Research Area 3-1. Develop consistent framework and standards for integrated energy/water planning models through standards bodies (AWWA, ASCE, ASME,) w/ DOE and fed agencies.	
Statement of Need	Currently some planning models exist, but are limited to local use. There is need for more detail, dissemination, and validation for wide-scale use. The current lack of modeling standards leads to disjointed development, inconsistent communication, varying levels of quality, and lack of consensus-building understanding.
Research Objective	Develop a consistent framework and standards for integrated energy/water planning models through standards bodies and federal agencies.
Impact/Benefits	More efficient planning process and common understanding of model inputs. Higher quality models. Reduction in planning time for new power facilities. Could avoid future energy production crises by improving planning.
Priority	Very high
Summary Scope of Work	Create a schematic framework that encompasses the diverse models, evolving common information definitions in the pre-processing (assumptions, data sources) and post-processing (tied to agency and stakeholder information needs) perspective. Development of common model quality standards.
Technical Approach	Leveraging understanding of existing regional models (high local confidence), and develop a common framework in terms of inputs and outputs in the critical modeling domains (physical, energy, economic, social, etc.) and "directionality" (supply, demand, scenario) that those local and national models would work through. Integration of these modeling domains at both the local and national (clearing house) levels. Developing the mechanism for allowing individual models to grow towards a quality standard.
Lead Investigators (academia, natl. lab, industry, international, partnership)	Consortiums of modelers from the various domains, guided by DOE.
Potential Collaborative Government Agencies	NSF, DOI (specifically USGS), NOAA, Corp of Engineers
Leverage Opportunities with Existing Programs	Climate modeling (CCSM, NEON). NSF cleaner-CUAHSI, GEON, hydrologic observatories. Energy modeling forum (Stanford). USGS integrated hydrologic models in development.
Constraints/Challenges (Policy, regulatory, technical, sequencing?)	Cooperation from the states, multiple agencies, multiple communities. Communication between modeling domains.
Estimated Cost	$10s of M per year from the federal government with additional industry investment.
Execution Horizon (early, mid, late)	Early large investment, but continuing maintenance/flexibility research needed. The federal burden would lessen over time.
Schedule/Duration	2-3 years initial, high-level examples are focused on, then growth from those over time
Level of Development/ Level of Maturity at completion	5-10 years medium to high maturity

Research Area 3-2. Develop energy/water-related policy and economic models for incorporation with climatic/water availability/energy research models.	
Statement of Need	Some models exist, but more effort is needed in development, integration, and dissemination. Models need to work at various scales and need to fit together into regional or national models.
Research Objective	Develop energy/water nexus-related policy and economic models for incorporation with climatic/water availability/energy models.
Impact/Benefits	Planning process becomes faster, more efficient and robust due to appropriate inclusion of social and economic impacts.
Priority	High
Summary Scope of Work	Systematic gaps analysis and research to resolve non-linear social, economic and physical model system coupling, including workshop efforts.
Technical Approach	Define the coupling of these varying domain models (social, economic, to physical/phenom). Identify existing economic, policy, and social models that have the best potential for linking into the energy-water modeling areas. Identify the gaps in the physical coupling capabilities. Research methods to overcome these gaps, including non-linear feedbacks and connectivity.
Lead Investigators (academia, natl. lab, industry, international, partnership)	DOE and Economic-Social science experts from Academia leading the efforts
Potential Collaborative Government Agencies	Policy and economy orgs, non-governmental organization (Rand, think-tanks)
Leverage Opportunities with Existing Programs	National Structure Simulation Analysis Center (SNL/LANL)l social modeling and interdependency. Industry leaders in social/economic modeling (McDonalds, Starbucks)
Constraints/Challenges (Policy, regulatory, technical, sequencing?)	Insufficient communication with lack of formality between these modeling worlds (actual information type, vocabulary differences). Lack of common understanding. Sequencing with standards development is important. Research of non-linear behavior, interdisciplinary systems.
Estimated Cost	$1M level /year.
Execution Horizon (early, mid, late)	Early – establish protocols. Research must occur soon to be integrated into upcoming modeling systems
Schedule/Duration	Early large investment, but continuing refinement research needed. The federal burden would lessen over time.
Level of Development/ Level of Maturity at completion	Medium – leads to coupling and analysis through these coupled models and connection to area 3-3.

