming you can recover production cost through your sale—develop a market that is sustainable—in ND we export 65-70% of electricity—conductor research—water underlies cheap energy exports—MO river levels has not affected ND yet but may soon—distribution to market ethanol fuels etc.—pipeline and wire—power co buying up all agricultural lands—exporting electricity not agric. Products—micro level affects local economy—discounted new sources of water—in desal—

Urban—ND. MN separated by Red river—Fargo gets water from red river—plan to divert MO river—any areas in the central region? In TX, Dallas and San Antonio—mining water in the plains—trends in urban sprawl—infrastructure—centralized water –revitalize aging water structure—vulnerability—grey water use…Chicago—renovating distribution system—decreasing water usage 25%--lack of metering, saving water to give it to urban sprawl—

More affluent we are more per capita energy is being used—10-15% increase during Thanksgiving and Christmas—rust belt—some of historic heavy industry—heavy water use and now there is shopping mall—tremendous changes—net savings or not—not sure—sun belt—that industry in decline in the US and we have specialty mills—not as water intensive—air conditioning increase in the northern part of the country increase—electricity consumption gone up—urban areas increases electricity and water demand—urban side quantity issue—quality issue—impact of surface water as well—more waste water—surface water dominated by treated water—impact on generation—may be site specific—quality issue of what we can use—boost water treatment—demand of energy for treatment—over pumping and decreasing water quality—lessening recharge—any big draw down—Chicago dropped 700 ft—San Antonio drops but recharges—Omaha surface water use—withdraw ground water declines water level—more in some places—

Areas that shifted from industry to commercial—those areas cycle in electricity peaks goes up during the day—seasonal or daily—

Recreation—Mo river basin competition—trying to hold more water in the dams—lake cabin owners—disproportional impact—much less market based—lakes are operated by federal agency operation plans—disproportionate political clout—who is more powerful—changes the amount of water available for withdrawal—taking out dams—boundary issues with recreational use—what happens down stream—with some of the reservoir they are holding sediments and

water no longer at the intake level—everything fits together—losing the effect of hydro power—reduces overall water supply for everybody and increase competition from everybody—design—sediments are more in some than others—reconditioning life—make it other category—
Competing uses—environmental issues—endangered species—discharges are regulated for the nesting period of plowers—NE—bought sand pits for plowers—alternative habitats—sturgeons—altered dam drawing water 60 fts higher to protect the species—big argument about managing water—how do you know how much is enough—modifications to dams/reservoirs, consideration we deal with—competing demand—recreation and all instream uses—turning off irrigation uses to satisfy instream uses in Kansas—

Agriculture biggest water user—conservation is another subsect—water relocation—management, quality, desal, sedimentation, water supply for all uses, reconditioning, states and state's rights, priorities, cost cutting issues—boundaries don't coincide with energy production—regulatory framing issue—energy production competing with itself for water—population growth can't conserve our way out of the problem—people mining water to support development, construction of water use, building codes and water—decentralization—grey water storage—aging water systems—water saved goes to more urban sprawl—groundwater aquifers—draw down issues more widespread—affluency increases water use—distribution problem—peak energy demand—seasonal and daily shift—recreation—disporportionate system of where water goes—wildlife uses of water a major competitor—
Houston is trying find surface water since ground water is disappearing—as in China—explosion of golf courses—consumptive water—recreational—irrigated use—
Death valley has golf courses with no water for miles
large process plants sends water into sewer—
Do we need a system to
Boulder uses grey water as an incentive—golf courses can use grey water—dream catcher—optimization tools—micro-macrfo—examples uses of grey water, reuse collocation—communicative use between surface and ground water
Need to know how much water we have—
Water optimization—nano bubbles and O2 –engineered water into application—high tech water—use it in golf courses—
Regional climate change—
Regional water and climate change—facilitator to put in dreamcatcher
Cyclic changes—80-90 years we have record—predicted data—what happens in 1000 years—1500's was very dry—do we understand duration and frequency
impact of sunk cost billions of dollars—has it produced technological solutions—DF:rebuilding New Orleans for example—how to manage water resources—reduces flexibility
Encourage analysis upto 40 years
US used to technology leaders in water treatment—lost edge—we plateaued—developing worlds are looking for innovative ways of doing it—cell phones for example—our opportunity to provide technology—
No incentive to move from where we are—huge sunk investments—
India lost because electricity is bad shape—
total cost—innovation is not making a large incremental change—then change will be rapid—sea change from coal to electricity

Coal to jet fuel conversion—technology developed by Germans—South Africa has a plant-other technologies that have been successfully used

1. Agriculture 18 reliability and crops driving digging for more wells
2. Water relocation 7
3. Water quality
4. States14
5. Energy production 10—exporting water and energy—coasts pushing the problem to the center—as a trend—pipelines, wires
6. Urban 8T. Boone Pickens—developer—
7. Aging water infrastructure
8. drawdown on aquifers
9. Energy amenities
10. seasonal issues
11. quality issues
12. recreation
13. Sedimentation
14. Endangered species

1. Agriculture
2. States
3. Energy production
4. Urban
5. Water relocation
6. Recreation—

Group B Breakout Session 3: Needs Identification

How do you put a value on water—market haves and have not—value low in public appreciation of water—farmers know value when you are pumping they are electricity and operating costs that assigns value—monthly bill gives value of cost—if you think about when decisions are made for water as a commodity and how does a state assign value on that especially since more demands means more allocation and how and what basis do you make the decision on the value of water—

competing use

Quality and location—great lakes vs arid region

How do you turn into need—to appreciate the value—there is a need to allocate—conflicting needs between different jurisdiction—there is a need to place a overall value on the commodity—need to establish a market system—does not mean completely free—like electricity—you can't sell water rights—

—water is under the economic market system..

Need

Place an overall value on water commodity-a market system that helps set value—but maybe not a completely free market

Do you declare a natural sacrifice for the location—a better system—states working cooperatively—water rights law—all of the major water infrastructure manifest destiny—huge social program benefited a small US population farmers and ranchers—that legacy we live with—leverage in the agricultural sector—water is very cheap for agriculture in comparison to urban use—also issue of social contract in this country—rely just on market forces to make sure equitable price available for water is there some way to blend all that since you can't rely on market force—

Yucca mountain—best site was Nevada—similarly can make sure to get water where it needs to be for example there could be a pipeline from Great Lakes as a national sacrifice area of course you can't sell it politically but could tie into the national needs-assessment

National needs assessment of competing value—quarter of a billion sunk in Yucca mountain however it will most likely not be used and instead the nuclear material will be held all over the US—the reason being that it is too hard and right now there is no national resolve to solve water problem—

Basic framework—water value—publicly owned and private owned resources—public resources—water utility decides on price—how to incorporate the negative extranalities of water used—needs to be sensible/logical—initial framework should be basic—much more troublesome for privately owned—

Mapping of water—how much to we have

Public vs. privately owned resources—how to deal with negative externalities

Value on those?

Tackle publicly owned at least

Water disputes settled in court between MN and ND share the Red River--MN has all the water—governing law should change—

There is a transition going on—Riparian states are looking at permits—looking at what the west and east did—valuable to get from this group—is there a need for market—market for water and water rights—problem with the market—if perceived a need for market—

What is market—market for land in IL are any allocations done by government?

Fights over water always gets settled in court

So does the state determine who can sell the water for example in IL if a landowner can extract water from land can he sell it?
He can sell it—
Any limitations in selling?
Sometimes for example in Champaign IL, the landowner can't export for more than 50 miles—\
Legal problems in quantifying water
Scarce water resources—when rivers run through different state and transcend state boundaries when there are disputes they are settled in court
Is there a move to make decisions scientifically in courts
Yes scientific testimony sought in legal battles
Yes—NE/CO/KS agreement for the Republican river—without water rights to be issued
Different views from different states need to have a common data
How much water do you have and the value assigned to it makes it essential for water supply management need to have uniformity in defining the geology, hydrology—common terminology and definition. Unfortunately since there is no regional water supply management with this data the information is not consistent
Water and quality levels
Overlays of big users and where they are
Water metrics-quality-quantity-volume—resource inventory, measurement techniques
Across the whole country—USGS has data
Uses and extraction across the region
Where are the power plants located and are the water pulled out from aquifers and water sheds?
Act together in state and deal with the overall with other states
A group of state geologists, to put together a system to understand all issues
Interstate water lawsuits—UTTON model interstate water compact—water resources in hands of state—if there is no water planning—states end up in court—state should work to avoid that—MO is a poster child of water litigation and bad management that is a governance issue there should be some way to reach agreement saying to share the river—talk about a sharing the water—
Agreement to do planning—sharing information?
Decision made on behalf of the states to do this—state level agreement—data together—use it—looking at it—Great lakes and Canada get together and allocating it
Need to understand the resources and know when to do resource planning—understand the resource—between state and cross state—
Whatever planning you do you need resource inventory—Ogolala ground water—those affected by it should study it—
Regions within a state and watersheds and aquifers to assemble and use the data and allow it to be used
New need—EPA update the water temperature criteria in the MO river—not just EPA and MO river—may be not just temperature—TMDL—total max daily loads—water quality—discontinuity is across state levels—
Reevaluate criteria for water quality among authorities that regulate it
Needs to be done in federal level—
Agreement and harmonization between state and federal—
Federal govt sets standard for MO river—criteria same down south over 700 miles—same standard—

Existing and future uses—criteria maxed out—artificially constrain new water body—
Different temp. criteria to be used at different levels
To set criteria—needs are different—MO river—make a manual for 15 years—they decided after not being able to decide together—got sued promptly
Better technology/standard scientific methods for setting temp/other criteria for water bodies impacting power production
Mo is unique—is not there in AR—or CO—but affects many states—
Competing demands
Regional water planning in NM—people in electric generation not involved—different viewpoint and need to be involved—you would add value
Other water competitors—consumption from agriculture—is there a need to come up with a way of reallocating agriculture to other uses
Legally in KS—no
—we are threshold on deciding allocation—whose speaking for power industry who is the advocate—coop? Need to accommodate future power generation needs—
There is a need to understand what the existing use is—energy production xyz power plant, they require x amount of water—no value judgment—unless you know what consumption is now we cannot make decision on future water needs
Need in quantitative fashion
Need a model which tells us how we are depleting the resources—different wells in the city, in process plant—any mathematical model—some models in IL—uncertainty with data issues—need better data—
Nonconsumptive and consumptive use
Some places have it and some don't—depends on agriculture of technology—
USGS does it have information is it compromised?
data base collected nationally but sparse—when we have problem spend money to get data—
Uncertainty in data-need better USGS data
Clear definitions—consummative use, other
Where do you want to stabilize drawn down
Investment in data gathering technology
Certain resolution for data and level of details for individual sites—
Energy and water needs—if someone wants a new power plant where would they have it—where resources are readily available—how do you quantify—water focused siting model
Need for water focused model/analysis for energy system siting-capability/availability-like wind turbines and wind
Come up with a map where water is available and color coded where water is not available
What data and criteria
Quality
Quantity
Temperature
Ownership
Not readily available makes it more expensive
New coal generating plant, resources in IL, individual possible information, 4 stool analogy—near field delivery, somewhat close to existing transmission lines—how the network accommodate this increase—transmission engineering aspect to it—water supply—stream flow—not enough water to run the plant—have enough land to support everything—air quality

problems—factor all these things—in WI very elaborate permitting details—site specific—companies know what data is needed and find it—
water resources are controlled by fed government—cheap coal and build coal plant and export power thro transmission lines—can be done more efficiently –maps where to locate wind turbines—
Flipside—energy planning need by technology
Is there need to set aside water for future energy—what role energy plays in water allocation
Characterization by technology of water required to use in planning and management of water
Is there a need to set aside water for energy production
WI is way ahead—siting law for 30 years
Worked for MN co,--detailed resource planning plan—to meet customer demands—peaking capacity—where do you site this facility—utilities decide where to put it—not put in MN but another state—
Does the energy industry playing a sufficient part
Need a better plan to integrate energy industry in water planning
Propose we need model for agriculture, urban needs,
Where water comes from, how we use it for all the things we need
Demand forecast consistent across the nation
Energy beyond 10 years is crapshoot
At least become a forecast—to know what load demand will be in 60 years is not possible—4-5$ per million—energy needs planning—having general feel for what are the impact on natural resources—need the data
Needs
Alternative forecasting/sensitivity capability
Transmission has been a nightmare getting it from one state to another—last energy bill—in national interest to update transmission system—all companies coming together—
Method for interstate coordination/planning
Gentle persuasion to do it logically so that we work in the national interest
Start at Governor's office
You have these methods of generating electricity with variable water demands for process—someone question if water demands is great—
Different scenarios to evaluate costs—new technologies to take the next step forward—as we are maxed out on a lot like cooling, better thermal discharge cooling—important in assessment—
Need better thermal cooling technology/discharge challenges
In times of extreme demand to cut back on withdrawal—where the decision will be made—energy may fall below drinking water above agriculture, recreational—
Need information to better inform contingencies with extreme events—interdependent analysis—what are the implication
What is impact of reduction in water mean to a power plant
We haven't had to worry about instream flow
Modeling need & forecasting needs to look at energy/water/other needs
Economic approaches/models to be looked into—urban controlling water for their uses—more realistic pricing of water—encourage agriculture conservation
Modeling details what level of details in the model
Data needs of individual model—gaps or holes in terms of data—need water pricing, know what data we need

Good decision support, data definition of model
Look at macro and micro scale, different type of distribution and
The connection on energy supply side of things, as they deal with less water, they are going to change process or recycle and reuse water—latter may require adoption of some energy consumption equipment that adds demand to the grid—saving water at one end and using energy at the other end—where is the breaking point?
Increases capital cost—45 mw to produce 600—
Economic modeling to manage agriculture water—
reducing consumption—urban and agriculture public utilities—potential for more authorities—using conservation pricing—increasing pricing—EPA 2000 10% increase in price 5-8%--in homes 10% increase only produces 4% decrease—identify public utilities who are facing depletion problems—those utilities and DOE to go into partnership—
Water consumption does not decrease in IL and KS—utilities not interested in water pricing from others—
Water is different since it can be stored—whereas electricity needs to be used
Not gaining too much by conserving water for electricity—since Agriculture uses most of it
AK is 5-10% for municipal utilities
KS is mostly agriculture
Model for optimum use of water to our farmers—it is economically driven—since gas etc. is so expensive—water is not being wasted—are they utilizing it in the most efficient manner—there are some tools—
Do we have a model for optimal use of water/other resources?
University of Nebraska has a model
Incentives to use less water—lot of money to technology changes and better nozzles—AK does not pay anything for water—just pay for the operating costs—In Kansas it is a property right—
Instead of litigation—give the farmer an incentive and they are saving energy and spending less—may be a better idea—
Is there an awareness and incentive need relative to agriculture conservation is there a water conservation summit for farmers
If this something the energy community support to educate the farmers and give them incentives..
Trying to reduce the water used by farmers, instead they are growing more crops—ND gives money to ask the farmers not to grow plants
Reduce the amount of water consumed.
Need is to figure out what incentives program to free up water for energy use.
NEED—An awareness incentive for agriculture water consumption
A summit for farmers and legislators
Energy other users support to free up water—reduce water consumed
Scientific/technical argument for it?
Need figure out incentives to free up water resources for other uses?
Incentives
Values for other uses
Tech potential
Like approach used for SO2? A cap?
Can water be sold by owner—is done in KS
Getting the message out—to free up water

CRP in ND for agriculture
Best practices of rural extensive water conservation ideas into the conservation security problem
Need on vulnerability on Homeland security, natural resources, terrorism..
Contingency planning
Can the global modeling-climate change, variability, precipitation, temperature variability
Interference with drinking reservoirs
Reservoirs vulnerability
Gathering analysis of existing data—who is doing it, how it is structured—background info on things we are bringing up—provide background info on key topic—
Tremendous activity going on—
Should DOE put out cost share proposal to all regions?
NRC report water use nationally
Look at everything out there—on going relationship with different states
future water needs based on new power plants—EPRI puts out information—where, what areas plants will be coming up—forecasting new plants—we can project water needs for power industry—
EPA and DOE know about permits are being processed
Helps us plan for water—sometimes when they site plants they think they can get water
Get EPA and Sierra Club at the table
Needs
Gathering/analysis of existing data/activities
Is NRC report adequate?
Survey of what is out there?
EPA and other data sources
What energy systems are and water will they need
Who are the key players and what do they know, what is their role? EPA, Environment
State reserved land, special natural reserves have some say for transmission routes—the state public commission uses corridor to the maximum possible
capture best practices and let everybody know
Energy sector involvement in water planning—there is need for the policy to address water used for energy—need for the national energy policy to address water energy—
1860 bill would augment energy bill to push energy water interdependence
Need to quantify the extent that cost/availability of water will limit development
Regulation Policy
Basing on standard scientific methods
Alternative energy in water supply
Need for water focused model/analysis for tools for energy system siting-capability availability like wind turbine and wind
Method for interstate coordination/Planning
Technology focused—need better thermal cooling technology to deal with discharge challenges
Need to figure out mechanism to free up energy needs
Model for optimum use of water—Univ. of NE, agriculture focused—add to forecast area as an example
Statement on we have extremes where they are rigidly controlled in some states while some don't have any control since they have not met similar challenges
Eg. WI-has more water than KS and IL

Need an awareness incentive for agriculture—free it up for other uses
When dealing with agriculture if you talk in terms of efficiency if you want reduce water use for energy—
Would you lose water rights if you use less
lease mineral rights in ND for a few years and in some places you can lease water rights
Forecasting climate—who is doing what where

Need to re-examine weather modification

Needs in brief
Gather analyses of existing data--1
1. Regional agreements
2. Forecasting and modeling energy/water
3. Forecasting and modeling competing uses or other uses
4. Regulation/policy
* Water in national energy policy
5. Better technology for thermal efficiencies
6. Conservation/agricultural water use reduction for freeing up water for other energy
* incentive approaches
7.Need to reexamine weather modifications

How much is available electronically—USGS, state websites, most states do have records for monitoring and permitting, they are not readily available as organized—
Format, and how useful it is for modeling purposes
Hour by hour vs. annually
USGS and EPA trying to have raw data compatible.
Every state under USGS has data. USACE, Vicksburg, ERDC, any regional institutions collect data
Research done for very specific topic, vary depending on specificity
Assess and limits on access so who gets to use it
Transportation, Army, EPA have streamlined to share data, DOE can enter into high level clearinghouse, steering committee for working groups to develop data sources
New technologies to gather data so that the models are response
In USGS the stream gauges are in realtime and gives data as it is developed.
Lot of remote sensing, WA
Sheer cost of put in the information, cost accelerating, we've seen agencies drop rates, it is a struggle to maintain data much less adding data
Any new technology out there
space based looked at but still pie in the sky
operation cost or installation cost?
Water use data base is really weak—many states make broad estimation
so much stock in water feed data and it is weak
small percent of agriculture is metered—so much based on estimation tool, pretty amazing considering how big a user it is, private property
Lot of data base out there-new data base.
Useful to have a clearinghouse for data,

