WATER ENERGY-NEXUS CAPABILITIES ASSESSMENT, 2013

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Coordinated Response to DOE - Request from:
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TABLE OF CONTENTS

SUMMARY

In response to DOE's request for a water energy nexus capabilities assessment, the National Labs were requested to conduct a self-assessment for DOE-defined Water-Energy topics in (A) Modeling and Analysis (topics 1 – 6) and (B) Technology (topics 7 – 15). Following other recent lab capability assessment procedures, the Labs were asked to self assess their capabilities as:

1) Enduring Capability
2) Emerging Capability
3) Emerging Interest
4) None – The Laboratory does not have capabilities in this area.

To support this assessment, the National Laboratories were also asked to provide information about FY13 projects related to the Water-Energy topics. This information was tabulated and synthesized to highlight relevant ongoing activities across the complex.

Graphical synthesis of the laboratory datasets is provided in Figures 1-3. Figures 1a-1c illustrate the funding level of water-energy research in FY13 by sponsor. Figure 2 illustrates the FY13 funding dedicated to different DOE-identified topics in FY13. Self-identified laboratory capabilities were transformed into matrices (Figures 3a & 3b), which illustrate the strengths as well as the gaps in water-energy expertise across the National Laboratories. As funding levels vary year-to-year (and most projects are multiyear endeavors), it is emphasized that the requested FY13 snapshot may not be representative of funding levels associated with other years. Several Laboratories also offered information about other relevant products or leveraging for the water-energy effort. For example, NERSC at LBNL reported 131 Million hours of compute time dedicated to water-energy topics in FY13 and LLNL identified developed flow chart products (https://flowcharts.llnl.gov/archive.html#water_archive). Over 400 projects were identified with a total FY13 budget of $226,108K.

National Labs were also requested to volunteer water-energy highlights that could be considered for inclusion into the Water-Energy report as sidebars, which are included as attachments.

FIGURE CAPTIONS

The following figures were developed from two sets of data tables – 1) National Labs self-assessment to the Water-Energy topics and 2) Lab Support Information, which includes FY13 projects related to the Water-Energy topics. The details of the tables are included in the Table and Attachment sections of this document for further reference.

Figure 1. Figures 1a, 1b, and 1c provide three different details of the combined total funding of FY13 dollars ($K) across the National Lab complex for Water-Energy related projects. In order to consolidate the data into similar detail, Sponsor Names were normalized. For some projects, a Sponsor was not identified and these were noted as "Not Specified". For DOE sponsors where a specific office was not identified, these were noted as "DOE-Not Specified". The term "Multiple" was used when there was more than one Sponsor identified. This could include multiple Work For Others (WFO), or multiple DOE offices, or a combination of WFO and DOE.

Figure 1a shows the highest summary of detail of funding by sponsors to illustrate a comparison of DOE to all other funding Sponsors. Approximately 53% of the projects identified by the National Laboratories is related to the Water-Energy discussion

Figure 1b shows some detail of funding by sponsors with a breakdown of WFO versus WFO-Federal and DOE with specific Program or Staff Offices.

Figure 1c shows a full detail of funding by sponsors to illustrate the variety of DOE Offices and WFO agencies.

Figure 2 is a summary of FY13 funding ($K) by DOE (Water-Energy) Topic. This figure consolidates dollars identified for a collection of projects by one Water-Energy topic. The input details provided by the National Laboratories on the Lab Supporting Information table can be seen in the Table Section. It should be noted that FY13 dollar amounts have been excluded from the full detail of this report.

Figure 3a shows a total count of the National Laboratories rating for each Water-Energy topics. The rating scale was defined as follows:

1. Enduring Capability. The laboratory is a recognized leader in this area, has depth in talent and tools and multi-year experience supporting DOE and a broad set of other customers in providing analyses and insights
2. Emerging capability. The laboratory has some limited experience in and has supported a limited set of customers.
3. Emerging interest. The laboratory aspires to work in this area, may have done some internal work to develop capabilities, but has not had the opportunity to apply its capabilities.
4. None. The laboratory does not have capabilities in this area.

There is a very clear indication that the National Laboratories have higher capabilities in Modeling and Analysis than in the Technology areas.

Figure 3b is the detail of each National Laboratory's self-assessment, shown in alphabetical order.

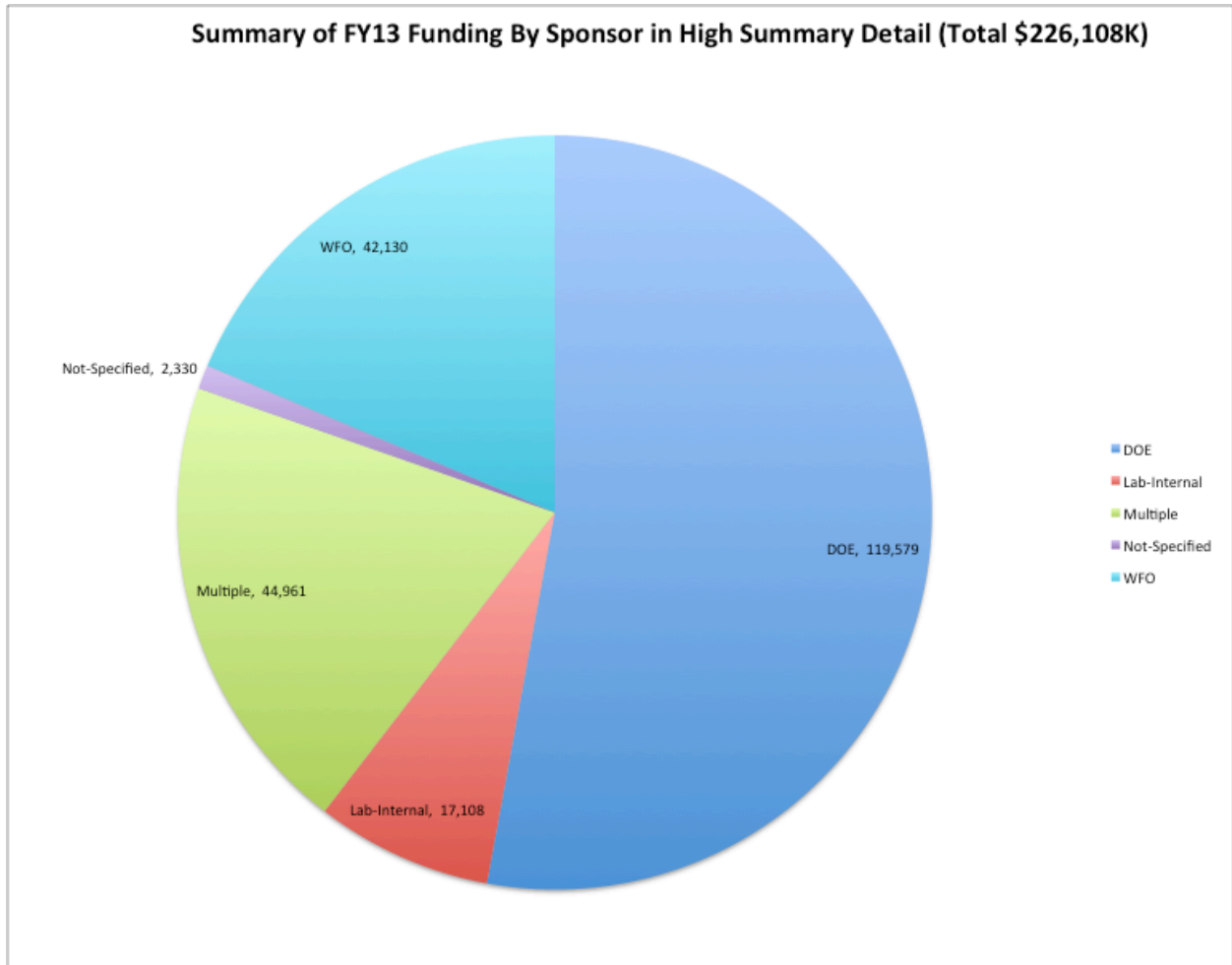**Figure 1a.   Total Funding by Sponsor in High Summary Detail**

Summary of FY13 Funding By Sponsor in High Summary Detail (Total $226,108K)

WFO, 42,130

Not-Specified, 2,330

Multiple, 44,961

Lab-Internal, 17,108

DOE, 119,579

- DOE
- Lab-Internal
- Multiple
- Not-Specified
- WFO

Figure 1b.   Total Funding by Sponsor in Some Detail

Summary of FY13 Funding By Sponsor in Some Detail (Total $226,108K)
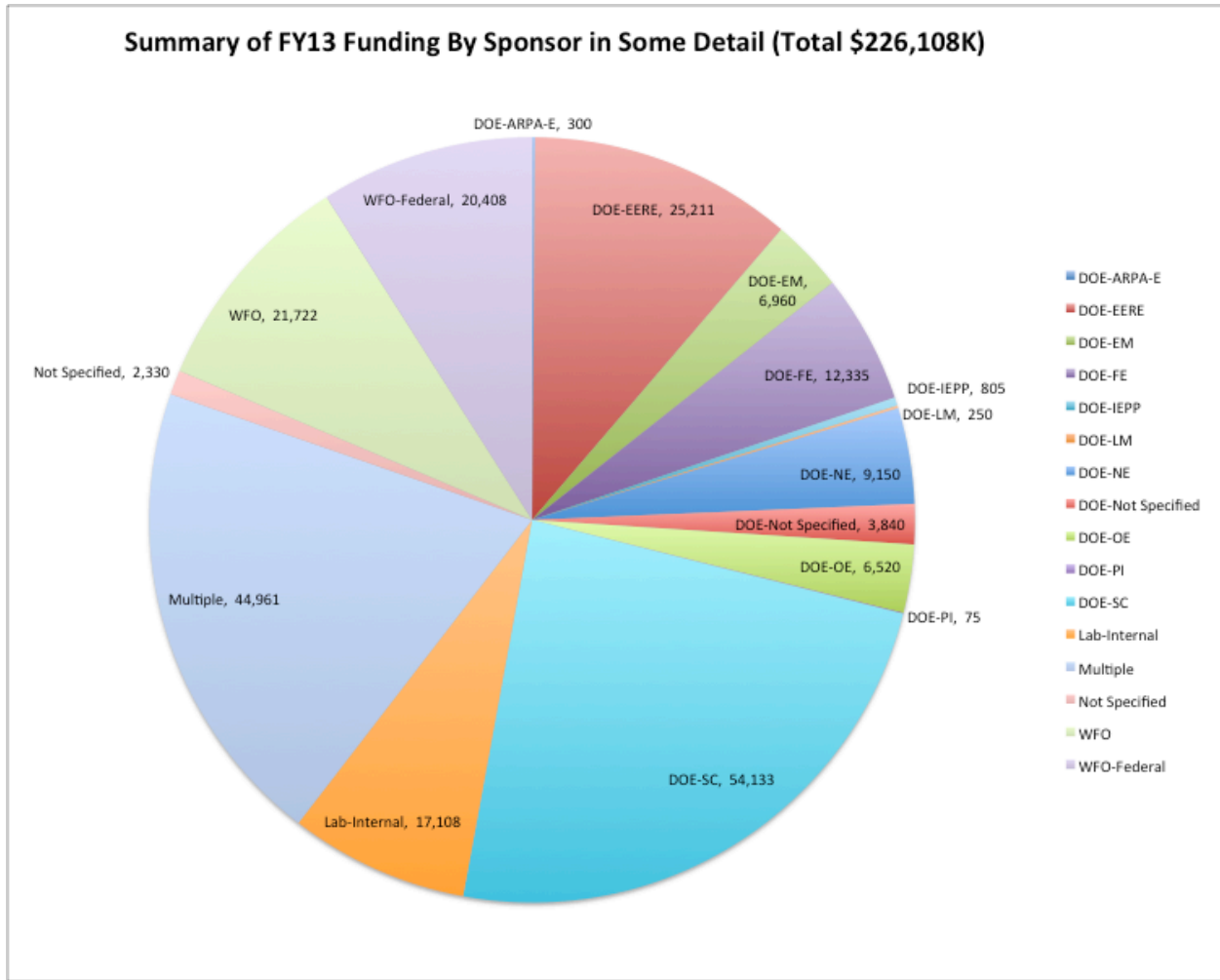
Figure 1c.   Total Funding By Sponsor in Full Detail

Summary of FY13 Funding by Sponsor in Full Detail (Total $226,108K)
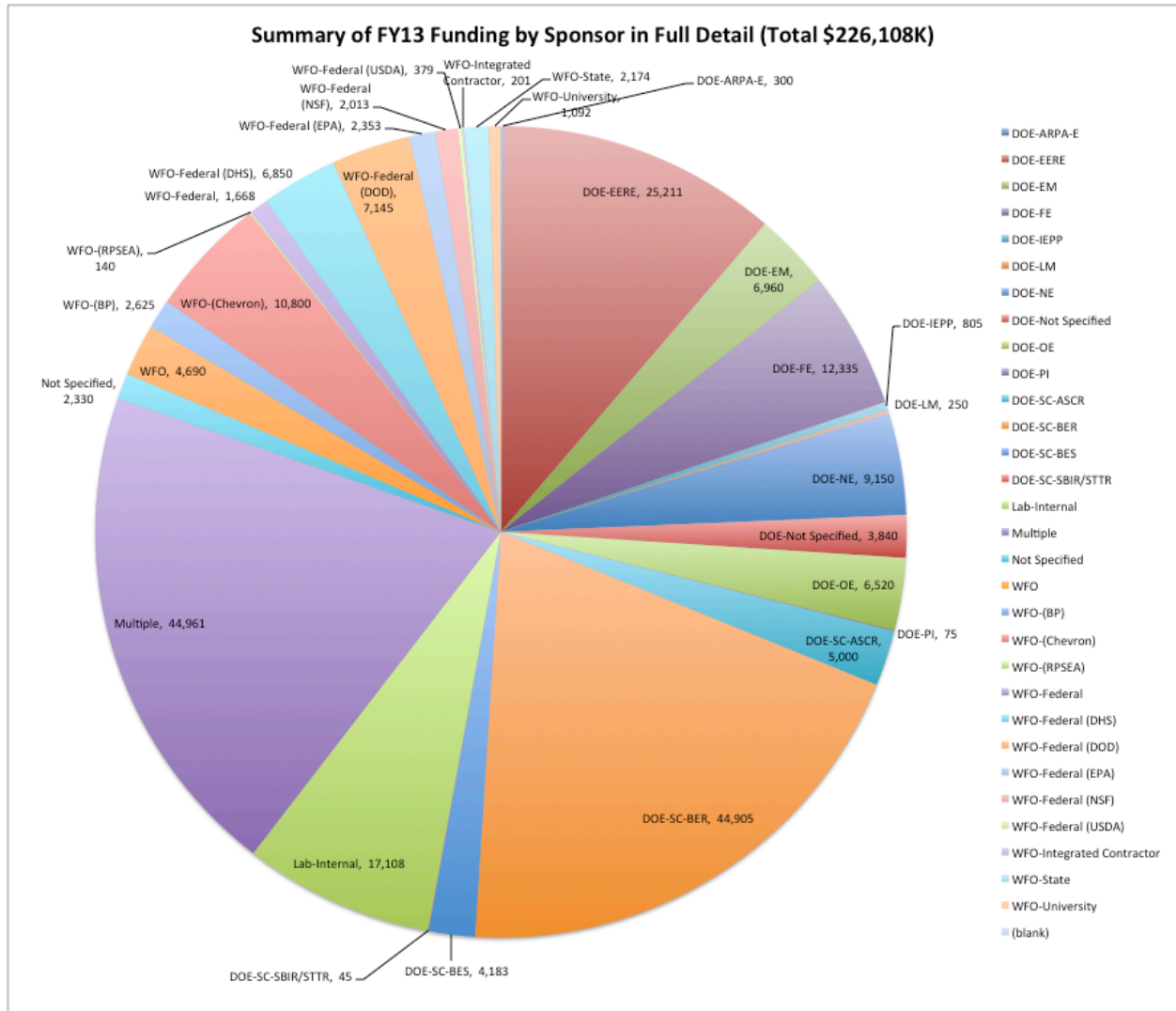
Figure 2. Summary of FY13 Funding ($K) per DOE Topic

	MODELING AND ANALYSIS
1	Integrated Modeling and Analysis of Human & Earth Systems
2	Modeling and Analysis of Earth Systems
3	Modeling and Analysis of Human Systems
4	Crosscutting Modeling & Analysis Capabilities
5	Computation, Software, Observations, and the User Interface
6	Outreach and Collaboration
	TECHNOLOGY
7	Water treatment
8	Advanced materials
9	Cooling technologies
10	Agricultural & Industrial Processes
11	Alternative working fluids
12	Advanced sensors and analytics
13	Data and Inventories
14	Energy/Water Systems Integration and optimal co-management
15	Technology Deployment and Scale-up

'Blank' indicates that no topic was specified.

Figure 3a. Total Count of National Lab Self-Assessment for Each Rating per Topic

Identified DOE Topic #	TOPICS	Count of National Lab Self-Assessments for each rating*			
	MODELING AND ANALYSIS	*1*	*2*	*3*	*4*
1	Integrated Modeling and Analysis of Human & Earth Systems	6	2	2	1
2	Modeling and Analysis of Earth Systems	8	2	1	0
3	Modeling and Analysis of Human Systems	7	3	1	0
4	Crosscutting Modeling & Analysis Capabilities	10	1	0	0
5	Computation, Software, Observations, and the User Interface	10	1	0	0
6	Outreach and Collaboration	5	3	2	1
	TECHNOLOGY				
7	Water treatment	6	2	1	2
8	Advanced materials	4	4	1	2
9	Cooling technologies	2	3	3	3
10	Agricultural & Industrial Processes	3	3	3	2
11	Alternative working fluids	3	6	0	2
12	Advanced sensors and analytics	6	1	3	1
13	Data and Inventories	3	6	1	1
14	Energy/Water Systems Integration and optimal co-management	3	6	1	1
15	Technology Deployment and Scale-up	4	4	2	1

*Rating Scale Definitions:

1. Enduring Capability. The laboratory is a recognized leader in this area, has depth in talent and tools and multi-year experience supporting DOE and a broad set of other customers in providing analyses and insights

2. Emerging Capability. The laboratory has some limited experience in and has supported a limited set of customers.

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4. None. The laboratory does not have capabilities in this area.