Research Area 3-3. Develop long-term (25+ year) energy/water planning models that incorporate increasingly complex water demand scenarios.	
Statement of Need	Lack of integration (temporal, physical, spatial {watershed, regional, national visibility}) of current long-term models lead to potentially inaccuracy in terms of outputs or lack of ability to identify largest contributors to uncertainty in key results.
Research Objective	Establish an integrated model for forecasting, risk assessment, what-if scenario planning, and uncertainty identification. Develop risk assessment/mitigation tools, including energy, water, econ, environment, policy and social issues and solutions into planning process.
Impact/Benefits	Improved communication and planning across agencies. Improved integrated tool with added functionality that more accurately describes long-term, scenario outcomes.
Priority	High
Summary Scope of Work	Develop integrated, cross-agency integrated model.
Technical Approach	Establish a cooperative between DOE (energy models) and DOI/Corps/EPA/States (water models) to identify the existing modeling and integration capabilities. Each group builds upon models into single integrated system that has the functionality described in the research objective.
Lead Investigators (academia, natl. lab, industry, international, partnership)	Equally spread across DOE, DOI (USGS water and biological division), EPA
Potential Collaborative Government Agencies	States
Leverage Opportunities with Existing Programs	California central valley models. East Snake River Plain model. NEMS (DOE).
Constraints/Challenges (Policy, regulatory, technical, sequencing?)	Cross-agency communication, control, business systems (funding). Cross election cycle horizon complicates model boundary details Follows 3-2
Estimated Cost	Early lower funding ($500K/yr), $5-10M total in execution phase.
Execution Horizon (early, mid, late)	Initial communications between agencies early, technical aspects build off 3-1, 3-2
Schedule/Duration	Several years development (3-5), ongoing implementation
Level of Development/ Level of Maturity at completion	3-5 years for medium. Field testing will bring to full maturity

Research Area 3-4. Visualization tools	
Statement of Need	The volume of data and number of interactions at the energy-water nexus require models of significant complexity. It is difficult to communicate the challenges and opportunities relative to the energy-water nexus.
Research Objective	Create graphic visualization tools so that energy/water interactions can be explained more clearly to decision-makers, the public, and other audiences.
Impact/Benefits	Not being able to effectively communicate the model results and their impacts makes most if not all of the model development expense a waste. This waste is avoided through this tool development.
Priority	High
Summary Scope of Work	Gather communication needs and develop methods of communicating model outputs.
Technical Approach	Gather decision-maker and stakeholder requirements on visualization tools. Create dynamic decision-making display tools (uncertainty, risk, cost). Build optimization decision-support tools that tie to the underlying model.
Lead Investigators (academia, natl. lab, industry, international, partnership)	DOE
Potential Collaborative Government Agencies	Other model building, data sources, decision-makers, and industry for software development.
Leverage Opportunities with Existing Programs	DOD visualization tools. Most technology exists, needs to be pulled together and integrated.
Constraints/Challenges (Policy, regulatory, technical, sequencing?)	Identifying needs and boiling them down to an executable set of requirements.
Estimated Cost	$1-3M
Execution Horizon (early, mid, late)	Start early, low speed, connects in time to 3-1 through 3-3
Schedule/Duration	1-2 years once models are at sufficient maturity
Level of Development/ Level of Maturity at completion	High at outcome