If you going to congress for xyz you need data.
No state is willing to give data—may be will share it
metadata about the data with gaps to fill
Conservation AGRICULTURE use to free up water for energy uses—incentive approaches
On utility has bought up land for powerplant in KS,
The state is trying to find money to make sure the farmer does not farm—stabilize the decline rate—piggyback on some federal incentive program—just NE in Republican river—
How about a landtrust purchased by energy and share the profit
Inland fee agreement with sunflower
Structure for water producing
Water saving performance contracts?
Farmers given incentive to plant trees instead of farm
Might work in west
One of the results may have regional solutions after 3 workshops
Low cost idea for clearinghouse in USDA with easy access to audit opportunities in rural extension outreach
What is the business opportunity by water you are saving? Again depends on the state if it can be transferred
USDA to DOE has been pushing agriculture extension service for greater educational training,
Conference on business models and water rights approach
Electric industry supporting farm measures to save water
Technology pieces in this as far as saving water
More local weather stations and better management and less application in theory
OK has a good system, extension might be one option –wiser management—soil testing
The cost could be very high for engineered water to be used.
Hybrids that need less water—
Extend DOE is doing, nitrogen carbon sequestration

plant intake contributes to low flows—high water users without producing anything
Better evapo transfer information to better manage water issues
Enhancing management of water
Monitor weather condition, farmers subscribe to it and decide when to irrigate and not when to irrigate
Renewable fuel standard expand demand for energy crops—energy crops saw grasses-
Forecasting for modeling for other uses:
Forecasting the energy requirements for new power plant energy water uses
How do we free up water for energy production
Both the cases need a national effort, at least a coordinating mechanism. DOE can sponsor universities around the US just like NASA did a couple of decades on real time data
NRC to put a panel of experts to have a straw man
To have a standardized approach—modeling, confident that output from the model gives them data they can bank on—national energy supply—need to have confidence in the data—if the states are the premier knowledge holders, make the model uniform
A water EIA—a consortium to agree on approach, economic water model, problems are not independent,

Develop tool to integrate model, algorithms, validation approaches, by DOE, or tools that can be built on
Can you get inside of agriculture processes and do modeling across the industry structure
Semi conductor industry have model that are proprietary.
If I want to model ground water use I want to model all uses—if optimization is the question then we focus on a particular use—we are interested in overall availability not optimization
Invest in technology both agriculture and process
information on water profiles of key industries.
Can do the same with water
What policy recommendation that will come out of the workshop
projections of future water use of different sectors and see how energy industry fits into that
Will policy makers use these to make the decision
Economic model how it will affect the state economy, any change in water is being administered is going thro legislative process, either prioritize by use, or cut the amount—there will not talk
Water planning in ABQ tool to look at what if scenarios—one of the option was all new construction use economic impact of the compact with TX huge problem—this model tracked ground water and surface water and impact of all uses—reduces surface flow—improve ground water extraction, but not delivering enough—eye opener for a lot of people
Investing money to take salt cedars in the Bosque
The way policies and economic modeling in KS is come about as a public open process so there is buy in before we take to the legislative process, it has a higher probability of work—flipside—if not relevant to their area they will throw it out
Bring in back to the area being discussed
Forecasting modeling of energy:
Solutions science and technology solutions
Wind resource data extended
NREL does it for federal lands throughout the west
Rail lines, transmission, transportation, GIS for developing energy plants
We have 6 years of data before doing anything—permission to put up tower, but it is done faster now
water for tributaries, go down to 7day q10—details on water flows
Flows on different days
If you are a winter peaker you need excellent data for that time of the year—but will be helpful for derating—some months you can go to dry cooling—that site has to be extremely valuable to have new energy source—so that there are no high risk factors you can click on GI sites and get annual flow data, goes back 50 or 5 and you get data on monthly basis
Are the forecast based on different scenarios—detailed characterization of different technologies—
Is this also weaving in the explosive development of ethanol plant in terms of its demands on water—that has not been given a lot of thought—depends on the area whether it means a big deal
Ethanol plant in my area—doing this incrementally to push the production up—cattle raised in NE that needs water
Multi year program plan of DOE should have water on it—objectives and milestones for water use
We seem to have an agenda that is bureaucratic—out of balance—hopes are on technology—use what we have better—we are pretty much tapped on that

sustainability element—hot button word—careful how you define it
we need solutions—things with traction and solution—conservation asking farmers to give up water—
technology can be more productive and valuable
new generation nuclear can use regular air for cooling
energy crops that can use comprised water—looking at reclaimed damaged soil and comprised water—whole energy water technology needs to be emphasized
Better technology for water use:
Thermal efficiencies
Advanced cooling
we struggle with thermal cooling, EPA and river solve regulatory issues with a technology on dry cooling
water assisted dry cooling is technology tested now—spray water to help on very hot days—
Should we talk about generating technologies that don't require cooling—
Ground loop cooling—do you use it?
Turkey Point, Date County, Florida, has a canal system, looks like a radiator from spaceship—needs a lot of land
Limestone cooling
Biomass are all steam cycles
Less water intensive mining extraction technology
That would be one for western workshop, jumpstarting oil shale
cheap ways of using and reusing that water
Is there a way wind and solar power can be integrated into this—the one qualification the manufacturing wind turbines is water intensive
Energy balances have been looked at.
When wind blows you reduce the demand on water for coal
Microturbines don't use water—fuel cells are a mini source of water
Talk of using hydrogen to generate electricity instead of just running car
Energy efficiency methods in industries that are heavy water uses
Regulation and Policy:
National energy plan, basically trying to put water on the map in relation to energy—don't know what solutions are
Revisit temperature limits in the MO with better science and data. . Regulations is driving since two new coal units are close to each other and have wells to draw water
You want to develop information to influence policy deliberation—a fact sheet and needed solutions. Dummy the information down—the tremendous situation—you have to have a champion—
3-5 years the standards are looked at—when is there an opportunity and who makes the case to the top
DOE is sensitive in the topic of doing policy—trying to capture the policy issues but the roadmap will focus on science and tech.—policy documented as backdrop
It could who we work with—DOE does work with NASIO on certain topics,
There is some philosophical road block—policies modified to go forward—EEI can do that—EPRI is sensitive about lobbying and just is DOE—EEI/ Farm Bureau/powerful state lobbying groups can go together

There are water conservation provision in the farm bill, that somebody did—who did that--
That is API—don't know who the ethanol lobbyists are
ACEEE?ASE
EPA and American Rivers are not here
If you have specific individuals in mind let us know
You have two fed agencies go at each other; NRC battle for EPA and they can't agree on anything
You have to have all players at the table to buy in to the modeling
Local EPA regions need to be contacted
Pricing
Public utilities
instinct is politically unpopular thing to do—test it on a place of high probability of success—find 15 highly energy utilities—recognize that higher pricing means capital improvement for subsequent generations—feeds back to cutting back water bills—with retro fits that can financed
Find out what programs out there and look for places to demo and prototype them—a model in KS city—reduced water use—the one in west, they provided low flow shower heads, toilets, they have xeriscaping—not with pricing but incentives—the city paid for practices—some of them scaled pricing—not necessarily resulted in reduction in water use—distributed in income with those who can afford it
Building codes, raw pricing—CA looking at building codes—
grey water is difficult to use—it has to be sanitized
Water audit programs
FEMA used to do water audit programs
Regional Agreements::
Does anything exist right now—a national governor's association or something
Some rivers have agreements, river basin authorities and we have a couple in Kansas—there are some—in depends on how regional you are talking, regional compacts are there
What info will be useful to organizations—
they need to know how much water is withdrawn in their jurisdiction—a region, or watershed—what their piece is in the whole pie and agree on the data—that would be the place to start. The ground water is or is not hydrologically connected to the surface water. In some places it is and some it isn't. It is important for basic concepts. What is the water balance for the area.
A group that we should run all the modeling info thro and review
We could start with the benefit of what we now know that we didn't know in the past
Are the parties involved interested in making the changes
Try to keep something that is workable—
compacts done before the ground water knowledge—we haven't adjusted compacts accordingly
There is no easy mechanism to look at ground water, surface water, quality, quantity much like the temperature we talked out before—the water quality changes every state line
You need to take this info how the region would be defined by the grid—as a component in coming up with an agreement—control areas don't pay attention—ground water is not the same as drainage basin—
Regional planning is important here instead of individual state plans
capture solutions under need, prioritize where you'd like them—highlight those on how we address the needs

Group B Breakout Session 4: Opportunity/Solution Identification

Solutions Group B

1. Data existing information
    a. USGS state website for baseline information where available
2. Payments to reduce irrigation and free up water for other uses, slow declines
3. Decentralize models and forecasting tools to universities to develop/use it (ie.NASA and its data)
4. Standardize modeling approaches so people can feel confident about results
5. Policy analysis capabilities in models and forecasts-economic, legislative, what if policy
6. Clearinghouse for data and information
7. Scenario capability in modeling with detailed characterization of technologies

Problem Flipchart Transcription, Energy Supply

FUEL PRODUCTION

- **ETHANOL**
  - NEPACT mandate for ethanol and biofuels, growing, new facilities—groundwater demand common across region
  - 860 acre-feet for plant with power gen using its waste heat
    - Also ethanol to jet fuel; 1000 acre-feet/year in addition to 13,000 acre-feet for power plant
  - Trend of ethanol with powerplants for waste heat, and coal
  - ADM/Cargill/Staley
  - Irrigation for ethanol fuel feedstocks increasing; near-term problem
    - How much is irrigated? vs. dryland
  - Biodiesel—How much? Near-term problem
  - Development of these alternative fuel sources by state related to water supply availability—geographic sensitivity—upper MO basin is tight, for example
  - Quality of water need for alternative fuels
    - Demineralized …
  - Effluent from alternative fuels
    - Discharge may not be issue
  - www.kansasenergy.org -- ethanol issue
  - Alternative production for ethanol and biodiesel and their demands for quantity and quality
  - Institutional—retaining reliable supplies, emergence of water authorities to control water—15-20 in IL—challenge to manage supply
  - Ethanol feedstock geographic distribution related to water
- Fuel production and economic development
  - Water districts
- Oil and Gas
  - Water reinjection to maintain pressure (near-term problem)
    - LA, TX, KS
    - Reinjection sensitive to cost of oil/water
    - Can produced water be used for this?
- Refinery location
  - Diversify location/access to resources
  - How far can expansion go at existing sites? (long-term problem)
  - Discharge issues
- Biomass production of waste-fired systems—MN
- Co-firing of biomass and energy crops
- Alternative fuel—food tradeoffs
  - Commodity prices?
  - Alternative fuel prices?
  - Water impact on both
    - Long-term unknown
    - High certainty in near-term

  - 85% ethanol in autos
  - For subsidies for E85
- Water/navigation—fuel delivery
  - Uncertainty
  - Maybe not much of an issue

ELECTRICITY PRODUCTION

- Low flows and high temps
  - Poor quality at intakes, gravel, etc.
  - Struggles with USALE operation
    - Water district and management decisions
  - Lots of uncertainty
  - Temperature of intakes
  - Heat driving demand up as generation goes down
  - Platte and Lake McConaghy
    - 7 temperature excursions
    - Tapping groundwater
    - Battle to maintain capacity
- Coal plants announced—2 in WI
  - Big Stone in SD, Power River Basin – MO watershed
  - New plants on different basin
  - Mid-American and Council Bluffs
- Moving away from once-through cooling, especially on MO river
- Reallocation of storage for hydropower to other uses – 40-50- year old
  - Recreation, fish, environmental, agricultural (near-term problem getting worse)
- Consistent inventory of energy/water demand is missing—total and where energy fits in it—what do we know?
- Generation has to be built—what fuels, what water goes with it, what technologies?
  - NG supply?
- Great Lakes withdrawal caps
- Cost of energy and US competitiveness
  - Regulatory barriers
    - LNG imports, facilities to handle, transport
    - $12-14 mmbtu for natural gas will change our competitiveness
    - Get at high cost of fuels
  - Water-environment, supply—are key to those siting problems
- NIMBY east and west coast push plants and energy infrastructure to middle of country—and environmental/water issues
- DoD and strategic siting of fuel production in middle of country/low water areas
- Even in areas with a lot of water—WI—there are rivers that won't support once-through; constraints are broader
- Difficult building reservoirs to support energy production—even in water-rich areas
- If NG is not the future, what is?
  - Coal, more water use, …
- Coal gasification future—ship CO2 to oil fields to extract oil (near- and long-term problem, increasing over time)

- IGCC requires water?

NUCLEAR

- If they aren't renewed or life-extended—implications for water and electricity
  - Licensing likely
  - New capacity and its cooling approach? Air cooled? Gas cooled?
  - Future of standardized design/PBR (near-term problem)
  - Energy bill incentives are going to be effective, or it won't happen
  - Greater heat dissipation requirement
  - Withdrawal is different from consumption
    - How much is it, how much will it be? Not an easy calculation. Need to model/know; site specific
    - NETL study: .1 vs 1.1 for consumption; 37.7 gal/kWh for withdrawal vs 1.2 gal/kWh
  - Water temperature criteria used to regulate river vs. needs for cooling
    - Review/study at national level
  - Water recycles on closed-loop
    - Use it continually once it is withdrawn
    - Make up water technology
  - Siting on major rivers is an issue
    - Vandalia example. In the future withdrawal and transport will be an issue—may be economic
    - Tapping into under-used resources/economics of under-used resources
- Fuel price volatility and cost – drive to new mix of technologies
  - Uncertainty of outcome
  - Alternatives use water

RENEWABLE RESOURCES

- Resource data on wind? Proprietary …
- Wind doesn't help with baseload
  - Positives and negatives on siting … uncertainty?
  - Correspondence with peak
    - Can depress NG consumption
    - Even with CTs for NOx suppression
  - Transmission access and where wind capacity can go—MN and ND acting to change
  - Wind siting issues
- Large scale solar—some for PV (long-term issue)
- RPS—Incentives—uncertainty?
  - Economic viability under incentives and without
  - Markets driven by standards
  - Low electric costs
- Wind has helped build transmission
- How much can grid accommodate
  - Of intermittents?
  - Can you manage it?

- Biomass pilot plants
  - Switchgrass
  - Waste fuels
  - Efficiencies?
  - Size/performance
- CHP—Energy recovery to make energy/water go farther (near and long-term issue)
  - Where will it go?
  - Less use
  - How much, and how can we make it easier?
  - Increasing trend
  - Adding to existing potential
  - How much and where can it be done?
  - Greenhouses
- Distributed Generation
  - Net metering laws
  - Standardized interconnection
- Hydrogen
  - Central or distributed?
  - Fuel—renewable or fossil energy
- Energy crops for DG
  - Farms to power
    - Economic diversification
    - Jobs
  - Anaerobic digestion
    - Positive water quality
    - Global warming
    - Odor
- Wind turbines to pump water for other power plants
  - On-demand into storage
- Geothermal
  - Water circulation to get HDR systems—needs lots of water
  - Depleted systems in CA
  - Recharge water compromised
    - Water condensate
  - Also have a cooling demand
  - Heat engines with oil wells
  - Closed loop

EXTRACTION

- CBM
  - Poor quality water
    - Discharge problems
    - Recovery opportunity
- Oil shale and its future
  - Big water user (long-term concern)
- Coal slurry transport?

- AZ—mostly short
- Uncertain future
- Navajo?

Problem Flipchart Transcription, Water Supply

AGRICULTURAL USES

- Getting more value out of water used doesn't reduce consumption
- Less run-off due to conservation—cuts recharge
- More efficient use offset by more extensive use?

- Move to irrigation—surface to groundwater reliance (18 votes)
  - 40,000 in AR, 1000 or more going in every year—in an area with 50" or more—unsustainable drawdown
  - What do you need to do?
    - Conservation
    - Efficient
    - Augmentation from irrigation projects
    - Demand on existing surface water
    - Huge increase that hits groundwater declines, withdrawals from major rivers
    - Economics/policy
    - Groundwater impacting wetlands and surface—correlation
    - Wetland/habitat
    - Power prices and irrigation—makes surface water more attractive
    - New technology
    - Southern Illinois University study 2005-2045
    - NRC report—future of irrigated agriculture
- Water relocation/movement caused by different management practices—buying acres of water right for power production (7 votes)
- Water quality—desal to use for power because of poor quality of concentrate and quantity
- 40% of water goes to ag; 40% to power
  - But ag is all consumed—it has the biggest savings potential—save water for energy by saving it in agriculture
- States set water withdrawal priorities—how will states divide it up? State-based boundary issue. (14 votes)
  - Fed has some incentive, other levers—MO river basing and the USCOE
    - If you don't permit buying water rights, that closes it

ENERGY PRODUCTION

- Energy production and its water will be exported—more growth in east (10 votes)
- Population increasing; can't conserve our way out of the problem
- Water underlies cheap energy exports
- Transmission and distribution to markets—pipeline and wire

URBAN

- As population grows can't just conserve our way out of the problem (1 vote)
- Power companies exporting electricity instead of ag products. Impact farm economy, local dist. Impacts.
- Diversions within state to serve urban growth—ND and TX

- Mining water for future development (8 votes)
- Urban planning/construction and water use—building codes and water
- Decentralized water manufacturing
    - Grey water, storage, vulnerability
- Aging infrastructure of urban water systems—lack of metering, infrastructure
    - Savings going to urban sprawl—not really saved
- Drawdown on aquifers—plus opposite reaction (environmental subsidence), reduction in quality across region—where used and quantity?
- The more affluent, the more water and energy amenities we want—may be offset by efficiency (2 votes)
- Rust Belt heavy water users are fading—any net savings? Will it be again?
- Summer peaks/demand increases power requirement, but takes more water too (1 vote)
- Quality issue—urban impact on water quality; urban runoff; treated water; boost treatment downstream
- Shift from industrialized accentuates peak energy demand and for water—seasonal and daily (1 vote)

RECREATION

- MO river basin competition—holding more in demands (3 votes)
- Disproportionate influence?
- Much less market-based
    - Crosses to environmental—driven by water level
- Very impacted by politics—Federal operational plans, very sensitive
- Competing influence on water for energy
- Misperception that it has not costs
- Removal of reservoirs for recreation
    - Ecosystem maintenance
- Boundary issues—recreation in my state is more important than downstreamers

OTHER

- Sedimentation—water supply for all uses, and for power—design lives of reservoirs
    - Reconditioning/life
- Endangered species problem
    - Plover and sand bars—protected areas
    - Alternative habitats
    - Dam modifications
        - Sturgeon
    - In-stream flow requirements
        - How much, timing, effectiveness

Group B Day 2: Needs Flipchart Transcription

Water—

As a commodity
In competing uses
By quality/location/jurisdiction

- NEED: Place an overall value on water
  - Commodity—a market system that help set value—but maybe not a completely free market
- NEED: National needs assessment of competing water values
- Public v privately owned resources
  - How to deal with negative externalities?
  - Value on those?
  - Tackle publicly-owned, at least
- NEED: A coordinated baseline of what we have, where it is, what is the quality
- Riparian water law barrier
  - Is there a need for a market in water rights states, like in the west?
- Legal problems in quantifying water
- Interstate water problems
- NEED: Scientific basis for legal/regulatory mechanisms
- NEED: Resource inventory
  - Water metrics
    - Quality
    - Quantity
    - Volume
    - Flow
    - Agreed measurement techniques
  - Agreement to do planning/sharing information?
- NEED: Regional agreements within and across watersheds and aquifers to assemble, allow the data to be used
  - Has to deal with wide variation in state water conditions, different approaches to regulation, law
- NEED: Reevaluate criteria for water quality among authorities that regulate it
  - Temperature
  - For energy production
- NEED: Better technology/standard scientific methods for setting temp/other criteria for water bodies
  - Impacting power production

Competing Demands

- Way to reallocate from ag to other uses?
- Voice for the power industry in decisions?
- Need to understand existing uses and where it goes