Figure 3b.   Detail of National Lab Self-Assessment Rating per Topic

Identified DOE Topic #	TOPICS	Ames	Argonne	BNL	INL	LANL	LBNL	LLNL	NREL	ORNL	PNNL	Sandia
	MODELING AND ANALYSIS											
1	Integrated Modeling and Analysis of Human & Earth Systems	1	1	4	2	2	1	1	3	1	1	3
2	Modeling and Analysis of Earth Systems	2	1	1	1	1	1	1	3	1	1	2
3	Modeling and Analysis of Human Systems	3	1	1	1	1	2	2	1	1	1	2
4	Crosscutting Modeling & Analysis Capabilities	2	1	1	1	1	1	1	1	1	1	1
5	Computation, Software, Observations, and the User Interface	1	1	1	2	1	1	1	1	1	1	1
6	Outreach and Collaboration	4	1	1	2	1	3	3	1	2	1	2
	TECHNOLOGY											
7	Water treatment	4	1	4	1	1	1	2	1	3	2	1
8	Advanced materials	4	1	2	2	1	3	2	4	1	2	1
9	Cooling technologies	4	1	3	2	2	4	3	1	4	2	3
10	Agricultural & Industrial Processes	4	1	4	3	1	1	2	2	3	2	3
11	Alternative working fluids	4	1	1	2	2	2	1	2	4	2	2
12	Advanced sensors and analytics	4	1	3	3	1	1	1	3	1	2	1
13	Data and Inventories	4	1	2	1	2	2	3	1	2	2	2
14	Energy/Water Systems Integration and optimal co-management	4	1	1	2	2	2	3	2	1	2	2
15	Technology Deployment and Scale-up	4	1	3	2	1	2	3	1	1	2	2

*Rating Scale Definitions:
1. Enduring Capability. The laboratory is a recognized leader in this area, has depth in talent and tools and multi-year experience supporting DOE and a broad set of other customers in providing analyses and insights

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LABORATORY SUPPORTING INFORMATION

The following table is the list of Lab Supporting Information provided by each National Laboratory. It details over 400 projects listing Project Titles, Sponsor & Office, Collaborating Institutions, and a Brief Project Description. Projects were also assigned to a Primary Water-Energy Topic, as it is seen as most relevant. Where National Labs identified multiple Topics, the first Topic was called out as the Primary.

This table is presented in Primary Topic order, then in alphabetical order by National Lab followed by the order in which the Project was listed by the National Lab. The ordering of projects was purely arbitrary with respect to how the National Labs presented the information, and no significance was placed on the order of the projects. (The Master Project Number refers to each project as it was numbered in the table when sorted by National Lab in alphabetical order. It is kept in this table, for additional reference.)

Table 1. Water Energy Nexus Capabilities Assessment: Lab Supporting Information

Master Project #	Lab Project #	Primary Topic	Secondary Topic(s)	Project Title	Sponsor & Office Name	Collaborating Institutions	Brief (2-3 sentence) project description	National Lab
1	1	1		An Integrated model for assessment of the environmental impacts of sustainable agricultural residue removal for bioenergy systems	DOE-EERE	Idaho National Lab	Agricultural residues have near-term potential as a feedstock for bioenergy production, but removal of agricultural residues must be managed carefully to maintain soil health and productivity. This project has developed an integrated modeling approach that utilizes high fidelity agricultural datasets to examine the impact of agricultural residue removal at various scales from subfield to national. This integrated model coupled the Revised Universal Soil Loss Equation, Version 2, Wind Erosion Prediction System, and Soil Conditioning Index models with a multi-scale set of databases describing crop yield, surface topography, soil characteristics, climate, and land management data. This work is currently being extended to include nitrogen and green house gas issues.	Ames
2	2	1		Federal Highways Climate Change Vulnerability Assessment Pilot.	WFO-Federal	University of Iowa, Iowa Department of Transportation	The project will monitor, predict, assess and provide an alert when vulnerable highway infrastructure assets are at risk by extreme rainfall events.	Ames
3	3	1		Short Course Development: Climate Change Adaptation in Agriculture.	WFO-Federal (USDA)	National Resource Conservation Service	Using past records of climate change and future projections to develop dialog with farm and ranch land managers on best practices to cope with current and projected future climate change. Primary emphasis is on water and its impact on crop production and soil erosion	Ames
4	4	1		Useful to Usable (U2U): Transforming Climate	WFO-Federal (USDA)	Mich St U, Purdue, U of Ill, SDSU, U of	Using regional climate model scenarios of current and future climate to create temp, precip, solar rad datasets for driving	Ames

Master Project #	Lab Project #	Primary Topic	Secondary Topic(s)	Project Title	Sponsor & Office Name	Collaborating Institutions	Brief (2-3 sentence) project description	National Lab
				Variability and Change Information for Cereal Crop Producers.		Wisc,	crop models to assess changes in corn production with climate change.	
5	5	1		Climate Change Mitigation and Adaptation in Corn Based Cropping Systems	WFO-Federal (USDA)	large number of universities	Contribution of corn agriculture to greenhouse gas emission, GHG emission reduction strategies, modeling of impact of climate change on US corn production	Ames
6	6	1		CNH: People, Water, and Climate: Adaptation and Resilience in Agricultural Watersheds.	WFO-Federal (NSF)	U of Iowa	This project involves linkages among human needs and perceptions of water availability and quality.	Ames
7	7	1		Collaborative Research: EaSM2: Advanced Climate and Regional Model Validation for Societal Applications.	WFO-Federal (NSF)	NCAR	This proposal specifically involves assessing climate simulations from the perspective of operational water managers and involved the Denver Water utility.	Ames
8	8	1		Water and Climate Change (WACC): Building Community Consensus for a Sustainable Future for Iowa and the World	WFO-University	none	Thisproject is especially germane because (1) it involves developing agent-based modeling, and thus injects human behavior into the hydroclimate modeling, and (2) it has strong overlap with energy needs and production, with Leigh Tesfatsion bringing in substantial experience in energy markets.	Ames
9	9	1		CORDEX Empirical/Statistical Downscaling Workshops: Establishing a Foundation for Climate-Stakeholder Interaction in Africa.	WFO-Federal (NSF)	foreign collaborators Univ. Cape Town; Norwegian Met. Inst	CORDEX is providing global coordination of Regional Climate Downscaling for improved regional climate change adaptation and impact assessment. It is a project of the World Climate Research Programme with projects on every continent.	Ames
27	5	1	2,3,4,10	Impact of projected biofuel production on water use and water quality	DOE-EERE	ORNL, NREL, PNNL, INL	Determination of the water footprint of biofuel production from various feedstocks via conventional and advanced production processes. Also determine water requirements under various land cover changes for feedstock mix production.	Argonne
34	12	1	2,3,4,10	Impact of projected biofuel production on water use and water quality	DOE-EERE	ORNL, INL, and others	Watershed modeling of biofuel feedstock production for tributaries in Mississippi River Basin. Developing methodology specific for biofuel application. Examining potential impact of increased production, land use change, and various land management programs on nutrient, sediments, and flow at watershed and river basin scale using hydrologic models.	Argonne
35	13	1	2,3,4,10	Water quality assessment of pesticide usage for biofuel production	DOE-EERE	Argonne	Watershed modeling to assess pesticides and herbicides from biofuel feedstock production at watershed scale in Upper Mississippi River Basin. Developing coding /modules to improve computation efficiency. Examine impact of extreme event on the water quality.	Argonne
42	20	1	4,14	Technical support to Sierra Nevada Region (SNR) of WAPA	DOE-IEPP		Develop a decision support tool (ForecastViewer) to help SNR visualize electricity prices and price trends. Tool assists SNR to make economically prudent electric power purchases for their customers. Also provide technical support for running the	Argonne

Master Project #	Lab Project #	Primary Topic	Secondary Topic(s)	Project Title	Sponsor & Office Name	Collaborating Institutions	Brief (2-3 sentence) project description	National Lab
							GTMax model, which is used by SNR to analyze the operation of their hydroelectric power system.	
43	21	1	13,5	Climate Change Impacts to Department of Defense Installations	WFO-Federal (DOD)	UIUC, Texas Tech, U Chicago	Dynamic and statistical downscaling methodologies are applied to the North American continental domain and evaluated against each other and observations. Extremes in precip/temp in current and future scenarios are computed and uncertainties estimated	Argonne
66	15	1	2, 3, 4	Climate, Land Use, Energy and Water (CLEWS)	WFO	IAEA, KTH	CLEWS is a IAEA sponsored program to develop an integrated suite of tools for the concurrent evaluation of crop production, national energy and water management, as well as the simultaneous assessment of selected GHG mitigation, vulnerability and adaptation scenarios.	BNL
67	16	1	2, 3, 4	Pilot Study of Energy-water Nexus in Upstate New York	Lab-Internal	Saint Lawrence University	A BNL funded effort to model energy and water issues in Upstate New York using the Water Evaluation and and Planning System (WEAP) model. The initial focus is on the potential for small hydro.	BNL
91	1	1	7, 10	National Alliance for the Advancement of Biofuels and Bioproducts	DOE-EERE	80 Institutions; large consortium	The National Association for Advanced Biofuels and Bioproducts seeks to advance multiple aspects of algal biomass development for biofuels and coproducts, including 1) Algal Biology, 2) Cultivation, 3. Harvesting/Extraction, 4) Fuel conversion, 5) valuable coproducts, and 6) Sustainability. The sustainabilty task includes modeling and analysis of the use, economics, and sustainability of resources including water during algal biofuel cultivation, harvesting, and fuel conversion.	LANL
92	2	1	5	Advanced Simulation Capability for Environmental Management (ASCEM)	DOE-EM	LBNL, PNNL, SRL,	A consortium of National Laboratories are developing and tersting a state-of-the-art high-performance computing system to simulate coupled, multiphysics processes primarily associated with subsurface flow and transport. The ASCEM framework includes a suite of integrated tools for uncertainty quantification, parameter estimation, decision support, data management, and visualization. In addition to providing multi-lab program management, the LANL technical portion focusses on high performance computing, uncertainty quantification, model setup, and some site applications.	LANL
93	3	1		Neutron imaging, scattering and modeling of salt-brine system	WFO-University	UC- Davis	Innovative measurements of salt/brine system using neutron techniques coupled with multi-scale multi-physics modeling for assessing the suitability of salt repositories for storing high-level nuclear waste. The capabilities developed will have many other applications including the broad water-energy areas.	LANL
94	4	1	5	Modeling for Environmental Programs at LANL	DOE-EM		Simulating of several processes in an arid environment including: (a) infiltration of surface flows, (b) surface water balance to determine infiltration zones, (c) siting, design and optimization monitoring and pumping wells, and (d) coupled vadose-zone and saturated-zone flow and transport models (see below),	LANL
95	5	1	5	Decision support and	DOE-EM		Development of methods to simulate decision support for a	LANL

Master Project #	Lab Project #	Primary Topic	Secondary Topic(s)	Project Title	Sponsor & Office Name	Collaborating Institutions	Brief (2-3 sentence) project description	National Lab
				particle tracking capability development			variety of hydrologic and environmental problems. Development of particle tracking methods for high performance computer simulations on unstructured grids.	
96	6	1	5	National Infrastructure Simulation and Analysis Center (NISAC) Water Infrastructure Analysis	Multiple	NA	Developing an integrated assessment tool to assist decision and policy makers in assessing advantages and disadvantages of specific initiatives performed at municipal level with the purpose to manage risks to resilience.	LANL
97	7	1	2,3,5, 14	Multiple CO2 Sequestration focused projects, including, US-China Clean Energy Research Center (CERC) and regional partnerships	DOE-FE	WVU, LLNL, Univ. Wyoming, Montana State Univ., LBL, INL, New Mexico Tech, Univ. of Utah, PNNL, etc.	Integrated assessment modeling for risks associated with large-scale geologic CO2 storage including impacts to shallow groundwater aquifers, development and application of models for optimization of regional infrastructure for large-scale, and deployment of geophysical and geochemical monitoring technologies. CO2 sequestration is closely coupled with the energy-water nexus: stored CO2 amounts will be driven largely by electricity generation and, due to reservoir management, geosequestration will provide vast quantities of saline waters that can be treated to enter the water supply including for thermoelectric cooling.	LANL
98	8	1	5, 7	System Modeling & Science of Geologic Sequestration	DOE-FE		(part of item above) Techno-economic system modeling for saline water production from geologic CO2 sequestration and subsequent water treatment for beneficial re-use including human consumption, agriculture irrigation, and thermoelectric cooling. The model has applications for produced water and EOR water treatment cost assessment and treatment technology assessment for alternative water sources.	LANL
99	9	1	2,3,5	National Risk Assessment Partnership (NRAP)	DOE-FE	LBL, LLNL, NETL, PNNL	(part of item above) LANL's CO2-PENS integrated assessment model is utilized to understand risks to shallow groundwater aquifers due to large-scale geologic CO2 storage. Groundwater aquifers provide ~20% of US water withdrawals.	LANL
100	10	1	3,5	Modeling for Chromium Assessment and Mitigation in Groundwater at LANL	DOE-EM		Groundwater investigatoin related to the chromium plume address several processes in an arid environment including: (a) infiltration of surface flows, (b) surface water balance to determine infiltration zones, (c) siting, design and optimization monitoring and pumping wells,(d) location and concentraiton of contaminants, (e) analytical laboratory work, and (f) coupled vadose-zone and saturated-zone flow and transport models. A series of site investigations and decision-support analyses have been performed related to a chromium plume in the regional aquifer beneath the Los Alamos National Laboratory (LANL). To solve this complex problem, advanced field, modeling and model-analyses tools have neem applied. The work implements high-performance computing and novel, efficient and robust model analysis techniques for optimization and uncertainty quantification (ABAGUS, Squads, multi-try (multi-start) techniques), which allow for solving problems with large degrees of freedom. Data collectionfor this project are addressed in Topic 13.	LANL

Master Project #	Lab Project #	Primary Topic	Secondary Topic(s)	Project Title	Sponsor & Office Name	Collaborating Institutions	Brief (2-3 sentence) project description	National Lab
198	28	1	4, 12	Climate Science for a Sustainable Energy Future (CSSEF)	DOE-SC-BER		CSSEF is designed to accelerate the development of the DOE Earth System Model. Work includes (1) Application of ecological observational data sets to evaluate and calibrate the terrestrial components of these models; (2) Efforts to introduce numerical methods that enable climate models to exploit future computing architectures; and (3) Research in uncertainty quantification to systematically characterize and optimize the physical fidelity of these models.	LBNL
200	30	1	4	Towards Integrated Assessment of Energy/Water/Climate Interactions (I/A Energy Water)	DOE-SC-BER		This coordinated program will study how climate change within the continental United States will affect water and energy resources during the twenty-first century. This study will serve as a template for subsequent Integrated Assessment work in other sectors. The common elements are: elucidation of major open water/climate/energy issues suitable for regional-to-global simulation; targeted process integration between the Integrated Assessment and climate components of iESM; diagnosis and simulation; and dissemination of papers and code to the broader climate and Integrated Assessment communities.	LBNL
209	39	1	2, 4, 12	CO2 Field Experiment with Injection into Freshwater Aquifer	WFO	Southern Company, EPRI, LANL	Evaluation of possible groundwater contamination from CO2 leakage into aquifers using thorugh observing and modeling field injection test.	LBNL
210	40	1	2, 4	EPA Research Project on CO2 Geological Storage	WFO-Federal (EPA)		Support for EPA's CO2 regulation framework. Development of calculation and modeling tools for large-scale CO2 impacts; support for UIC regulation to protect groundwater resources from CO2 and brine leakage; geochemcial laboratory studies	LBNL
211	41	1	2, 4	Regional-scale Modeling of Hydrological Impacts from Large GCS Projects	DOE-FE		Assessment of groundwater quality impacts due to deep carbon sequestration projects. Currently working on optimization of pressure management with brine extraction and co-management for produced water use.	LBNL
212	42	1	2, 4	Large-scale Hydrological Impacts from CO2 Geological Storage Sepcific to California - Central Valley	WFO-State		Assessment of possible changes in groundwater hydrology due to deep carbon sequestration projects. Specific study to Southern San Joaquin Valley conditions.	LBNL
226	56	1	2,4,13	Modeling Analysis of Hazards to Groundwater Related to Hydrofracturing for Hydrocarbon Production from Shales and Tight Sand Reservoirs	WFO-Federal (EPA)		Scenario modeling for hydraulic fracturing to understand potential for methane and brine leakage into groundwater resources. Assessment of the environmental impact of hydraulic fracturing for shale gas production on the quality of overlying shallow potable ground water resources.	LBNL
243	73	1	2, 4	Nuclear Energy and Waste	Multiple		Modeling potential groundwater contamination from geologic repositories for radioactive waste. Modeling impact of seismic events on critical infrastructure such as nuclear power plants (can be expanded to energy and water infrastructure).	LBNL
245	75	1	2, 4	National Risk Assessment Partnership	DOE-FE	LLNL, LANL, NETL, PNNL	Developing a risk-profile methodology, through collaborations on key research needed to quantify the residual risk associated	LBNL