Research Area 3-5. Validate cooperative processes and approaches with regional field tests.	
Statement of Need	As a component of model and process development activities, there is a need to validate the same in the field under real-world conditions.
Research Objective	Validate cooperative process and approaches with regional field tests.
Impact/Benefits	Given execution of areas 3-1 to 3-3, proves the value of the effort. Opportunity to present the process to decision-makers and the public.
Priority	High
Summary Scope of Work	Apply model outputs to multiple regional systems and evaluate results.
Technical Approach	Identify multiple regional prototype application sites that are undergoing rapid development (scale dependent on integrated model development from Research Area 3-3). Measure/evaluate appropriate indicators (technical and social / policy, including stakeholder involvement and dispute resolution) and compare to model results. Discuss and developed lessons learned in national workshop environment.
Lead Investigators (academia, natl. lab, industry, international, partnership)	Equally spread across DOE, DOI (USGS water and biological division), EPA
Potential Collaborative Government Agencies	States
Leverage Opportunities with Existing Programs	Funding from multiple agencies planning development in regions/areas of interest. DOE Atmospheric Radiation Measurement program mobile facility.
Constraints/Challenges (Policy, regulatory, technical, sequencing?)	Sequencing with previous areas (3-1 through 3-4)
Estimated Cost	Data management issue and some data collection ($10s M per demonstration site borne over 10-20 years)
Execution Horizon (early, mid, late)	Mid-late depending on outcome of Research Area 3-3
Schedule/Duration	Start collecting data early, but duration of study exceeds 10 years (depending on model application horizon)
Level of Development/ Level of Maturity at completion	High because this completes the modeling cycle

Research Area 3.6a. Water rights – Economic Policy Models.	
Statement of Need	Identify water rights stakeholders to assist in modeling for energy needs and data validity.
Research Objective	Determine water right ownership for future planning – sharing, leasing, banking model.
Impact/Benefits	Understanding social concerns of the value of water: environmental, social, religious, cultural, and aesthetic benefits to diminish any negative impacts.
Priority	High. Source of water availability for development needs to be determined with the values of the population.
Summary Scope of Work	
Technical Approach	Modeling with all inputs to have reliability in results via databases
Lead Investigators (academia, natl. lab, industry, international, partnership)	Tribes, Sandia National Laboratories ,NREL, Academia Utton Center, States
Potential Collaborative Government Agencies	Law - Bureau of Reclamation, USGS, EPA
Leverage Opportunities with Existing Programs	EPA value of water, BOR 2025 Funding
Constraints/Challenges (Policy, regulatory, technical, sequencing?)	Court cases that have created barriers for positive development. State water law and regulation.
Estimated Cost	$10M/year for 5 years
Execution Horizon (early, mid, late)	Mid
Schedule/Duration	5-10 Years
Level of Development/ Level of Maturity at completion	Working model – Ready to be tested

Research Area 3-6b. Water rights—Sharing & Leasing.	
Statement of Need	Describe the variables that define an energy model.
Research Objective	Identify and define each needed variable (i.e., water amount, environmental concerns, social/culture/religious issues, economic impacts, water rights holders, physical characteristics of basin, present uses, institutional/legal constraints, etc.) to produce a model.
Impact/Benefits	Visualization of potential means/ways to determine contingency plans.
Priority	High
Summary Scope of Work	Description of variables and their definition for eventual visualization of contingency plans.
Technical Approach	Determination of databases, data holders, data banks, which will be used to input into model.
Lead Investigators (academia, natl. lab, industry, international, partnership)	National laboratories, Academia, Industry, States, Tribes
Potential Collaborative Government Agencies	LANL, LNL, USGS, DOE, NETL, EPA
Leverage Opportunities with Existing Programs	California universities (contingency plans fore earthquakes, blackouts, water, etc), EPA plans
Constraints/Challenges (Policy, regulatory, technical, sequencing?)	Legal, institutional, regulatory, state water laws
Estimated Cost	$10M/year for 5 yr. period
Execution Horizon (early, mid, late)	Mid
Schedule/Duration	5-10 yr.
Level of Development/ Level of Maturity at completion	Working model (Ready to be tested)

Research Area 3-6c. Water rights—Water Transfers	
Statement of Need	Better understanding of existing legal , institutional and economic constraints to water transfers to provide water recovery for electric power plant construction.
Research Objective	Determine improvements/changes to existing laws and institutions to facilitate water transfers.
Impact/Benefits	Facilitate the transfer of water from low to high value uses, including necessary new power plants.
Priority	High priority
Summary Scope of Work	Collect information about recent successful water transfers and not successful water transfer attempts. Collect information about relevant laws, institutions and economic and hydrologic information that explain the success of water transfer. Perform statistical analysis with data to help determine the union of legal, institutional and economic environments that facilitate transfers. Wyoming, Nebraska, Colorado, California, Arizona
Technical Approach	Use statistical tools in a model to determine which legal and institutional options favor transfers.
Lead Investigators (academia, natl. lab, industry, international, partnership)	Utton and LBL
Potential Collaborative Government Agencies	USGS, other academic institutions (University of New Mexico) state water agencies, USBR
Leverage Opportunities with Existing Programs	Similar pilot studies being performed at UC Berkeley, other academic institutes. This will be a study with broader scope than existing or previous studies.
Constraints/Challenges (Policy, regulatory, technical, sequencing?)	Data constraints are severe. Much of this study (50%) will be focused on data gathering
Estimated Cost	$1 million per year for 5 years/year for 5 yr. period
Execution Horizon (early, mid, late)	Early
Schedule/Duration	2007 - 2011
Level of Development/ Level of Maturity at completion	Mature model