  - Ag …
  - Urban …
  - Incorporate into other uses like modeling
- NEED: A model that shows how resources are being depleted—for whole region?
  - Uncertainty in data – need better data
  - Clear definitions – consumptive use, other
  - Where do you want to stabilize drawdown
  - Investment in data gathering technology
- NEED: Water-focused model/analysis tools for energy system siting—capability/availability—like for wind turbines and wind—Better water leg for 4 legged stool
  - Quality
  - Quantity
  - Alternative energy in water supply
  - Temperature
  - Availability/ownership
  - Renewable (wind) data—performance data
- NEED: Characterization by technology of water required to use in planning and management of water
  - Is there a need to set aside water for energy production? What will be needed?
- NEED: A better integration of energy industry into water planning.
- NEED: Demand forecasts out 60 years for water and energy.
- NEED: Alternative forecasting/sensitivity capability
  - Alternative energy approaches, cooling approaches
  - CHP/co-location
  - Water needs based on new powerplants
- NEED: Method for interstate coordination/planning
  - For research agreements
  - Start at government office
- NEED: Better thermal cooling technology to deal with discharge challenges
- NEED: Information to better inform contingencies with extreme events
  - Interdependency analysis—what are implications
  - What data does the sensitivity/forecasting model need? Water pricing/economic.
- NEED: The data definition of the model
  - A decision-support model
  - Look at macro in region
  - Microscale in plants, communities in costs, alternatives—internal uses and tradeoffs
  - Connection/interaction to energy and water
- NEED: Modeling
  - Publicly-owned water/utilities
    - Use of pricing mechanisms to influence consumption—EPA studies, experience in cities, industrial and residential
    - A decision making framework
    - Identify locations in critical need of improvement?
    - Conservation disincentive for utility –it is how they get paid

        - Water can be stored, no peaking
        - Is it much water to free up? How much?
    - Do we have a model for optimal agricultural use of water/other resources?
        - Overuse? U of Nebraska work
        - Incentives to use it? Are they effective?
        - Property rights
- NEED: An awareness/incentive need for ag water consumption?
    - A summit for farmers? For legislators?
    - Energy/other users support to free up water—reduce water consumed
    - Scientific/technical argument for it?
- NEED: Figure out incentives to free up water resources for other uses?
    - Incentives
    - Values for other uses
    - Technical potential
    - Like approach used for SO2? A cap?
    - Deployment approaches
        - Best practices for rural extension/outreach
- NEED: Forecasting/contingency planning
    - Climate change
    - Variability in precipitation
    - Temperature
    - Reservoir vulnerability
- NEED: Gathering/analysis of existing data/activities
    - Is NRC report adequate?
    - Survey of what is out there?
    - EPA and other data sources
    - What energy systems are and what water will they need?
    - Who are the key players and what do they know? What is their role? EPA? Env
- NEED: For the national energy policy to address water-energy
    - SB 1860
- NEED: To quantify the extent that cost/availability of water will limit development
- NEED: To re-examine weather modification

Solutions Flipchart Transcription

Information/Data

- Data/existing information (4 votes)
    - USGS, State websites
        - Where is it posted?
    - NSF geoinformatics
    - State offices
    - NASA satellite
    - FORMAT
    - USDA ag research
    - RELIABILITY
    - Digital
    - USGS/EPA database compatibility
    - USACE, Vicksburg, ERDC
    - Access-Security
    - DOT, Army, EPA model for agreement—a DOE/EPA other steering group on data sources
- New technologies to gather data (1 vote)
    - Real-time stream gauges
    - Remote sensing
    - Lower-cost sensing equipment
    - Space-based
    - Lower O&M costs
- Water use database is weak—varies by state, lots of estimation
- Very small amount of ag water use is metered—extend
- Clearinghouse for data (3 votes)
    - Sharing
    - Metadata about sources
- Gaps to fill

Conservation of Ag water for Other Uses

- KS plants buying water rights
- Payments to reduce irrigation (3 votes)
    - To free up water, reduce, decline
- Piggyback state incentives on federal
- Land trust by energy users to secure water
- Water saving performance contracts?
- Clearinghouse in USDA with easy access to audit opportunities, rural extension outreach
    - Business opportunity in saved water
    - Similar to renewable energy outreach
    - Conference business models and water rights approaches (1 vote)
- Electricity power industry supporting farm measures to save water
- More local weather stations for better management
- Crop research at extension offices

    - Less water
    - Energy crops
    - C and N sequestration
- Satellite-based measurement of soil moisture
- Getting rid of water hungry invasive species
- Evapotranspiration on control, management
- Controls of irrigation that uses the info and data

Forecasting/Sensitivity of Other Uses

- Decentralized to local users/institutions (2 votes)
    - Sponsor universities to develop/use it like NASA did with their data
    - Challenge NRC to come up with how to do it
- Standardized modeling approach that people can feel confident about—national energy supply (2 votes)
- A water EIA—a consortium to agree on an approach (2 votes)
- There are local models that are good, but
    - Economics
    - Surface/groundwater
- DOE to develop tools—models (1 vote)
- Model all uses/components
- Information of water profiles of key industries
- Better projections by sectors
- Policy analysis (3 votes)
    - Economic modeling
        - Local benefits
        - Economic incentives
    - Legislative information
    - What-if policy scenarios—NM example
    - To be relevant to policy issues
- Regional planning applications
    - Relevant input to those processes
    - Specific to situations
    - By drainage basin, etc.

Forecasting Energy/Water Needs

- Wind resource data extended—not proprietary
- Water, transmission, transportation
    - GIS, detailed water indo on flows, seasonal, other
- Scenario (3 votes)
    - Detailed characterization of different technologies
    - Ethanol and other biomass systems
        - Water—irrigation, feedstock, dryland, process
    - Milestones in R&D that address water use of technology
    - Sustainability element to technology (1 vote)
    - Gray water for energy and crops

        - Crops that can use reclaimed water

Better Technology for Energy/Water

- New cooling/thermal efficiency (1 vote)
- Water-assisted dry cooling
- Dry cooling
- Generating technology that doesn't require cooling
- Groundloop cooling
    - Collocation
    - Limestone cooling loops
- Less water-intensive mining/extraction technologies
    - I.e. oil shale
- Cheap ways to use/treat compromised water from extraction
- Water use in mfg of RE
- DG doesn't use water (1 vote)
- Fuel cells as source of water
- Hydrogen to generate electricity
- Energy efficiency measures (1 vote)

Regulation/Policy

- Revisit temperature limits in MO
    - With better science and data
    - Coal-fired units on MO moving surface water sown to well because they can't discharge
    - Local EPA regions
- Information/case that influences policy
- Who makes decisions
- How to intervene
- Who makes case
- EEI/farm bureau/API/ACEEE/ASE/NRECA/GEC/RFF
- Implementation of farm bill
- Missing EPA, env groups
- Public utility pricing models
    - Innovative uses
    - Demos/prototypes of conservation pricing
        - Depletion/demographics/social where water is a concern
        - Amenable legal environment
        - KC area example
    - Low flow showerheads, xeriscaping
    - Pricing
    - Block rate pricing
    - Evaluation
    - Building codes
    - Reuse-golf courses
    - Water and its programs

Regional Agreements

- Some agreements on existing rivers that could expand (1 vote)
- Need basic water info on withdrawals, etc. and agree on (2 votes)
- Basic concepts of hydrologic systems – groundwater/surface water connections
    - What is water balance
    - Need to have information from litigation in past
- Something workable and scientifically-based
    - Compacts need to adjust
- Need easy method to look at quantity/quality, etc. … common understanding
- Take a look at issues from grid viewpoint

Appendix E: "Raw" Notes from Group "C"

The Problem
Breakout Session #1
Group C
Jack Whittier, Facilitator

Name and Interest
David French-- UTTON Center Policy issues and energy problems and issues
Roger Taylor-- NREL Water boundaries/ Tribal Energy Program manager Energy supply and angst over historical water use in dams and flooding issues. Peak oil issue tracking as well. Alternative fuels and agricultural opportunities/competing demands on water supply
Bill Bryson --Local and city state regulators on oil and gas and water injection oils -DOE Oil and Gas interests /Regulatory policy interests
James McMahon—Interested in economic issues
Ahmad Hilaly --Technology standpoint and policy standpoint --Company has a lot of interest in water-they use a lot of water.
Jim Plogard -- Kansas City Corp Comm.Energy Efficiency and RE, conservation
Carl Vansant --HCI publications hydro business interests Energy and Water as a source
John Gaspar –ANL Team from Labs- interest is energy and environmental analysis
Dave Koland –Garrison Diversion at one time million acre irrigation project now muni water supply Water and Energy issues associated with technology development.
Dan Titerle – San Antonio Water -interrelation between water and energy. Oil and gas background
John Peck--teaches Law-water law. Kansas water allocation issues. Some law practice Here to be educated on the energy side. Small hydro plant experience in Ka
Eric Hixon –Cen NE PP&I -a reservoir on the North Platte River. Area has four hydro plants, agricultural water use, two fossil plants lots of competition for water, environmental concerns.
Bhasker Dave – Nalco Co. Water treatment company Coal. Fuel cell research. Water use reduction R& D development, membrane separation in water decontamination area.
Robert Abboud --RGA Labs- private consultant software and hardware, investor owned utilities, energy trading, marketing power systems, marketing, nuclear engineering, long term interest is how do we as a country move forward as a market –driving capital investment big generating issues.
John Merson—overall programmatic responsibility for water activities at Sandia. On the hook for publishing roadmap.
Robert Goldstein – EPRI -arrived late and did not share interest

Focus on the S&T aspects although we will not be unmindful of policy.

Top Level Issues- Presented to Wrap - Up Session, Day One

Energy Supply Problems

Cooling Water /Heat Sink

Economics – Highest Value
Competition for resources

Integrated National/Regional Resource Planning
Market Signals Insufficient
GIS-Grid Topology

Social and Regulatory Infrastructure –Institutional Chaos
Social Contract

Water Value-How to determine?
Water life cycle

Legal Issues—Who owns the water

Water Supply Problems

Utility/Industrial
Cooling – water availability/thermal/hydro/EPA
Waste Heat

Ecosystem Sustainability-Ecosystem A better than Ecosystem B

Equitable Alternatives- Renewable Energy
Limited Supply

Thermal Performance/Water use Efficiency

Legal Water Rights

Discussion, Session #1

Peak Oil
Serious times face us. Change is imminent Peak oil issue.
Peak Oil = 2 trillion barrels of light crude oil on the earth. We are rapidly loosing/using this up with our population growth, and energy and transportation use exploding. Between now and through a few years from now (flow rate problem) we will use up what is available. Increasing prices, competition for the remaining supplies. We must look at what are we going to do for our transportation needs?

opportunities are there—advanced conversion technologies maybe 1/3 of needs from biomass energy generation. Biofuels will become more and more important. There is movement toward electric transportation systems (biofuel conference in Denver). The long haul transportation needs. RE technologies don't resolve the liquid fuel consumption problems.
Business as usual is not anymore. Water tie-in is the agricultural impact and transportation as it impacts the electric system. How much more water needed for bio activity? Some are dry crops that can be grown on drier land however don't have an actual water use figures—mostly modest use. Roger wants to paint the picture that the flexibility with respect to energy generation is disappearing.

-Subtle underlying issue is transportation burning fossil fuels, but also it is what we do re the CO2 issue in the atmosphere and global climate changes. Energy and water balance is still there, but it does not take much to upset that balance.

- whole group of CO2 people that should be interfacing with this effort
Roger T- Liquid's technologies take a lot of water in the conversion and cleanup processes—Canadian Tar Sands using great deal of water—Coal to liquids technology to take off.

- Boiler 90% quality desalination corrosive coal bed methane problem for the extraction industry.
Bill B. Coal Bed methane water use demand ----de-watering process—some places you can use it some places you can't use it-- with treatment, change a by-product to an asset
Evaporate it, clean it up, or inject it.
Solutions: Bill B some solutions are accepted by some: regulators, people in general
What happens when the land owner wants to irrigate and the water is gone, or of poor quality.

--at what point does water become an increasing issue- no industry response to the increase of oil prices.
With the high price of oil, the mature fields are being extended, resulting in more water usage.
Have water when you don't need it, or when you need it you don't have it.

A certain amount of water is needed for drilling – water availability in drilling issues.

The science and technology hook is what? The ability to extract additional oil using steam injection, which doesn't care what kind of water it is.
The dollar issue is a key to this discussion--the dollar value of the barrel of oil compared to the value of a barrel of water rather than the availability of the water or the quantity of oil.

**Tar sands and oil shale fields the issue of water required for processing and extraction 3 to 1 for sands 5 to one-- million barrels of water per barrel of oil extracted.

Water limitation in the more traditional areas of energy generation.

Comment on the history of irrigation/agricultural issue of transferring water from one basin into another Missouri to the Red River/ Hudson Bay area. Through the political process North Dakota agreed to only use the water for muni use.
There is a pecking order in terms of how we use water. Energy production is a high priority. With higher oil prices it enables us to pay more for water. 200 hundred dollars an acre foot verses agricultural use of 100 dollars per acre foot.

Import food from other cheaper sources, we don't have to use our resources.
Importing energy in the form of other products that can be produced in other parts of the world.

What is water worth in the various applications? $8 per gallon for drinking bottled water.

–selling water at retail rates for recovery processes. State government caveats that states can't use fresh water.

- water for drinking—an issue in Chicago area. Groundwater is an enormous issue. Lots of water studies at the county level. County studied projection of development 40-55% deficit at 20 year point considering projected development. Studies done of Hydrology of area of four counties near Chicago. They are running up against issues of groundwater potablility. Lots of uncertainty at the social/ population level and they are concerned for the value of their water plus the impact on the ground water availability.

Oil producing states such as Texas set protection issues.

Real Estate developers in California plan without regard to where the resources are located.

- new capacity for gas –in order for plants to perform they need water and the areas in which they were located=low availability. Extracting the water creates damage to deep aquifer—approval denied due to this issue. Generation displaced/not installed because of issue of going after groundwater.

We need a Reserve and Resource evaluation such as is done in the oil and gas field—this much proven reserve, this much resource due to existing rock structure. Is there a comprehensive study on resources available – USGS has done studies? No representation from USGS. No National Data base on water storage. Original capacity studies are old.

- No survey of how much water is stored in Hydro electricity. How much is stored behind dams? Price for dispatchable energy is high, but where are the studies of what is available as stored energy?

No national "will" to do the surveys of stored energy. Some of the world's best supercomputing available –mapping-satellites etc., but nothing on the water side, i.e. look at well log records. No financial resources are allocated to study this.

Historically there has been no value placed on water. Water is free. But put a value to water and it becomes an economic issue. The price of water= a one- time fee.

Hydro—stored energy has value. Is there an S&T issue that is not getting addressed? We have the market value issue.

.
What can I do to address this issue of higher oil prices and higher energy prices? What are the low hanging fruit and the Hydro industry needs help to solve the problems

It's a water shed management issue.

Environmental issue.
Downstream flow upstream passage, fish friendly turbines, etc.

Hydro has similar problems as nuclear energy generation—source fuel is essentially low priced and reused. Both technologies have extremely low impact on the environment compared to the impact of fossil fuels. The problem is, both technologies have huge social and land use impacts that, as a nation, we have decentralized –no national "will" to move forward. No one out there to build the huge projects, no overriding governmental organization or policy that takes this on.

The risks for dam failure is the same as the risks to nuclear catastrophic failure.

The question from DOE perspective is to bring the policy forward so that the markets are willing to make the investment and build that dam.

Hoover Dam is water shed management. Electricity is secondary issue. Who is going to build the new Hoovers. CEC will be spending lots of money to look at issues in wine making process, but small incremental changes in how they manage electricity. Most population increases on the arid side of the state. CEC thinks they will use the same amount of water in 2025 as they do now. How realistic is this without developing new storage of water that is ultimately used for electricity generation.

We don't know where our water is. If we know that we can move forward with how to manage it.

The topology of the grid verses the capacity of the use. We don't have resource knowledge
USGS not here—must understand what the resource is.
Great lakes workshop reached the same conclusion. All these workshops concluded the same thing. How do we manage something when we don't know where it is?

How do we do it???

Assign a value to water.

Political issues need to be considered. Evaluate a liquid in a rock or on the surface similar to how oil and gas does it.
Quality component-- take samples and figure out where it is –get a map
Many states do have that information. But which and which do not?
The data set isn't integrated on a regional scale.
Once you have dataset, how do you establish the policies related to its use? Ex. Wet cooling towers. Temp is too high to discharge back to the river. Evaporate water then, but who pays for the water that is gone into the atmosphere. Where does it come down as rainfall? Certainly, it is gone from the local area. Who pays for it, how do we decide that use?
Are we doing things at the EPA level requiring users to use more water than they would otherwise?

National "inventory" of water evaporation.

Heat sink EPA requirements make a change in the way the water is valued. It's OK to make use of all the water you want, but if you change the temp, then that's not OK.

Negative water balances—depleting available water
Re: Ogallala aquifer-- depletion is slower recharge than rate of use.
250 gallons a day per capita to 150 per day. Must change the way they operate.

CEC and water issue—200 billion dollars to spend. Acceptance of a different technology strategy to making new potable water as part of the energy supply industry. No incentive to produce water. The value of water has been displaced. Not willing as a policy strategy to put it in the marketplace.

Compare the value of one project to another without addressing the value of water.
Hoover Dam management district –could you today under venture capital state the investment value?

Major problems on the table

Increase more water efficient power production.
Sandia is doing some work on 4^{th} generation power plants and the amount of water they use. Thermal efficiency of 33 and 43% efficient Thermal impact on water. Goal should be to raise the level to at least 60% efficiency.

Water use efficiency and electric generation efficiency are related and should be viewed as interdependent.
Dry cooling technologies.

-warm water discharge-can it be piped to some other use such as agricultural use that doesn't care about the temperature?? Temperature is not an issue so much. Middle East and Russia for

example use it for heating. They have a social fabric that sets the stage. National policy verses a Federal policy.

Problems are universal but the solutions get tailored to the specific region.

Restructuring the way we view and use water as a society. Ex.: our road system. Underlying structure on which the whole country depends. But we don't have the luxury to not address this societal issue.
People are living in the wrong place in reference to where the water is.

Power side is looking for impaired water that can be used instead of fresh water.

Cooling with higher water use efficiency.

Roger Taylor- biggest national research issue—must get a GIS basis handle of what our resources are and where they are located.
The Lab on the building side looked at evaporative cooling—did a study of water use per kw 40 gallons per kw hour 2-3 per kw hour-evaporation of reservoir is huge.

Two issues: energy balance charts for water? Need regional water energy balances. We need a National inventory so we know what the true dynamics look like, what water limitations there might be—broad regional multi-state planning is not being done.

–can you replace water consuming technologies with other RE technologies? How do you integrate them into the grid---you want solar and wind to be integrated because they don't use water. You have these Renewable technologies:
Geothermal – huge opportunity for that kind of power
Wind—time domain and grid integration and access to windy places
Solar- huge opportunity at small scale but not cheap enough
Small hydro study potential?? What is the capacity for small hydro? In-stream hydro, wave and tidal options
Hydro plants on 3% of the dams in the US DOE has looked at that some dams that warrant the installation of hydro facilities—could be developed but aren't .

The problem is the costs issues and equipment performance issues. Build the technology so that the operation costs are low.

Big difficulty is how to dispatch the small power RE generators into the grid. They are marketing a green product. (Wind companies) Cheaper to build wind turbines than coal plants.

Existing technology is old; the average age of coal plant is more than 30 years old. No new nuclear stations.

Extraction Industry
Coal problems – Produced water from oil becoming regulated-what are the issues? Could the future bring issues about handling the water without treating it to a higher standard?

Clean up the water in better ways. Coal mining itself has the de-watering process problem as well. Al lot of water has to be moved out--some of it is clean and usable untreated.

Transportation /slurry issue.

Fuel production

Refineries? Post extraction processing. No new refineries –no increase in water usage here because no one will be building new ones.

