

Row 1, Extraction

- Permitting problems (5 votes)
 - Balky process (up to 5 years to secure permits)
 - 3 organizations in CO involved in permitting process
 - Multi-agency jurisdictional issues
 - Can spend up to \$300k or more on permits
 - Difficulties proving water to be non-tributary (roadblock to beneficial use)
 - Water quality concerns with surface discharge
 - Hydrocarbons/heavy metals
 - Must utilize 100% of production—Compact issues
 - WY better than CO
 - SOLN: use produced water in drilling mud
 - Roadblock: mindset of drilling engineers
 - Need applied RD&D for mud engineers/frac companies
- CBM produced waters (3 votes)
 - Create saline lenses in reservoirs
 - Regulatory issues facing groundwater discharge to surface waters
 - State water law concerns
 - Impacts of saline discharge in reservoirs—competing use concerns
 - Lack of modeling on impacts
 - Quality drives discharge
 - Soil/water impacts unknown (1 vote)
 - Gaps in understanding of hydrology
- Mine dust suppression
- Solids removal/water recycling (4 votes)
 - Need active system to remove coal fines
- Legal issues
 - Water type definition
 - Tributary, non-tributary, not non-tributary
 - Lack of data/modeling to help define
- CA offshore oil/gas issues
 - What resource being left in-ground?
- Oil shale/tar sands
 - PEIS underway in UT
 - Water demands unknown
 - Energy balance suspect
- In-situ coal gasification

Row 2, Fuel Production

- Coal to diesel
 - Water the limiting factor?
- Liquid coal enhancement
 - Electricity production
- Reliability of reclaimed water (7 votes)
 - Supply/quantity concerns from treatment plants

- Efficiency efforts to reduce costs
- Brackish water use as backup
- Biodiesel
 - WY—economics are the limiting factor (transportation)
 - Water availability an issue
- Biomass
 - Thinning and positive water quality impacts
- Protecting water right
 - Tribes proposing to grow sugarcane in AZ—could be part of the problem, not the solution
- WA biomass
 - Need knowledge of water demand/availability/impacts
- CO oxygenate market issues
 - Clean air reducing ETOH demand

Row 3, Electricity Production

- Hydro spill versus electricity production (4 votes)
 - Impacts on CA unknown
 - More monitoring of spill v barge efficacy
 - Trust issue between/among stakeholders
 - 1000 MW of Colorado river out in 20 years
 - Lose ability to hydrofirm renewables
- Techniques to assess highest social use don't exist
 - Needs research
- Reclaimed/backup water constraint
 - Constrain water provider/use
 - Colocat desal/power
 - Permitting/relicensing
 - Benefits: screening R&D
 - Brine discharge understanding
 - Cost understanding
- Transmission constraints (7 votes)
 - DC power lines expensive
 - Funding
 - Permitting
 - FERC (east-west divide problems)
- Groundwater resource (6 votes)
 - Impacts
 - Lack of knowledge
 - Surface-groundwater interactions
 - Data confidentiality
 - Deep aquifer is a mystery
 - Data avail off the coast (in CO, UT, WY, e.g.)
- CA—cannot use freshwater for electricity production
 - Need to understand energy impacts of getting reclaimed waters

- Hydro relicensing (3 votes)
 - SMUD priorities, 2% drop in production to meet competing needs
 - USFS priorities, 8% drop to meet competing needs
 - Not getting “credit” for air quality and other positive attributes
 - Need holistic approach
 - National and state level assessments
 - Institutional issues/FERC—segmented world views
 - Revisit federal rules
 - Many laid down in mid 1900s, assumptions now outmoded/outdated
- Future Gen
 - Need to build it
 - Air/CO2 focused
 - Factor water into technologies
 - CO2 capture/sequestration
 - Geochem of aquifers
- Western states not adjudicated all water rights (4 votes)
 - Fundamental building block to rationalized water use