Research Areas 3-9 and 3-13. Integrated water and energy infrastructure. **3-9. Siting of national-level interstate grid to enable improved use of water efficient energy production or reduce fresh water use for energy production.** **3-13. Develop efficient, self-sufficient, integrated future infrastructures that reduce energy demand.**	
Statement of Need	9—The nation's electrical grid is constrained by bottlenecks and significant deferred upgrades and maintenance; as a result, it is difficult to move electricity from generating locations to consumption centers. 13—Today's energy and water infrastructures are far from efficient. There is a need to investigate more efficient, integrated infrastructure systems. **Design and siting and operation, regulation, policy etc. to consider** • Water use • Fuel use • Delivery reliability • Emissions • Aesthetics • Economics • Environment • Regional cultural issues and social (acequias, Native American) issues/economic development • Energy security
Research Objective	9—Siting of national-level interstate grid to enable improved use of water efficient energy production or reduce fresh water used for energy production. 13—iDevelop efficient, self-sufficient, integrated future infrastructures that reduce energy demand. **to enable design and development and validation of energy-water infrastructures that meet the above needs**
Impact/Benefits	An integrated E& W infrastructure would enable power generation and transmission that is water efficient, and water treatment and distribution that is energy efficient. Makes both secure, stable and reliable, environmentally-friendly
Priority	High
Summary Scope of Work	Beginning with a review of existing tools, identify those that would be most useful towards creating integrated planning toolbox to meet needs of integrated planning at local and regional and national level. Identify technologies that could contribute to the integrated infrastructure and ensure they can be evaluated by the toolbox Apply and evaluate the toolbox, refine, fill gaps, and deliver toolbox to DOE…. • Conduct the development and evaluation with a cross-cutting stakeholder set (might be regional)
Technical Approach	In addition to scope above: Collect information on diverse technologies for analysis within planning toolbox – dg, water treatment, etc. Include tools for generation, water, DG, Diversity of technology, generation resource size, types (DG and CG)

	Include collocation of water and energy facilities in toolbox. Assemble framework for developing the toolkit Recommend framework for regulator and policy interaction
Lead Investigators (academia, natl. lab, industry, international, partnership)	DOE - National labs, EPRI, Unviersity Research CentersAWWArf, BoR
Potential Collaborative Government Agencies	NASEO, CEC/DWR, AWWArf, WERF, WRF, ACEEE, CEE, ASE, NREC, DOI (USGS, BoR), COE, DOC, FERC, USDA, EPA, State offices – water, PUC's, electric reliability council, universities
Leverage Opportunities with Existing Programs	USGS, DOE water 2025, NETL, NYSERDA
Constraints/Challenges (Policy, regulatory, technical, sequencing?)	Lack of policy incentives collaborative energy-water management, existing policy that is a disincentives to do so, ditto regulation. No entity has absolute responsibility for grid operation and integrity? State regulation, regional reliability, national environmental policy, FERC power management – lack of national policy maker that can provide crosscutting policy and regulation. Much water and power regulation is within states, and done separately within states… Use or lose water policies. Groups pursuing narrow agendas that are often have negative impact elsewhere which they are not considering. "cylinders of excellence"
Estimated Cost	$5-10M/yr And an infinite supply of political chits to make agencies talk…
Execution Horizon (early, mid, late)	Early
Schedule/Duration	5-10 years with ongoing analysis
Level of Development/ Level of Maturity at completion	Initial regionally-applicable prototype in 5 yrs. Usable product at end of schedule, but will evolve and gain capability over time as more widely used. A building block for other activities.