Are there technologies on the horizon that would make the use of waste heat to more efficient treatment for potable water?

De-sal plants built along the coast but people don't want the plants on the coast. "Not in my back yard." What is the technology issue to resolve this?

The infrastructure and scale efficiency is a concern—go to more distributed systems as opposed to great big centralized operations. An option could be RE, gas, etc. with self-sufficient individual communities.

New coal plants will use cooling towers. Dry cooling is not widely being used because there is a huge efficiency penalty and because of capital concerns. Hybrid structures could cut some of the costs. Dry cooling uses some electrical portion of the plant's output.

Hydrogen—and the hydrogen based economy and its impact on the water resource and the energy to extract the hydrogen. Available water for hydrogen extraction. Fuel cell technology needs to address the efficiency issue.

Discussion Afternoon Session #1, Cont'd

Cooling by use of water High certainty it will be a problem in the next 10 years..

Hydro resources as they relate to drought. Most of the hydro systems aren"t there for hydro power, it is a by-product. Hydro is for river management.

Grid Topology is an issue High certainty. Immediate issue

Technology issue is conservation itself. Increasing building efficiency by 40% --

Climate forecasting –hydro as true storage. Problem with weather forecasting is that we can't say in June that we will or will not have sufficient recharge to cover energy needs in September. This is a dispatching issue. Predict or characterize the climate and its consequences. Question: If we knew the climate how would that change? You could predict how much megawatt power you would have sitting in the reservoir and can appropriately dispatch the electricity to optimize use and minimize impact. How about industrially focused forecasts?

Structural implications of the use of hydro depending upon the river basin. High certainty

Nuclear---recognizing both hydro and nuclear systems have the capacity to increase the availability of drinking water as well as issues of heat sink—social acceptance and policy problems.

Lack of physical alternatives. We have not built new generation plants. This problem is a cooling problem. The question is increasing the supply of water for cooling. U.S. is not investing in the nuke technology to get thermal efficiencies.

Missed opportunity of using thermal waste heat for desalinization. This is a solution rather than a problem. Reference DSM

How much waste heat are we getting rid of and what can we do about it? How do we get rid of it; for example, a bottoming cycle can extract 20% more energy with no more fuel.

The value of water ~the value of waste heat.

Low head energy—perhaps use addressed by river turbines and wave action systems.
Nuclear systems suffer from the problems of water cooled reactors from the historical development of reactor technology-- problem of low head, low quality steam.
It all boils down to how much it costs to develop low head energy.

The economics of life cycle analysis. We don't have a good handle on what the whole life cycle picture is.

New construction will be a bigger problem

Integrate regional planning.

Institutional Chaos—includes regulatory but not a science and technology issue.

Wind or Solar technologies: The integration of these renewable resources in load shifting. No water requirements. But this depends upon how big you draw the circle. The manufacturing use of water is a component. Similar to saying Hydrogen production has no water use.

Social infrastructure: Property purchase, eminent domain, regional planning issues, the population recognizes the land resource and creates a machine. More than just a regulatory approval process. Mandate to Serve. Compares to oil companies providing to society all the oil we need and being a service to the public, then transitioning to profit generating machines. Historical strategy for utilities has been to fairly use funds generated from fees for improving infrastructure and service to the customer. The clear agenda of the utilities was that they needed to serve. Upon deregulation, the ability to look forward to determine how to invest in big capital was lost—it became profit driven.

The acceptability of degraded water and where does this issue fit in—is it nuclear, some technologies are ok with using degraded water; for other technologies it is unacceptable.

A Small hydro problem is how to facilitate/mobilize the development of small hydro. Small hydro not encouraged. What can one do to make more of that happen—production credits, demo projects, money?

Why would we take advantage of low head hydro—who is going to build it?? How do you get a company to go build lots of small installations? The answer is when they find out they can't build the huge ones, they will build the small ones.

Today there is much less penalty to be short. It's the distribution company that takes the hit. The generating company doesn't lose.

Bio power/ fuels: food and energy trade off. If it's a problem with agriculture it's a problem with biofuel—corn takes a lot of water. Biofuel built on excess agricultural capacity. Biofuel process is more of an energy issue rather than a water issue.
This may depend upon what path you follow. The next ten years it will be. Medium certainty.

Resource management of biopower: Is there a water issue here? Pulp and paper issue is the biggest here. Medium problem

Renewables as a class are part of the solution rather than part of the problem.

Coals bed methane: broadly speaking water extraction is a medium issue because how long this will be a viable resource—only so many coal beds and so many places to mine. Maybe a ten year issue. The older the field the greater the produced water. High regional issue. Could be short or long term issue.

Coal Oil Gas and Tar Sands- relates back to peak oil situation. Coal liquifaction-- High level of certainty—ten plus years
Produced waters with oil and gas. As it relates to water quality, chemistry of the water..
Availability of water for the processing of oil from shale.

Economics and the value placed on water -- high certainty

Renewables will relieve pressure on the water and should be integrated to the grid.

Integrated Regional and National planning
Integrated regional planning is the resource assessment. Information is available but we just don't have access to it.
How do we define what we know? We don't know storage and we don't know groundwater. Many states are against the reporting of the information, despite it being collected in some fashion.

Social infrastructure: social contract. High certainty, forever.

Regulatory infrastructure: the issue of social infrastructure

Import/export sufficiency and independency. If we run out of something we import it or if we have extra, we ship out.

Local economy is deprived of the resource to make money; this goes back to who owns the water.

Water Supply Discussion Afternoon Session #2

What are all the problems in water availability and water use as it relates to the above list? What are some of the problems you see with regard to urban use?

Regulatory and social but we haven't really mentioned legal. This is a higher level issue than regulatory because of the illegality of taking water. By the constitution itself one of the issues is who can use that water from the legal standpoint, who has the power to condemn it, and should they condemn it. Ex. And out of state company coming in and using water in Kansas then exporting it out of state.

Who controls the water, who owns the water, what is the value of water. Water rights are for a specific use. There will be legal issues faced for a purchaser of water.

Legal issues crosses surface, ground economic and environmental issues. Why break it up into surface and ground? The issue is to have water, does it matter how it is obtained, whether it is surface of ground and how much it costs to get it. Perhaps surface water has more contaminants. Treatment technology will drive whether you use surface or water.
Urban use has two facets; drinking and watering lawn. Some places regulate lawn watering should come from reprocessed water. The overarching problem is supply. Needs outstrip the original capacity built. Population increases but the water use has remained level through conservation. At some point will reach a point of diminishing returns. This impacts the economic development category.

Water is free. Water rates will need to reflect the cost to producing water. The infrastructure costs remain constant.

Economic development means industrial development in a community. You may not need the same quality of water—perhaps higher quality for industrial use.

Conservation reuse and higher water efficiency.

Interuse competition between agriculture, urban use, etc. for water. Urban users will always win because they can pay for it. How does that damage industry, agricultural and recreational uses? Where the population is more dense, the costs are lower.

Recycled water is one solution. Urban areas have a vested interested in improving the usage of water.

It depends on the conveyance.

Buying water from other places. Lay a pipeline? Paper trade all the way up and get it where you need it.

Economy changes when they lose water for agriculture stop growing—not selling fertilizer, not hiring labor.

Lose diversity in the economy if you lose the water.

Market pricing/realistic market pricing of the water source—cities are artificially subsidizing the cost.
Some states have in their state statutes constraints—legal water preference inhibits the market from working and this varies by state. Most states have a preference for agriculture. Because when the laws were written, agriculture was the main industry.

Physical conveyance of water in the Central region is an issue. Tremendous resistance to this from the eastern states that have rights, and Canada. They are afraid Western states will want to take water from the Great lakes. Inter basin transfer resistance. Haves want to keep it.

Infrastructure today was designed for an archaic usage pattern.

Storm water management —flood control issue. Storm water management—not mixed with sewage. Use infiltration fields for recharging lawn watering purposes.
Most urban systems have a storm water problem. How do we redirect that water back to usage? Problem of sewage separation from the storm water and how to conserve and save it to be used.

Water trading will be more prevalent in the future. Ex. Las Vegas helps construct water treatment for San Diego.

National Trading house established? Hubs scattered across the US. Paper deal –buy water tickets, traded nationally. Market based approaches to water management.

Environmental issues as they relate to market/trading issues. Understanding what the regional water flows are and the trading aspect. An opportunity to trade water where you balance supply and demand.

Need to collect it and move it efficiently if you are an urban community. Rural community wants to use it inefficiently.

Water quality issue as relates to storm run-off.

Re-use of water—one problem is there are legal constraints in increasing consumption patterns. Once the water right is established you can't reuse it because you increase consumption, which conflicts with the legal right.

It's all about value, season of use, under value, over value. There really isn't any generally recognized instrument that recognizes the time value. It can be compared to wind—when you have too much you want it to go away.
On the agricultural side, the problems cost of energy- the drop in aquifer level.

The agricultural impact to nutrients and more efficient use of fertilizers. Run-off. That is a downstream problem, not an ag problem, are they penalized for the quality of their run-off? Yes, it is an ag problem because of the concentration of the soils. Incentive to ward off the problem on the part of the farmer to prevent regulation.

Surface water in NE is regulated but the ground water is not regulated. This is true for many states. Many states meter.
Increase water use efficiency in agricultural use.
How does new infrastructure get built –4-5 super farms could get together and do this, but this scaled kind of issue impacts the population—ex. Filling in 15 towns to dam a river. Machinery is therefore large infrastructure but is there the public wherewithal to do build them.

Flood control and recreational purposes. Managing the flood, maintaining water levels for recreation economy.

Water supply Problem Session #2, Cont'd

Recreational Sector and the utility industrial sector have not yet been addressed.

What about the EPA sector?
Environmental Protection Sector—supply impacts of water
It creates a demand for water, within a certain boundary, considering the temporal pattern of the in-stream flow. What is the in stream flow that would be best? How faithfully do you have to replicate what the original temporal pattern of stream flows may have been?
Withdrawal of water can affect water quality as well as usage. Land use patterns impact quality and quantity of water. And biological uses of that land.

Ecosystem management and sustainability.
What are the demands of resource management that can ensure ecosystem management and sustainability?

These are localized issues—they show up a certain places and in certain time which gets back to the GIS idea of a comprehensive survey of what you have.
Chemical run-off from agricultural products—how are they best handled?

Dam removal issue. Dams may have created to the degradation of the system but then did that dam create another ecosystem? The mercury concentration in the silt creates a problem when the water is released back into the stream.

In-stream flow requirements the standards by which all these decisions are made. The creation of a dam has damaged ecosystem A but created ecosystem B. Does one ecosystem have more value than the other. Does the supply of water have more value than the original ecosystem that was originally there? Native American perspective is that eco system A is more value and capitalism be $$%^^%. As the supply gets scarcer, the issue of prioritization becomes more important.

Water is the least transported, most local commodity. Water as a commodity is least transported? Not traded or costed in that manner. But you don't give a commodity away.

Recreational category of water supply issues
In-stream use competing demand for the water. Will recreational use become a higher level of use than it is now? Reluctant to vary the levels of reservoirs because of the needs of the recreational community. When hydro systems are managed, the needs of the rec user are taken into consideration—downstream flows for recreational uses.
The local economy depends upon the recreational use. Must have the support of the local area in order to build a project (storage) in order to make it successful. It provides a real social support mechanism that helps drive all the other issues.

Tribal concerns and income levels.

In the context of water supply, recreational use-- the problem will be how we are going to optimize the use to the benefit of all the users.

In the Energy water nexus, recreation is a complicating factor.

Industrial Utility Sector
How does the operation of the utility impact the water supply? The operation of the hydro plant, how they release water downstream. The thermal impact. Discharge at EPA levels and limits. Most EPA limits are based upon the water supply itself. You can only pump so much energy into the water before you run out of margin. Generating stations can affect water quality. The magnitude will depend upon the particular watershed.
Air emissions can impact water quality as well as direct discharge.

Ranges from very local impacts, to broad, even global impact (smog). Upstream as well as downstream issues with water quality.

Measuring priority in terms of dollars, efficiency impacts

No integrated water/air approach. Ultimately it takes one down the road of global climate change.

EPA regulates on the impact on the environment rather then the use of the water downstream. Impacts on the organic food supply.

Industrial and environmental impacts are not the same. Industrial affluent and its impact on the water quality downstream to use for power generation. Ex.: The meat packing plant and particulates –just because there is an EPA limit doesn't mean that water quality is sufficient for use in power generating. Huge volumes of water and if there is a conflict between shared resources—what one user does effects what the other user can or cannot do.

Ecological sustainability—

Reconvene for wrap-up. (See bullets on page 2)

Group C Needs Discussion, Day Two

Needs

The goals of this session are to take the problems articulated in the plenary session and identify the needs for addressing the problems.

Starting with the Energy Technologies

Future Energy Production Technology

from the Hydro perspective –over the years they have done R & D forums. Pretty easy for the hydro industry to reach a consensus on the top 3-4 items. Work on the top issues would generate societal benefits.

Hydro hit list from Vasant's perspective: New expansion for hydro or adding new hydro on existing dams and the expansion of existing dams into hydro production of electricity.
Hydro conveyance systems
Optimizing performance-the technology is there but there is not incentive to apply it. Uncertain technology – water use optimization requires investment on the part of the owners but it is not tangible to them. There is uncertainty in the analysis. Ex given of a plant built in 1940 that was able to show a 10% increase in performance.

Financing is such a long-term commitment; the payback isn't timely enough for the owners.

Life-cycle costing verses capital costs. The capital markets don't get any payback from life cycle costs. Investments are so long term that the company declines the investment; indicating there are better places to invest, despite the value in electricity provision. How do you feed back to the market? The value is not in the transaction between the buyer and the seller. The players in the transaction are not reaping all the values—there is a greater value to the community. Rate of return of 6% is not worth the cost of capital. The issue for the players is not making electricity, but making money.

The **need is low cost money**? Can the private sector take care of it--Sufficient capital to make the investment worth it through production credits/National policy strategies. How to evaluate the social value and give the government a yardstick by which to measure the value to society. Is the answer in the computation of tax credits? The government would get paid back in intangibles.
How to come up with a logical way to value societal benefit.

Exxon Mobil- Overarching need is a lack or missing link in identifying resources verses what the needs are. We don't know where the resources are to link them to the users. A + B = C type of thing that needs to be done on a National basis.
Oil and Gas generates a great deal of water. Identify all potential resources. Could be muni waste water, storm water, agricultural run-off, produced water,etc.

Produced water recovery- not all have the same level of contaminates. Range from clean to terribly contaminated.

We don't even have a framework to know if produced water is even a resource—is it a trivial amount or enough to make an impact as a water resource.

An unconventional resource in terms of power generation—is it 10% or 50%?

The need for the oil company to know what it produces, for Ex. Exxon knows what it produces. Difficult to find a data base that has this information. How much treated sewage goes into the system—must go to each individual muni-no centralized data. State agencies have it but don't release it.

Need----a significant data structure that is totally encompassing to link all water resources with users and crosses all boundaries-state as well as industrial.
Produced, surface, ground, storm run-off. Last time any database was in 1967—water inventory. The states fight it tooth and nail. A great deal of resistance to integrating data. Political resistance--this is one of the challenges and all agree the federal level is appropriate.
Could private industry take on this task? Would it be reliable if they did?
Perhaps from the large central stage power plants and what their practices are.
A way of collecting data is to go to the power producers. **The need is to identify who has this information, collect it and disseminate it.**
Have there been any plants that have been denied because of a lack of water supply? Yes, there have been a few. In VA is one example where they were denied expansion because they would be drawing too much water from the lake, impacting recreational/economic uses.
There is great challenge to build a database. The quality of the data must be addressed and what influences what is in the data.

What kind of data base is this or who should own it? Maintained at the State , muni, or national level? Data *is* collected by the states but is not readily available.
Data inconsistency. Data base must be managed on the federal level to address this problem and must be generally made available. Consistency of data. And the data must be integrated between municipalities, state, local community so when a builder comes in they can communicate.

Volume, quality, location, ownership, impacts on other uses of that water This is crosscutting all the technologies.Hydro, oil,etc.
A <u>need</u> to understand in any given location, the legalities of consumptive use of produced or used water. Can that water be sent somewhere else and used again instead of being dumped in the river. Depends upon state law.
Despite lack of data, business is still going on. The critical question is do we want a national/regional planning policy—if yes, then clearly the data structure, while daunting, but must be done. Subcontracted privately. This is a frustration as to why we can't get any information.

The alternative is let the market decide the structures.

The concern for having a database is step 2, a correct analyzer for the data. Verifying the quality of the data—Quality assurance.

A problem of not getting our act together is that we are buying from Canada –there is an opportunity to exploit the US market because we can't get our act together.
The ultimate goal is to produce energy. We cross many state boundaries to get from source to sink. Therefore, information about water is needed from different locations. The same applies to oil and gas. It is an integrated picture. An issue of financial resources.
Oil and gas are in one place and can't' be moved. Water is found. But you can argue that oil and gas can be transported (the energy derived from it) somewhere else.

The knowledge about water availability.

Evaluating where you want to site a facility based upon where the resources are.

Reference the map of water resources: You either transport the water somewhere or you transport the electricity somewhere.

In the history of electricity, generation was more localized. Now we have this huge grid.

Regionally between eastern US and Western US, proposal to build plants with most of the power going to California through large transmission lines.

Imports and exports and precipitation rates. In order to have a complete map.

Re the Climate discussion from yesterday: Having an accurate weather forecast to help with dispatchable power issues.

Nuclear issue: capital funding to put up a new facility. Use life-cycle costs for calculating how much capital is necessary. Energy projects are very capital intensive. Cost of capital as well as access of capital. Today's market places a high penalty on long term capitalization. The time scale of energy projects, how to price the risk, for ex. A hold on the completion or a costly delay in construction because of some environmental issue that stops building is incredibly risky. In the old days there wasn't the same kind of risk
<u>Need</u> for political consensus and will to build the facilities and provide capital investment.
<u>Need</u> some way to influence public policy to say we need this here because we are anticipating this growth here. We <u>need</u> a national or regional group that says here is where we need energy, here is where the supply is, and here is the optimal site for this facility. A need for Integrated national and regional energy water planning. Some kind of cross-cutting organization to do facilitate planning. Is this public power?
<u>Need</u> Knowledge transfer between water and energy

Whose responsibility is it to do this? Penalty for overcapacity as well as under capacity. Who pays it? Society pays it.
We are tying to move water from one part of the country to the other, why aren't we moving the people instead?

People pick a place to move not due to infrastructure in place, but because they like the area for other reasons.
We are hitting on social issues here and need to refocus.
.
Is there a risk to production that is of benefit to private companies by knowing the risk of overproduction?
A need for the DOE to engage in a national energy plan that serves as a catalyst that draws the various players in. that pulls off the implementation plan. No planning function in place at the DOE level.

There is a reactive quality at the Federal level. Many gas terminals in planning stage because of demand but there isn't anyone looking at the big picture on the national level. State levels do this. Many planning councils do this at the local level. It all began to fall apart when decentralization happened. There is no one responsible, a disconnect.

The National Energy Policy is a sum of all lobbies. No integration, no integrated vision

<u>Need</u> an integrated vision to accommodate future energy needs.

An individual marketer does not see the larger vision., resulting in a loss of capital. Vision and planning would assist.

DOE mission is to make sure this country has energy. The deregulation of electric power administration has resulted in the inability of the utilities to think locally or nationally. The solutions are two: a.. Nationalize or b. stick with privatization model, and provide a roadmap, incentive, a guide to see the vision.

Where did the data come from in the opening remarks? This information is a start of forecasting. No one has given any thought as to where the energy is going to come from.