Row 4, Renewables

- Lack of understanding of intermittent resource
- Grid integration issues (2 votes)
 - Physical integration
 - Stability threshold—lack of understanding
- Grid reliability in the west
 - Loads and distance issues
- Species interactions (wind and birds)
- Pumped storage
 - Social (wineries—economics)/aesthetics/air quality during construction phase
- Evap cooling/water flooding
- Geothermal cooling water needs?
- Solar power costs (5 votes)
 - Need R&D to drive down price
- Geothermal
 - Brackish water—heat exchangers foul
 - Wide application
- Transmission and wind (1 vote)
- Power plant—algae—ethanol
- Expectations for renewables (6 votes)
 - Impacts of adoption unknown
 - R&D and outreach
 - Lack of public education/priorities
 - Tie to cost and price

Row 5, Energy, Other

- Brine disposal problem (3 votes)
- Wind—hydrogen production
 - Water impacts unknown

Row 6, Urban Uses

- Location of urbanization
 - Discharge concerns (SF, Sacramento)
- Source control/protection
 - Watershed protection
- Equate quality to use
- Recharge (lack of)
 - Stormwater to non-hardscapes
- Lack of water efficiency program on national scale (7 votes)
 - EPA/Alliance for Water Efficiency
- Water quality regulations driving increased energy consumption
- Energy intensity of end-use
 - No DOE reporting of this
- In-stream flow problems and concerns
- Population growth/household size
 - Increasing energy and water consumption as household size decreases and square footage increases
- Population growth in energy/water intensive areas (LV, PHX, SoCal)
- External residential use
 - Plant selection/vegetation
 - State report AB2717 (CA)
- Research implementation gulf
 - How to move findings to practice?
- No holistic view of water efficiency at federal level/turf battles/political and institutional issues (8 votes)
- Integrating storage—dual system
 - How to move fire suppression systems to dual system ...
- Lack of communication/consistent terminology (2 votes)
- Get contracts to include efficiency (Fed and state level)
- Flood control releases (1 vote)
- Energy efficiency/water efficiency not linked (2 votes)
- Lack of knowledge about resources (physical)
- Communicate with flood control districts to more effectively manage resource
- Water heat
 - RD&D to generate electricity (residential and industrial scale)

Row 7, Agricultural Uses

- Energy use for pumping (site specific)
 - Increase consumption efficiency of farm, reduce energy consumption (1 vote)
- Unintended consequences
 - Increase efficiency, reduce return flows
 - Water quality decreases, treatment costs downstream increase
- Water law outdated (1 vote)
 - Beneficial use is problematic

- Ownership issues
- How to measure conservation?
 - Location
- Need incentives to conserve (2 votes)
 - If you increase efficiency, can you irrigate more acres?
- Acreage limits/tie-ins
- Groundwater impacts
 - Nitrates
 - What is cost?
- In-stream flow concerns (5 votes)
- Economic impacts of 80% of water tied up in Ag?
- Concentrated animal feedlots
 - Surface water and groundwater impacts
 - Tech transfer needs
 - Dairy-wastewater treatment plant collocation? (1 vote)
 - Find least impact
 - DOE pilot projects as treatment plants

Rows 8 and 9, Electricity and Energy Production Uses

- Entrapment/entrainment (4 votes)
 - Single pass cooling/hydro
- Thermal plumes/temperature gradient
- Increase ability to use reclaimed water
- Hydropower temp issues
- In-stream flows
- Short-term fluctuations
 - Dams as peakers—tradeoffs unknown
- Siting in low water areas
- Beneficial use of natural gas (1 vote)
- Water use in LNG plants
 - Entrainment
- Pricing structure of federal regulations
- Lack of incentives/R&D for desal collocation (4 votes)
- Hydro spill impacts on fish

Row 10, Recreational

- Boating-convenient release schedules—impact on generation
- Reservoir drawdown conflicts (housing, e.g.) (1 vote)
- Economic development along canals
 - Have created recreation
 - Release timing conflicts
- Economic evaluation of recreation and conflicts (1 vote)
- Water quality
 - Discharge tanks/oil and gas leaks
- Introduced species problems

- Golf course runoff—nitrogen loading
- Hydro effectiveness impacts
- Aesthetic impacts of energy development
- Lost opportunities from dam/opportunities created by dams