Research Area 3-10. Develop models of infrastructure failure to reduce/avoid system losses in future.	
Statement of Need	Massive quantities of water are lost each year due to distribution infrastructure failures; predicting these events offers the chance to upgrade/repair before failure, thus conserving both energy and water
Research Objective	Develop/apply models of infrastructure failure to reduce/avoid system losses in future
Impact/Benefits	The impact is potentially large, but unknown. Benefits go beyond conserving water and energy since the reduction in failure rates will minimize the disruption of other infrastructures.
Priority	High along with development of appropriate sensor and data collection technology
Summary Scope of Work	The research need is specified for distribution systems not transmission systems such as aqueducts which can also have significant losses. Restricting this to distribution systems means that low cost, mass produced sensors and data collection systems must be developed.
Technical Approach	There are existing empirical data bases on replacement schedules. A new predictive model would need to be developed based on detecting degradation in performance before catastrophic failure, i.e. "leak before break". Leak detection for a distribution system means low cost, mass produced sensors and data collection systems must be developed and deployed.
Lead Investigators (academia, natl. lab, industry, international, partnership)	Industry, national laboratories, International Partnerships
Potential Collaborative Govt. Agencies	Municipalities
Leverage Opportunities with Existing Programs	There may be sensor/monitoring programs being developed by DHS that could be adapted for this research need.
Constraints/Challenges (Policy, regulatory, technical, sequencing?)	The technical challenges for such a data collection system are very great. It would involve developing and adopting new standards for distribution systems.
Estimated Cost	$1--$5M for development; ?? for deployment
Execution Horizon (early, mid, late)	Early
Schedule/Duration	Early/Development would be about 2 years/deployment is long term
Level of Development/Level of Maturity at completion	Development would be high/ maturing and reliability would be unproven.
Additional comments	

Research Area 3-11. Develop methods to quantify "unaccounted for" water.	
Statement of Need	Much water is "unaccounted for" in the U.S. leading to difficulties in accurate data collection and modeling "unaccounted for" water.
Research Objective	Develop methods to quantify "unaccounted for" water in agricultural, municipal, industrial, etc. sectors.
Impact/Benefits	In municipal systems, such "unaccounted for" water is approximately 20% of the system capacity.
Priority	High along with development of appropriate sensor and data collection technology.
Summary Scope of Work	In municipal systems, there are three main contributors to water unaccounted for: 1)losses 2)fire protection 3) system maintenance (e.g., flushing of mains) Therefore, for this sector the scope of work could include such items as improved maintenance schedules and procedures and metered use of water for fire protection. Typical overall "unaccounted for water" is ~20% in municipal systems.
Technical Approach	For municipal systems there three programs to consider: 1) developing metering system for fire protection 2) develop maintenance procedures that minimize the needed "unaccounted for" water. A simple accounting system would keep track of this usage. 3) This means that the remainder is losses. A system that more directly measures losses from leaks could be linked to the predictive maintenance system proposed in 3.11.
Lead Investigators (academia, natl. lab, industry, international, partnership)	Industry, national laboratories
Potential Collaborative Govt. Agencies	USDA, UGS,
Leverage Opportunities with Existing Programs	Possible DHS connection.
Constraints/Challenges (Policy, regulatory, technical, sequencing?)	Technical challenges are low for items 1 and 2, but very high for Item 3.
Estimated Cost	TBD
Execution Horizon (early, mid, late)	Early for Items 1 and 2; mid for Item 3
Schedule/Duration	1 year for Items 1 and 2; 2 years for Item 3
Level of Development/Level of Maturity at completion	Highly developed.
Additional comments	The percentage of Water Unaccounted For is the Metered Consumption related to the Treated Water delivered to the distribution system in municipal systems. This includes unmetered water provided for fire protection purposes and to flat-rate consumers, water used for flushing and maintenance of water quality, and water lost through leakage. We did not address agriculture and industry.