Master Project #	Lab Project #	Primary Topic	Secondary Topic(s)	Project Title	Sponsor & Office Name	Collaborating Institutions	Brief (2-3 sentence) project description	National Lab
				(NRAP)			with long-term stewardship at a CO2 storage site. NRAP includes research on induced seismicity, and groundwater impacts.	
252	82	1		Estimating Policy-Driven GHG Trajectories in California	WFO-State	Other CA energy agencies (ARB, CEC, CPUC, Gov Office), E3 (informally)	Build an integrated model of the California economy that includes all greenhouse gas (GHG) emissions and develop at least 3 scenarios: committed policies, aspirational targets and potential policy/technology futures. Included in this model is an accounting of water conservation across sectors and the impact on energy and GHG savings.	LBNL
295	1	1		Development of Indicators for Changing Sustainability and Resilience through the Analysis of Global High-Resolution Climate Change Simulation	WFO-Federal (EPA)		The purpose of this project is to develop a high resolution modeling capability to achieve the following: 1) Determine the extent to which high-resolution climate change modeling (HRM) can improve upon global and sub-global (continental to watershed scale) climate change statistics by evaluating the response to short term forcings and examining the ability of the model to properly simulate climate extremes; and 2) Assess and apply the predicted climate response with HRM to produce metrics for sustainability and resilience in a changing climate scenario.	ORNL
296	2	1		Improving the Representations of Human-Earth Interactions	Multiple	PPNL JGCRI, LBNL, University of Maryland	The goal of this project is to strengthen the coupling between climate and Earth System Models (ESMs) and Integrated Assessment Models (IAMs) by exploring interrelated issues such as land use change influences, substitution of biofuels for fossil fuels, human decision-making about water use & water resources, evolution of carbon sinks, and human decisions about energy futures & climate adaptations.	ORNL
297	3	1		Quantification and Reduction of Critical Uncertainties Associated with Carbon Cycle-Climate System	Multiple	Los Alamos, LBNL, UC Irvine	This project seeks to improve understanding of carbon cycle climate feedback with the following approach: 1) quantify critical uncertainties in global-scale climate predictions associated with carbon-climate feedbacks; 2) improve our understanding and model representation of processes controlling these feedbacks through zonally-specific model-data evaluation exercises; and 3) extend our data-based evaluation to quantification of carbon-climate feedback responses and uncertainties in a large population of global-scale carbon-climate models.	ORNL
350	1	1		Platform for Regional Integrated Modeling and Assessment (PRIMA)	Lab-Internal		PRIMA is a five-year (FY10-14) lab-level LDRD initiative to develop and link state-of-the-art models of key human and natural systems to support regional-scale decision making. It integrated models of regional climate (WRF), hydrology (CLM), agriculture and land systems (EPIC, AgLU, LULCC), energy systems (BEND, EOM, SITE), and socioeconomics/integrated assessment (GCAM). It combines a flexible and modular simulation platform with stakeholder-driven experimental design and uncertainty characterization, delivering insights on issues ranging from regional natural resource management to grid reliability to renewable portfolio	PNNL

Master Project #	Lab Project #	Primary Topic	Secondary Topic(s)	Project Title	Sponsor & Office Name	Collaborating Institutions	Brief (2-3 sentence) project description	National Lab
							standards. NOTE: Also address Topic Area 4.1, 4.3, 4.4, 4.5	
351	2	1		Developing a Framework for Regional Integrated Assessment Modeling (RIAM)	DOE-SC-BER	ORNL	RIAM leverages and extends PRIMA to address issues related to energy infrastructure vulnerability and the value of integrated multi-scale modeling in the context of the Southeast/Gulf Coast Region. Major thrusts include the impacts of hurricane-induced storm surge, sea level rise, and land subsidence on the exposure of Gulf Coast energy production facilities and refineries; the combined impacts of heat waves and droughts on energy system performance and sustainability; and the scale sensitivity of climate-sensitive regional agriculture and energy system modeling.	PNNL
352	3	1		Algal Biofuels Resource Assessment	DOE-EERE	Sapphire Energy	Biomass Assessment Tool (BAT) - integrated model, analysis, and data management architecture that couples advanced spatial and numerical models to capture potential site environmental conditions, production potential, resource requirements, and sustainability metrics for bioenergy feedstocks. GIS and multi-scale modeling to conduct systematic assessments of water, land, and ecosystem resource availability and constraints for energy production. NOTE: Also address Topic Area 4.1, 4.2	PNNL
353	4	1		integrated Earth System Model (iESM)	DOE-SC-BER	LBNL, ORNL	The iESM project is a collaboration between three national laboratories to create a first generation earth system model with a fully integrated human systems component. We are coupling the GCAM integrated assessment model with the CESM earth system model. The GCAM integrated assessment model is housed and developed at PNNL and is used in the coupled model to represent human activities affecting land use and greenhouse gas emissions. The CESM teams include a group at ORNL working with the Community Land Model and a team at LBNL working with the full CESM model. The objective of the five-year project is to produce a fully integrated model code coupling these elements, and to exercise the coupled system to explore the future evolution of bioenergy systems, hydrology, climate adaptation and climate mitigation.	PNNL
354	5	1		Salmon benefits from the Columbia River estuary	Multiple	NOAA, Portland State University	Quantify the benefits to salmonids of habitat restoration actions in the lower Columbia River and estuary in relationship to hydropower system operations. This project has developed a watershed-level, multiattribute model linking land use/land cover changes and river flows to wetland habitat size and function as it relates to health and survival of juvenile salmon within the lower Columbia River and estuary. These quantitative methods were tested and deployed to index species-specific life history diversity for salmonids and habitat connectivity in the study area, and estimate the survival benefits associated with specific habitat restoration actions.	PNNL
355	6	1		Integrated Science Support to Missouri River Recovery Program	WFO-Federal (DOD)		Develop, test, and deploy a predictive capability that links climate-driven Missouri River flows, geomorphological change within the river, and flow/dredging management scenarios to	PNNL

Master Project #	Lab Project #	Primary Topic	Secondary Topic(s)	Project Title	Sponsor & Office Name	Collaborating Institutions	Brief (2-3 sentence) project description	National Lab
							population growth/health responses of avian and fish species. This predictive modeling capability links hydrologic, hydraulic, erosion/deposition processes to terrestrial and aquatic population responses within a probabilistic framework.	
356	7	1		Hydrosystem modeling for hydropower	Multiple		Series of projects involve the development and deployment of computational fluid dynamics models to assess engineering and biological performance of hydropwer system components including fish friendly turbines, dam spillways, and temperature and dissolved gas.	PNNL
357	8	1		Global Change Assessment Model (GCAM)	Multiple	Many	GCAM is a partial equilibrium model of the world with 14 regions. GCAM operates in 5 year time steps from 1990 to 2095 and is designed to examine long-term changes in the coupled energy, agriculture/land-use, and climate system. GCAM includes a 151-region agriculture land-use module and a reduced form carbon cycle and climate module in addition to its incorporation of demographics, resources, energy production and consumption. The model has been used extensively in a number of assessment and modeling activities such as the Energy Modeling Forum (EMF) , the U.S. Climate Change Technology Program, and the U.S. Climate Change Science Program and IPCC assessment reports. GCAM is now freely available as a community model.	PNNL
358	9	1		Phoenix (AKA Second Generation Model or SGM)	WFO-Federal (EPA)		Phoenix is a global, dynamic recursive computable general equilibrium model that is solved in five-year time steps from 2005 through 2100 and divides the world into twenty-four regions. Each region includes twenty-six industrial sectors. Particular attention is paid to energy production in Phoenix. There are nine electricity-generating technologies (coal, natural gas, oil, biomass, nuclear, hydro, wind, solar, and geothermal) and four additional energy commodities: crude oil, refined oil products, coal, and natural gas. Phoenix is designed to answer economic questions related to international climate and energy policy and international trade. Phoenix replaces the Second Generation Model (SGM) that was formerly used for general equilibrium analysis at JGCRI.	PNNL
389	1	1		EXPANDING TOOLS FOR INTEGRATED ASSESSMENT RESEARCH: TOWARD CONNECTIONS BETWEEN INTEGRATED ASSESSMENT MODELS AND CRITICAL INFRASTRUCTURE PROTECTION	DOE-Not Specified	ORNL, LANL, PNNL, MIT	Collaborative project focused on integration of critical infrastructure modeling into integrated assessement models	Sandia

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				MODELS				
390	2	1		Water-Energy-Land Chapter for 2013 NCA	DOE-Not Specified	NREL, PNNL, NOAA, EPRI	Support toward preparation of the Water-Energy-Land Chapter in the 2013 National Climate Assessment	Sandia
10	10	2		Climate Change and Environmental Sex Determination in a Geographically-widespread Species.	WFO-Federal (NSF)		Evaluation of changes in terrestrial species habitat that will force migration under climate change	Ames
11	11	2		Ea SM 2: Attribution of changes in precipitation intensity over the central United States	WFO-Federal (USDA)	NCAR	Investigation of alternative contributions to the causes of precipitation in the central US	Ames
12	12	2		Collaborative Research: Arctic extreme temperature and precipitation - Detection and projection of their climatic change and physical causes.	WFO-Federal (NSF)	Multiple institutions	The arctic region is experiencing some of the largest and most rapid changes in the global climate system. Through its changes in surface albedo, this region has high feedback to the climate system. The shallow and highly stable atmospheric boundary layer and extreme creates challenges for modeling extremes in temperature and precipitation that are critical to understanding feedback rocesses.	Ames
13	13	2		Collaborative Proposal: Improving Decadal Prediction of Arctic Climate Variability and Change Using a Regional Arctic System Model (RASM).	Multiple	Naval Postgraduate School, U Arizona, U Colorado, UC Santa Cruz, U Texas El Paso, U Washington, Iowa State U, and Los Alamos NL	This project will develop and apply a regional Arctic System model for enhanced decadal predictions. It builds on successful research by four of the current PIs with support from the DOE Climate Change Prediction Program, which has resulted in the development of a fully coupled Regional Arctic Climate Model (RACM) consisting of atmosphere, land-hydrology, ocean and sea ice components. An expanded RACM, a Regional Arctic System Model (RASM), will include ice sheets, ice caps, mountain glaciers, and dynamic vegetation to allow investigation of coupled physical processes responsible for decadal-scale climate change and variability in the Arctic.	Ames
39	17	2	3,5	Environmental technical support to Colorado River Storage Project	DOE-IEPP	Bureau of Reclamation, U.S. Fish and Wildlife Service, Humboldt State University	Modeling and targeted field studies to provide science-based information for operational decisions. Included were evaluations of the effects of hydropower operations on the downstream trout fishery and endangered species.	Argonne
44	22	2	4,5	Framework to Advance Climate, Economics, and Impact Investigations with Information Technology FACE-IT	WFO-Federal (NSF)	University of Chicago, University of Florida	FACE-IT project will develop, apply, and evaluate a new approach to data sharing within sustainability science using computationally enriched data stores that will contain not only data but also programs for extracting metadata from data (to populate catalogs and thus enable discovery), for converting among data formats (to enable data sharing among tools and communities with different conventions), and for data analysis. By reducing dramatically the costs of data publication, discovery, transformation, and analysis, and by incorporating rich methods for recording and acknowledging user contributions and interactions, FACE- IT Instances will break down barriers to cross-disciplinary data sharing and use.	Argonne

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54	3	2		FASTER	DOE-SC-BER	GFDL, GISS, Stony Brook	BNL has extensive experience with the Weather Research and Forecasting model (WRF) and using WRF nested within the NCAR Community Earth System Model (CESM). Expertise in individual ocean models on the regional scale e.g. storm surge (Stony Brook collaboration).	BNL
55	4	2		CSSEF	DOE-SC-BER	mulit-Lab	Development of single-column model testbed and precipitation metrics based on ARM radar observations, both for the Climate Science for Sustainable Energy Future (CSSEF) program	BNL
56	5	2		2xITCZ	DOE-SC-BER	Stony Brook	The SBU/BNL collaborative project uses ARM measurements to understand and reduce the double ITCZ bias in the CESM	BNL
75	8	2		Water Mgmt Decision Supt 02	Multiple	Colorado School of Mines	Evalution of water availability for oil shale production in the Piceance Basin	INL
77	10	2		Carbon Sequestration Program	Not Specified		Evaluation of subsurface injection of SCCO2 in to the subsurface	INL
78	11	2		Carbon Sequestration Par	Not Specified		Evaluation of regional groundwater response to the potential injection of SCCO2 in the subsurface	INL
84	17	2		Bakken Water Use	Lab-Internal	Montana Mines	Evaluation of hydraulic fracturing water use in potential development of shale oil in eastern Montana.	INL
101	11	2	3, 12	Aerosol Pollution, Mixing State and their Impacts on Climate and the Water Cycle	Multiple	PNNL, BNL, ANL, MTU, CMU, Manchester, Aerodyne, DMT, UC Davis, CU-Boulder, CSU-Fort Collins	LANL performs state of the art measurements in the field (ground and airborne for DOE field campaigns) and laboratory of aerosols (like soot and organic carbon) emittted from combustion and fires for DOE - Climate programs. We use our data to determine parameterizations of impacts of aerosols on clouds and rainfall, including the charachterization of pollution in water. LANL has strong expertise in ultraprecise and sensitive maesurements of black carbon, including its light absorption and toxicity effcets on human health. LANL has exceptional laboratory and field capability to analyze water quality/contamination in the field (e.g. proposed Aerosol Mass Spect) that EES and C can partner strongly in. LANL has high profile pubs including Nature-Comm in aerosol-cloud-water science.	LANL
102	12	2	3, 12	Atmospheric Carbon, Water and Nitrogen Observations to Elucidate Amazonian Ecosystem-climate Mechanisms and Scale Heterogeneities	DOE-SC-BER	Caltech, Harvard, JPL, NOAA-ESRL, LBL, ORNL, BNL, PNNL	LANL will deploy its robotic laboratory with a solar Fourier Transform Spectrometer and in situ laser sensors to measure the water, carbon and nitrogen cycles over tropical forests. Our multiscale measurements will be used to upscale couplings and heterogeneities in these cycles in DOE earth system models. The system will also be used to validate NASA Satellites. http://campaign.arm.gov/goamazon2014/documents/AmzonSolarFTS-Science-abstract.pdf?id=87	LANL
103	13	2		"SFA: Climate, Ocean and Sea-Ice Modeling" Part 1, Regional and global climate modeling,	DOE-SC-BER	LBNL, LLNL, ORNL, NCAR	Developed under core SC funding, LANL has a 20-year track record of developing global ocean, sea-ice and land-ice models for climate application (http://climate.lanl.gov). These models have been used as components of the NCAR/DOE Community Earth System Model and are included in the IPPC Assessment Reports. More recently, LANL has developed and released a multi scale global ocean system applicable to both global and	LANL

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							regional applications (http://mpas-dev.github.io). This modeling system is ideally suited for the study of extreme events within the atmosphere, ocean or ice systems.	
104	14	2		"SFA: Climate, Ocean and Sea-Ice Modeling" Part 2, Ocean, and ice system modeling & analysis	DOE-SC-BER	LBNL, LLNL, ORNL, NCAR	The development, validation and scientific application of climate model components (specifically ocean, sea-ice and land-ice) has been a core activity at LANL for the last two decades. Scientific application is typically conducted on leadership class computing facilities, thus requiring high-performance data analysis tools and visualization. Model validation and analysis is conducted via comparison to in-situ and remotely-sensed observational platforms.	LANL
105	15	2		Modeling and Analysis of Earth Systems, Coastal ocean modeling and sea-level rise	Not Specified		Coastal ocean modeling, along with the accompanying sea-level rise modeling, is a natural application of the multi scale ocean modeling framework already in place for global ocean applications. LANL hopes to build out its global ocean modeling capability into coastal ocean applications (that include sea-level rise, salt intrusion, coastal flooding and coastal biochemistry) over the next several years.	LANL
106	16	2		"Developing a next-generation approach to regional climate prediction at high resolution"	WFO-Federal (NSF)	NCAR, U. Washington, U. Penn	The project is to further develop a variable-resolution climate model (MPAS), to do coupled data assimilation with the model, and to develop downscaling and decision support tools. LANL work is data assimilation, coupling the MPAS ocean model to NCAR's DART data assimilation framework.	LANL
107	17	2		"Beyond the black box: Combining system and model dynamics to learn about climate uncertainties"	DOE-SC-BER	NCAR, U. Exeter	The project develops new uncertainty quantification methods using reduced models to combine uncertainties in climate system dynamics across multiple coupled climate models, and update them with observational data to provide predictive uncertainties. The application of this method focuses on quantifying uncertainties in individual, component-level regional climate feedbacks. It also studies "future learning", the expected reduction in uncertainty over time as more data accumulate, and the application of learning to decision support (e.g., cliamte-economic integrated assessment).	LANL
108	18	2	4	Next Generation Ecosystem Experiment, NGEE- Arctic	DOE-SC-BER	ORNL, LBL, BNL, UAF	This project aims to significantly reduce uncertantity in the prediction of Climate impacts and feedbacks in the terrestrial arctic through the integrated development and application of multi-scale data sets and multi-scale modeling platforms. LANL is contributing new high resolution and intermediate scale thermal-hydrologic-geomechical modeling frameworks, remote sensing data analysis and assimilation techniques and data products for model initialization and evaluation, and multi-scale hydrologic and geomorphic observational data sets for improved scaling of processes in the Community Land Model (CLM), which is part of the NCAR Community Earth System Model (CESM).	LANL
109	19	2		Quantification and reduction of critical	DOE-SC-BER	ORNL, NCAR	Developed more realistic canopy representation and succession dynamics in Community Land Model (CLM).	LANL

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				uncertainties associated with carbon cycle – climate system feedbacks				
110	20	2		Effects of wintertime warming on Arctic vegetation	Lab-Internal	Norwegian Nature Institute, Abisko Nature Researsch Station (Sweden)	This project evaluates the impacts of decreased snow cover on Arctic vegetation in Northern Sweden. Decreased snow cover may cause large-scale vegetation mortality in these areas via deep freezing of plant tissues and/or nutrient leaching, leading to major impacts on the water cycle.	LANL
111	21	2	12	How do trees die: multi-scale studies of carbon starvation and hydraulic failure during drought	Lab-Internal	Zurich Technical University and EMPA	In this project we developed a portable Nuclear Magnetic Resonance (NMR) system for detecting changes in plant water content and use in vivo in field conditions, and will conduct targeted experiments to understand the physiology that leads to tree mortality during drought. This understanding will improve our capabilities to model and predict vegetation changes related changing climate.	LANL
112	22	2		Predicting Climate Impacts and Feedbacks in the Terrestrial Arctic.	Lab-Internal		The project has developed the capability for high-resolution coupled surface/subsurface hydrology simulation capability using high-performance computing and is currently working to incorporate the hydrological effects of and feedbacks to the surface ecosystem. A flexible and extensible modeling framework is a key enabling capability developed in the project. The computational tools and the integrated characterization and multiscale modeling framework developed in the project has broader applicability for understanding and modeling the response of integrated surface/subsurface hydrologic systems accounting for the internal watershed dynamics associated with vegetation response.	LANL
113	23	2		Quantification and reduction of critical uncertainties associated with carbon cycle – climate system feedbacks	DOE-SC-BER	ORNL, NCAR	Developed more realistic canopy representation and succession dynamics in CLM	LANL
114	24	2		Next Generation Carbon-Nitrogen Model	Lab-Internal	UC-Irvine	To develop, test, and calibrate a next generation nitrogen limitation model and integrate this model into CLM	LANL
115	25	2		A hydraulic framework for understanding drought-induced mortality in Southwestern USA	DOE-SC-BES	Univ New Mexico, Colorado State University	Testing the original hypotheses and models of how trees die during drought.	LANL
116	26	2		A unified theory of vegetation survival and mortality (SUMO) during drought	DOE-Not Specified	UC Santa Cruz, University of New mexico, Colorado State University	We are developing, testing, and applying a theory of vegetation survival and mortality during drought that appears to be universal for all vascular plants. We are testing this through experimental ecosystem manipulations of drought, and model development, tests, and application	LANL
117	27	2		Modeling of infiltration, groundwater flow, and radionuclide migration at	DOE-EM	LLNL, USGS, DRI, Navarro-Intera	LANL Develops models and conducts hydrologic analyses for the arid Nevada National Security Site (NNSS). Most projects are associated with vadose-zone and saturated-zone subsurface	LANL