Row 11, Environmental

- Losing generating capacity to halt saltwater intrusion (1 vote)
- Lose flexibility due to spill requirements
- BiOP “Master manual” spring rise
 - Impacts downstream power plants
- Tanker spills
- Well integrity/groundwater contamination
- Bioaccumulation of nuclear byproducts
- Thermal plume issues
- Positive biomass impacts (1 vote)
 - Water quality mitigation (post-fire mudflow)
 - Air quality impacts (thin versus fire)
 - Waste stream use for power production
- Climate change
 - Altering hydrology of reservoir system
 - Less snow
- Habitat degradation impacts ESA
- Habitat degradation impacts energy facility siting
- Air quality from mining development/energy
 - Visibility issues—Grand Canyon
 - Health
- Subsidies encourage development in substandard locales
- Clean-up/containment impacting groundwater storage schemes
- Long-term nuclear repository issues
- Higher efficiency keeps more water in river
- ESA species protection impacts water users (2 votes)
- SOLN: Create wetlands
- SOLN: Wastewater use in plants (C&H)
- Hg levels from coal combustion
- Urbanization
 - Higher winter/lower summer flows
 - Alters hydrology
 - Need understanding of how urbanization impact environment
- Drainage impacts on wildlife
- Selenium
 - Runoff from natural sources?
- Lack of lifecycle impact and environmental impact assessment (cumulative effects of choices)

General

- Cost of water (7 votes)
 - Undervalued/unvalued
 - DOE R&D on real cost of treatment
 - Subsidy structures
 - Fed pricing/subsidy issues (8 votes)
 - Lead to more efficient use
 - True costs hidden (in property taxes)
 - Externality costs/in-stream flows
 - Environmental water account CALFED
- Lack of science-based decisionmaking processes(3 votes)
 - Slows regulatory processes
- Physical scarcity

Priority Energy Problems

- Reliability of reclaimed water (7 votes)
- Transmission constraints (7 votes)
- Expectations for renewables (6 votes)
- Groundwater resource vis a vis Electricity Production (6 votes)
- Permitting issues (5 votes)
- Solar power costs (5 votes)

Priority Energy-Water Transition Problem

- Hydro relicensing/spill v power/trust/monitoring

Priority Water Problems

- Cost of water; Federal pricing/subsidy issues (15 votes)
- Lack of water efficiency standards (7 votes)
- Holistic view/left-hand-right-hand/jurisdictional issues (7 votes)
- Climate change impacts (6 votes)
- In-stream flows (5 votes)

Priority Problem: Hydro

- NEED: Overriding federal direction on how to rank uses/how to manage waters
 - Weighting matrix
 - Methods to describe waters' value as/in energy
- NEED: Understanding of spill efficacy
 - More research on fish impacts, turbine effectiveness
 - Courts not science-based
 - Need lower mortality/injury turbine design
 - Aquatic environment effects
 - Approaches (some) not acceptable
 - Research on limiting factors
 - Scientifically determine effects on fishery
 - Adaptive management—incorporate data as it is generated
- NEED: Modeling/understanding of global climate change of taking hydro out of operation
 - Efficiency balance?
 - Economic issues
 - Construct what—if models/games
 - Technology/economic tradeoffs
- NEED: Better integrate energy/water planning
 - Federal/State
 - Long-range modeling
- NEED: Demonstration/testing of new technologies
- NEED: Tech transfer/lessons learned to “make” hydro renewable

Priority Problem: Cost of Water/Federal Pricing Structures and Subsidies

- NEED: Firm property rights to enable markets
 - Transfer opposition concerns in UT
 - Wealth losses/compensation
- NEED: Analysis of impacts on water/energy from elimination of water and crop subsidies
- NEED: Federal power/water price interaction analysis—encourage or discourage efficiency?
- NEED: Look at other impacts (land use, food, environment)
 - 480,000 acres of irrigate land out of service in CO due to population growth
 - Who is being subsidized?
 - Open-ended analysis—see where it leads you, but don't use the “subsidy” word
 - Water efficiency linked to energy cost
- NEED: Understanding/economic valuation of water used for environmental purposes
 - Abandon beneficial use
 - Drive to interstate transfer consistency (NB-WY issue)
- NEED: Analysis of conservation worth/incorporate in policy on supply
- NEED: Mechanism to gradually increase price to avoid waste