Research Area 3-12. Reduce cost of water pumping meters to allow for complete water accounting.	
Statement of Need	Water intakes meters are currently expensive to purchase, thus many utilities do not calculate the water they draw from a water body. This complicates accurate accounting of water use.
Research Objective	Reduce cost of water intake meters to allow for complete water accounting.
Impact/Benefits	Impact depends on market penetration of improved meters; Benefit is determined by how much water losses are reduced. However, the current cost of such meters is about $10,000 for a meter capable of measuring 10,000,000 gallons per day.
Priority	Low
Summary Scope of Work	Commercially available produce of moderate cost so this is an manufacturing cost reduction effort.
Technical Approach	Reduce manufacturing cost
Lead Investigators (academia, natl. lab, industry, international, partnership)	Industry
Potential Collaborative Govt. Agencies	EPA
Leverage Opportunities with Existing Programs	NA
Constraints/Challenges (Policy, regulatory, technical, sequencing?)	If such meters become a regulatory requirement, the market would potentially be greater.
Estimated Cost	Unknown, but given the relatively low cost of meter, it should not be high.
Execution Horizon (early, mid, late)	Early
Schedule/Duration	TBD
Level of Development/Level of Maturity at completion	These are Commercial off the shelf items so highly developed, highly mature.
Additional comments	Authors are not experts in this area

Research Areas 3-14 and 3-15. Combine opportunity/demonstration of co-located energy-water facilities.	
Statement of Need	14—Assess the opportunity regionally and nationally to co-locate energy and water facilities and assess energy efficiency and water efficiency improvements 15—There is a need to demonstrate the synergies and benefits of co-location in order to facilitate the adoption of such arrangements by the private sector.
Research Objective	14—Assess the opportunity regionally and nationally to co-locate energy and water facilities and assess energy efficiency and water efficiency improvements 15—Develop pilot-scale opportunities for co-location demonstration projects Assess the opportunities to collocate energy and water facilities and demonstrate synergies and benefits of collocation.
Impact/Benefits	Lower line losses, cheaper rates for water treatment and distribution due to accessibility of wholesale power rates, potential use of waste heat. Re-use of waste water effluent, reduction in wastewater treatment requirements? Desal of warm discharge more energy efficient Enable mitigation of regional water deficits by making desal and water treatment processes cheaper by collocation. Load management potential – off-peak desal (stored desal water) Can put DG at load – e.g. wind for ag water pumping, aeration of water Can capture water from energy activities (produced water…) Use water facilities as sites for DG – power from water conveyance systems, PV on aqueducts… Note – traditional co-generation may have larger benefits and should be encouraged (in terms of energy savings and associated water use.)
Priority	High
Summary Scope of Work	Assess the opportunity regionally and nationally to co-locate energy and water facilities and assess energy efficiency and water efficiency improvements Develop pilot-scale opportunities for co-location demonstration projects
Technical Approach	Carry out inventory for opportunities for collocation, inventory existing technology that enables collocation, perform case studies of existing collocated facilities. Evaluate and document regulatory barriers especially to new technologies and combination of existing technologies. Evaluate time-dependent synergies – are resource and load available together - take advantage of ability to store water Quantify benefit of collocation (vs parameters in research areas 3-9&13 Pilot scale projects to demonstrates success – regionally and by technologies – multiple projects. Find organizations to champion and publicize existing/new successes

Lead Investigators (academia, natl. lab, industry, international, partnership)	DOE labs, EPRI, targeted water treatment districts, Bureau of Rec (desal), RFP to industrial suppliers
Potential Collaborative Government Agencies	Progressive municipalities, co-ops, power companies Agricultural interests (both water supply and waste treatment) Small to medium business that have water problems POTW, ACWA, universities
Leverage Opportunities with Existing Programs	Stressed municipalities dealing with issues of water supply, energy costs… DWR, BoR desal programs, targeted water districts, Texas water development board, Florida, CA desal efforts, Arizona PUC
Constraints/Challenges (Policy, regulatory, technical, sequencing?)	Lack of policy incentives collaborative energy-water management, existing policy that is a disincentives to do so, ditto regulation. Lack of coordination/stove piping State regulation, regional reliability, national environmental policy, FERC power management – lack of national policy maker that can provide crosscutting policy and regulation. Much water and power regulation is within states, and done separately within states… Funding "cylinders of excellence"
Estimated Cost	Development - $2M/yr Demo (leveraged) - $10'sM/yr
Execution Horizon (early, mid, late)	Early
Schedule/Duration	2-4 for development 6-10 for demo
Level of Development/ Level of Maturity at completion	Pilot-scales demonstrated