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				the NNSS			systems. However, the studies also consider infiltration from precipitation and from surface ponds.	
118	28	2	3	Texas Drought	WFO-Federal (DHS)	SNL	Modeling, simulation, and analysis of water-energy impacts from prolonged drought in the Texas region. Focus areas included municipal water, nuclear energy, and economic impacts	LANL
119	29	2		NISAC Dam and Flood Control Infrastructure Analysis	Multiple	University of Mississippi, DOD USACE ERDC	Advanced modeling, simulation and analysis of flood control infrastructure and the impacts of flood events. simulation includes cascading impact analysis to energy and water infrastructure systems	LANL
172	2	2		Tropical Forest Ecosystems under a Changing Climate	Lab-Internal		Integration of experimental, observational and model-based studies to advances understanding of climate-relevant tropical forest-atmosphere interactions.	LBNL
173	3	2		Developing a mechanistic high-latitude soil carbon and nitrogen cycle model	Lab-Internal		Integration of extant molecular microbiological 'omics' datasets into a carbon and nitrogen cycle representation in the NCAR community land model, with a focus on soil N-cycle processes, which are expected to change substantially over time and have strong impacts on soil carbon cycling and CO_2, CH_4, and $N20$ effluxes.	LBNL
174	4	2		Ecosystem and Land Management Interactions with Atmosphere and Climate	Lab-Internal		Improving the understanding of the degree to which ecological and land management processes influence the physical Earth system and feedback to climate change through evaluating and improving models of land-atmosphere interactions and climate change field experiments.	LBNL
175	5	2		Interactions Among Cloud Processes, Convection, and Climate Change	Lab-Internal		Numerical, observational and theoritical research investigating interactions among fast cloud physics, cloud feedbacks on climate change, and anthropogenic global warming.	LBNL
178	8	2		Multiscale Methods for Accurate, Efficient, and Scale-Aware Models of the Earth System (Advanced Scientific Computing Research-Scidac	Multiple		This project is developing, validating, and applying multiscale models of the climate system based upon atmospheric and oceanic components with variable resolution. The project is exploiting new variable resolution treatments of atmospheric and oceanic dynamics and accelerating the development and integration of multiscale atmospheric and oceanic parameterizations into the Community Earth System Model (CESM). Among other tasks, LBNL will provide analysis of and empirical evaluation of hydrometeorological extremes simulated by the multiscale models. LBNL is developing innovative stochastic parameterizations of critical climate processes and is introducing adaptive methods for simulating multiscale atmospheric phenomena including hurricanes, atmospheric rivers, and other climate extremes.	LBNL
180	10	2		DOE LM - Reactive Transport Modeling and Prediction of U(IV) Stability	DOE-LM		Development of a predictive and mechanistic understanding of the role natural U(IV) plays in sustaining groundwater U plume persistence at the floodplain scale as a result of upstream nuclear energy production activities.	LBNL
188	18	2		Simulating Earth's	WFO-Federal		Development of new approaches to use remote sensing	LBNL

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				Spectra.			signatures to quantify emissions and other processes critical for predicting climate change	
189	19	2	4	Subsurface Biogeochemistry Sustainable Systems SFA	DOE-SC-BER		Development of a predictive understanding/capabilities of how the subsurface microbiome modifies biogeochemical cycles, and how those interactions vary with land use and climate change. Includes the development of genome-to-watershed reactive transport simulation capabilites.	LBNL
191	21	2		Meta-omics Analysis of Microbial Carbon Cycling Responses to Altered Rainfall Inputs in Native Prairie Soils	DOE-SC-BER		Use of multi-omics techniques to determine the impact of changes in rainfall patterns on soil microbial communities and carbon cycling processes in the Great Prairie of the United States. Includes development of new omics tools for analysis of complex soil microbial communities.	LBNL
192	22	2		Terrestrial Ecosystem Science SFA	DOE-SC-BER		In-situ soil experiments to elucidate principles governing soil carbon dynamics and nutrient cycling to improve land model predictions and above ground measurements to improve predictions of emissions of gases and aerosols within the community earth system model	LBNL
193	23	2		Atmospheric System Research SFA	DOE-SC-BER		The Atmospheric Carbon task produces high quality observations at DOE ARM facilities and combines them with models to estimate regional land-atmosphere carbon and water fluxes, investigate interactions of convection, radiation, and ecosystem processes, and improve the ability to predict exchanges of carbon, water, and energy across spatial and temporal scales. The Cloud Dynamics task uses advanced methods like large-eddy simulations to addresses those dynamical aspects of moist convection that must be better characterized to improve convective parameterizations in global climate models, such as entrainment.	LBNL
194	24	2	1	Climate and Earth System Modeling SFA (CESM)	DOE-SC-BER		The CESM SFA focuses on modeling fast climate processes that play significant roles in hydrological and biochemical cycles. We investigate some of the central issues for the global environment, including the scale of human-induced forcings and feedbacks, the modes and probabilities of abrupt and extreme climate response, and the interactions of terrestrial ecosystems with climate change.	LBNL
201	31	2	12, 4	NGEE-Arctic	Multiple	ORNL; University of Alaska Fairbanks	Experiments and observations tightly linked with the development of multi-scale models to gain a predictive understanding of terrestrial arctic systems, their evolution, and their feedbacks with climate. Includes consideration of coupled hydrological, geochemical, thermal, geomechanical, biological and energy processes across a wide range of temporal and spatial scales.	LBNL
202	32	2		Mapping Soil Carbon from Cradle to Grave	DOE-SC-BER		To define a molecular blueprint for how organic carbon decomposition and stabilization processes in soil are impacted by the interactions between plant roots, the soil microbial community (bacteria, archaea, fungi, microfauna) and the soil matrix.	LBNL

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203	33	2		Biological Systems Research on the Role of Microbial Communities in Carbon Cycling & Carbon Functional Traits	DOE-SC-BER		The two projects under this effort aim to (1) determine the how microbial phylogeny and function evolve in the rhizosphere during plant root growth, death and decomposition and (2) to determine the key microbial traits that regulate surface plant litter decompositon and develop trait-based models to predict how global change (nitrogen deposition and precipitation) may impact these processes.	LBNL
233	63	2	5, 13	CCP Aquistore EM Monitoring	WFO-(BP)		Modeling and analysis of electromagnetic monitoring of deep saline aquifer with application to carbon sequestration	LBNL
238	68	2		Geochemical processes at environmental interfaces	DOE-SC-BES		Fundamental science to quantify geochemical interacations at pore fluid-mineral interafaces relavent to energy and environmental challenges	LBNL
248	78	2		Investigating the long term persistance of a Uranium Plume in Rifle, CO	DOE-LM	Stanford SLAC	Geochemical studies to investigate the persistance of a uranium plume associated with a DOE legacy waste site	LBNL
269	99	2		PISCEES - BISICLES	Multiple	U. Bristol, U. Exeter, LANL	Modeling of ice sheet dynamics using multi-scale numerical techniques, using the adaptive CHOMBO framework.	LBNL
270	100	2		REALM - CDWR	WFO-State	Ca Dept. Water Resources	Hydrodynamic transport in SF Bays and estuaries, with complex shorelines, mudflats, flooding; uses Chombo adaptive mesh refinement.	LBNL
272	102	2		EaSM2	Multiple	Colo. State	Advancing extreme value analysis of high impact climate and weather events, including precipitation extremes. The focus is on developing new statistical methods using a few case studies as guidance.	LBNL
276	106	2		BISCLES	DOE-SC-BER	LBNL	NERSC staff were funded on BiSCLES code work. Simulations ran on NERSC.	LBNL
280	1	2		PCMDI	DOE-SC-BER	Many, many US and global climate modelers! See http://cmip-pcmdi.llnl.gov/cmip5/availability.html for a partial list	The Project for Climate Model Diagnoses and Intercomparison brings together many of the worlds climate models, experts and institutions. The project leverages climate expertise, high performance computing and advanced data analytics and archival to determine where each model has particular skill and/or deficiency.	LLNL
281	2	2		DOE OFS "Early Career" Detection and Attribution: Droughts	DOE-Not Specified		Celine Bonfils: The goal of this project isto improve understanding of the nature and causes of past changes in droughts to identify potential onset of future drought. The problem of identifying a component forced by climate change is typically addressed using established statistical detection and attribution (D&A) techniques. These techniques identify the characteristic "fingerprints" associated with climate change and connect them to likely causesin the system.	LLNL
282	3	2		Ameriflux Surface Flux Exchange Experiments and Observations	Multiple	U. Oklahoma, LBNL, Oregon State, UC Davis	This involves measuring and modeling vegetative water loss for natural systems (forests mostly) and agricultural applications. We determine surface flux exchange and research the Soil-Vegetation-Atmosphere Continuum (SVAC)	LLNL
285	6	2		Groundwater flow	Multiple		Not explicitly Energy/Water Nexus, but uses groundwater	LLNL

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				modeling related to radiation contamination			modeling capability that could be explited at EW Nexus, and is directly coupled to water contamination issues that could be associated with nuclear power and nuclear waste.	
298	4	2		Short-Rotation Woody Biomass Sustainability	DOE-EERE	USDA-US Forest Service at Savannah River, University of Georgia, Oregon State University, University of Saskatchewan	Evaluation of impact of intensive SRWC silviculture on water quality; assessment of efficacy of forest best-management practices (BMPs) under SRWC production; recommendations for BMP modifications if needed.	ORNL
299	5	2		Applying Computationally Efficient Schemes for BioGeochemical Cycles (ACES4BGC)	Multiple	ANL, PNNL, LLNL, LANL, NCAR	Development of improved tracer and biogeochemical cycle representation in ESMs	ORNL
300	6	2		Climate Change - Terrestrial Ecosystem Science Focus Area	Multiple	USFS	Understanding ecosystem carbon cycles and responses in the context of climatic and atmospheric change is the focus of ORNL's research in the Terrestrial Ecosystem Science Focus Area. The combined efforts include large-scale manipulations, carbon cycle observations, process-level studies, and an integrating suite of modeling efforts. SPRUCE is one of the tasks under this project.	ORNL
301	7	2		Next-Generation Ecosystem Experiments-Arctic (NGEE)	Multiple	University of Alaska, Los Alamos, LBNL, Brookhaven, PNNL	The Next-Generation Ecosystem Experiments (NGEE) project will address how experiments, observations, and process models can quantify the response of physical, ecological, and biogeochemical processes within the Arctic to atmospheric and climatic change across molecular to landscape scales.	ORNL
302	8	2		A Hierarchical Regional Modeling Framework for Decadal-scale Hydro-climatic Predictions and Impact Assessments	Lab-Internal		Develop a computationally-intensive framework to use a suite of Earth system models and statistical techniques to downscale predictions from a multi-model ensemble of IPCC-AR5 global models to an ultra-high horizontal resolution of 4 km over the United States and the South Asia.	ORNL
303	9	2		Multiscale Investigations on the Rates and Mechanisms of Targeted Immobilization and Natural Attenuation of Metal, Radionuclide and Co-Contaminants in the Subsurface	DOE-SC-BER		In this FY we formulated reaction networks describing the microbially mediated changes to groundwater and solid phase geochemistry following introduction of different carbon sources to stimulate microbial activity. The resulting model was used to simulate laboratory and field scale experimental results. We also created a model to describe the geochemical changes occurring during titration of acidic groundwater and this model was used to simulate disparate laboratory experimental results. Three journal articles were published describing the results of this modeling work.	ORNL
304	10	2		Coupled Simulation of Surface-Subsurface Hydrologic Processes and Terrestrial Ecosystem and Climate Feedbacks	Lab-Internal		This project has developed models of rigorously coupled surface-subsurface hydrologic interactions and subsurface freeze-thaw dynamics, and integrated these into the open-source, massively parallel subsurface flow and reactive transport model PFLOTRAN. A framework for coupling this	ORNL

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							extended PFLOTRAN model has been developed for on-line coupling with the Community Land Model (CLM)--the land component of the Community Earth System Model (CESM)--to enable novel studies, at field to regional scales, of the interactions between surface-subsurface hydrologic and biogeochemical processes and the terrestrial ecosystem and associated climate feedbacks, especially those related to hydrologically induced surface and subsurface carbon cycling.	
359	10	2		Development of Frameworks for Robust Regional Climate Modeling	DOE-SC-BER		This project is designed to understand the effects of resolution and different modeling frameworks on different Earth system processes, especially extreme events, using the Weather Research and Forecasting (WRF) and CAM/CESM models	PNNL
360	11	2		Spatial-temporal anaysis of water availability	DOE-EERE	U of Washington	Project is focused on hydrologic modeling at subwatershed to basin scale to forecast streamflows over a range of time frames including day ahead, monthly, and seasonally. Results support water use optimization to maximixe hydropower production while satisfying multiple objectives including renewables integration and instream flow requirements.	PNNL
361	12	2		Climate Science for a Sustainable Energy Future (CSSEF)	DOE-SC-BER	LLNL, ORNL, …	This is a major multi-lab project to improve the resolution, utility, and performance of Earth system models.	PNNL
362	13	2		Regional Earth System Model (RESM)	Multiple		RESM, provides dynamically downscaled climate information for other models in the PRIMA framework, including for the RIAM project. RESM couples the Weather Research and Forecasting (WRF) atmospheric model, the Community Land Model (CLM), and the Regional Ocean Modeling System (ROMS) using the Community Earth System Model (CESM) flux coupler. RESM uses boundary conditions from global climate models or global reanalyses. For the initial PRIMA numerical experiments, RESM is being run over the conterminous United States at 20-kilometer resolution using boundary conditions from CESM under two different scenarios of global climate forcing.	PNNL
363	14	2		Puget Sound Modeling	Multiple	Washington Department of Ecology	Develop a high-resolution 3-D model of hydrodynamics, water quality (thermal, chemical), and biological community composition for the Salish Sea (Puget Sound, Georgia Basin, Strait of Juan de Fuca). Model links NOAA tidal/weather data, USGS stream flow gauged data, and NOAA monitoring station data into a predictive model that will serve as the basis for understanding the response of this complex system to climate, human development, restoration activities, and ocean energy development.	PNNL
364	15	2		Improved decision-making tols for watershed management	WFO-Federal (EPA)	University of Washington	Develop an integrated watershed-level decision support system for the Snohomish Basin of Puget Sound. Project links regional climate models to shallow groundwater recharge, surface/subsurface hydrology, coastal circulation and water quality, and human water use/management infrastructure.	PNNL

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							Product establishes an integrated modeling/data management decision-support tool, future climate/land use scenarios, alternative aquatic system management, and case studies	
365	16	2		Nearshore/Littoral evolution	Multiple		Using Delft3d-FLOW to develop high resoution (m to 10m) models for specific locations around the world to predict bathymetry evolution in coastal regions and estuaries in response to flow changes and sea level rise. Key inputs include current/recent bathymetry, substrate, hydrograph, tidal forcing, meteorlogical forcing, water discharges (surface water and industrial/municipal), and physical structures (e.g., reefs, weirs, docks, etc.).	PNNL
366	17	2		Community Land Model	Multiple		CLM is a community model that simulates simulates the biophysical, hydrological, and biogeochemical processes by which terrestrial ecosystems affect, and are affected by, climate. In addition to being the land surface model used in RESM and CESM, CLM also provides the basis for much of PRIMA's distributed water supply and demand capability. The Model for Scale-Adaptive River Transport, or MOSART, model has been coupled to CLM to simulate river dynamics. Several improvements and enhancements made to CLM have been included in the official release of CLM4.5	PNNL
367	18	2		Interactions of Aerosols, Clouds and Precipitation in the Earth System	DOE-SC-BER	NCAR, LLNL, LANL	This project is designed to improve and apply the Community Atmosphere Model (CAM) of the Community Earth System Model (CESM), with a focus on aerosols, clouds, and precipitation.	PNNL
391	3	2		Advanced Disposal System Modeling	DOE-NE	ANL, LBNL, LANL	Developing High Performance Computing Total System Analysis capability including 3D flow and reactive transport and uncertainty quantification. Has applicability to earth systems in general.	Sandia
392	4	2		Reducing Uncertainty in High-resolution Sea Ice Models	Lab-Internal	n/a	Implemented anisotropic ice model in LANL CICE code and evaluated sensitivities of model output to material parameters. Optimized model based on satellite data for ice deformation and motion.	Sandia
393	5	2		Invasion Percolation	DOE-Not Specified	Penn State University	Multiphase flow in capillary regimes is a fundamental process in a number of applied problems including CO2 sequestration, long-term disposal of nuclear waste, NAPL migration and geothermal energy production. The goal of this project is to advance existing invasion percolation models to represent multiphase processes in non-uniform porous media, with the support of direct experimental observation of pore-scale displacement mechanisms.	Sandia
394	6	2		Climate Impacts on Water Infrastructure	WFO-Federal (DHS)	n/a	Explore potential impacts of climate change on basin wide, integrated water infrastructure in the Platte River basin.	Sandia
24	2	3	4, 9	Water Resource Assessment of Geothermal Systems	DOE-EERE	INL	Analysis of critical water issues including cost of acquisition, transport, and treatment of water for geothermal systems and the role of the geothermal reservoir, power generation selection, and cooling technology selection in the water consumption	Argonne