Pick Sloan plan. Planning efforts have taken place in the 30s and 40. Under a market economy all of the capital will be invested in the densely populated areas. The intent of Pick Sloan was to move population densities.

DOE has nothing about energy security for the country and energy planning. No overriding view that says this is where we want to go. RA bets that 20 years ago there was some plan.
DOE has the general goals-safe, secure, sustainable energy, but there is nothing that says how it will develop a plan.

Coal: What needs are there? When this question was asked of the participants, they remained silent for a significant amount of time. Vasant commented that everyone was silent because they didn't have any collective knowledge.

Oil/NG/CBM/Oil shale

Thermal electric generations require cooling systems and they use water.
A need to increase, improve cooling

1. **Advanced cooling technologies to use them to the greatest water use efficiency.**
2. **Substitute degraded water for fresh water**
3. **Improve thermal conversion efficiency.**

These are all short term needs.

<u>Need</u> Quantify and collect industry wide data of water resources. Data base for produced water.
<u>Need</u> to identify potential users. Avoid water management costs if possible.

We know how to treat the water but the question is how much we want to pay to make it usable and how valuable is this for the user. Reverse Osmosis is the technology. We know what it costs, it is a mature technology. Nothing really out there that is going to alter the costs. Maybe there is some new break through technology that is out there that might cut the cost. Does the disposal of this water cost much? Depends upon where it is and how far it has to move. The range is fairly significant.

Steam flood operations water needs are limited to CA. In Central region the issue is recycling produced water.

Oil Shale
No commercial or even prototype projects on the way now. Long term need. To extract oil from shale --Is this an inherently water intensive process? All approaches use water in one way or another. It is an energy intensive extraction process.

There is a <u>need</u> for oil shale technology, period. Long term.

Back when studies were done oil was cheap and the benchmark for the development of other technologies. Now that it is becoming more expensive other technologies are more attractive.

Coal Bed methane
The produced water is of better quality. Perhaps some viable use for this water. Produced water in very remote areas, thus there is a transportation issue. Presently produced water is wasted. **The <u>need</u> to is link the available resource of produced water with potential users**. Each operator knows the amount of water but the industry as a whole does not have this info.

The <u>need</u> is to understand the sustainable certainty. This is a use that is not sustainable because there is an uncertain supply. But what is available now is being wasted.
This water is being discharged so it is being used, you could argue. But it is not being managed very well. Is there a need to treat this produced water, better, more –it is now being release without much treatment.

Hydro needs:

No much opportunities for large projects. There are some technology issues and some technology issues with opportunities. Advance Hydro turbine fish friendly program stopped before it concluded**.**

A <u>need</u> to reinstitute programs that were halted—improved turbine technology and variable speed machinery. **Some kind of demonstration program that would knock the risk down.** The barrier is inertia. No one is willing to take the risk from the owner's perspective. A little bit of incentive could take someone over the hump. Retrofit with variable speed equipment.

A <u>need</u> for big picture knowledge of hydro storage in terms of how many megawatt hours stored, how it is used, where it is going, power capability. We don't know nearly enough about the storage in the hydro system. How it's being used, how much there is, and some of the other data issues that individual operators know but is not available on a wider scale.
Grid planning issue where the grid is huge. Capacitive and transmission effects of the lines themselves. Demands for four quadrant operations.
How big is the need for hydro—understand grid stability and the value of Hydro's value in grid stability services

A need to inventory the opportunity.

Transmission

It is a problem on the grid in general. Very little margin left on the grid today. Transmission may be too big of a problem. Beyond the scope of this exercise? It's an issue only if you are going to build large scale generation. This may be a long term problem or need. **The overlay of where demand is and where generation happens**. The need of the grid is refurbishment and upgrade**. <u>Need</u> to overcome NIMBY mentality. Social acceptance of transmission lines.** Is this almost a footnote to the rest of the discussions?
If you are going to have generation of electricity you need to be able to move it. It connects to the issue not in and of itself, but is part of the big picture
The <u>need</u> is to integrate transmission into this national energy water vision

Self Sustainable Community/Distributed Generation
Depends upon how you define DG. Potential for low head dam, more efficient use of back up, peak shaving and other management strategy. The vision is using more DG. What kind of issue is this need? **The <u>need</u> is to develop a model case of DG and see if it is a viable option. To understand on a local level. More along the ideas of a self-sustainable community.**

Nuclear scale needs
Close on the fuel cycle. Not limited to just Yucca Mtn. <u>need</u> to look at reprocessing the fuel. Fuel reprocessing so that we truly close the waste stream.
Reprocessing is much smaller volume of waste that is much more manageable**.**
We <u>need</u> to move forward in the reactor technology—improve reactor core type, a cooling/moderating strategy, not a reactive issue. Leads to higher thermal efficiency
The technology needs to be improved.
Licensing and planning needs. **Streamlined licensing process.**

Cost of Water
In Saudi Arabia $11 per 1000 gallons. The cost varies. It is an important factor but there isn't a uniform market for it. **There is no methodology to cost water**. A multitude of factors may or may not be calculated.

Why don't we have a market for water? **There is a <u>need</u> to understand what the value of water is. How to determine that? A need for an education process?**
Consider the great lakes region. Billions of gallons of water flow over the Niagara Falls to the ocean. But yet lake counties can't draw on lake water**.** Inconsistent subsidies of water.
The cost of water changes on a regional basis and depends upon the existing water rights and what has already been allocated. **<u>Need</u> to understand regional user and by time variables.**
A <u>need</u> to determine a levelized cost of water per unit produced.
Needing a secure water supply for 50 to 60 years. The value is dependent upon availability.
There is a <u>need</u> to differentiate/understand the difference between the *cost* and *value* of water. How much am I willing to pay?

Competing Demands
Flow chart of tying all these competing uses of water together. This is a systematic chart of short term needs.

Water permitting process in each state could give you a reasonable view of the allocation process.

Demand side aspect of efficiency
Demand side management conservation efficiency awareness.
<u>Need</u> for public understanding/ knowledge sharing. Save more energy by turning off the light than using less water.
If you conserve and the utility ups the bill because you conserve, the public does not understand why the water or electric rates go up because they conserve. **<u>Need</u> to reexamine the whole rate structure.** There is no real price of water.
What is the long term investment we need to make to protect the aquifer from the draw down of the well? When gas becomes scarce the price goes up dramatically.

Produced water is not a reliable supply.

Perhaps the solution is not in looking at these issues in a singular fashion but as an integrated system.

<u>Solutions</u>

1. Data Inconsistency /Availability

Should be a state maintained data base on energy and water. No National data base. An assessment template –GIS application. An agreed to set of fields. Some data consistency, some evaluation consistency. This is being attempted in the oil and gas industry. Try a database between three states perhaps as a place to begin. Since data exists in different places it is an assessment rather than a data base.
There is a data inconsistency. This is better resolved at the state rather than Federal level. Example Kansas and Nebraska. Some kind of integrated planning group comes to the table and starts talking.
In many cases this data has not been developed or is in a different format. Consider the software world and how they are able to integrate.
Perhaps a water information template with 2-3 states as a pilot.
First step is to inventory what are the data collection practices across the states.
Comparing to the oil and gas industry, for example, there are subsets of data that maybe we don't know exist.
What is the subset character of data points: Supply irrigation, industrial uses, end use profile, volume quality ownership, legalities, location, and industrial use.

Do you start with conjoined states, disparate practices? Or base upon a common cultural or topographical basis? Riparian, coastal, watershed,
Difficult to capture data at the state level? Too many territorial /tensions/rivalries issues to leave it at the state level, it needs to be at the Federal level.

The question is still, should it be the state level or the federal level. Cost is an issue because it will cost to develop and maintain a water use and availability inventory/index at the state level.

Payoff is huge---you can't manage what you don't know. It has a huge payout but difficult to quantify. Like trying to initially evaluate DARPA's original investment in the internet.

The risk:. Exposure in litigation/ increase in interstate tension. Introduction of a whole new irritant to the mix.
But to do anything else you need the data. Must give clear direction as to what the purpose of the template "form" is when the process begins. Risk base data management. Oil and gas has a similar data base that has 20 states' of input. Template developed by the states themselves in response to an EPA requirement. Through an organization that works across several states. Can this be modified to reflect water issues? Common federal law drove this tool.
Do we need a regulatory imperative to mandate this water resource data base? No. but there is a precedent with this oil and gas Risk Data Base.

The timeframe: needs to be started now. Short term.

2. Thermal Electric Generation

a.Develop and test cooling technologies and cooling strategies that would increase water use efficiency.

Applied Engineering R& D

Dry/ Hybrid systems
Utilization of degraded water

Huge pay-off- cuts dependency on water.
Reward is huge because the impact is huge. No down side risk

Could be state, utility or government funding. This is a broad action and probably would take a CRADA type effort. The hardware would be customized to the situation. Applied Engineering R&D for dry cooling or hybrid techniques. The components exist; they may just be put together differently.

b.Develop and test generation technologies that would improve thermal efficiencies.
Materials development
Fluid dynamics
Applied engineering
The tricky part is how to get the plants to displace there existing plants. You can regulate, incentivize it or something such as that.

Huge pay-off
Reward is huge because the impact is huge. No down side risk

Are there issues related to the installation of new technologies that open up changes of licensing issues? Does it open Pandora's Box because you have changed one part of the system? Retrofitting can work but we must design for next generation plant. After ten year payoff

3. National/Regional Energy Water Vision Planning-ongoing
Vision for Water and Energy

The solution *is* a Vision, to be distinguished from the roadmap
Elements of the vision
Energy Security
Sustainable Infrastructure
Efficient Use of Resources
Ultimate protection of the Environment
DOE needs to facilitate a vision
Put together an advisory group
Coordinate state-regional-national

What is Kansas going to look like in 2023? Someone needs to develop a vision.
Created by the stakeholders, national for the national stakeholders, regional for the region stakeholders.

Technical construct organized by DOE, working through all of the stakeholders.
Big project
On the regional level it would be consortia of the states and their units.

Someone in a leadership position comes out and states we need a plan. A roadmap is a start to a program plan. We need something we don't have yet. The RDMP is a start for getting to the vision.

What does the term Resource mean here? Energy from the Demand side to the Supply side. The big planning concept.
The big vacuum is we have no concept of where we are going.
Is it planning or is it vision. Most are comfortable with both

There needs to be some resources and money and manpower into this at a national level.

With the energy water crises facing us, we as a nation we put a man on the moon global leadership and innovation to bring math and science back into the schools. Can the Water energy issue be the catalyst?
Perhaps we are creating the political platform for the next leader.
Energy security – how do we make a stable energy supply that allows you to build an economy upon which the global market place can grow? Prosperity we want to be sustainable.
The US has competed world wide through cheap energy, plentiful food, free water.

4. Cost/Value of Water

Part of this is to know what you have before you can put a value. Its value is derived by what you do with it.
Commodity trading value of water—Water is like air to some extent. Who owns the air.
Study the ramification of commodity trading of water.

- **Differentials of use**
- **How important is it**
- **Strategic importance**
- **Regional differences**
- **End use differences**
- **Ownership**
  - **Time of acquisition**

It's not that the information isn't there; we in this room don't know it. Known but not known to me.
When you export goods out of state and you used water to produce that export, do you track that? Huge water cost to meat production.
Is the water a strategic resource for that region? Is it a relevant question to ask? If a power plant comes in and have to buy water, do they buy it from the beef industry?

The message is that water is no longer free, it needs adult supervision. We are now taking the problem seriously. We will begin to manage it on a national level.

Most people think that when they are paying for water they are buying the water rather then the water delivery.

Who values the water more—the city or the industry with the big contract with China.
Is the water being subsidized? Make an analogy with land use in the west. It's free but you have to use it within the year.

"Other"

Water usage indices
How much water does it take to produce a pound of beef, how much water does is take to grow a bushel of corn, how much to ….It the data, stupid!!!

Interstate Ground Water compacts aren't in existence.

Reconvene and present results.

Group C, Day One, Problems

"Priority" Problem Flipchart Transcription, Summary Presentation

- **PRIORITY ENERGY SUPPLY PROBLEMS**
  - Cooling water availability
  - Economics
    - Water value
  - Integrated Resource Planning
    - Competition for limited resource
  - Social/Regulatory
    - Infrastructure
    - Social contract

- **PRIORITY WATER SUPPLY PROBLEMS**
  - Utility/industrial
    - Externalities
  - Ecosystem sustainability
    - Land use
    - EPA may not be sufficient?
  - Equitable allocation of limited water supply

Problem Flipchart Transcription, Energy Supply

Extraction

- **METHANE—COAL BED (NEAR AND LONG-TERM)**
  - Water by-product extraction
    - Is it an asset?
    - Irrigation water quality
  - Chemistry—RO
  - Regulatory environment
  - Mature field
    - Life extension at $60/bbl
    - Water associated with production; disposal=$
    - Steam injection; secondary/tertiary recover
- **COAL**
  - Liquefaction (Long-term problem)
    - Requires lots of water
  - Dewatering
    - Quality
- **OIL/GAS**
  - Produced water (Near-term problem) (2 votes)
    - Disposal
    - Water quality
    - Disposal at depth, no additional problems
    - Chemistry—improve water quality
- **OIL SHALE (LONG-TERM PROBLEM)**
  - Well-regulated
  - Water available
    - 3 bbl water per 1 bbl oil
- **GROUNDWATER INVENTORY**
- **SURFACE WATER INVENTORY**
- **GIS OF ALL WATER**
  - Hydrodynamics
  - Water balance

Renewables

- **GRID INTEGRATION**
  - Temporal issues
  - Access to grid/transmission
- **PV**
- **SMALL HYDRO**
  - Large capacity opportunity

  - Low head technology
  - In-stream/in-river turbine technology
    - Corrosion
    - Ice
    - Cyclic
  - O&M issues
- **WAVE/TIDAL**
- **HYDROPOWER**
  - Store energy
    - Value?
  - Environmental aspects
  - Watershed management
  - Technology
    - Turbines
  - Where will next big hydro come from?
    - Technology issues
    - Policy issues
- **WATER RESOURCE ASSESSMENT**
  - Limited information due to limited funding
  - Model—mass balance
  - Where is water?
  - Limited to date
  - State level knowledge exists
    - Lack of regional integration of existing data
- **POWER PRODUCTION**
  - Technology
    - Increase cooling efficiency
    - 60% thermal efficiency **(1 vote)**
    - Heat rate / "water rate"
    - Cascaded use
      - Couple power with desal
    - Dry cooling—rate of acceptance/efficiency penalty
    - Impaired water utilization
  - Market
    - Firming of wind
- **PEAK OIL (2 VOTES)**
  - Water implications
  - Transportation focus
  - Flow rate/production
  - Biomass to liquid fuels
    - 1/3 domestic supply
  - Electric transport in the long-term
    - Big load
  - Water tie
    - Agriculture to energy/food tension
  - Fossil

        - Climate change/CO2
        - Water balance
    - CO2 groups
        - Need to interface with groups
    - Coal to liquids consumes lots of water

Other—Energy Supply Policy/Insitutional

- **ECONOMICS—NEAR- AND LONG-TERM PROBLEMS (9 VOTES)**
    - Water value
    - Water life cycle
- **INTEGRATED NATIONAL/REGIONAL PLANNING (14 VOTES)**
    - GIS
    - Inventory uncertainty
        - Surface water storage
        - Groundwater storage
- **GRID INTEGRATION OF RENEWABLES—NEAR-TERM PROBLEM (1 VOTE)**
- **SOCIAL INFRASTRUCTURE/CONTRACT/REGULATORY INFRASTRUCTURE (8 VOTES)**
    - Siting

Electricity Production

- **COOLING WATER AVAILABILITY; NEAR- AND LONG-TERM PROBLEM (15 VOTES)**
    - Efficiency
    - Heat sink
- **HYDRO POLICY (5 VOTES)**
    - Structural limitations of hydro use
    - Cyclic production—drought
    - Climate forecasting
    - When to use stored energy
- **GRID TOPOLOGY (1 VOTE)**
    - Demand growth
    - Water supply
- **WASTE HEAT—DESAL OPPORTUNITY**
- **DEMAND-SIDE MANAGEMENT OPPORTUNITY**
    - Low-quality energy
- **HEAT RATE / "WATER RATE" TAXONOMY (1 VOTE)**
- **DEGRADED WATER**
- **INCREASED USE OF HYDRO/NUCLEAR—NEAR- AND LONG-TERM PROBLEM**
    - Increase efficiency
    - Increase potable water
    - Decrease CO2

Random

- **ENERGY PRODUCTION—SOCIAL REQUIREMENTS**
    - TX regulatory protection

  - Long Beach example
- **CAPACITY ADDITION**
  - Co-location with water supply
  - Grid location/topology
  - Capital available; no regulatory approval
- **ENERGY SUPPLY**
  - Water value
  - Compare with other projects
    - See the larger picture
- **SOCIETAL VALUE OF WATER INFRASTRUCTURE**
- **DESAL**
  - MSF
  - Location—coastline
- **HYDROGEN**
  - Energy balance
  - Water availability
- **EXTERNALITIES**
  - Evaporation
    - Who pays
    - Who is affected
    - Establish priorities
  - Heat sink—EPA
  - Inventory
    - EPA "free"
  - Water balances—regional
- **RENEWABLES**
  - Geo
    - Cooling
    - Injection
  - Small hydro (near-term problem) **(5 votes)**
    - Facilitation
    - Mobilization
  - Biofuels (long-term problem)
    - Agriculture (food vs energy; competition for water)
  - Biopower (long-term problem)
    - Cooling
    - Resource management—pulp and paper

Problem Flipchart Transcription, Water Supply

- **STORMWATER MANAGEMENT**
  - Sewage separation—water quality
  - Conserve water **(1 vote)**
    - Keep in communities
  - Drainage efficiency
    - Move to storage/reinjection—urban
    - Keep in ground—rural/recharge
- **FLOOD CONTROL**
  - Societal werewithal
- **URBAN**
  - Aging infrastructure
    - Cost to replace **(1 vote)**
- **INDUSTRIAL EFFLUENT—NEAR-TERM PROBLEM**
  - Impact on downstream power generation **(1 vote)**
  - Shared resource
  - Process requirements vs alternate uses
- **AGRICULTURE**
  - Increase utilization effectiveness
  - Dropping aquifer levels **(3 votes)**
  - Energy cost
  - Nutrient levels
    - Run-off
  - EPA regs
  - Surface water/groundwater
    - Differing regulations by state
  - Aging agricultural infrastructure **(1 vote)**
- **RECREATIONAL**
  - Competing use
  - Flow rate—minimum for recreation vs other use/ecosystem use
  - Water level **(1 vote)**
  - Don't speak as one voice
  - $ of recreation community vs legal standing
    - $ has influence
    - Understand intervention process
  - How to utilize the resource for all users **(2 votes)**
- **ENVIRONMENTAL/ECOSYSTEM SUSTAINABILITY (9 VOTES)**
  - In-stream flow—temporal pattern
  - Water quality **(1 vote)**
    - Withdrawals affect water quality
    - Chemical runoff
  - Land use patterns
    - Runoff (quality and quantity) **(4 votes)**
  - Local issues
  - Dam removal