Research Area 3-16. Integration of diverse DG resources into grid to reduce fresh water use.	
Statement of Need	While distributed generation promises much, there is a need to overcome some fundamental concerns related to the integration of DG units at differing points on the grid. Only when these concerns can be put to bed will DG realize its promises.
Research Objective	Evaluate grid integration of distributed generation systems (microhydro, wind, etc.). Investigate line/DG integration issues as a means to making use of smaller, localized impaired water sources for cooling. Demonstrate capability to manage dg assets on grid
Impact/Benefits	Enable use of wide-scale DG technologies that 1. Use virtually no water 2. Are of a scale to use existing, small, impaired water resources cooling and other plant needs 3. Balance transmission system 4. Treat local impaired water 5. Handle and integrate potential of renewable dg resources that don't use water 6. Capitalize on collection of dg sources where individual dg sources are not feasible 7. Potential for low/no C02 emissions 8. Grid security and reliability
Priority	High
Summary Scope of Work	1. Leverage other projects that are ongoing regarding dg, and focus on water benefits of dg. 2. Assess conditions/places/ where dg helps solve water resource and energy generation needs 3. Assess how availability of renewable assets complement the hot day poor performance of dry cooling and other conventional power systems 4. Assess timing of when renewables are delivered relative to climate – daily, seasonal, drought v wet periods 5. Assess economic and other values of renewable dg (value may be greater than "cost" if it is saving water and emissions) 6. Assess potential of combined wind, hydro (hybrid systems) to store hydro energy when wind blows
Technical Approach	1. Develop tools to optimize integration of dg onto grid 2. Develop dg energy/ water control management systems 3. Identify appropriate existing and developing demonstration projects See above
Lead Investigators (academia, natl. lab, industry, international, partnership)	dg manufacturers independent power generators water/wastewater utilities DOE OEDER
Potential Collaborative Government Agencies	FERC Electric utilities Universities Utility Wind Interest Group Investor owned utilities State agencies NARUC

Leverage Opportunities with Existing Programs	DOE OEDER DOE EERE Existing or developing demonstration project
Constraints/Challenges (Policy, regulatory, technical, sequencing?)	Utility adoption Cost Who owns transmission reliability? Decreasing incentive levels Water saved by dgs is under valued
Estimated Cost	$2-5M /year
Execution Horizon (early, mid, late)	early
Schedule/Duration	5-10
Level of Development/ Level of Maturity at completion	Apply assessments and integration processes to existing and developing dg demonstration projects

Research Area 3-17. Economic development opportunities associated with the availability of produced waters.	
Statement of Need	Identify and understand the economic development opportunities associated with the availability of produced waters.
Research Objective	Develop economical uses of produced water. Research needed to support this include: • Develop a detailed spatial/temporal inventory of produced water availability and quality at regional and local scales. • Identify and develop strategies for overcoming institutional, regulatory (e.g., water rights and disposal restrictions), and policy barriers to beneficial use of produced waters. • Identify and assess a comprehensive portfolio of alternative produced water uses including support of alternative energy sources development. • Develop detailed S&T roadmap identifying treatment and management technologies required to support alternative beneficial uses. • Development of systems analysis and economic enterprise models for detailed evaluation of sustainable approaches and locations.
Impact/Benefits	Benefits: Results of this effort will: • Reduce produced water management based restrictions on oil and gas production due to produced water disposal limits • Create economic development opportunities based on currently unused produced water resources • Create opportunities for alternative energy resource development and utilization (e.g., hydroponic biomass for fuels utilizing distributed energy such as wind and solar).
Priority	High – oil and gas resource production such as CBM are currently significantly restricted due to produced water management issues.
Summary Scope of Work	1) Detailed situation assessment (resource inventory, institutional barriers, technology requirements and feasibility, development scenarios) 2) Systems/economic model development 3) Adaptive management based demonstrations
Technical Approach	The following technical approaches will be used: • Situation assessments will be conducted using GIS databases and models at local to regional scales over short-to long-term time horizons including resource assessments, institutional barriers analyses, technical feasibility, development scenarios, etc.). • Systems analysis will be used to evaluate the optimum siting and technology mixes for utilization of produced water, land, and distributed energy resources within regulatory constraints along with product alternatives such as biomass for fuels, water for agriculture and livestock, etc. • Demonstrations of alternative approaches will be conducted using adaptive management concepts.
Lead Investigators (academia, natl. lab, industry, international, partnership)	Situation assessment: National labs and universities with industry contributions Systems modeling: National labs and universities with industry support Demonstrations: National labs and industry with academia involvement