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							profile of these systems.	
25	3	3	4, 9	Life Cycle Water Consumption for Carbon Capture and Sequestration	WFO-Integrated Contractor		Life cycle assessment of the direct and indirect water consumption from carbon capture and storage projects. It will expand the system boundaries beyond those of most previous analyses while utilizing the same methodology to evaluate a range of system configurations to facilitate comparison and evaluate the relative water impacts of different CCUS technology pathways.	Argonne
31	9	3	6	Modeling and Analysis of Pumped Storage Hydropower	DOE-EERE	NREL, Siemens PTI, MWH, Energy Exemplar	Model and analyze the value of advanced pumped storage hydropower, including their role in accommodating large shares of variable renewable energy resources. The main objectives of this 18-month project are: (1) to improve the modeling representation of advanced pumped storage hydropower and conventional hydro plants in power system and energy market simulation models; (2) quantify their ability to provide various grid services; (3) quantify the value of these services under different market structures and renewable energy (wind and solar) penetration scenarios; and (4) provide information for developing a business case for new investments in PSH and CH plants.	Argonne
36	14	3	4,14	Analyze the impact of changes in operations at Glen Canyon Dam on electricity market prices throughout the Western Interconnection	DOE-IEPP		Determine how operations at Glen Canyon Dam affect electricity prices throughout the Western Interconnection (WI). Operation of the WI was simulated for two scenarios that span the range of possible operating regimes at GCD. Electricity prices at selected market hubs were computed and compared to see how much the prices change between scenarios and whether any price differences occur only at hubs close to the dam or over a wide area.	Argonne
37	15	3	4,14	Economic Analysis of Environmental Operating Restrictions at Flaming Gorge Dam between 2001 and 2012	DOE-IEPP		Determine the cost impacts of operating the Flaming Gorge Dam with environmental restrictions compared to operating without such restrictions over the time period from 2001 to 2012.	Argonne
41	19	3	4,14	Financial analysis of experimental releases at Glen Canyon Dam	DOE-IEPP		Determine the financial implications of conducting experimental flows at Glen Canyon Dam. This study is conducted annually for WAPA and determines whether the experimental releases in the previous year resulted in a cost or benefit, and also the amount of that cost or benefit.	Argonne
50	28	3	5	Nuclear Fuel Storage and Transportation Decision Support System	DOE-NE	SNL, ORNL, SRS	Creating a decision analytical framework that will enable DOE, other policy makers, and prospective host communities to systematically and transparently structure and evaluate decision options related to the transportation and storage of used nuclear fuel.	Argonne
51	29	3	5	Checkpoint Strategy Simulator (CSS)	WFO-Federal (DHS)	SNL, INL	The CSS is a system dynamics model that simulates the effects on aviation security checkpoint performance based on the behavioral and decision-making processes of security personnel that are affected by technology, procedure, policy changes, and	Argonne

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							other factors. Contributes to understanding and correcting psychological, social, cultural, institutional, organizational, and cognitive factors that degrade security performance.	
52	1	3		Atmosphere-Ecosystem Modeling	Lab-Internal	Rutgers University	Evaluation of land cover particularly vegetation type, including barren, on precipitation in regional scale model. Using DOE-ARM data. DECERNS, discussed below, could also be used to address ecosystem modeling issues.(see 6 below)	BNL
65	14	3		Global Shale Gas Development Study	Not Specified		This project examines the trade implications between different regions of the world if shale gas is developed outside of the United States. There are potentially large declines in gas exports from Russia, the middle east and the United States.	BNL
71	4	3		Geomechanics in Shale	WFO-University	Univ. of Utah	Hydraulic fracturing in tight formation modeling.	INL
76	9	3		Leach Study of Spent Oil Shale	WFO	ExxonMobil	Evelution of potential contamination release to GW from oil shale production	INL
82	15	3		Mountain Home Geothermal	WFO-Federal (DOD)		Evaluation of hydrogeothermal potential of energy production at MH.	INL
85	18	3		SPH-DEM Simulations	Lab-Internal	UofU, CSM, OU	Evaluation of proppant transport in hydraulic fractures	INL
86	19	3		Fluid trapping in Hydraulic fractures	Lab-Internal	Colorado School of Mines	Evaluating the effect of using water trapping in hydraulic fractures on gas production	INL
87	20	3			Lab-Internal	Utah State	Developing a model on energy production in a basin and its effect on water use.	INL
120	30	3	4,5	NISAC Energy- Water Interdependency Analysis	WFO-Federal (DHS)	INL, American Water, United Water, City of Newark, Jersey City, North Jersey District Water Supply Commission	Large scale analysis of water distribution system resilience to all-hazards with an emphasis on cybersecurity and energy dependence.	LANL
241	71	3	6, 5, 1, 10, 12	Development of real-time decision support tools for Basin-scale water supply and water quality management	WFO-Federal	DWR, SWRCB, UCM, USGS, GWD	Working directly with CA and Federal water supply and regulatory agencies (DWR, USBR, SWRCB) to develop a suite of decision tools for water allocation and salinity load forecasting. Development of integrated surface-groundwater models for assessment of Basin-scale planning decisions.	LBNL
261	91	3	2	Urban Water Utility-- Water Storage and Electricity Use Tradeoff	WFO-State	UC Berkeley	The project evaluates urban utilities use water storage to avoid high (peak) electricity prices.	LBNL
263	93	3	2	Climate Impacts on the Electricity Infrastructure (temperature, flood and fire risk)	WFO-State		Provides estimates of the impact of global warming, sea level rise and wildfires on California's electricity grid. The current infrastructure would need to about 40% larger to deal with peak summer temperatures at the end of the Century.	LBNL
266	96	3		Technical Support Document evaluating benefits of efficient water heaters	DOE-EERE		Detailed benefit cost analysis, indicating water and energy benefits associated with different water heater efficiecy levels.	LBNL
267	97	3		Technical Support Document evaluating	DOE-EERE		Detailed benefit cost analysis, indicating water and energy benefits associated with different cloths washer efficiecy levels.	LBNL

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				benefits of efficient clothes washers				
268	98	3		Benefits of drought resistant biofuels-- evaluation of potential for genetically engineered drought resistant switchgrass	Lab-Internal	U.C. Davis	Study the potential to genetically engineer drought tolerant switchgrass as needed to avoid land use conflict with food crops and other land uses.	LBNL
284	5	3		Stochastic Inversion for Geothermal Field Mapping	DOE-EERE		Modeling and simulation of hydrological flows in geothermal reservoirs using stochastic inverstion.	LLNL
286	1	3	4,5,6,13	Energy and Water in a Warming World	WFO	University of Colorado-Boulder; NCAR; Stockholm Environment Institute;	The Energy and Water in a Warming World (EW3) is a collaborative effort between the Union of Concerned Scientists (UCS) and a team of more than a dozen independent experts to build and synthesize policy-relevant research on the water demands of energy production in the context of climate variability and change. The initiative includes core research collaborations intended to raise the national profile of the water demands of energy, along with policy-relevant energy development scenarios and regional perspectives.	NREL
287	2	3	4,5,6,11	Energy and Water in the Western and Texas Interconnects	Multiple	Sandia National Laboratories; Argonne National Laboratory; Electric Power Research Institute; Idaho National Laboratory; Pacific Northwest National Laboratory; University of Texas-Austin	"In response to the Research Call to DOE/Federal Laboratories for "Technical Support for Interconnection-Level Electric Infrastructure Planning, RC-BM-2010" Area of Interest 3: Water/Energy Nexus. According to the stated needs in the Research Call, three overarching objects are identified: 1. Develop an integrated Energy-Water Decision Support System (DSS) that will enable planners in the Western and Texas Interconnections to analyze the potential implications of water stress for transmission and resource planning. 2. Pursue the formulation and development of the Energy-Water DSS through a strongly collaborative process between members of this proposal team and the Western Electricity Coordinating Council (WECC), Western Governors' Association (WGA), the Electric Reliability Council of Texas (ERCOT) and their associated stakeholder teams. 3. Exercise the Energy-Water DSS to investigate water stress implications of the transmission planning scenarios put forward by WECC, WGA, and ERCOT.	NREL
288	3	3	4,5,6,11,13	Water Constraints in an Electric Sector Capacity Expansion Model	Lab-Internal	Sandia National Laboratories	The goal of this project is to expand the capabilities of NREL and its electricity capacity expansion modeling analyses by developing a functionality in the ReEDS model to consider water resources as a constraint to future electricity generation. Additional beneficial result s of this work will include a national level assessment of freshwater availability by county and by watershed, in addition to a national level assessment of shallow brackish water resources that could be used for power production. Such new capabilities will allow NREL to evaluate proposed water policy changes, such as the recent EPA	NREL

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							proposed regulations on power plant cooling systems, in addition to effectively assessing the likelihood of new plant builds in areas of water stress.	
289	4	3	4,5,6,11	Water Issues with Large-Scale Solar Projects	DOE-EERE	Sandia National Laboratories	The aim of this project is to evaluate the potential for large-scale solar projects to utilize alternative sources of water resources, such as municipal wastewater and shallow brackish groundwater. This work considers the location and costs of various types of water resources in addition to the location of proposed sites and designated zones for solar energy projects.	NREL
290	5	3	4,5,6,13	Life Cycle Water Intensity of Electricity Generating Technologies	DOE-EERE	Electric Power Research Institute	The purpose of this project is to consolidate and harmonize existing estimates of water usage (withdrawal and consumption) throughout the life cycle of electricity generating technologies. This work involves a comprehensive literature review, harmonization of underlying assumptions, and sensitivity analyses to provide ranges of water use intensity.	NREL
291	6	3	4,5,6,11	U.S. Energy Sector Vulnerabilities to Climate Change and Extreme Weather	DOE-PI	Sandia National Laboratories; Oak Ridge National Laboratory; Energetics Incorporated	This work—part of the Administration's efforts to support national climate change adaptation planning through the Interagency Climate Change Adaptation Task Force and Strategic Sustainability Planning process established under Executive Order 13514 and to advance the U.S. Department of Energy's goal of promoting energy security—examines current and potential future impacts of climate trends on the U.S. energy sector. It identifies activities underway to address these challenges and discusses potential opportunities to enhance energy technologies that are more climate-resilient, as well as information, stakeholder engagement, and policies and strategies to further enable their deployment.	NREL
292	7	3	4,5,6,13	Natural Gas and the Transformation of the U.S. Energy Sector: Electricity	WFO	University of Colorado-Boulder; Colorado State University	This work addresses aspects of the changing role of natural gas in the U.S. electric power sector and some of the implications of the rapid increase in the production of unconventional natural gas in recent years. Major areas of focus include greenhouse gas emissions, regulatory interventions, electricity generation portfolio, and water management impacts.	NREL
293	8	3	4,5	Land Use and Water Efficiency in Current and Potential Future U.S. Corn and Brazilian Sugarcane Systems	DOE-EERE	UNICAMP (Brazil)	Direct land use, life cycle GHG emissions, life cycle energy use, and water use of Brazilian sugarcane and U.S. dry grind corn ethanol were analyzed through literature review and meta-modeling. Historic, current, and potential future impacts of the biofuel technologies were evaluated for improvements due to technological learning and improvements in management practices and tradeoffs among biorefinery configurations.	NREL
305	11	3		New Stream-reach Development Resource Assessment	DOE-EERE		From the most recent federal hydrography, elevation, and streamflow datasets, estimate the national untapped new hydropower resource focusing on run-off-river projects	ORNL
306	12	3		Forecasting water quality and biodiversity	DOE-EERE	ANL	Quantify the change in water quality and quantity associated with converting landuse to grow bioenergy crops and stover for the Mississippi River basin.	ORNL
307	13	3		Collaboration on	DOE-EERE	Reclamation,	This research will provide a much needed set of predictive	ORNL

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				Hydrodynamic and Water Quality Modeling Improvements for Temperature and Dissolved Gases (Cumberland and Columbia Basins)		USACOE, Iowa University, Vanderbilt University	water temperature, Dissolved oxygen, and Total Dissolved Gas equations derives from high fidelity models and mechanistic approaches based on long term data analysis that will be included in hydropower operational scheduling tool to optimize generation while minimizing environmental impacts downstream of hydropower dams. The first application and testing of this research is to assist the COE Nashville District and CADWES with the implementation and testing of the developed equations in their hydropower scheduling tools for the Cumberland River system and Mid-Columbia River system, respectively.	
308	14	3		Brazil Collaborations on Sustainable Production Pathways & Land-Use Change Analysis	DOE-EERE		The project supports research collaborations which aim to: (a) develop comparable indicators, criteria and measurement protocols to assess the sustainability of bioenergy production (e.g., indicators including soil and water quality); (b) develop, test and share improved management practices for water, soil and residues associated with biofuel production; (c) improve analysis and modeling of land-use change (LUC) associated with bioenergy policies.	ORNL
309	15	3		Sustainability, Ecosystem Services, and Bioenergy Development across the Americas - a Office of International Science and Engineering (OISE) - Partnerships for International Research and Education (PIRE) Project	WFO-University		In collaboration with other universities and research centers in the US and the Americas, ORNL contributes to tasks related to sustainability measurement and indicators, helping the team test two hypotheses: (a) A suite of indicators and metrics can be identified and tested to provide useful, scientifically based assessments of the relative sustainability of bioenergy systems in the Americas and (b) the suite of indicators can be adapted to reflect sustainability priorities at different scales. The suite of indicators includes energy-water nexus issues in forested landscapes managed for bioenergy across the Americas.	ORNL
310	16	3		Defining Sustainability	DOE-EERE	University of Tennessee, NC State, Texas A&M, Great Lakes Bioenergy Research Center (GLBRC), Council on Sustainable Biomass Production (CSBP), Global BioEnergy Partnership (GBEP), NCASI, NREL, Argonne, INL, PNNL, Savannah River	"The goal of this ongoing project is to ensure long-term supply of sustainable feedstock and bioenergy by determining how bioenergy production can affect sustainability at a watershed scale and how sustainability of bioenergy systems can be measured, assessed, and improved. Our focus is on: • Indicators, targets, and quantitative methodologies for evaluating sustainability • Scientific consensus on definitions of bioenergy sustainability • Consistent, defensible messages on bioenergy sustainability	ORNL
311	17	3		Application of GIS for Identifying and Characterizing Siting	DOE-NE		This effort has led to the development and refinement of Oak Ridge Siting Analysis for power Generation Expansion (OR-SAGE), a tool to support power plant siting evaluations. The	ORNL

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				Options for Small Modular Reactors			objective in developing OR-SAGE was to use industry-accepted approaches and/or develop appropriate criteria for screening sites and employ an array of geographic information systems (GIS) data sources at ORNL to identify candidate areas for a power generation technology application.	
312	18	3		Assistance with Incorporating Impacts into Integrated Assessment	DOE-SC-BER	LANL, SNL	Developing concepts, tools, and databases to connect Integrated Assessment Models (IAM) with Connected Infrastructure Dynamics Models (CIDM) and Impact, Adaptation, and Vulnerability analysis tools (IAV) in order to improve the science base for examining interconnections between the energy and water sectors and other sectors as well, including land.	ORNL
313	19	3		Regional Integrated Assessment Modeling (RIAM)	DOE-SC-BER	PNNL, MIT, LSU	Analyzing relationships between climate change and energy systems in the US Southeast, including effects of climate change on ambient air and water temperature, which in turn affects the operating capacity of thermal electric power plants.	ORNL
314	20	3		Sustainable Development of Algae for Biofuel	DOE-EERE	University of Tennessee	Conducting sustainability studies (including identification of sustainability indicators, targets, best management practices, and case studies) and resource analysis for algal biofuels	ORNL
368	19	3		Electricity Operations Model (EOM)	DOE-Not Specified		EOM is an open-source unit commitment and optimum power flow model that can be used to explore, among other questions, electric reliability impacts of heat wave scenarios and drought conditions.	PNNL
369	20	3		CCS Modeling	DOE-FE		This program consists of a portfolio of projects focused on development and deployment of the STOMP simulator: A suite of computer codesfor solving subsurface multifluid flow and reactive transport problems. Projects involve application of STOMP to support laboratory and field investigations of: geologic sequestration of greenhouse gases; coupled reactive transport; oil shale production; and natural gas hydrate production including the assessment of energy production on water resource availability and quality.	PNNL
370	21	3		BEND Model	Lab-Internal		quantify impacts of extreme weather patterns on the buildings electricity and heating fuel consumption on an hourly bases across many regions	PNNL
371	22	3		Energy infrastructure siting (SITE) model	Lab-Internal		SITE evaluates the feasibility of power plant siting options based on environmental restrictions (e.g., cooling water availability, clean air act, etc.) and economic considerations (e.g., interconnection costs)	PNNL
372	23	3		Building Energy Demand (BEND) model	Multiple		BEND combines DOE's EnergyPlus model with a geostatistical analysis of climate, population, and other trends to estimate building energy demand for a utility zone or larger region. It can be used to model, for example, the impacts of extreme weather patterns on the buildings electricity and heating fuel consumption on an hourly basis.	PNNL
373	24	3		Hydrosystem modeling to improve environmental	Multiple		Develop high resolution 3-D model of thermal behavior/response of hydropower reservoirs under alternative	PNNL

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				performance of hydropower installations			flow/system operational scenarios. Model is used to determine hydrosystem operational parameters that will maintain compliance with federal regulations and standards, given alternative water year/climate scenarios.	
395	7	3		Drinking Water Resilience Improvement through Advanced Situational Awareness, Threat and Risk Assessment	WFO-Federal (DHS)	LANL	Seedling funding to develop a tool to evaluate the cloud to tap vulnerabilities of the integrated infrastructure of the U.S. water supply chain to natural/human hazards, climate change and population growth.	Sandia
396	8	3		Energy and Water in the Western and Texas Interconnections	DOE-OE	ANL, PNNL, NREL, INL, EPRI, UTX	Worked with WECC and ERCOT to integrate issues of water and climate into long-term transmission planning. Key product is maps of water availability and cost across the western U.S. for over 1200 watersheds and five different sources of water.	Sandia
397	9	3		Task within US Energy Sector Vulnerabilities to Climate Change and Extreme Weather	DOE-PI	NREL lead effort	Scoping level analysis of cost to convert all existing thermoelectric power for zero freshwater use. Considered least cost alternative between conversion to wastewater, brackish groundwater or dry cooling.	Sandia
398	10	3		Systems Engineering	DOE-EERE	n/a	A multiyear project (suffered for FY13 $) developing a physics based economic model for Enhanced Geothermal Systems.	Sandia
399	11	3	4	Institutional Transformation (IX)	Lab-Internal	n/a	IX aims to provide a modeling tool that will allow institutions (including SNL) to evaluate impact of implementation of long term (20-30 yr) energy conservation strategies. This is not directly a 'water-energy' project, but energy savings at large institutions will reduce water demand for electricity production.	Sandia
15	15	4		Multiscale Design of Materials	DOE-FE		While materials play a critical role in technology, they come into the design process only through selection. Our goal is to create the computational and information framework that will enable the integration of materials design into the overall design process.	Ames
16	16	4		Nanotwinned Materials for Energy Applications	Multiple	Carnegie Mellon U	This program is an integrated experimental, modeling and simulation program to develop nanotwinned materials for technological application. The modeling and simulation is multiscale, linking a range of computational methods, with a focus on developing predictive tools. This is extensible to other multiscale problems.	Ames
17	17	4		Extending Dislocation Dynamics with FFT to Address Dislocation Patterning and Slip Band Formation	Multiple		The goal of this project is to replace the use of empirical constitutive relations within continnum models of polycrystal plasticity with direct simulations of the underlying dislocation flow. It represents a direct coupling between simulation methods across scales. It includes uncertainty quantification.This is extensible to other multiscale problems.	Ames
45	23	4	6	Ag-GRID, AgMIP, and ISI-MIP	WFO-Federal (NSF)	University of Chicago, LBNL, PNNL), Universit of Florida, Columbia University, NASA,	Study to assess climate impacts on global agricultural production. The study involved a preliminary intercomparison of seven Global Gridded Crop Models (GGCMs) and culminated with the submission of six papers to a special issue of the Proceedings of the National Academy of Sciences.	Argonne