        - Degradation of ecosystem
        - Prioritization of ecosystem vs other uses
- **LIMITED WATER SUPPLY/COMPETITION**
    - Equitable allocation **(8 votes)**
    - Urban votes/$ -- winner
    - Density—CF increasing
    - Inter-sector competition
    - Economic diversity
    - "Realistic" market pricing
        - Disrupted by cities
        - Ag disruption by surface use
    - Legal water preference—statutory
        - Varies by state
        - Historic ag bias
- **UTILITY/INDUSTRIAL**
    - Hydro—Near- and long-term problem **(2 votes)**
        - Operation has impact on downstream supply
    - Thermal impact—water discharge (Near- and long-term problem) **(2 votes)**
        - Discharge at EPA limit
        - Location of plant relative to water temp
        - Efficiency impact
    - Generating stations—externalities (near-term problem) **(6 votes)**
        - Impact on air and water quality—multimedia integrated approach
        - Changes for all users
        - Range: local to large region
- **LEGAL**
    - Who controls/owns water **(5 votes)**
    - Specific use
- **VALUE (1 vote)**
    - Rates
    - Water trading **(4 votes)**
        - Market based
    - Difficult to capture time value of water
    - Commodity?
- **URBAN USE**
    - Surface
        - Bacteria
        - Contamination
    - Economic development
        - Water rates
    - Reuse
        - Diminished use downstream
    - Aging infrastructure
    - DSM
- **PHYSICAL WATER CONVEYANCE**
    - Resistance to interbasin transfer **(2 votes)**

- $
- Land use ROW
- Water supply infrastructure
- Storage

- **IRRIGATION—FLOOD TYPE**
  - Surplus crop
  - Return flows—transfer basins
  - Pecking order in water use
  - $
    - $20/af—ag
    - $200/af—utility
    - $2000/af—utility
  - Imports
  - Value of water by application
    - $8/gallon for bottled water
  - Retail rates
    - Secondary recovery
    - Better water quality
      - Greater yield

Group C, Day Two, Needs and Solutions

"Rough" Flipchart Transcriptions, Needs

- **NEED: Transmission**
  - Need to include within energy/water vision
- **NEED: Self-sustaining Community (3 votes)**
  - Need to understand benefits on local level
    - Energy
    - Waste
    - Water
- **NEED: Oil/Natural Gas (near-term)**
  - Avoided waste management cost
  - Need industry-wide database for produced water
  - ID potential users
  - Know how to treat
- **NEED: Nuclear (4 votes)**
  - Need to close fuel cycle
    - Fuel reprocessing
    - Yucca mountain
  - Need to incorporate new reactor core
    - Leads to higher thermal efficiency
- **NEED: CBM**
  - Link resource to potential users database
  - Need to understand sustainable aspect of water production/inventory
- **NEED: Cost/Value of Water (5 votes)**
  - Need to understand value
  - Need to understand water cost per unit produced **(1 vote)**
  - Need to understand regional/location/time differences in cost **(1 vote)**
  - Need to understand distinction between value—cost
- **NEED: Future Energy Production Technologies**
  - Hydro—capacity scale
    - New hydro at existing dams/facilities
    - Understand grid stability value of hydro
    - Storage—how much store (MWh stored) and where?
    - Optimize performance—weather forecasting
    - Reinstitute fish-friendly turbine R&D
    - Variable speed machinery—pumped storage. Reduce risk with demonstrations. Inventory the opportunity with rehab schedule.
- **NEED: DSM/Conservation**
  - Need for public understanding of the water—energy linkage
  - Need to reexamine water rates that discourage efficiency/conservation
- **NEED: Water Availability**
  - Link resources—information

  - Produced water utilization **(3 votes)**
    - Fresh to hypersaline
    - Extreme variability
  - All water
    - Stormwater
    - Wastewater
    - Surface
    - Ground
  - Needs
    - Understand how much
    - Lack of verified data sources
    - Volume
    - Quality
    - Location
    - Ownership
    - Legalities of consumptive use/of used water/municipal and industrial treated water
- **NEED: Data Inconsistency/Availability (7 votes)**
  - Hinders policy/decision making
  - State variation
  - Data needs to be available to all
  - Missing data
    - Storage—surface and subsurfact
    - Last time USGS – 1967
  - Consistent data—Regional/national
    - Availability
  - QA of data
- **NEED: Time Scale for Energy Projects**
  - Capture of externalities
    - Value/cost of water
    - Low ROI for energy projects
    - Difficulty of attracting capital vs risk
- **NEED: National/regional group to facilitate planning (2 votes)**
- **NEED: National integrated energy/water vision (3 votes)**
- **NEED: Need for utility and water planners to communicate (1 vote)**
- **NEED: Production credit for recycling water**
  - Recycle
  - Recharge
  - Cooling water
  - Model—coal seam incentives
- **NEED: Generation; Thermo-electric** (Near-term problems, increasing in severity over time)
  - Need to increase efficiency of cooling **(3 votes)**
  - Substitute degraded water for fresh water
  - Improve thermal efficiency **(1 vote)**

"Rough" Flipchart Transcriptions, Solutions

- **SOLUTION: Data Inconsistency (near-term activities)**
  - State database—maintenance/capture
    - Available to all
  - Inventory of collected available data
  - Huge—can't manage what you don't know
  - Risk—exposure in litigation
- **SOLUTION: Generation; Thermo-electric (near-term activities)**
  - Develop and test cooling technologies/strategies
    - Applied engineering
    - Dry/hybrid systems
    - Utilization of degraded water
  - Develop and test generation technologies to improve efficiencies
    - Materials
    - Basic thermodynamics
    - Applied engineering
    - Bottoming cycle
- **SOLUTION: National/Regional Energy/Water Vision and Planning**
  - Elements of vision
    - Prosperity
    - Energy security
    - Efficient use of resources
    - Sustainable infrastructure
    - Ultimate protection of environment
  - Solution
    - DOE facilitate vision
    - Put together advisory group
    - Coordinate activities at state—regional—national levels
- **SOLUTION: Cost/Value of Water**
  - Study ramifications of market for tradeable water
    - Differentials of use
    - How "important" is it
    - Regional differences
    - End-use differences
    - Water quality differences
    - Ownership—time of acquisition
- **SOLUTION: Other**
  - Water intensity usage index
  - Interstate groundwater compacts

Appendix F: "Raw" Notes from Group "D"

Day 1 Group D

Scott: Discussion Leader

Focus on the science and tech angles of the different issues;
Developed, deployed to guide institutional issues

l
Matrix: Water for Energy
Problem Area Identification

Starting Point: Renewable Sources

Geothermal limiting ground water availability or the problem with contamination
Near term issue
Site specific
What is the availability?

Quality of ground water varies greatly in So Missouri
Ozarks sees quantity issues also

Site specific
Water deep and hot, but extraction very expensive
Lots of mineral content, can't use as potable
Cost of geo prohibitive
Potential for distribution in rural area
How do you get it where you need it?
$100K for one well, one family
Reference sources for artesian wells thru Dept of Interior
Lot of well-drilling, federally funded so information available
EPA web site has information

Drinking water for state of MO, info high reliability

How large of geothermal systems
Ground Heat pumps distinguished from other power generation plants

Wind: water problems associated with this technology?

No water-associated problems for wind energy
Potential solution requires that you use less water or no water

Wind is appropriate everywhere

So many connections that politically the hydro electric can impact your ability to get permitted to get into the queue to get into the grid

Indirect, yet political affect
Interconnection, wind can be solution

Transmission infrastructure, no one has done much with it because it has not grown
If you talk about wind, it doesn't use much water and you need wind, transmission infrastructure does not support you getting resource from one point to another

Where there is wind, look to it as a potential solution for sharing water resource
Wind can be considered offsetting when you have drought
No direct need for water for wind, wind valuable for generating water
Cost of power production and distribution prohibitive, develop wind energy source to decrease cost of pumping water and making water available
Free up water for additional uses

Other issues:
Transmission availability

Solar Energy

Won't this be similar to wind?
What do you do for back-ups.
Solar designed for small systems

What about using solar for pump storage?
Pump at night. Electricity is cheaper

Not familiar with solar energy process
PV and batteries is nature of knowledge

PV fields available allows large (600 HP) motors
Arrays required
Solar set asides: Pump water when needed. When not needed, put that power back into the grid.

Biomass & Water issues

Wastewater Treatment

Livestock
Capturing Methane

History and work experience is an attempt to use wastewater methane to run heaters, generators for electric power.
Low quality is the issue
Cost of technology to install is too much (economic perspective)
Water-intensive process to transport slurry, to move waste
If they could use some of that water
Reduction of water, will it improve energy use?

Municipally derived bio gases, get into issues of personal care products. They end up in landfill as potential pollutants (i.e., deodorant becomes a pollutant)
Internal combustion engines not a problem

How big does system have to be to be useful

Kansas is reviewing opportunities. Web site is at KDA.org
Contact is Robert Brendage of Jefferson City, attorney

Dakotas are big biomass producers. What are their concerns? Part of it is Ag because corn, for instance is very water intensive.
Generation of ethanol production
What do you do with the run-off?
Waste water treatment cost and water needed for run-off

You need water to irrigate corn,
Then you have water that has chemicals. So you have problems with run-off cleanup.
Environmental concerns with wastewater, runoff, etc.

Water reclamation technologies; make it potable from post production
This is a need and a solution.
This will require more energy
Western Kansas
There is no run-off. Aquifers are deep.

If you keep the water and don't release it, then you don't have the same problem

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Hydro
Large scale
Small scale

Drought and competing demands for the water on the Missouri River are both large issues. Do you keep the water behind the dam or do you release it?

There is a fight that goes on.

Problem with upstream and downstream and agriculture versus recreation?

$16M spent for relocation water intake. We wouldn't fight so hard about the political side of problem.

Better to have more flexible water intakes. Intake moves on rivers and reservoirs

Technology needs require better regional models for the system to help make decisions.

Do more modeling of water draw downs.

Fishkill, low oxygen,
Endangered species: release rates low with temperature rise in river, then fish kill high

This is a problem with hydro electric use and environmental
Technology and policy interaction

Discharge at power plants starting to see thermal limits because of how they were structured in the past.

There can be a downstream temperature concern with hydro. Withdrawing water at different points can change level of temperature. Solve problem (environmental) of fisheries. As you try to reduce the water rise in the reservoir, you decrease the efficiency of the hydroelectric plant. Problem is the specific location where you pull off the water.
The problem is the issue of discharge water along with efficiency of the energy extraction with the turbine. Temperature dependent on where water is extracted

Problem is with renewing permit for turbines that have downstream fish kill in Ozarks with a hydro plant

Problem is not intake for the hydro, but for the other users drawing water off the reservoir, or river. Try to improve the water intake technology to adapt better for changing levels of the water.

There have been problems of nuclear, fossil, and other energy formats, not just hydro.

Hydro facilities are aging. Who is doing the upgrades?

No experience with hydro, when re-licensing happens, then the consideration down the road will show that some may have to be removed

Missouri River excellent example of the biggest dump in history with what is on the bottom of the river. Fort Randall, i.e., not a long-term problem… that dam will silt in. The sedimentation issue is shorter than planned. Sedimentation Action Coalition is a resource.

Weren't dams designed to silt in?

USGS is doing a study on sediments in reservoirs (Kyle Jarachek)

Energy generation & hydro electric w/ cross cutting issues

Is conservation a renewable (approach)? This is a conservation of water and energy balancing act. Less water, but more energy available is also something challenged by technology. Water utilities make money on water that is sold. Utils subsidize the rest of the city operations.

Competing uses does not fit into solution. Who else will want that water? What are they willing to pay for it? Environmental users will demand that the water not appropriated to be preserved so that no others can use it.

Water rights differ from state to state. This is a regional issue for how the rights are handled.

What legal considerations cross state lines? Once you decide scientifically or technically, then you have to develop how to live within the rules.

What are the collaborative issues? There are 500 tribal governments in the country, but are willing to collaborate rather than to litigate. Competing uses through conservation strategies are preferable. Institutionalized approach to go through water compacting.

New Mexico has an example of collaboration.

Even the environmental laws differ from state to state? There is no standardization even with EPA from region to region. 80% of state, there are no recognized "zones"… watershed permitting is difficult getting people involved, like watershed trading. This is still a modeling issue in determining who gets which slice of the pie.

Institute for Environmental Conflict Resolutions are a national resource to implement processes. They have done some modeling for what works and what does not.

You have to have stakeholder buy-in.

Electricity Production & Water Use

Focus on the conventional

From DOE two broad areas: availability vs impact on water quality.
They cannot get permits to operate plants. What kind of power plant will require less fresh water? How do you recover the water? Typically you put the plant where you need the power. If you move to an enhanced air cooling systems, that are less efficient, then you create more air quality because you burn more fuel.

Five competing factors when having a power plant are water availability, technology, transmission avail, fuel & fuel transportation, and air quality. Not in my backyard. Water in relation to the other factors… if you have a reduced need for water, it opens up an opportunity to open plants in other places. Example: They are currently 'siting' a power plant: good access to fuel, marginal transmission to export, yet water is the problem. They had to go to water cooling that reduced efficiency.

People tend to overlook efficiency of generation of using air cooling technology versus increase of air pollution to burn fuel.

Advances in dry cooling may translate to designs in turbines at higher efficiencies. There are more opportunities from R&D standpoint. On the wet side, come up with hybrids for consumptive losses. Technology problem: Evaporative loss on wet cooling system, the plant has to draw make up water. Water you withdraw is consumed and not returned. Cooling water intake with organizations in organisms: this is a reduction in fish kill.

Can you locate a site then can you retrofit.

Match turbine to turbine technology for condenser-pressure systems. The turbine won't work to retrofit. It will not accept the back pressure system.

R&D issue around wet cooling: use of impaired or produced water versus fresh water is another opportunity. What about underground coal-water? This is a technology issue to treat water. There is a lack of experience and lack of technology to be able to use other sources of water. West Virginia is example to prevent acidic water from escaping into river by using produced waters or impaired water.. You will create some other water. Limerick in Pennsylvania another example of using mined water for cooling.

Look at long-term availability when building new power plants – maybe 30 to 50 years down the road. Reclaimed water and use of poor quality water that may not be suitable for irrigation or domestic use will create economic considerations for treatment, but this is all that is available. It will be evaporative, a non-discharge solution.

The water is there. But because of the cost, there is no market-based incentive there to look at alternatives until you are absolutely out of options. It is not until the power utilities are shut off that the investors are motivated to look at other technologies or options. These could be tax credits, etc.

Water quality as you make air quality more stringent, there is a potential to transfer trace metals that go into the water and get into surrounding water bodies. The pollutants are transferred into other media. The potential exists for effluent transients.

Are there problems with feeding or linking technologies to feed different types of renewable energy into the grid: geothermal, wind, --- related to transmission capacity
Water required for coal-bed methane is tremendous.

LUNCH

REGROUP

EXTRACTION PROBLEMS

Oil, gas, methane, coal

Environmental effects, drilling and effect on aquifers, removal, transportation of refined and unrefined oil that can spill, storage. Water issue is pollution for potable purposes.

How about coal transportation? Isn't it a quality problem? What about quantity?

Scaling causes things to blow up. Total dissolved solvents. Production of the product can use saline water. For oil and gas extraction, you can use brine or pretty crappy stuff. They can use water below Drinking Water Standards. Too much (volume seems big) is a matter of perspective. From the consumer end, the numbers are small compared to other uses.

As an oil and gas producer, the water is injected back from which it came. Are there problems with regulation?

If there were beneficial uses, surface, use for the water, then there is no need to treat. How do you treat to a usable standard? Most of the water associated with coal bed is fairly useful with salinity at 1ppt (thousand). Generally speaking, the coal-bed water is a viable resource. It boils down to cost and what you can do with it. The question is what it costs to treat the water. In most cases, it does not compete.

Any market in the Southwest?

There is variability in quality. The deeper you go, the greater the salinity.

Arizona Clean Fuels is a resource. It is cost prohibitive to treat water after you have produced.

Pipelines cost about $1M per mile. One of the problems with coal-bed natural gas is that the capability for injection is not available. Most convention oil and gas regions, it's not a big issue. DOE has many resources.

DOE NETL has studies about produced water.

EPA has done quite a bit of regulatory work, not necessarily reuse or reinjection.

Appalachian coal has mine drainage. Underground coal mines discharge into lakes, rivers. Acid mine drainage, mine pool discharge – why siting power plants atop these mines is a potential solution.

Technologies for more treatable water? Let's say I'm going to produce gas that has water of a less quality, is there a possibility to use "worse" water?

Allow for different cycling to use less make-up water?

Tie recoverable reserves for produced water. The amount of oil determines how much produced water. How do you control the production of water. Water is a byproduct. Expend energy to recover fluid from the ground. The commercially viable part is the oil and the gas. How do you lock the energy production? Mitigation is done as much as possible, so there is no silver bullet. There is a lack of technology to control the production of water for extraction. The equation is: the higher the production of water and gas for the flue, the greater the economic impact for the extraction industry. When we discharge produced water, we are strictly regulated (for effluents).

Electricity production – we are struggling with the clarity of the rules. It would be really nice to know what the rules are. If the regulations could get their act together, then that would help. It's thermal discharge permits that we are talking about. The EPA is saying that even though you are operating within your permit, you are still outside of the limits.

There is an unmet demand for the rural communities. To build one transmission line is a matter of cost/benefit to meet the demand. Our electricity is generated through hydroelectric means.

Maybe we need local production.

Is there any increased efficiency in small operations?

It may depend on how far you have to send the electricity. There may be a benefit in doing some small generation, especially when people are concentrated in a remote area. There are ways of generating electricity on a smaller scale.

It's all about transmission. We are putting the permits in… cost is prohibitive. A $3M line was just completed to serve 15 people and a water intake. Unless this is supplemented, including the upgrades, then this issue is still cost prohibitive.

PROBLEM AREA: ENERGY SUPPLY

Focus: Water for Energy/ Breakout Session 1

RENEWABLE ENERGY

Geothermal – GSHP & Power

- Availability of Groundwater
- Quality varies by region and quality
- Cost of extraction
- Potential for distribution: How to get where you need

Wind

- Hydroelectric facilities can impact ability to get permits for transmission (potential)
- Wind as possible way to increase water availability (possible solution)
- Source of power for pumping water

Solar

- Pumped storage possibility

Biomass

- Quality of methane from Agricultural process
- Low quality from municipal water and waste water systems
- Impacts on equipment from personal avenue for municipal waste stream
- Cost of technology needs
- Recycle and reduce water use in facility

Ethanol: What are water concerns for ethanol producers?

- Production
- Competing uses
- Waste water treatment and environmental concerns
- Water needed for feedstock (corn); runoff of irrigation water inputs, surface and groundwater (but NOT in Western Kansas)

Hydro: Drought impacts and competition for water

- Lack of good technology for water intake systems
- Ways to reduce the temperature of discharge water based on intake location
- As intake level changes efficiency of the turbine is impacted
- Fish passing through turbine
- Water intakes for users drawing water off the river or reservoir
- Better technology to address changing levels and costs
- Aging equipment needed to re-tool for better power production

HYDRO (cont)

- Re-licensing may require removing dams
- Sediment issues are part of planning, but must be addressed sooner than planned
- Sediment is impacting reservoir storage
- Mining tailings in reservoir sediment & impact on dredging
- Keep out sediment in first place
- Reduce energy generation

NEEDS

- Develop water reclamation technologies
- Lack of flexible intake technologies
- Regional modeling of watersheds, dams, etc.
- Improved water conservation technologies
- Energy conservation technologies
- Develop regional strategies to address the competing uses of water through technologies, conservation policies, etc., with objective of institutionalizing conservation policies

ELECTRICITY PRODUCTION PROBLEMS

- Water availability: use less fresh water through reduced cooling and intake needs
- Siting: five factors include water, fuel, transportation, transmission, and air quality
- Water impacts: as water impacts other issues resolved, reduced need for water can open up other opportunities (e.g., Need RR tracks, less air impacts)
- Reduced efficiency: Use of air cooled technologies increases fuel use and air quality for generation of electricity
- Turbines: facilities cannot be retrofitted later down the road
- Consumptive loss: wet cooling systems disadvantage
- Fish kill: impingement of organisms on cooling water intake structure at cooling plants
- Ability: to use impaired, reclaimed, or poorer quality water versus fresh water
- Pollutants: removed from air stream end up in the water systems or in the solid waste stream due to tightening of air regulations
- Alternative energy sources: problem with feeding alternative and renewable sources of power into the grid create a transmission capacity issue.