Priority Problem: Lack of a National Water Efficiency Program

- NEED: A national “WaterStar” program
- NEED: Incentives to promote conservation
 - Tax rebates
- NEED: Mandates and standards
- SOLN: Design competition ala h-axis washing machine
- NEED: Education/Advocacy
- NEED: Funding—Federal cost shares dwindling
- NEED: Recognition program
- NEED: Integration of efficiency/conservation into Federal programs
 - Revolving loan projects, e.g.
- NEED: Federal spec for equipment purchases
- NEED: Federal R&D to move technologies to implementation
- NEED: Allow saved water to be sold
 - Incentivize savers
- NEED: Incentives to reduce toxicity of effluent
- NEED: Data on “salvaged” water (from salt cedar removal, e.g.)
- NEED: Mechanism for energy/water credit outside of jurisdiction
 - Esp. when energy/water saved or conserved outside of service area
- NEED: Standards on durability of drip irrigation systems
- NEED: Better irrigation controller
 - Smart/easy-to-use/affordable
- NEED: Research on less-thirsty crops
- NEED: Irrigation load forecasting

- NEED: Waste heat capture technologies
 - Residential waste heat capture
 - Cold water improvements (conveyance/transportation costs saved)

Priority Problem: Holistic view/left-hand-right-hand/jurisdictional issues

- NEED: Better coordination between HQ and field operations within agencies and between agencies
- NEED: Integrated energy/water planning
 - What level? Regional? Utility boundaries?
- NEED: Legislation to require energy supply before legislation (ala water in hand legislation in CA)
- NEED: Better forecasting of water use
- NEED: Federal agency boundaries to technology implementation
- SOLN: Cositing power plant/treatment plants

Priority Problem: Lack of Adequate In-stream Flows

- Define/provide/protect
- NEED: Alter state law so that in-stream demands compete equally
- NEED: Allow seasonal transfer “donations”
- NEED: Ability to protect environmental in-stream flows
 - Ex: Program put water in river, no way to ensure it stays there
- NEED: Monitoring attached to BiOp
- NEED: Greater data collection
 - Site specificity/life-stage specific
 - Limited number of dated studies currently available
- NEED: R&D on timing issues
- NEED: Funding mechanism for acquiring environmental in-stream flows
 - User fees?
 - Taxes?
- NEED: Define biological objectives then define Plan B

Priority Problem: Climate Change Impacts

- NEED: Redundancy to accommodate variability
- NEED: Utilize modeling to examine long-term water supply
- NEED: Federal directive to model/incorporate findings
 - How to get agencies to incorporate?
- NEED: Research on impacts of pulling land out of use
- NEED: Flood plain management research
 - Natural storage
- NEED: Underground storage concerns
 - Recharge over time
 - Quality and interactions
 - Movement/extraction
 - Aquifer management—effluent injection
- NEED: Landcover changes

- Understand impact on recharge
- NEED: Build on current info, create regional models
 - Watershed models
 - Interstate river basins
- NEED: Way to make research widely applicable (site specific problems)
- NEED: Quantify GHG reductions from water efficiency, energy efficiency programs
 - Would it make a global difference?
- NEED: Phase-in CFLs like 2.5gpm toilets
 - Subsidize low income
- NEED: Tech transfer
- NEED: “No regrets” policy – prepare for worst.