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						Monsanto, Colorado State University, Washington State University	Currently engaged a new model and data partners (now 18+ models in 11 countries) to participate in a new, more substantial and rigorous, GGCM Intercomparison (GGCMI). This project will greatly expand the international capacity for multi-model climate impact assessment and advance an ambitious scientific agenda.	
57	6	4		DECERNS - Decision Evaluation in Complex Environmental Risk Networks	DOE-Not Specified		BNL developed a software tool that integrates a GIS platform with Multi-Criteria Decision Analylsis Techniques to provide a platform for evaluation of multiple constraints (time, technical feasibility, societal goals, ecological risk, etc) on risk management strategies to help select the optimum solution.	BNL
58	7	4		A Regional Earth System Model of the Northeast Corridor: Analyzing 21st Century Climate and Environment	Multiple	City University of New York, Marine Biological Laboratory, Rensselaer Polytechnic Institute, University of New Hampshire	Building a Northeast Regional Earth System Model (NE-RESM) that improves understanding and capacity to forecast the implications of planning decisions on the region's environment, ecosystem services, energy, and economy through the 21st century. Major advances include: coupling of meso-scale atmospheric physics and chemistry models to a terrestrial-aquatic ecosystem model; geospatial modeling of energy and anthropogenic emissions and biotic source/sinks at improved temporal resolutions; a linked ecosystem services accounting tool; and meso-economic input-output model to evaluate the impacts of ecosystem services constraints on sub-regional economies.	BNL
59	8	4		Long-term Energy-Water Planning for New York City	Multiple	New York State Research and Development Authority, City University of New York	Systems analysis and modeling of detailed energy and water sub-systems and technologies for supporting short- (2020), medium- (2030) and long-term (2050) decision making. Deployment analysis for advanced and new technologies. Energy optimization, emission reduction and increasing water efficiency.	BNL
70	3	4		Modeling Mitigate Risk of CO2	WFO-Integrated Contractor	Univ. of Utah	Evaluation of geomechanical changes due to subsurface CO2 sequestration and impacts to GW	INL
73	6	4		Geothermometry	DOE-EERE	Univ. of Idaho	Evalation of reservoir temperature for potential geothermal production	INL
74	7	4		Fractured Permeability Study	WFO	ExxonMobil	Evalation of the permeability changes in oil shale due to pyrolysis heating	INL
79	12	4		Hybrid Geothermal Solar	DOE-EERE		Evalation of using solar energy combined with hydrogeothermal power generation	INL
80	13	4		Hybrid Geothermal Solor Binary	DOE-EERE		Evalation of using solar energy combined with hydrogeothermal power generation	INL
121	31	4		The World's First Drought and Insect Caused Global Tree Mortality Monitoring System	Lab-Internal	LANL	To develop the world's first automated global drought/insect-caused tree mortality monitoring system for SW US, combined with advanced uncertainty quantification and data assimilation approaches	LANL
122	32	4		Coupled modeling of wellbore integrity	DOE-FE	NETL, UWVa	Coupled modeling of leakage processes in wells due to geomechanical stresses or wellbore defects including migration	LANL

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							of fluids to USDWs.	
123	33	4		An Integrated Multifaceted Approach to Mathematics at the Interfaces of Data, Models, and Decisions	DOE-Not Specified	UT Austin, MIT, Stanford University, Colorado State University, Florida State University, ORNL	For many complex problems in computational science and engineering, the so-called forward problem solution of the underlying model to yield outputs of interest, given input parameters is difficult enough. As the target physical problems have grown in complexity to encompass strongly heterogeneous, possibly stochastic, multiphysics behavior over a wide range of length and time scales, the demand for advanced mathematical methods has become acute. However, there is an urgent need to move beyond solution of forward problems, to address what is often the ultimate goal of these analyses: decision making. This requires to tackle a spectrum of mathematical problems that subsume, and are thus even more difficult than, the forward problem.	LANL
124	34	4		Multi-scale Modeling for Earth Systems	Multiple		Under joint SC-ASCR funding, LANL is extending its multi-scale modeling capability via the multi-lab project "Multi-scale Modeling for Earth Systems." Under this 5-year proposal, LANL is developing ocean turbulence parameterizations amendable for use with multi-scale global ocean models.	LANL
125	35	4		Climate Science for Sustainable Energy Futures	DOE-SC-BER	LLNL, SNL	Under SC funding, LANL has developed climate-related UQ capabilities under the multi-lab project "Climate Science for Sustainable Energy Futures." At present, the capability is focused on parameter constraint and optimization.	LANL
126	36	4		The World's First Drought and Insect Caused Global Tree Mortality Monitoring System	Lab-Internal	LANL	To develop the world's first automated global drought/insect-caused tree mortality monitoring system for SW US, combined with advanced uncertainty quantification and data assimilation approaches.	LANL
127	37	4	1,2,3,5	Wildfire	WFO-Federal	USF, INRA(France), CSU	HiGrad/FIRETEC is an R&D100 winning LANL HPC simulation platform for modeling vegetation atmosphere interactions and wildfire. This study focuses on effects of complex topography, insect impacts, and fundamental wildfire behavior including critical watersheds.	LANL
128	38	4	1,2,3,5	Wildfire Phenomenology	Lab-Internal	USF, UCB, INRA	R&D project studying fire-atmopshere interactions that can lead to severe fire events such as pyrocumulus collapse, which potentially effects local weather and global climate (e.g due to aerosol injectin into upper atmosphere).	LANL
129	39	4	1,2,3,5	Wildfire and Facility Protection	WFO-Federal (DOD)	USF, Eglan AFB, INRA	Analysis and wildfire modeling study of land use management to mitigate damage and sustain ecosystems.	LANL
196	26	4	2	Early Career Research Program - "A Multiscale Reduced Order Method for Integrated Earth System Modeling"	DOE-SC-BER		Reduced order approaches developed for terrestrial land models	LBNL
199	29	4	5	Quantification and reduction of critical uncertainties associated	DOE-SC-BER		Advancing and implementing modeling capabilities to quantify terrestrial ecosystem - climate feedbacks and associated uncertainties, particularly in vulnerable (Arctic and Tropical)	LBNL

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				with the Carbon Cycle-Climate System Feedbacks			systems.	
216	46	4	11, 13	Geochemistry and THMC Models for the Newberry EGS Project	DOE-EERE	AltaRock Energy	The Newberry Volcano EGS Demonstration will allow geothermal industry and academic experts to develop, validate and enhance geoscience and engineering techniques and procedures that are essential to the expansion of EGS. The LBNL component of this project is to develop a coupled THCM model for the Newberry system that can be used to design and evaluate the results of the reservoir stimulation activities.	LBNL
218	48	4		Simulation of University of Bergen Carbon Sequestration	WFO-University		This collaborative project between the University of Bergen (UoB) and Lawrence Berkeley National Laboratory consists of teaching a UoB PhD student how to use the TOUGH family of codes to simulate important energy related topics, such as CO_2 sequestration and gas hydrates. The PhD student will simulate available data from experiments, and will participate in laboratory experiments and their analysis.	LBNL
220	50	4		Laboratory Studies in Support of Characterization of Recoverable Resources from Methane Hydrate Deposits	DOE-FE		The objective of this work is to measure physical, chemical, mechanical, and hydrologic property changes sediments containing methane hydrate, gas, and water subjected to injection of a mixture of carbon dioxide and nitrogen. This work is to support analysis of data from a field test in Alaska in which a mixture of 77% nitrogen and 23%bcarbon dioxide was introduced into a methane hydrate-bearing reservoir, and then gas extracted. We are measuring permeability changes and geophysical property changes resulting from the gas exchange.	LBNL
223	53	4		Experiments in Support of Controls On Methane Expulsion During Melting Of Natural Gas Hydrate Systems	WFO-University		The objective of this work is to investigate the effects of different warming trends on gas hydrate dissociation and release to the environment. Laboratory measurements are performed to support the theoretical and numerical investigations to be performed at the University of Texas. In these tests, methane hydrate is formed in porous media in a long vertically oriented pressure vessel, while simultaneously measuring pressure, temperature, hydrological, and geophysical properties of interest. Different warming approaches are implemented to induce system changes.	LBNL
227	57	4	5	LBNL CORE: Project 3	WFO-(Chevron)		Integrated reservior management, sensors and risk assessment	LBNL
228	58	4	2	LBNL CORE: Project 6	WFO-(Chevron)		Integrated reservior management, sensors and risk assessment	LBNL
230	60	4	12	LBNL CORE: Project 5	WFO-(Chevron)		Integrated reservior management, sensors and risk assessment	LBNL
231	61	4		LBNL CORE: Project 4	WFO-(Chevron)		Integrated reservior management, sensors and risk assessment	LBNL
239	69	4		Geophysical imaging of fluids	DOE-SC-BES		Integrated experimental, numerical and theoritical investgations to quantify the geophysical signature of fluids in the subsurface	LBNL

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255	85	4		WaterSense	WFO-Federal (EPA)		Water efficient product program to show the energy savings from water conservation.	LBNL
258	88	4		Alternative Energy Development and China's Energy Future	DOE-EERE		This project examined China's alternative, non-fossil, energy in terms of drivers, technological challenges and resource constraints, with emphasis on the life-cycle resource requirements of raw materials, land and water. The lifetime water input requirements for each type alternative energy technology (solar PV and concentrated solar power towers, onshore and offshore wind, hydropower, nuclear, and advanced coal alternative technologies) were evaluated using simplified life-cycle analysis and modeling.	LBNL
259	89	4		Climate Change Mitigation and Impacts	WFO-University	UC Berkeley	Graduate level teaching course at UC Berkeley.	LBNL
260	90	4		Cross-Sector Impact Analysis of Industrial Process and Materials Improvements	DOE-EERE	NREL, ORNL	This project is a component of the broader AMO analysis effort to estimate benefits for current and future AMO activities and respond to quick turn-around requests as needed. LBNL's primary focus is on developing an analytical architecture and associated cross-sector impact analysis tool, which includes integrating water/wastewater demands (distribution, use, treatment) and associated energy requirements throughout MECS classifications of the U.S. manufacturing sector	LBNL
264	94	4		Energy Savings from Water Conservation	WFO-State		Project to identify electricity savings associated with water conservation programs in California.	LBNL
271	101	4		CHOMBO	DOE-SC-ASCR		Multi-scale simulation of complex physical systems	LBNL
277	107	4		VACET	DOE-SC-ASCR	LBNL	NERSC analytics staff work on storm detection	LBNL
315	21	4		Basin Scale Hydropower Opportunity Assessment	DOE-EERE	PNNL	Used national databases of environment, hydrology, and hydropower assets to identify opportunities to simultaneously develop hydropower production and environmental protection	ORNL
316	22	4		Providing environmental flows while maintaining hydropower operational flexibility	DOE-EERE	PNNL, ANL	National assessment of hydrologic and ecological impacts of hydropower-altered stream flows with the goal of developing tools and methods for maintaining operational flexibility and environmental protection. Data analysis utilized years of continuously collected stream flow data at thousands of stream gages nationwide.	ORNL
317	23	4		Mercury dynamics in a stream ecosystem	Multiple	University of Tennessee, Texas Southern	Developed dynamic model of mercury transformation and transport throughout a contaminated stream ecosystem (floodplain, groundwater, surface water, sediment, and biota).	ORNL
318	24	4		Thermal stress dynamics in fish	WFO	Tennessee Tech University	Developed thermal stress model for fish to understand their response to dynamic and extreme temperature exposure that is outside of natural ranges like that at a powerplant discharge.	ORNL
319	25	4		Biological Monitoring and Abatement Program	Multiple	B&W, Honeywell, UT, UCOR	Long-term ecosystem monitoring program uses multidisciplinary and quantitative tools to assess spatial and temporal changes to aquatic stressors. Causal analysis and investigations provide key data for facility operations and decision support.	ORNL

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320	26	4		Hydropower Cost Model	DOE-EERE	Corps of Engineers, Bureau of Reclamation, National Hydropower Association	ORNL is building program capability to model the effects of technology advancements, physical water availability changes, and water policy constraints on hydropower capital and production costs.	ORNL
321	27	4		Environmental Mitigation Predictor Tool	DOE-EERE		Develop model that predicts likely mitigation requirements (e.g., fish passage, instream flow, water quality criteria, etc.) based on project characteristics, environmental setting and resources, and a national characterization of existing mitigation.	ORNL
322	28	4		Stream Classification Tool	DOE-EERE		Predict and validate streamflow and fish assemblage responses to hydropower development, and prioritize hydrologic variables and fish species for future mitigation feasibility studies. These models will aid in developing information requirements for models predicting likely mitigation requirements.	ORNL
374	25	4		The Multifaceted Mathematics Center for Complex Energy Systems	DOE-SC-ASCR		Develop scalable UQ algorithms for predictive modeling and planning of power grid systems	PNNL
375	26	4		Carbon Capture and Storage Uncertainty Analysis	DOE-FE		Develop scalable UQ software for Carbon Capture and Storage modeling and simulation	PNNL
376	27	4		Cyber-Physical Research laboratory and powerNET testbed	WFO-Federal (DHS)	University of Illinois Urbana-Champaign , USC Information Sciences Institute, SRI	The goal of this effort is to leverage the emerging DOE PNNL Center for Collaborative Cyber-Physical Research—which houses analytical tools, cyber-physical research equipment, and special purpose equipment—in such a way that the resources can be made available to a broader community and combined with similar resources via DEFT. The power networking, equipment, and technology (powerNET) testbed is an implementation of a multi-user experimental CPS testbed. powerNET combines simulation, virtualization, emulation, and real cyber-physical equipment in one testbed.	PNNL
377	28	4		Enterprise sustainment requirements forecasting model development and implemention.	WFO-Federal (DOD)	HQDA (G-4/G-8/ASA-AL&T), DASA-CE, AMSAA	Analyze existing data, policies, and methods for developing life-cycle resource requirements for Department of Army programs as well as the downstream budget planning and programming efforts which increasingly rely on more accurate and defendable estimates of long-range resource requirements. Working with collaborating institutions, develop enhanced techniques (procedures, models or applications/tools) to: 1) improve the visibility of life-cycle program costs, 2) rapidly assess the impact of significant program changes, and 3) better defend Army-defined funding requirmeents.	PNNL
378	29	4		Vulnerability-Resilience Indicators Model (VRIM)	Multiple		VRIM is a structured method for analyzing country, sector, and local vulnerabilities to climate change.	PNNL
379	30	4		Vulnerabilty of DOD installations to climate change	WFO-Federal (DOD)		The objective of this project is to develop, pilot, and evaluate an approach to assess installation vulnerability tailored to DoD decision-making needs and processes.	PNNL
380	31	4		Scenarios for the National Climate Assessment	WFO-Federal		PNNL has been heavily involved with the scenario development activities, such as the Representative	PNNL

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							Concentration Pathway (RCP) process, for many years. This particular project was for the U.S. National Climate Assessment.	
400	12	4		Event Detection	WFO-Federal (EPA)	EPA, Texas A&M University	Rapid and accurate detection of contamination incidents in drinking water is critical for the protection of human health. As part of this research, the real time event detection software CANARY was developed. This software has been installed for use at several water utilities in the US and abroad. CANARY was recognized as a leading innovation with an R&D100 award in 2010.	Sandia
401	13	4		Contaminant Response	WFO-Federal (EPA)	EPA, Texas A&M University	Following the positive detection of contamination in a water distribution network, water utilities would rely on emergency response plans for intervention strategies. This project develops modeling, optimization, and visualization software tools to help water utilities minimize human exposure to contaminants.	Sandia
402	14	4	5	ParVis: Parallel Analysis Tools and New Visualization Techniques for Ultra-Large Climate Data Sets	DOE-SC-BER	ANL, PNNL, NCAR, UC Davis	Developing a new parallel analysis library that interfaces with the NCAR Command Language (NCL), a widely used scripting language for post-processing and visualization of climate model output. Sandia is contributing parallel analysis algorithms based on the discretization library Intrepid and other Trilinos components.	Sandia
18	18	5		Virtual power plants	DOE-FE		The goal of this project is to develop an open source integration framework to support decision making for complex systems. This framework brings together visualization, multiple heterogeneous analysis tools & models, and human-machine interaction to build an integrated computational environment. This framework (VE-Suite) was built over a period of 10 years and will completed in FY 13. This project has rec'd 2 R&D 100 awards. This work has been extended to environemental systems.	Ames
19	19	5		Virtual engineering training environment	DOE-FE		This project uses the VE-Suite integration framework developed by the Ames Laboratory to support real-time interactive training on complex systems. FY 13 work included completing the development of the opensource visualization engine latticeFX, LatticeFX updates volume rendering and VTK pipelines based on improved OSG 2.5 capabilities. This will provide improved, faster workflows for the large complex unstructured grids encountered in the large complex system.	Ames
20	20	5		Merged environments for simulation and analysis	DOE-FE		This project uses the VE-Suite integration framework developed by the Ames Laboratory to integrate complex physical systems and computational systems together to provide a integrated computational environment capable of analsysis, exploration, and control of cyber- physical envrionments. A new scene graph (JAG) is being developed by the Ames laboratory and will be completed in FY14. This scene graph is emphasizes the interation and visualization workflow	Ames