OTHER ISSUES

- Transmission availability
- Discharge of water into ESA, environmental issues
- Develop regional strategies to address the competing uses of water through technologies, conservation policies, etc., with objective of institutionalizing conservation policies
- No standardization of environmental regulations, water laws, property rights
- Institutional need for market incentives for alternative sources of water

CROSSCUTTING ISSUES

- Cost of new technologies, competing uses
- Cost of new regulations (meeting compliance standards)
- What is the value of the water, the energy
- Education for the consumer (Technology happens so much in the background for water, energy) they object vehemently when rates increase. You don't get an absolutely clean environment with energy. They don't understand what the costs are. People understand about environmental issues, but people don't understand that it takes water to refine petroleum products. There is 3 X as much to run appliance and turn on switch than water used to take showers. Water use for energy production is high.
- In some areas, no amount of incentive will create a market because there is no economic development. There are still homes in SD that do not have running water and electricity. Across the board, if you relate only to market-based issues, then there are parts of the country that will be left out. What energy company is going to come out and build a plant to sell energy to that market? No one can afford to buy the energy.

PROBLEM AREA: WATER SUPPLY

Focus: Water for Energy/ Breakout Session 2

Primary issues of water supply related to different sectors

General Discussion

South Dakota is not urban. The cost of distribution and the money to run those distribution for water is astronomical. A cost of $389 M for 14,000 people may seem unreasonable, yet must be funded. REFERENCE: Report to Congress funding for very small populations.

Price of subsidized water found in projection plans for some states. This site includes energy reports (Texas Board). If you hold water for hydro purposes, will people reevaluate to sell the water off to others who have the ability to pay for the water?

This is not an arid locale problem. The issue is how much you use relative to what you've got.

Is this good or bad? It depends on who you are. It is clearly bad for rural America.
There is a federal law in place about charging rural areas in excess of x dollars.
The technology is not available for treatment of non-potable water. The cost of the technology is also at issue.

What do consumers pay for water? You can't say that you can't afford to pay if you are within 2% of increase.

It is a regulated rate. It could cost $30 for 4000 gallons. Annual income is based on the ability to pay. If a rural water system wants to increase rates, then they must apply to feds.

It could be rural versus urban.

What about the cost of energy to move the water?

Aren't we asking how much more is in the water? You can do more and better monitoring for surface and ground waters.

We need better technology for treating waste water effluents.

Huge stigma for using industrial treated water for consumption.

Need for education on the re-use of water.
Implicit scaling on the value of recycled or gray water.

Lack of education use of waste water. Problem is that people have to treat the water and the cattle are using the same water. There is not differentiation in that you are using the same rate for watering cattle… treating water that cattle are using.

Do you have to make two distribution systems?

Dept of Interior has funding to keep from building huge distribution system for all uses. Save potable water for human use. We need alternatives for non-potable water uses.

No general perception that there is a shortage of water. Promote activities that mean use less water or that you can use treated water to make the problem smaller. People make a choice to use water for leisure.

Higher rates in Colorado so that people would continue to conserve. This could be cultural and economic. Conservation is not the issue. It created more problems because people were not conserving. What is the water policy for that group?

Regressive pricing can be used to influence people to not waste water.

Flat rates are declining.

It used to be the more water you use, the less it costs.

Lack of uniformity in how water systems price water.

If you want to see a successful effort at a pricing system, look at Hays, Kansas.
The problem is that Hays is outside of system and does not have ground water nor are they located near surface water. They had to put in severe restrictions, -- a pricing system and enforcement system that worked well. The more water used, the greater the costs: low flow toilets, shower heads, water fines from police for water running down street, you were ticketed.

Do we know what is consumed versus what is wasted? There is a lack of knowledge of conservation issues.

We have to report annually what is diverted.

We send out annual report on every point of diversion, surface, ground. The people in Kansas have data on 40,000 lines in detail. They know their agricultural use. The collection of the data indicates trending. They tell in municipal and industrial what is discharged back into system.

USGS has reference document

There are 14 different uses of water from 8 regions, every point of diversion. Irrigation is published down to the township level.
How do you get irrigation information?

It is a form designed by Kansas Water System, so they are collecting data needed.

Make collection of data useful.

Ranchers will have a lot to say because of the nature of their economy. We can learn a lot from the states that are going dray about what not to do. How do get away from being in that state of drought?

Industrial processes – water didn't cost anything, but they did not count the other costs. Real capture is different.

Modeling is the technology. Model how much is available (fixed yield). Somebody gets charged for what is doled out. The problem is that you don't want to dole out, then model.

If the resources are not there, then don't create a population.

Everything we talk about leads back to technology.

At some point, we have to renew. The problem is that we don't model on the right scale or until we are nearly out of the supply. Model before you get in trouble.

Should cities like Phoenix or Las Vegas continue to grow where they are water deficient? We could be delaying the inevitable.

Atlanta has water supply problems…

RECREATION

Leave enough water in the river. Recreation is seen as another competitor. This should not be treated any differently than industrial or consumer need?

When do you need water in the river? Maybe the lack is a need for increased location of quantity of water. In stream use can be more demanding than power in some areas.

In-stream use is the number one industry in SD. Everybody sees the upstream fish spawning as recreation, viewed as a low priority.

In stream vs down stream use see recreation as an economical issue. Competing issues: leaving enough water in the watersheds for recreation, fish, wildlife, etc.

Natural water cycle is interrupted. But without regulation, can this be achieved?

Water Supply and Power Production

We have to look at 50 to 60 years to risk the investment. It is important that when you are pursuing the water supply that you have a legal right to that water for a long period of time. The problem is in competing use, and 50 years is a long time for anyone to agree to an assured supply. Permits last in amount of time depending on the source. They are based on minimum storage levels in the reservoir. They can be cut also. Withdrawal is a different issue as you may have state and interstate concerns. You may not be able to build system long enough to experience the economies of scale.

Agricultural economy: In the upper Midwest, you have great production where people don't want to address non-point source runoff solutions. Irrigation is such a huge use of water. This is a cultural concern, with subsidized economy that is a 'sacred cow' or regulation.

Look at technology to reduce use of water.

What big water users need to cut back and still get the same results?
Tom Bohl

Are we growing the wrong crops in the wrong areas?

How do we assess the best use for energy production and water use and prioritize those issues for a particular area? Who decides it? How do they decide it? How do you fund it? Every area is going to have a different tolerance issue for cost, conservation, etc. We need a decision matrix for each area that would call for integrated resource planning.

Is there a lack of flexibility to change from one type of generation of power to another? Are we able to switch, adjust to different technologies.

It is a lot of risk, no ability to recapture investment. You need to recoup your capital investment. When you don't have a mature technology (gasification of fuel development versus gas development)

Change and collaboration are not easy issues. Change is hard and collaboration is expensive.

Any time a big technology program comes along, the first person to take this leap takes a big risk that is not attractive.

Water-cooled versus air-cooled power plant costs.
Capital costs air cooled is 2.5 x greater than water cooled
Wet cooling, water consumption 8x greater consumptive use than dry cooling
Efficiency is 6% less water cooled
In plant needs (auxiliary) for power plant more for water cooled, 9% for wash down, air pollution control, no water for cooling

Wet Versus Dry Cooling Stats

	Wet Evap Cooling	ACC
Condenser Back Pressure	Base	216% increase
Condenser Back Pressure Limit (HgA)	5	8
Turbine Heat Rate (%)	Base	6.2% increase
Station Service (%)	Base	8.6% increase
Capital Cost (%)	Base	256% increase
Make-up Flow (%)	752% increase	Base

- Note the percent increase is JUST for cooling, not additional plant operation

Compared efficiency impacts for DOE to switch from wet to dry cooling. References at NETL web site. E & Water Resources… part of public document

Alternative methods for cooling – do we have good enough methods to prevent efficiency hit with dry cooling

These take up a larger footprint. They seem to be working on the smaller scale.

Problem, developing air cooled system that is more efficient gets you to a point of diminishing returns.

You do reach a physical constraint size.

The size of the unit will depend on the area where you are. You cannot assume that air-cooled systems can be used just anywhere, including the consideration that humidity also effects the use of the technology.

Is there technology to capture the heat off these systems available for another use?

Use of hot water from power plant, pump it in ground, use the underground coal mine as a heat sink.

Policy Issues

We have policy issues in this region. Come up with something that would be uniform in this region.

This is such a diverse region climatically and geographically.

The regions need to match the legal realities. Prior appropriations must be considered for various concerns. Texas has a rule of capture that differs from everybody else.

Is there anything that is constant? You've got climate and geographical differences, how do you coordinate transmission?

Commonality in the world of utilities, yet are reluctant to share when they develop innovations.

Why should we stress our system to sell resources (electricity or water) to you? There is a disincentive for you to share your power or water first. No one wants to invest in a distribution system because you may not get your investment back.

Water Survey Session Summary

There were five areas discussed in regard to water supply: urban use, agricultural use, energy production, electricity generation, and recreational use.

The group voted on the top three concerns for the session

1. How do we prioritize and assign uses to the limited water supply?
Some of the uses of water are for agriculture, energy production or could be provide for municipal groups, or industrial users. The point is that there is a general lack o integrated resource planning.

2. How do you correct the problems with modeling before you allocate water?
In many geographical areas, there is evidence where there is no modeling at all.

3. How do you overcome the issue of establishing a power plant?
Power plant siting needs 50 – 60 year supply of water in order to risk investment. You cannot always get rights through permits for this amount of time. Further, the property rights could also involve inter and intra state jurisdictional issues with water supply. There are conflicting from one state to another.

Day 2 Group D

Needs in Social Regulatory Process

Disincentive to invest from power side of the house, need to reduce risk f or generation…

Capacity is the problem for additional technology

Use intermittent technology to do other jobs rather than try to change up grid

Do you have a local need that can be done just when the wind blows. People don't want to use technology just when the limited resource is available

Is adding new transmission an economic issue only? No it is even a social issue

Need to streamline the process. Need to look at as a social issue how we prioritize permits. We have capacity to generate huge wind. Impoverished area needs prioritization. Permitting area does not care why you need. Look at how we prioritize permitting based on poverty

Competing applications matter too.

Sioux Tribe could not get into grid, but accessed power through casino

Part of the studies done when adding new generation is third party impact. When you want to add generation into the grid and cause third party impact, then you have to resolve those impacts either monetarily or with infrastructure to undo bottlenecks. This takes time. You have to show that you are not going to negatively impact others without the effort to fix the problem.

You have entrenched interest

When we can't get energy sources up and running

Is ROW a problem for generation or is it all social

Biggest problem in siting is NIMBY. It depends on where you are trying to build the additional transmission. The need is for new transmission. You don't want all of your transmission on one line. Otherwise you have redundancy. If you want to build more transmission in a place like Minnesota, then give yourself 20 years.

What about the social contract? What are the needs?

Is it possible that we punt on some of these issues and move on?

There needs to be a recognition in some parts of this country that you even need to plan about water.

You will have a nice booklet with pretty colors so that no one will read.

Tools needed to layover the models so that you have common language similar enough that people can talk to one another. Generate standard tools and terms.

Integrated energy and water data base.

Develop constant, on-going integration of data.

Is there a 10-year operating plan for environmental and water issues?

They created regional groups from different fields, divided state up to keep geography similar… these folks met with scientific staff that included Texas scientific board, debate over plans… sessions were intense. You had the needs people and the scientific people just to give them some reality. Google Texas water plan. They were trying to do that for ground water, but it just didn't work this time.

Interstate water state compacts do have serious planning processes involved in them. How did they get the states in the room before there was water or a problem?

Kansas water office has a website.

They do (KWO) have a board appointed by the governor. It is a planning process. It is not a plan. It is not perfect.

The Army CE can get us all in the room. They are a hook for the region. They are starting something called MSREC (Mister REC) They are talking about conserving water.

If there are planning tools that are there, then find out why they are not being used. The tools can be so cumbersome that people don't bother using them.

The biggest problem may be the collection of the data not the availability of the tools.

There are correct models out there. It's just that there is no data to put in them.

The tribes are usually left out of the process with serious governmental stakeholders with huge water rights.

Gathering the data can be very costly.

Sometimes you just have to reconstruct the data. This is done all the time in abandonement cases.

Comparison to peers.

Include all stakeholders should mean to include all the tribes who become parenthesis. Anywhere you have navigable water, you have tribal water rights who are routinely left out along with others with water rights.

There needs to be clarification for who owns the water.

Congress has left this right to water to the states.

It is not true.

NO INTENTION TO DEAL WITH a NATIONAL WATERLAW.

It is a matter of state law who owns the water, except with respect to federal reservation and Indian water rights (that are senior even to the fed)law.

It is a complex issue that cannot be resolved easily. Treaty water rights depend on the tribe and when states came into the union. It matters when the states came into the union.

Competing uses

What are the needs for power and water, the different in-stream uses. Different stages, different organisms need different flows.

We estimated how much water would be needed for thermoelectric use, the amount of ground water, surface water will remain the same, relatively flat to withdraw freshwater…

Is there any better information on a monthly basis? You will have different indications for monthly use.

Summer and winter are the greatest strains

You're talking about seasonal affects

Case studies in Calilf, San Juan with Zero net… snow runoff and power plant is out of phase with the river. There are different individual species information. That data is easy to collect. It does exist. IN NM we have the blunt nose shiner. The biologists are not sure what the correct environment is for the fish. The sedimentary flow shows that event he ripple flow in the sand makes a difference. You have the general misunderstanding so that in Central NM where the river runs dry where the silvery minnow did not die with limited flow.

Include endangered species into the model

Maybe there is a need to relook at the Endangered Species Act in terms of unreasonable demands.

It's worth writing down. Take on the Endangered Species Act.

Any where you look, you will find that they have integrated the issue. The first thing that people look to do is to conserve. There needs to be inter-federal agency coordination, including sharing data. Usually it is a separate mandate from Congress to make them sit down together. The DOE and Water, with Homeland Security

Federal geographical data is available and can easily be shared.

States will have offices like that that coordinate information like that. They combine state data and national data.

Anything else there with competing uses

It's just amazing to me that four groups met and these are the priorities.

We started from the back and will work to the front.

Are we trying to say that there is enough there or not enough there?

These are just the cross cutting issues from more than one group.

Move to needs for siting process

One of the needs for siting (DOE perspective). People in the energy business don't understand the need for water. The need is to educate at the congressional level, policy makers… close link between power generation and water. We use 3x more water in turning on our water, power projects need water… linkage between how critical that water is or you don't have electricity. The need is the education.

Include environmental groups for sure (in the education of the link)

Educate the owners of the water. Where water rights are huge issues is where there is also great energy demand.

The highest priority is to educate Congress (at the highest level to appropriate money).

Consistently the money has been going down with states and matching funds. It has gotten to the point where it has to be a crisis before funding.

People don't seem to understand getting data or information on anything. It seems to be a problem in general that information costs money to collect and you have to have it.

At least in the water area, the fed government pays for half of it. Interstate energy compacts, the fed government gave 50%, but the state cut the funding. Shop around and find larger groups.

The comment can be generic to all these issues.

We need to say need for funding to collect data and collaborate.

What Sandia hopes to do is to have Congress appropriate money.

And to make data available to all stakeholders.

Has he asked the group to define how near-term these needs/solutions are

9:50 am BREAK
10:12am

What data are we talking about? Are we talking about quantity and quality data?

Ground water, surface water.

What technology is out there to reduce consumption?

This is a big can of worms. We need to focus on what data we're looking at. If we are going to look at data, then we need to coordinate.

What the quality of the quality data?

There are efforts to integrate water quality data?

Data management plan.

USGS, US Fish & Wildlife, DOE, Dept of Interior, EPT, ACE, Bureau of Reclamation have data, but there is not much integration.

A whole host of data from agencies exists. Are we talking about flow data or characteristic data?

Separate what the specific data needs are.

Something that can be done under a future effort by Sandia.

States have done the water quality testing and have the data (for EPA)

Indicate near-term, short term needs, etc.

Are there any long term needs that are on the short term list?

You have a need to do that now. I'm assuming you have a range. This is going to be done over time. Is there a way that you can quantify? Are you going to do some part of this over time?

Fire Alarm 10:24am
Fire Alarm Return 10:32am
Fire Alarm 10:33 am
Fire Alarm off 10:34am

Displace power from vicinity
Siting a plant, we don't have to move the power out of the immediate region. We'll displace other power that we require.

Lack of value of water, what is the need?

Define the value of water.

It's more than money. What is the value of being able to turn on the faucet as opposed to having to drag it back from the river.

We neglect water, we know it is important for life, but we don't establish a value. There is a need to educate about the value of water. Things get devalued because we think that it will always be there. It may become non-renewable.

There is not a science and technology fix. The things we have talked about are more policy and regulatory.

There is a whole economic field of cost/benefit. Water suffers from that disconnect. We don't have a good way to connect water in a matrix to quantify it in dollars.

ALARM 10:40 am

Methodology from think tank can take on establishing the value of water.

The value of water or the cost of water will be where it is, what does it cost to have the right standard.

Maybe it's a problem of data gathering. You don't have information across the board. People in the industry know how much it costs.

Law and economics do the integration. There is an under valuation of water. The value of culture to tribes, for instance, has never been quantified.

The going price for water is what in that region people find its worth.

What about a commodities market for water?

In valuing real estate, you pay the value of the property. Your point is right.

Water has a social value. The federal govt can step in and say the you can't sell it above this price nor below this price. The need is to develop an approach to establish a value for water.

The value is based on the need. Example of $550,000 home/property that just sold. Needed irrigation rights to convert to industrial, but they had the sand underneath that added value.

There is a cost of no action. You don't get the requisite amount for developing an energy infrastructure. Those costs and values compared to other uses need to happen in the face of all the competing uses.

We don't want the federal government or the state governments to step in and tell you the value of the land.

Competing demands issue, can you say more about it?

Haven't heard much on the agricultural end about reducing withdrawal for energy production or use

There is a need for each competing use to look at ways of reducing water consumption. Develop efficiency technology for each sector.

There is a trade off. NIMBY is real. Feed lots is a problem. You can't grow corn in western Kansas without irrigation. We put the cattle where the corn was. Now we're running out of water. We can't put the cattle where the water is. That's where the people are… you can transport corn a lot cheaper than you can transport the water to grow the corn. Grow the crop where it best fits.

Information is the key. We talk about managing this and that. You can't manage everything.

When we were controlling the price of pumping natural gas, we were pumping water like there was no tomorrow. When we had to pay the real cost, then things worked.

Should the federal government tell people less or control it less?

Just tell the people what they need to know.

Won't that be based on the local concern?

There has to be some kind of mix.

Are you moving to a greater chaos, where you have water wars again? Is it better to have a national discussion?

There is a balance, but we are getting into an area where we cannot solve the issue.

Most of the discussion is around the quantity of water. Make sure that we blend in that quality inputs are necessary.

Cost effective technology of treating water is part of the water quality and quantity

I'd like to see a way to value the inputs. The price of nitrogen is so cheap. But in growing corn, this leads to nitrate problems in rivers.

They don't see the cost.

What about precision application?

You mean charge the people who are polluting.