Priority Problem: Reliability of Reclaimed Water

- NEED: Explore additional potential uses (Produced water—PW)
- NEED: Bring groups together across state and basin
- NEED: Develop best practices docs (Muni reclaimed water—M)
 - BLM working on disposal
- NEED: Salt extraction/treatment technologies (M)
 - Brine disposal/softeners
- NEED: Understanding of long-term impacts of surface discharge (PW)
- NEED: Education of public on reclaimed water (M)
- NEED: Clarification of legal/ownership issues (M)
 - Interstate/international
 - Impact of future gas production
- NEED: Western state roadmap on use of reclaimed waters (M)
- NEED: Prepare infrastructure for reclaimed use (M)
- NEED: Research on municipal reclaimed water reinjection (M)
 - Detriment to aquifer?
- NEED: Grey use
 - Incentives to builders
 - Direct-to-biomass water
 - Education
 - Plumbing code barriers
 - County health department barriers
- NEED: Aquifer receptivity research needed
- NEED: R&D on brine; productive use
- NEED: DOE at helm of inter-agency groups
- NEED: New process to remove solids/fines
 - Improved filters/metal membranes
 - Tech transfer from ORNL
 - Site specific development
- NEED: Understanding of lab—field results disconnect
 - More realistic studies
 - Start with real-world samples

Priority Problem: Expectations for Renewables/Solar Energy Cost

- NEED: Integration study of impacts, benefits, and costs of large-scale/high-penetration of wind and other intermittent sources on grid operations
- NEED: R&D to increase efficiency of solar
- NEED: Public education on role/impacts of renewables
 - Needs an honest broker
- NEED: Turbine design/improvement
- NEED: Raise solar cell efficiency to 20%
- NEED: Reduce cost of cells
- NEED: Increase R&D funding/stability
 - Leapfrog technologies/R&D
- NEED: R&D on solar water heating/space conditioning
- NEED: National loading order
 - % of load, rank ordering
- NEED: R&D on tidal applications
- NEED: Analysis of solar serving ag
 - Clarify/evaluate what energy-water can be addressed by what technologies
- NEED: Energy-water technology transfer clearinghouse ala EPA
- NEED: R&D on kinetic run-of-flow turbines
 - Grid interactions
 - FERC rehash on rates paid
 - Streamlined permitting, same as big hydro
- NEED: Storage techs to ease grid integration
 - Environmental impacts/economic impacts
 - EPRI past work
- NEED: Build on past work
- NEED: National energy conservation

Priority Problem: Transmission Constraints

- NEED: Transmission for remote renewables—lack of “room” on grid currently
- NEED: Streamlined permitting—competing agencies/missions at federal level
- NEED: Mechanism to encourage T&D construction
- NEED: Examine line losses—need additional RD&D
- NEED: Additional pipeline capacity
 - DOE role in AK-Lower 48 NG pipeline?

Priority Problem: Groundwater vis a vis Electricity Generation

- NEED: Better understanding of groundwater resource
 - How much? Where? Quality?
- NEED: Understanding of surface water—groundwater interactions
- NEED: Better models/better finite element models
 - Easier to use, higher scientific reliability on yields
- NEED: Better understanding of permitting needs/processes
- NEED: Better monitoring/characterization of resources

- NEED: Work within existing bureaucracies
- NEED: USGS/Lab interface
- NEED: Easier-to-use chemical models
- NEED: Methodology to resolve groundwater interstate issues
- NEED: Industry/government consortia and collaboration
 - Include all stakeholders—Universities, NGOs, Labs
- NEED: Tech transfer from industry to government
- NEED: Data mining of logs
- NEED: Integrate reservoir engineering models with hydrologic models
- NEED: Tons of data, needs to be merged
- NEED: Additional isotopic-generated data—link to application
- NEED: “Lit review” workshop with existing model owners
- NEED: Data standards for models

Priority Problem: Permitting

- NEED: Policy flexibility to encourage competition
- NEED: Standardization/clarity on process requirements
 - Requirements v discretion
- NEED: Federal Office to help permit applicants
- NEED: Best public interest determination
- NEED: Cross-jurisdictional co-op (single voice)
- SOLN: Enterprise architecture in agencies
 - Similar processes/dissimilar missions and interests

- Allocation issue vs supply issue
- Farm v fish v power on Colorado River
- SOLN: Market to move water to where valuable
- SOLN: BPA buyback 2001
- Use it or lose it is counterproductive
-