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							needed to support large-scale complex system applications.	
21	21	5		Virtual paint	WFO		This project uses the VE-Suite integration framework developed by the Ames Laboratory to create training environments in which computational models, physical tools, and human actions are integrated together in realtime within a virtual reality environment to track the outcomes of human actions within a manufacturing system. The product developed has been commercialized and currently has 80-90% market share.	Ames
22	22	5		Visualization and analysis tools for complex systems	WFO		This project uses the VE-Suite integration framework developed by the Ames Laboratory. Heterogeneous models are integated together to supportto engineering analysis and investigation of complex large scale machines.	Ames
53	2	5		ARM Climate Research Facility Engineering	DOE-SC-BER	ORNL	BNL directs external data center for ARM. Capability of taking in data external to ARM, integrate it into ARM data system, and make it subsequently available to research community. Expertise in database structure and data management.	BNL
130	40	5		See ASCEM in Topic 1				LANL
131	41	5		See Tree mortality in Topic 4				LANL
132	42	5		See CO2-PENS and System modeling in Topic 1				LANL
133	43	5		Multiple Infrastructure Simulation Tool	Multiple	NA	Research and development of an integrating architecture for simulation of infrastructure systems (eletric power, natural gas, petroleum, water, dams) for exercise decision support systems.	LANL
134	44	5		See Multiscale modeling for Earth Systems in Topic 4	DOE-SC-ASCR		A key feature of LANL climate model development over the last 15 years has been efficient computation on leadership class facilities. Numerous projects (Multi-scale Modeling for Earth Systems, Climate Science for Sustainable Energy Futures and core SC funding) all include deliverables related to optimization of numerical algorithms on existing and emerging architectures.	LANL
135	45	5		Advanced Geospatial Analysis and Visualization Environment	WFO-Federal (DHS)	NA	Client application for model deployment to DHS customers.	LANL
176	6	5		Advanced Simulation Capability for Environmental Management (ASCEM)	DOE-EM	LANL, SRNL, PNNL	Development of a modular and open source subsurface flow and transport simulation and analysis framework that can be executed on a variety of platforms and which includes capabilities for data management, visualization, parameter estimation and uncertainty quantification	LBNL
197	27	5	2	Development of Frameworks for Robust Regional Climate Modeling	DOE-SC-BER		Predicting the regional hydrologic cycle at time scales from seasons to centuries is one of the most practical yet challenging goals of climate modeling. Water supports ecosystems as well as a wide range of human activities such as energy, agriculture, and transportation. Large uncertainties remain in projecting	LBNL

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							climate change at the regional scale, which limit our ability to inform policy decisions that will address climate change impacts, adaptation, and mitigation. Increasing model resolution to more explicitly represent finer scale processes may be a key to improving simulations of the hydrologic cycle. The overall objective of the proposed research is to develop frameworks for robust modeling of regional climate and hydrologic cycle, and to improve understanding of factors contributing to uncertainties in simulating future changes in the regional hydrologic cycle.	
235	65	5	2	Development of Stochastic Methods	WFO-(Chevron)		Stochastic joint inversion methodologies for imaging reservoirs and associated processes	LBNL
236	66	5		Advanced EM imaging tools	WFO-(Chevron)		Improve performance of frequency-domain electromagnetic modeling/imaging code. Develop automatic mesh generation capability. Improve inversion performance using preconditioning techniques.	LBNL
237	67	5		Improvements for Time Domain	WFO		Continue development of time-domain electromagnetic modeling/imaging code. Application of imaging capability to Petromarker marine EM configuration. Carry out synthetic test data inversion studies.	LBNL
247	77	5		Advanced Data Assimilation	WFO	Subsurface Insights	Development of computational framework to allow constraints of models using streaming field datasets	LBNL
256	86	5		Developing guidelines, indicator system and tools for low carbon city development, with energy-water nexus as KPIs	WFO	World Bank	BEST-Low Carbon Cities is designed to provide city authorities with strategies they can follow to reduce city-wide carbon dioxide (CO2) emissions. The tool quickly assesses local energy use and energy-related CO2 emissions across nine sectors (i.e., industry, public and commercial buildings, residential buildings, transportation, power and heat, street lighting, water & wastewater, solid waste, and urban green space), giving officials a comprehensive perspective on their local carbon performance. Cities can also use the tool to benchmark their energy and CO2 performance against other cities inside and outside China, and identify those sectors with the greatest energy saving and CO2 emissions reduction potential	LBNL
257	87	5		Developing indicator system and tool for low carbon eco-city development, with energy-water nexus as KPIs	DOE-EERE		The goal of ELITE is to evaluate Chinese prefecture-level cities according to reported performance in 33 low-carbon eco-city indicators while minimizing data input requirements and transparently presenting results for each indicator, each indicator primary category, and the city's total score. By using this tool, cities can evaluate their progress towards achieving best-performance levels in each indicator and indicator primary category. In future iterations, the tool will be expanded to compare a city's performance against other cities in China, as well to subsets of cities grouped based on key climate and economic characteristics.	LBNL
262	92	5	1	Model of Water and	WFO-State		Working with a fully linked water energy model, we illustrate	LBNL

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				Energy Flows in Sacramento			impacts of climate change on a water and energy use in California's capital. Model helps identify key climate sensitivities, from an economic perspective, and key sources of model uncertainty and variablity.	
265	95	5	1	Linking Water Energy Models in a California Basin	Lab-Internal		Developed a fully linked water energy system model for a California basin. The model links demands and supply for energy with the demands and supplies for water. In principle, the model can be used to identify life cycle changes in water use, associated with energy and life cycle changes in energy use, associated with water.	LBNL
273	103	5		Tigres - Template Interfaces for Agile Parallel Data-Intensive Science	DOE-SC-ASCR		Data processing scientific workflow definition and execution tools to enable high throughput computing on data.	LBNL
274	104	5		FRIEDA: Flexible Robust Intelligent Elastic Data Management	DOE-SC-ASCR	ANL	Collaborative scientific data sharing that supports emergent usage patterns such as on-demand computing	LBNL
275	105	5		Visual Data Exploration and Analysis of Ultra-Large Climate Data	DOE-SC-BER		The Visualization project seeks to transform our ability to visualize and analyze the output from ultra-high-resolution simulations that will increasingly underpin national and international assessments of climate change. This project focuses on advancing an integrated visualization and analysis framework for scientific discovery from ultra-high-resolution simulations of near-term climate change. The team's approach focuses on using a set of science drivers, which reflect challenges in understanding regional-scale climate-change phenomena, as the basis for a coordinated effort that includes visualization of ultra-large data, statistical analysis, and feature detection/tracking techniques. The aim is to deliver new capabilities needed by the climate science community to tackle problems of the scale required by Intergovernmental Panel on Climate Change (IPCC) Assessment Report 5 (AR5) objectives.	LBNL
278	108	5		NERSC Computing	DOE-SC-BER	many	FY13 climate and water computing at NERSC, procurement benchmarks	LBNL
323	29	5		Biological Monitoring and Abatement Program	Multiple	B&W, Honeywell, UT, UCOR	Extensive experience in managing and integrating multidisciplinary data from long-term ecological assessment programs. Approach emphasizes the collection and storage of extensive metadata (i.e., analytical methods, standardized station locations) that enable the proper interpretation and retrospective analysis of the underlying measurement data.	ORNL
324	30	5		Bioenergy Knowledge Discovery Framework (KDF)	DOE-EERE		The Bioenergy Knowledge Discovery Framework (KDF) provides support to the research mission for the Bioenergy Technologies Office (BETO) along with their funded researchers and industry partners. The primary focus of this system development is the creation of a national geospatial-temporal decision support capability through the provision of	ORNL

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							comprehensive data, modeling, and knowledge resources in conjunction with analytical and visualization capabilities. The Bioenergy KDF will allow web-enabled analysis, synthesis, and visualization of data that facilitates data sharing and collaboration while also reducing data duplication and distributed data silos. The Bioenergy KDF can be access at https://bioenergykdf.net.	
325	31	5		VERDE: Visualizing Energy Resources Dynamically on Earth	DOE-OE	NGA, DHS, Northcom, various Utilities	Major power outages in the United States over the past decade have the following recurring themes: (i) the lack of a wide-area electric grid status view is a key factor that contributes to blackouts and (ii) the lack of a broad predictive view of the grid's state has made managing the preparedness for and response to destructive events extremely difficult. VERDE ingests data in real-time from various sources (through agreements, open source, established providers, etc.), runs the diverse streaming data through an analysis pipeline, and presents the outputs in an intuitive spatio-temporal manner valuable to end-users. Energy a wide-area real-time electric grid status view for the first time. This supports superior grid behavior modeling and simulation capabilities, and coordinated human response that will enable greater grid stability.	ORNL
326	32	5		Daymet database and model	Multiple	NCDC	Daymet generates daily, gridded surfaces of temperature, precipitation, humidity, and radiation over large regions and takes into account areas of complex terrain. Daymet has broad applications over a wide variety of scientific and research fields including hydrology, terrestrial vegetation growth models, carbon cycle science, and regional to large scale climate change analysis.	ORNL
381	32	5		Integrated Water Resource Management System (IWRMS)	Multiple		A software system that allows for the integration of multiple hydrological models in order to perform comprehensive modeling for water resource management in King County. The system includes advanced data harvesting mechanisms, data management (reproducability), workflow managment, and distributed computing support.	PNNL
382	33	5		Velocity	WFO-Federal (DHS)		Quantitative analysts, i.e., statisticians, applied mathematicians, and computer scientists, need easy-to-use, flexible tools to perform deep analytics on big data. Velocity will be a software framework that permits quantitative analysts do develop highly customized, advanced analytic models on large data in near-real-time. It takes care of all the distributed computing and processing required for handling big data, while still allowing the quantitative analyst to interact with the data as if they were performing their work in a desktop environment.	PNNL
383	34	5		Scalable Reasoning System (SRS)	WFO-Federal (DHS)	John Hopkins University Applied Physics Lab	SRS is a software framework and library of analytic, visual and harvesting components that support the rapid development of custom visual analytic web applications. Applications have been developed, deployed and are in active use across a variety	PNNL

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							of domains including social media, cyber security, critical infrastructure protection and patent analytics.	
384	35	5		Airborne Radiological Enhanced-Sensor System (ARES)	WFO-Federal (DHS)	LBNL, SAIC, RSL-Nellis AFB	The next generation aerial radiation detection platform (including hardware and software). PNNL's work focuses specifically on the software, creating new algorithms for background estimation, anomaly detection, and localization as well as a software integration framework that supports near real-time analysis and visualization of the information gathered.	PNNL
385	36	5		Global Nuclear Detection Architecture (GNDA) scenario tree and node visualization	WFO-Federal (DHS)	LANL	Effort to examine ways to visualize vast scenario tree associated with potential nuclear terrorism pathways and detection architectures. Potential is for millions of such branches on the scenario tree. Will invoke unique ways to visualize this tree, scroll in/out, various labels, etc. all automated based user inputs about the scenario setup. Visualization will also operate with the Radiological and Nuclear Terrorism Risk Assessment Methods (RNRAM) tool to display and analyze computed risk for each branch for this vast scenario tree.	PNNL
64	13	6		China and India Projects	DOE-Not Specified	U.S. Energy Companies, U.S. Trade Representatives, U.S. Foreign Commercial Services	Work with Chinese and Indian ministries and cities to implement enabling strategies and policies for deploying advanced technologies in Chinese and Indian cities, Facilitate markets for U.S. services and technologies in China and India an Enable Chinese and Indian investment in participating U.S. cities	BNL
136	46	6	12	Non-linear acoustics (PTS 4)	WFO-(Chevron)	Chevron	Investigating the use of LANL's non-linear acoustic sensor technology in a whole range of applications related to the optimization of drilling efficiency, oil production, and reservoir management in deep wells.	LANL
137	47	6	12, 15	Swept frequency acoustic interferometry (PTS 14)	WFO-(Chevron)	Chevron, General electric	Investigating use of LANL's advanced acoustic sensor technology in a whole range of applications related to fluid flow through pipelines and wellbore tubulars. Applications range from determining various factors involved in fluid quality (flow rate, density, viscosity, chemical composition, oil/water/gas volume fractions etc), the interaction of the fluid with the pipeline (e.g. depositions such as scale, asphaltenes or hydrates), and the condition (e.g. erosion/corrosion) of the pipeline itself.	LANL
138	48	6	11	High energy stimulation (PTS 21)	WFO-(Chevron)	Chevron, Colorado School of Mines, ATK	Development of environmentally friendly and safe HE systems to create fracturing in situ within geologic formations.	LANL
139	49	6	12	Steam quality discriminator (PTS 28)	WFO-(Chevron)	Chevron	LANL is developing a steam quality discriminator to monitor vapor fraction within piping used in steamflooding operations for production from heavy-oil reservoirs.	LANL
140	50	6	12	Non-linear pore pressure (PTS 29)	WFO-(Chevron)	Chevron	Investigating the use of acoustic technologies to estimate pore pressure within rock formations. Experimental studies are planned in bench-scale and laboratory-scale environments.	LANL
141	51	6	12	Programmable spectral	WFO-	Chevron	Building on recently demonstrated LANL technology, a high	LANL

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				imager for methane (PTS 35)	(Chevron)		spectral resolution programmable spectral imager based on addressable Microelectromechanical systems (MEMS) optical devices, optimized for detection of hydrocarbon gases in the infrared spectral regions, is being developed.	
246	76	6	3, 1, 10	Assessment of groundwater reserve planning for drought mitigation	WFO-Federal	USGS, USBR, UCSC, SCWA	Development and assessment of the concept of groundwater reserve planning for drought mitigation. Development of site-specific applications in Soquel Creek Water District and in the Sonoma County Water District.	LBNL
279	109	6	13	Multi-agency leverage in data	Multiple	many	NERSC stores and shares large NASA, DOE, and NOAA datasets.	LBNL
294	9	6	7,9,11	Low-Enthalpy Geothermal Desalination	DOE-EERE	Colorado School of Mines	This project provides a decision support tool (DST) that generates optimized solutions for low-entalpy geothermal desalination potential given source water quality and quantity, desired product water quality, and availability of low-enthalpy heat from geothermal power plants. The DST will be able to compare required energy for water treatment with available energy at the power plant site and suggest a range of desalination and pretreatment processes that are applicable to the location and time of operation.	NREL
327	33	6		Biological Monitoring and Abatement Program	Multiple	B&W, Honeywell, UT, UCOR	The Biological Monitoring and Abatement Program has hosted well over 200 students from dozens of universities across the country.	ORNL
328	34	6		Drought Risk Modeling for Thermoelectric Power Plants Siting Using an Excess-Over-Threshold Approach	Not Specified	George Washington University	Collaborative exploratory project (i.e., white paper development and/or letter of intent)	ORNL
329	35	6		Impacts of Shale Gas Fracturing on the Ecosystem and the Energy-Water Nexus in the Host Locations	Not Specified	George Washington University	Collaborative exploratory project (i.e., white paper development and/or letter of intent)	ORNL
330	36	6		A Multi-Agent Reinforcement Learning Approach for Energy-Water Nexus under Climate Change Uncertainty	Not Specified	George Washington University	Collaborative exploratory project (i.e., white paper development and/or letter of intent)	ORNL
386	37	6		Great Lakes Bioenergy Research Center (GLBRC)	DOE-Not Specified	Many	This is one of several projects that leverage, extend, and apply PNNL's expertise using the EPIC crop model and related capabilities to assess bioenergy sustainability concerns as part of the GLBRC, one of DOE's bioenergy research centers that brings together multiple institutions across public, private, academic, and NGO communities.	PNNL
387	38	6		Basin Scale Assessment	DOE-EERE	ORNL, State Agencies, Local Government,	Using the upper Deschutes River as a case study, develop an outreach, stakeholder engagement, and multitradeoff analysis process that would enable development of new hydropower	PNNL

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						Irrigators	generation using existing irrigation impoundments and canal infrastructure while allowing all existing uses of the water to be retained.	
388	39	6		Marine Spatial Planning	DOE-EERE	Oregon State University, State Agencies	Work with stakeholders in Oregon and Washington, representing fisheries, federal agencies, state agencies, recreationalists, and local governments to develop input to a marine spatial use plan that incorporates ocean energy development into state and federal marine spatial planning.	PNNL
38	16	7	15,12	Emerging water treatment technologies and approaches for oil refineries	WFO-(BP)	Argonne	Testing and scale up bench to pilot of wastewater treatment technologies to remove mercury from oil refinery wastewater to meet very stringent Great Lakes Discharge criteria	Argonne
88	21	7		Forward Osmosis Purification of Produced Water	DOE-EERE	none	An assessment will be made of the system energy requirements and the energy present in the co-produced fluids, which will consider both the technical feasibility of the process and the potential economic benefits. With confirmation of feasibility and potential, testing would be done to establish viable membrane materials and draw solutions, with the entire process subsequently tested in a laboratory setting using a simulated heat input and an integrated lab-scale demonstration and test unit.	INL
89	22	7		Water Purfication Using Switchable Polarity Solvent and Forward Osmosis	WFO-(Chevron)	Chevron	In the Phase I of this project INL will build lab scale systems comprising the various SPS-FO process steps. The apparatus will be used to treat various feed solutions provided by Participant. The Test Samples contain various concentrations of components therein so that INL may treat the Test Samples using its SPS-FO technology utilizing membranes and forward osmosis to produce water enriched in the concentration of components and water depleted in the concentration of components to evaluate the effectiveness of SPS-FO technology.	INL
90	23	7		Forward Osmosis-based System for Treatment of Waste Water Generated During Energy Production Using Waste Carbon Dioxide and Waste Heat	DOE-SC-SBIR/STTR	Porifera	This SBIR Phase 1 project will determine the best operating conditions and demonstrate economic viability of a new forward osmosis water treatment system. This system will use a novel recyclable switchable draw that uses carbon dioxide during the water treatment process developed at Idaho National Labs. The system will have higher recovery and be able to treat more problematic water with lower energy use compared to state of the art technologies.	INL
142	52	7		See System Modeling & Science of Geologic Sequestration in Topic 2			Modeling of costs and processes for treatment of produced and alternative (brackish and saline) waters	LANL
143	53	7		Treating Frac Flowback Waters	WFO-(RPSEA)	RPSEA/HARC /TAMU/IX Power	Developing organic pretreatment methods for oil and gas produced water and fracture-flowback waters, specifically removal of organic compounds including Benzene, toluene, ethylbenzene, and xylenes and other nonpolar compounds. Field testing on oil and gas produced waters and Marcellus	LANL