There is no value placed on what goes on downstream.

That is a problem not just with nitrogen. It's a problem with everything. No one put a price on the hazardous waste. In the 1950s the price was the price of the raw materials…

But not of the residual effects. It's called externalities of the cost

Do we have enough materials to make the energy that we're talking about? Are we supposed to assume that we have what we need?

We have enough coal. BG said that we are not running out of water. The question becomes will power plants get the water… the conflicts come into play where we see that we have the ability to produce energy… In the future, based on what you see, coal is cheap we will not have access to material as a show stopper.

Add industry for competing demands.

Domestic supply (human consumption) should be included. We're not urban, but we need water for human use.

Externality of water degradation after use (should be added to competing demands).

Building power plants based on assumptions.

The time horizon is driven by your investments.

Need for risk management for protection of investors… likelihood of losing your investment due to changes in policy, water demands. This is really a social issue or a policy issue that needs to be addressed.

We need long range planning to balance the needs.

It's bigger than that. The utility wants to be assured that they can have access to that water. The planning is good, but it's more than that.

It needs to be a management approach there to do the prioritizing.

You need to plan the commitment. It depends on what source you're looking at. If you look at ground water, you may have a right after you develop your source, but it is always subject to more senior rights. Say your aquifer goes down, then you are subject to be shut down.

In Kansas, you can just go condemn the more senior rights. It is a state law for a public utility, you have condemnation power.

Senior rights have a high price tag.

The question is what is the water worth to you in comparison to the power plant.

The risk is more than jurisdictional, especially when you look at stream flow.

It depends on the streams and any storage on the stream.

There is a major need to look at and manage the navigable rivers in the country. There is so little time and money is invested to look at this collaborative management.

John Wesley Powell would be clapping in his grave if he had two arms if you had potentates on high making these kinds of decisions about water management.

The real problem is the economics. It's a lot cheaper to send corn than water.

And that relates to efficiency too.

I don't know to what degree we are quantifying water transport and relocation to solve energy problems. I can't buy into the fact that this is a solution.

Transporting water across basins… Red River Valley example to flow through Hudson, you have transboundaries (Canadian issues with Lake Winnepeg),… down the Missouri, you have jurisdictional issues when it comes to transferring water.

Why is water being transferred?

To meet the growing population demands.

Centralized versus decentralization?

Need for technology to reduce the cost of rural water being distributed. There is also a need to reduce the cost for treatment and extraction systems.

I think of sensors and monitors to detect interruption.

Smaller water systems are less of a target.

There are point of use systems that are more costly. It would seem that the power distribution side starts to solve the problem of getting the water where it should be.

Mineral treatment needed when you have poor populations… you would see the market shift.

Distributed generation might be the solution to some of the problems. They are developing turbines that could be one for a house or a neighborhood.

We are looking at geothermal as a solution. It's costly and it's risky. Add subsidization to it, then you can have people move toward that.

Water recovery and reuse technology… this in on the quality side… we're looking at advanced treatment at power plants. This is longer term. There is no evidence that there is a problem at this time. Mercury is the big issue the we hear about.

If the fly ash has the contaminants, it could eventually end up in the water.

From a technology point, detect it (pollutants) then treat them, removing from the water, not necessarily from the fly ash. These are more mid to long term.

Need incentives and technology for water recovery and reclaim

Another technology need is to improve technology on intake structures.

Improve flexibility to adapt to intake structures. …316B is an issue.

Solutions/Opportunities

NEED 1: Water Use Reduction

The basic solution: MONEY!

Benefit of doing work in Indian country… demonstration contract costs is less. Gear these projects to Indian country. The actors would be Indian tribes, federal government. No one else plays.

It simplifies things. That's a general statement for any of the solutions.

The permitting is easier.

Create funding for basic research and development, demonstration

Payoff time frame?

10-15 years

Actors?

Labs, universities, states, energy technology companies, electric utilities

You need the suppliers in there too for technology providers

Department of the Interior, grants, funds, etc.

Energy tax credits, tax exempt bond financing credits… market-based incentives. You also inter-agencies…Then there are economic enterprise zones (system). Actors there are primarily federal, but you have states, tribes,… it has to be a government entity

Where is Agriculture in this discussion? They are one of the largest users of water.

What about the concept of misusing Indian land, leaving waste. Should the statement be so broad about the use of Indian country for all demonstration projects?

We think of those demonstration projects as renewables. Tribal governments can self-determine to ensure that there are no racial issues. Poverty will drive you to take on oil or other projects with no payment from the federal government. There are already restrictions attached to the money that we other wise would not get. Permits are streamlined. Maybe we should say federally-funded projects are welcome for demonstration projects.

NEED 2: Planning and Modeling

USGS to be used to help with modeling and to be the lead agency.

What's nice is that they are always matching funds.

And they are trusted.

Unbiased.

Everybody likes the USGS.

Everybody but the Interior (Dept)

Develop standardized database that everyone can submit their data. There's a lot of data out there, just not easily accessible. Development of a national data base would be nice.

Seeing some of the sites and how they maintain their data could be overwhelming. Example of naming wells for a remediation project in undergrad became difficult for tracking.

You need all the stakeholders to agree on the format

They are running out of money to get people to go out and do jobs…

There is a new federal data base with the EPA that every one has to report to. This is the case for Missouri. I think this is the case with every state.

Make this web accessible. They have things where you can get real time read outs. At least flow data …

The gauge is $30,000. The technology is coming down.

It's more cost efficient to make this part of the system… to have a constant format.

When you have something that's going to flood, that's when you need real time data. But do we need real time data on all of the planning?

One of the things we saw on the TMDL process… what happened is that because of the court cases, the stakeholders when they were included were the last to know.

Part of it is Congressional mandates and rule-making processes

Formalization of process to get agencies to work together is also what you need. If you are going to do watershed planning, you are going to have to get people to share data.
SH: Who would do that? Who takes responsibility for the formalization of watershed planning? Are there models out there?

USDA/ Dept Interior and EPA: interagency agreement so that you don't have to go through different processes with each agency. Required negotiating rulemaking…they can't do a regulation except you have to do it by consensus.

Who are the actors?

Permitting agencies.

States can do it too.

How about less time for the final session?

Can we finally get that cold fusion?

Perpetual motion machine.
The problem is that there are entrenched interests that don't want these new or advanced technologies. It's the role of utilities to generate electricity.

50-50 cost share at utilities when they can be used for demonstration of new technology.

Risk of lost opportunity, lost production when you apply new technology to your existing operations

There are things that the power company does not want to promote like solar. Unless it's in the best interest of the utility, then why would they promote new things?

They don't have to add generation, so they are willing to promote a technology that they have to take 15 years to develop.

See all the solutions to need one.

What about the impact of renewable portfolios? Sterling Dish example from Calif. DOE is actually helping with control technology.

Case with environmental regulations: increase the standards or we will force you to the new technology. You might have to select carrot and stick approach whether federal, state, or local.

Some states are motivated. Voters are putting these type issues on the ballots that help get renewable energy in motion.

Standards mandate

For renewable portfolios

Basin Electric has already adopted a 10% renewable portfolio

Public image has pushed this drive for renewables. Utilities are sensitive to public image.

Increase public knowledge of the benefits of renewable energy.

We need tape that actually sticks.

Any other issues or solutions that we have not addressed.

When will we know that you have enough water?

The utilities may not be able to get their hands on that water.

We don't have a clear indication depending on the industry.

Any solutions with more of a short-term payoff?

Conservation on the energy an water side are more immediate response in the short term. It may be miniscule, but it has an impact.

We need a way to help Ag become more efficient in their use of water. Even small increases add tremendously to water availability to power generation. We have to be able to help them and make them pay for it. The delivery method is already there through the USGS and the Water Resource Committee… If you could put a program in place, then you are moving toward the solution.

The technology is not lacking. It's a problem of putting the resources there for Ag.

Explore incentives in energy and water for conservation.

Any federally funded project will have to include in the requirements. Build in the requirements.

This is a very short-term path. Market incentives are short term. Demonstration projects are more medium to longer term solutions.

When we say increased funding…

... We have no indication where it's coming from…

Reinstate funding for farming, conservation… it has to do with how you lobby the issue.

What about just making it easier to site generation facilities?

I'll vote for that!

Were we talking about building more lines or increasing capacity?

Research being done on conductors so that you have less line loss.

Maybe we can generate funds for Energy/Water to get a trip to western Kansas.

I lived in western Kansas… I said get me the hell out of here!

Where did you live?

Liberal

Well, that was the problem.

There is a Garden of Eden in Lucas. Dinsmore made his own Garden of Eden… killed his wife off… The joke is that her husband killed her off making her pour concrete… You have not lived until you've been to the Garden of Eden in western Kansas…The world's largest ball of twine is there. You can't miss Castle Rock. Nothing but the best is here in Kansas.

Flip Chart Notes

NEEDS Identification Session

Social/Regulatory/Regulations

- Need to increase capacity of existing lines
- Need to add new transmission
- Streamline permit process for new wind sites/transmission to connect to grid
- Prioritize based on need/economic conditions (Permits) for tribes

Planning/ Models

- Need to increase awareness of need to integrate plans
- From the ground up, include all stakeholders versus top-down (include tribes)
- Standardize tools/terms
- Integrate water/energy data bases (MAPS/GIS)
- Institutionalize the process; combine science with needs
- Need to figure out why tools that are there are not being used
- Need to improve data collection

Water Supply Modeling/Planning/Management

- Need to include long-term supplies in planning process, risk management included
- Need for collaborative management of major river basins
- Quantify practicality of water transfers

Siting (of power/water utility plants)

- Educate Congress, policy makers, owners, environmental groups, public about link between energy generation and water needs for that new or modified power plant about to go online
- Need for funding to collaborate, collect data, make data available to stakeholders, conduct R&D
- Need to reduce water use by plants

New Generation Technologies

- Long-term, we need to look at new technologies for energy generation (e.g., integrate wind energy to produce hydrogen)
- Integrated technologies for energy and water
- Better storage technologies
- Production of electricity from low temperature waste heat
- Continue efforts to develop solar

Competing Demands / Uses

- Add industry to list, domestic
- Develop efficiency technologies (quantity & quality) for each sector. Better planning and information dissemination to users and policy makers.
- Develop cost effective water quality technologies for treating water
- Need to quantify externalities of non-point, run-off treatment. There is degradation after use

- Include all stakeholders, including tribes early in the process
- Need to clarify who owns the water (complex issue): states, feds, tribes
- Modeling identify and clarify needs for aquatic organisms – How much water flow at various times? How do energy plants' needs impact this? Need to coordinate periodic demands.
- Better understanding of complex biology
- Better coordination of federal, state, local, tribal agencies and consolidation
- Integration of data for water quantity and quality data
- What's their cost, technologies available?
- What are the data needs?

Value of Water

- Define the value of water
- Educate about the value of water
- Develop consistent methodology, approach to help with establishing the value analysis, data gathering and reporting
- Quantify the economic value of social issues
- Factor value into policy decisions

Develop technologies to reduce use of water by power generation

- Advanced cooling technologies to site plants in water deficient regions
- Water recovery and re-use technologies and incentives
- Advanced treatment and detection technologies for all effluents – transfer of pollutants into water to detect once it gets to water
- Improve technology and flexibility on intake structures (all uses)
- Need to continue R & D and D to continue efforts focused on IGCC
- Share risk of demonstration of the technology (and all new technologies)

Homeland Security

- Need to develop lower cost distribution systems, extractions, and treatment systems
- Develop monitoring and detection technologies
- Integrated Distributed Generation technologies with distributed treatment systems for decentralized water systems

Need to support deployment of energy efficiency and water efficiency technologies to residential sector, include builders and public housing residents

> **This statement was made when the primary note taker was out of the room and does not appear to fit readily in the priorities established at the plenary session.*

SOLUTIONS

Need 1: Water Use Reduction Technologies (for power generation)

Fund demonstration projects in Indian country
Costs less, permits streamlined
Actors: Feds, tribes, and industry

Increase funding for basic science through R&D and D (10-15 yr payoff)
Actors: Labs, utilities, universities, tech providers, federal & state governments, tribes

Market incentives
Tax credits, tax exempt bond financing, EEZ expanded to include energy
Actors: Federal, state, tribal government, industry

Conservation – Energy & Water
Incentives, requirement for federal funding

Need 2: Planning/ Modeling Data tools, analysis methods

Increase funding for standardized data collection, formatting analysis, model development, tool development.
Actors: USGS to lead, other stakeholder agencies

Develop national water and energy data base; standardized accessible web- based data
Actors: USGS takes the lead

Formalize the process to use the tools and data developed above, and involve all stakeholders in their implementation
Actors: Feds, permit writers, states, tech innovations, permitted entities

Need 3: Advanced Generation Technologies

Reduce risk to utilities of advanced generation projects through cost shared R&D with DOE, USDA, DOI, BIA, etc.

See all solutions to need
Mandates for RPS requirements

Increase funding for public education to increase awareness of all technologies
Actors: Congress, public, environmental groups, utilities, regulators
---
* Support deployment of energy, water conservation technologies for Ag sector through cost sharing
* Demonstrate technologies
*Restore funding for renewables and efficiency programs in farm bill (e.g., USDA 9006)

Prioritization of Needs Summary

1. Develop technologies and incentives to reduce use of water for power generation

- Cooling technologies
- Water recovery and re-use
- Intake structures
- Treatment and detection

2. Implement coordinated integrated resource planning models and processes

- Data collection
- Standardized tools and terminology
- Institutionalize processes
- Involvement of all stakeholders

3. Continue and increase R&D funding for advanced generation technologies

- IGCC
- Storage
- Wind to hydro
- Low temperature heating

Group D, Day One, Problem Area: Energy Supply Flipcharts

RENEWABLE ENERGY

Geothermal – GSHP & Power

- Availability of Groundwater
- Quality varies by region and quality
- Cost of extraction
- Potential for distribution: How to get where you need

Wind

- Hydroelectric facilities can impact ability to get permits for transmission (potential)
- Wind as possible way to increase water availability (possible solution)
- Source of power for pumping water

Solar

- Pumped storage possibility

Biomass

- Quality of methane from Agricultural process
- Low quality from municipal water and waste water systems
- Impacts on equipment from personal avenue for municipal waste stream
- Cost of technology needs
- Recycle and reduce water use in facility

Ethanol: What are water concerns for ethanol producers?

- Production
- Competing uses
- Waste water treatment and environmental concerns
- Water needed for feedstock (corn); runoff of irrigation water inputs, surface and groundwater (but NOT in Western Kansas)

Hydro: Drought impacts and competition for water

- Lack of good technology for water intake systems
- Ways to reduce the temperature of discharge water based on intake location
- As intake level changes efficiency of the turbine is impacted
- Fish passing through turbine
- Water intakes for users drawing water off the river or reservoir
- Better technology to address changing levels and costs
- Aging equipment needed to re-tool for better power production
- Re-licensing may require removing dams
- Sediment issues are part of planning, but must be addressed sooner than planned
- Sediment is impacting reservoir storage
- Mining tailings in reservoir sediment & impact on dredging

- Keep out sediment in first place
- Reduce energy generation

NEEDS

- Develop water reclamation technologies
- Lack of flexible intake technologies
- Regional modeling of watersheds, dams, etc.
- Improved water conservation technologies
- Energy conservation technologies
- Develop regional strategies to address the competing uses of water through technologies, conservation policies, etc., with objective of institutionalizing conservation policies

6.1.1. ELECTRICITY PRODUCTION PROBLEMS

- Water availability: use less fresh water through reduced cooling and intake needs
- Siting: five factors include water, fuel, transportation, transmission, and air quality
- Water impacts: as water impacts other issues resolved, reduced need for water can open up other opportunities (e.g., Need RR tracks, less air impacts)
- Reduced efficiency: Use of air cooled technologies increases fuel use and air quality for generation of electricity
- Turbines: facilities cannot be retrofitted later down the road
- Consumptive loss: wet cooling systems disadvantage
- Fish kill: impingement of organisms on cooling water intake structure at cooling plants
- Ability: to use impaired, reclaimed, or poorer quality water versus fresh water
- Pollutants: removed from air stream end up in the water systems or in the solid waste stream due to tightening of air regulations
- Alternative energy sources: problem with feeding alternative and renewable sources of power into the grid create a transmission capacity issue.

OTHER ISSUES

- Transmission availability
- Discharge of water into ESA, environmental issues
- Develop regional strategies to address the competing uses of water through technologies, conservation policies, etc., with objective of institutionalizing conservation policies
- No standardization of environmental regulations, water laws, property rights
- Institutional need for market incentives for alternative sources of water

CROSSCUTTING ISSUES

- Cost of new technologies, competing uses
- Cost of new regulations (meeting compliance standards)
- What is the value of the water, the energy
- Education for the consumer (Technology happens so much in the background for water, energy) they object vehemently when rates increase. You don't get an absolutely clean environment with energy. They don't understand what the costs are. People understand

about environmental issues, but people don't understand that it takes water to refine petroleum products. There is 3 X as much to run appliance and turn on switch than water used to take showers. Water use for energy production is high.

- In some areas, no amount of incentive will create a market because there is no economic development. There are still homes in SD that do not have running water and electricity. Across the board, if you relate only to market-based issues, then there are parts of the country that will be left out. What energy company is going to come out and build a plant to sell energy to that market? No one can afford to buy the energy.

Group D, Day One, Problem Area: Water Supply Flipcharts

POLICY CONCERNS

- Regional solutions should match climate, geography, legal structures, grid operation
- Disincentive to build transmission and distribution systems (both electric and water) companies who build to be forced into sharing system of access
- How do we prioritize and assign uses to the limited water supply? We have agriculture, energy, municipal, and industrial entities. There is a general lack of integrated resource planning
- Risk of new technologies, deployment (e.g., aversion to using new energy generation technologies)
- Less efficient power generation for air-cooled versus wet-cooled trade-offs between water savings versus efficiency hit; cost of this ambient air temperature and humidity impact
- Competing uses – leaving enough water in the watersheds for recreation, fish, wildlife, etc. --- problem is little coordination of timing of when water is needed for in-stream use
- Development leading to additional pollutants in storm water discharge systems, pavement runoff, other wasteful water behavior
- Power plant siting needs 50-60 year supply in order to risk investment… cannot always get rights for this long period of time. Also cross state jurisdictional issues with water supply
- Sacred cow of agricultural economy. There are tradeoffs in producing food versus pollution from run-off.
- Lack of technologies for conservation
- Growing wrong crop in wrong place and conflicts with subsidies of paying people not to grow crops
- Lack of knowledge of where consumption is taking place within economy. Lack of data to track discharge. Lack of data collection reporting for water use, data for consumptive use, and discharged water
- Problems with modeling. Model before you allocate water. Some instances where there is no modeling at all
- Population demand growth in locations that are water deficient
- Lack of education on re-use of wastewater for industrial, landscaping, etc., (everything except water for drinking)
- Single distribution system for all uses (e.g., taking pasture taps off drinking water systems) – costly to do this. We need alternatives for this.
- Lack of public education on water supply problems (e.g., watering lawns in the rain)
- Problem with pricing / rate structures that have unintended consequences
- Lack of uniformity in regulations, pricing, and rate structures

WATER SUPPLY FUNAMENTALS

- Availability of potable water, cost to build distribution systems, cost of energy to run such systems

- Ability to pay for water: supply will go to the highest bidder. Rural vs urban uses (agricultural versus municipalities)
- Treatment of non-potable water and costs of drilling – lack of technology & cost
- Water quality is deteriorating – both surface and ground water
- Re-use systems: need better technology for treating waste water effluents for potable use

Group D, Day Two, Needs Identification Flip Charts

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