Potential Collaborative Govt. Agencies	DOE, BLM, USGS, NASA, EPA, State and local gov't
Leverage Opportunities with Existing Programs	BLM EIS programs and regional resource management plans, and state agencies can provide baseline data. Can build on ongoing efforts to develop technologies for produced water treatment and reuse. May also leverage DOE-EERE alternative energy resource development programs.
Constraints/Challenges (Policy, regulatory, technical, sequencing?)	Central funding agency is not obvious. Resolution of multi-jurisdictional regulatory barriers are also considerable.
Estimated Cost	$20M - $30 M
Execution Horizon (early, mid, late)	Early
Schedule/Duration	Assessment: 2 yrs Systems modeling: 2 yrs Demonstration: 3-5 yrs
Level of Development/Level of Maturity at completion	Many components currently fairly well developed. Minimal efforts underway relative to systems integration and demonstrations. Completion of this effort will provide representative demonstrations of economically viable and sustainable uses of produced water-based enterprises.
	John Gasper, Richard Skaggs, and Paul Wichlacz
Additional comments	

Research Area 3-18. Quantifying hydropower benefits.	
Statement of Need	Hydropower industry needs to synthesize knowledge gained in large number of relicensing and federal project system studies that can define the long-term benefits of project construction and operation and build understanding of multiple-use benefits (and costs).
Research Objective	Develop/demonstrate new methods to define tradeoff relations among project design and operation variables and economic and environmental benefits; do studies in a way that addresses transferability from one project to another.
Impact/Benefits	Future relicenses and system studies will be more effective and efficient; there would be significant value in understanding the full benefits of things like recreational facilities, etc.
Priority	Medium
Summary Scope of Work	1. Develop information repository of past cases where multiuse benefits have been quantified in relicensing or system studies (how done and what results), plus associated monitoring data; make data geo-specific and retrievable by state/region/river basin with upstream-downstream linkages. 2. Study transferability (e.g., how useful are results from one project or at different points it time to decisions at a new site or time?) and use of monitoring data to determine effectiveness/transferability. 3. Apply existing information to define tradeoff relations and document benefits of hydro. 4. Apply tradeoff and benefit relationships to demonstration projects and validate with field assessments
Technical Approach	Establish Hydropower Information and Analysis Center that would collect or link to project data from multiple sources, including FERC filings, state and federal agency energy and water databases. Center research efforts would define structure of database, including spatial and temporal linkages between projects and data. Use statistical approaches to define tradeoff relationships and confounding features of projects and operations. Center would establish a web presence for industry and other stakeholders to use in relicensing processes, with documentation and references to scientific findings.
Lead Investigators (academia, natl. lab, industry, international, partnership)	DOE in partnership with USGS and academia
Potential Collaborative Govt. Agencies	FERC, Corps, Bureau of Reclamation; TVA, EPA
Leverage Opportunities with Existing Programs	TNC flow alteration database, NBII-USGS, NAWQA-USGS, State-level WQ surveys and assessments
Constraints/Challenges (Policy, regulatory, technical, sequencing?)	Proprietary data and sensitive information, disparity of data types, spatial and temporal gaps in data,
Estimated Cost	$1M/yr for five years
Execution Horizon (early, mid, late)	Early, with continuity to future relicensing/basin studies
Schedule/Duration	Intensive effort in first year to populate database, significant efforts in mid-years to establish relationships and methods of analyses, ongoing efforts to entrain new data and add to analyses, periodic reviews of performance (including relevance to understanding project benefits and making best possible relicensing decisions).
Level of Development/Level of Maturity at completion	
	Mike Sale, Dave Culligan, Brennan Smith
Additional comments	