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							Shale fracture flowback waters was performed. Patented technology #7,767,078	
144	54	7	8	Silver-doped glass coatings	Lab-Internal		Capability: Deposition of metal-nanoparticle containing glass coating for biofouling control	LANL
145	55	7		Capacitive Deionization	WFO-(Chevron)		Capacitive deionization in oil/water separations (proprietary)	LANL
177	7	7		EBI (Energy Bioscience Institute) Petroleum Microbiology	WFO	University of Illinois at Urbana-Champaign, UCB, BP	Development of modeling and monitoring approaches to gain a predictive understanding of the metabolic potential of reservoirs for mitigating or remediation souring and for enhancing hydrocarbon production	LBNL
179	9	7		DOE EM Fukushima – Cesium transport in the Environment	DOE-EM		Data gathering and synthesis to translate DOE's experience in quantifying and remediating metals and radionuclides in the environment to the Japan Fukushima effort	LBNL
190	20	7	2, 4	Upscaling of Uranium Desorption and Transport Modeling from the Bench to Meter Scale	DOE-SC-BER		Experimental and modeling project of uranium adsorption and transport in large-scale tanks utilizing contaminated sediments from the Naturita UMTRA site.	LBNL
205	35	7		Subsurface Conditions Controlling Uranium Incorporation in Iron Oxides: A Redox Stable Sink	DOE-SC-BER		The fate of U in subsurface systems depends entirely on its redox transformation and interactions with solid mineral phase. This project is tasked with understanding a new potential subsurface sink for U, incorporation into Fe (hydr)oxide minerals. By understanding the controlls on this process and the stability of the resulting co-precipitates we can better predict the movement of U in teh subsruface and potentially lead to new in situ or ex situ U treatment technologies.	LBNL
242	72	7		Assessment of potentially deleterious effect of CCS oper	WFO-State		Leakage of stored CO2 from geologic repositories is one of the main risk scenarios that needs to be understood for proper risk assesment of geologic CO2 storage activites. This project focuses on assesing the potential deletrious effects on potable groundwater in the California Central Valley from elevated CO2.	LBNL
244	74	7		Uranium and Strontium Fate in Waste-Weathered Sediments: Scaling of Molecular Processes to Predict Reactive Transport	DOE-SC-BER			LBNL
283	4	7		Desalinization using electrostatic ion pumping	WFO-State		Developed a new desalination technicque (electrostatic ion pumping and/or capacitive deionization) used sucessfully at salinities < 6 g/l. The technology uses new materials which are expected to handle corrosive environments.	LLNL
403	15	7	8	Integration Cooling System with Membrane Distillation to Substantially Reduce Water Requirements	WFO	n/a	Utilize waste heat within a power plant to produce distilled quality water. Project is evaluating Graphene Oxide as the filter media.	Sandia
32	10	8	7	Water desalination	WFO-	UC	Development of water desalination technology with advanced	Argonne

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				membranes	University		gold-thiol nanoparticle embedded membranes	
33	11	8	7	Water desalination membranes	Lab-Internal	LDRD	Development of water desalination technology with nanofiber embedded membranes	Argonne
46	24	8		Novel Free Piston Linear Motor Compressor	DOE-ARPA-E	GTI, U Texas	Development of corrosion-resistant, energy-efficient natural gas compressors for home use. ANLs role involves coating development and tribology testing of the linear compressor unit.	Argonne
47	25	8		Advanced Lubrication Additives for Improved Fuel Efficiency	DOE-EERE	Lubricant OEMs	Investigation of fundamental phenomena associated with the formation of protective tribology-films on surfaces exposed to engine lubricants. Project focuses on the use of advanced analytical techniques such as FIBS to characterize the structure and chemistry of nanometer thick chemical films on surfaces for the development of corrosion-resistant, energy-efficient systems.	Argonne
48	26	8		Lab-Engine Correlation and In-Situ Validation of Fuel-Efficient Engine Lubricant Technologies	DOE-EERE	Engine component suppliers	Application of lab scale test rigs to simulate field conditions found in vehicles (engines and transmissions). Goal of project is to establish high-fidelity test protocols to use lab scale results to reliably predict behavior corrosion-resistance and energy-efficiency in field applications.	Argonne
49	27	8		Ultra-Fast Boriding for Improved Energy Efficiency and Reduced Emissions in Materials Processing Industries	DOE-EERE	Heat Treater	Development and demonstration of an ultrafast chemical boriding process to for protective, wear-resistant coatings/surfaces on mechanical components and increased corrosion-resistance and energy-efficiency.	Argonne
146	56	8		See: Advancing the State of Geologic Sequestration Technologies in Topic 1			Membrane science development for separations capability	LANL
147	57	8		Supercapacitors for energy storage	Lab-Internal	Washington State University	This project is focused on tailoring the electrolyte solutions (both aqueous and non-aqueous) in supercapacitors for improved energy storage.	LANL
148	58	8		Water vapor furnace	DOE-NE		Capability: Water vapor furnace allows testing of materials at temperatures up to 1250 C and simultaneous mass spectrometry.	LANL
149	59	8		Molybdenum tubing	DOE-NE		Thin wall Molybdenum tubing synthesis by fluidized bed chemical vapor deposition. Application field is for nuclear reactor cladding with improved accident tolerance. Cycle R&D campaign.	LANL
150	60	8		Corrosion in High S and cyanide-containing environments	WFO-(Chevron)	Chevron	Alloy corrosion during petrochemical refining, in high S and CN bearing media	LANL
151	61	8		Long-term PuO2 corrosion	DOE-NE		Corrosion of DOE 3013 containers of PuO2-study of long-term aging and corrosion.	LANL
152	62	8		Silver-doped glass coatings	Not Specified		Capability: Deposition of metal-nanoparticle containing glass coating for biofouling control	LANL
331	37	8		Titanium sheets for reverse osmosis	WFO	Campbell Applied Physics	This project worked to develop a separate supply chain from the airline industry in order to make available 8-millimeter thick titanium sheets for heat exchange during reverse-osmosis	ORNL

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							of sea water.	
332	38	8		Specialized Technical Assistance for the Corrosion Prevention and Control Program (CPAC)	WFO-Federal (DOD)	NCP Paint Company	Develop superhydrophobic paints and temporary coatings for Marine land and amphibious vehicles. Present coatings do not survive well in salt water and high humidity environments, leading to coating degradation and severe corrosion. Highly water repellent coatings protect the underlying surfaces and prevent corrosion	ORNL
333	39	8		Low-cost self-cleaning reflector coatings for concentrating solar power collectors	DOE-EERE	Rioglass Solar and Flabeg Holdings	This project aims to develop self-cleaning, optically transparent coatings that can be directly applied to the first surfaces of heliostats and collector mirrors of concentrating solar power electricity generating facilities. These coatings will considerably reduce the maintenance time and costs associated with cleaning these mirror surfaces while having a negligible impact on the optical performance of the mirrors, thereby ensuring that the maximum amount of solar energy is collected.	ORNL
334	40	8		Cools Roofs & Urban Heat Islands	DOE-EERE	Dow Chemical and LBNL	Project goals are to develop acrylic coatings that not only have excellent reflectance and UV resistance, but are also waterproof, which is essential to maintain the roof coating long term performance. A reflective coating that maintains very high water resistance with increased long term soiling and microbial resistance would provide additional energy savings (as high as 2x) and extend roof service life.	ORNL
335	41	8		Zebra-Muscle Mitigation	Lab-Internal	US Bureau of Reclamation	The goal of this project is to establish the viability of water repellent and anti-biofouling coatings as a zebra-muscle mitigation mechanism. If successful, ORNL-based superhydrophobic coatings could be used worldwide to prevent or reduce the negative effects of zebra-muscle infestation.	ORNL
336	42	8		Nanostructured Superhydrophobic Coatings for Breakthrough Energy Savings	DOE-EERE	Ross Technologies	This project deals with nanostructured superhydrophobic powders developed at ORNL that can be incorporated in highly water repellent coatings to prevent corrosion, reduce drag and eliminate bio-fouling. The major objective of this project is to implement the nano-structured super-hydrophobic technology so that breakthrough energy savings can be realized using these materials.	ORNL
337	43	8		Superhydrophobic Materials Technology-PVC bonding techniques compatible with pinned oil	Lab-Internal	Veloxflow, LLC	The project developed application techniques for applying superhydrophobic diatomaceous earthpowders to PVC pipes and materials, and then applying and pinning a siloxane oil to the water repellent surface coating the PVC pipe or other surfaces that are wet-cleanable, anti-fouling, waterproof and anti-corrosion.	ORNL
30	8	9	8	Advanced cooling fluids with reduced evaporative loss	WFO		Develop functional nanoparticles and introduce them in cooling tower water to enhance thermal properties, increase heat capacity and increase apparent heat of vaporization. The overall impact could be in reducing the overall water loss from evaporation in the cooling tower.	Argonne
60	9	9		China Water Energy Team	WFO	Sandia National Laboratory, Circle of	Participated as one of four U.S. experts on China Water Energy Team for nine roundtable discussions in Beijing during the	BNL

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						Blue, Pacific Institute, Delaware River Basin Commission, Greenovation Hub, Chinese Academy of Sciences, Natural Resources Defense Council-China, China Institute of Water Resources and Hydropower Research	week of August 5, 2013 with the goal of gathering information and data to identify research, legal, policy, and NGO priorities for China to begin dealing with water-energy confrontations and explore opportunities for further U.S.-China cooperation on these issues. Support developing a bilingual Water-Energy Roadmap report that captures insights from this exchange and lay the groundwork for more detailed discussions on this subject.	
61	10	9		U.S.-China Low-Carbon EcoCities	DOE-Not Specified	Chinese Ministry of Housing and Urban-Rural Development, China Energy Cooperation Program at AmCham, U.S. and Chinese cities, U.S. energy companies	Develop Eco-City plans, policies and enabling strategies facilitating effectively deploying U.S. energy efficient and renewable energy technologies. Share lessons learnt through joint training, workshops and exchange visits.	BNL
62	11	9		Promoting Near-Zero Energy Cities and Industrial Zones in India	DOE-Not Specified	Four Indian Ministries (including, Urban Development, Industries, New and Renewable Energy, Heavy Industries), eight Indian cities, Energy Cooperation Program, U.S. energy companies	Develop long-term plans and strategies for deploying energy efficient and renewable energy (EE&RE) solutions, in an effort to leapfrog Indian cities to advanced infrastructure consuming lower energy and providing environmental sustainability. Under this, proactive cities like Mumbai, Chennai, Ahmedabad, Solar Cities like Surat, Gandhinagar and New Town and industrial zones/regions like Dholera, Noida and SriCity are devising policies to deploy EE&RE in identified zones and projects; including green buildings, distributed renewable energy and smart grid, transportation, industries, water supply and sanitation and solid waste disposal.	BNL
63	12	9		Implementation of Energy Conservation and Building Codes in the State of Tamil Nadu, India	DOE-Not Specified	Alliance to Save Energy, Pacific North-West Laboratory, Bureau of Energy Efficiency, Ministry of Power-India, State of Tamil Nadu and six state departments, U.S. energy companies	Provide support and tools to help State and local partners implement ECBC at the state and local levels. This activity will raise ECBC awareness among state and municipal officials and other professionals to build operational-level capacity on the technical and procedural aspects of the code's implementation in two pilot States/cities.	BNL
81	14	9		ARRA Air-Cooled Condensers	DOE-EERE		Efficiency of using air cooled condensers in binary hydrogeothermal power plants	INL
153	63	9		Electrocalorig refrigerator (Hehlen)	Lab-Internal		Development of a novel electrocaloric refrigerator using dielectric fluid thin film technology	LANL

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154	64	9		"Upscaling" Nanoscale Thermoelectrics: The Meso-macroscale Design Challenge for Real-World Energy Needs	Lab-Internal		Addressing the challenge of scale that is uniquely relevant to nano-enabled thermoelectrics (TEs). Nanoscale phenomena can dramatically alter the fundamental properties of semiconductor materials for applications in TEs, such as the electronic density-of-states and charge-carrier or phonon mobilities and interactions.	LANL
404	16	9	14	Integration Cooling System with Membrane Distillation to Substantially Reduce Water Requirements	WFO	n/a	Utilize waste heat and non-traditional raw water (make-up) water to reduce the cooling system requirements within a power plant while simultaneously producing distilled quality water; thereby, lowering the plant's water requirements	Sandia
29	7	10	7,15	Biomass production and nitrogen recovery	DOE-EERE	Argonne	Development of water-sustainable approaches for biomass production at the field and watershed scale	Argonne
155	65	10		See Topic Area 1: National Alliance for the Advancement of Biofuels and Bioproducts			Scale-up of algal biofuel cultivation, harvesting, separations, and refining	LANL
249	79	10		Process Modeling and Life-cycle Assessment of Emerging Biofuel Pathways	WFO	University of California, Berkeley	This project demonstrates the feasibility of establishing a link between chemical process modeling and LCA using two pilot projects. The first involves how lignin is most effectively used. The second is the development and refinement of an Aspen model based on a novel pathway that integrates biological and chemocatalytic routes to convert acetone/butanol/ethanol fermentation products into ketones, which can be used as fuel as is or hydrotreated to produce other drop-in fuels.	LBNL
254	84	10		Low-cost, Scalable, Fast Demand Response for Municipal Wastewater and Recycling	WFO-State	Prime recipient AutoGrid, Inc (subcontractor LBNL)	The goal of this project is to provide a reference for facilities such as waste-water treatment plants and recycling plants to provide Fast Demand Response within California. Pilot deployments of OpenADR2.0 in these industrial facilities (i.e. wastewater treatment plants, Recycling Facilities), will act as an industry reference for OpenADR2.0 deployment within California. The project aims to bring several innovative technologies already proven in laboratory settings at leading academic institutions in California to demonstrate their applicability in mainstream industrial settings.	LBNL
405	17	10		CO_2 reduction using Intensive Production Agricultural Techniques	WFO	New Mexico State University (Institute for Sustainable Agricultural Research), LANL	Evaluating Intensive Production agricultural methods for improving soil fertility and sequestration of carbon in soil. Includes monitoring of soil carbon changes.	Sandia
156	66	11		Discovery Science of Hydraulic Fracturing: Innovative Working Fluids and Their Interactions with Rocks, Fractures, and High Value Hydro-carbons	Lab-Internal	Chesapeake Energy, Universities	Coupled experimental and computational studies of hydraulic fracturing designed to elucidate fracture mechanisms in order to optimize water usage and hydrocarbon extraction with an emphasis on using supercritical CO_2 as an alternative to water.	LANL

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214	44	11	13	Geothermal Energy Production Coupled with CCS: Heat Recovery Using an Innovative High Efficiency Supercritical CO2 Turboexpansion Cycle	DOE-EERE	Texas Bureau of Economic Geology	Field demonstration of the use of CO2 as a working fluid at the Cranfield CCS site. The methodology is referred to as combined geological carbon sequestration/geothermal heat extraction (GCS/GHE) that targets large brine-bearing sedimentary formations with natural permeability and are the targets for geological carbon sequestration (GCS).	LBNL
215	45	11	4, 13	Experiment-Based Model for the Chemical Interactions between Geothermal Rocks, Supercritical Carbon Dioxide and Water	DOE-EERE	Palo Alto Research Center (PARC)	This joint project consists of fluid-mineral experiments and coupled process modeling to develop the capabilities of simulating an EGS-CO2 reservoir during its transition from water to supercritical carbon dioxide (scCO2).	LBNL
217	47	11	4, 12, 13, 6	Demonstration of a Deep Enhanced Geothermal System at the Northwest Geysers Geothermal Field, California	DOE-EERE	Calpine Corporation	The enhanced geothermal systems concept to be demonstrated at the NW Geysers geothermal field is coldwater injection to induce shear reactivation of fractures for stimulation of a fractured rock. LBNL has conducted pre- and post-stimulation geomechanical modeling, and has performed monitoring of the stimulation using InSAR and microseismic methods.	LBNL
406	18	11		Controlled Rapid Pressurization	DOE-EERE	n/a	Investigating the use of environmentally friendly energetic materials for stimulation of Enhanced Geothermal System reservoirs. Gas, liquid and solid phase energetic materials are being examined. Depending on the environment this work can dramatically decrease or eliminate the amount of fluid required for reservoir stimulation.	Sandia
157	67	12		Fiber-optic sensors (Hehlen)	Lab-Internal		Fiber optic pressure and temperature sensors that can work in extreme environments.	LANL
158	68	12	13	Multi-Scale Science Framework for Climate Treaty Verification: Attributing and Tracking Greenhouse Gas Fluxes Using Co-Emitted Signatures	Multiple	Caltech, JPL, Harvard, EPA, BLM	Multi-scale observations (in situ, airborne, column and satellite) and modeling of greenhouse gases and co-emitted signature pollutant gases and isotopes for climate treaty verification. Methodol development for detection of abrupt release of GHGs like methane and carbon dioxide from the thawing Arctic. LANL has over $2M worth of field deployable instrument for observations of the water-energy nexus and has a world class field deployment team that runs the ARM sites and project for DOE ($10M/year)	LANL
159	69	12	13, 4, 6	Methane Detection and Attribution	WFO-(Chevron)	NASA-JPL, Chevron, RMOTC	Evaluation of current sensors and development of next generation sensors to monitor, quantify and attribute fugitive methane leaks from oil and gas plays and distribution systems. Project included a methane controlled release study at DOE's RMOTC facility with ground, airborne and mobile sampling. LANL has a mini-FTS and isotope specific methane samplers and is developing a patented MEMS imager to quantify fugitive leaks of methane that are the largest limiting gap in our ability to harness domestic gas for national security.	LANL
160	70	12	13, 4, 6	Off-the-shelf Commercial Compact Solar FTS for	WFO-Federal	Caltech, NASA-JPL	Exploitation of commercial off the shelf portable and movable solar spectrometer to monitor greenhouse gases and water cycle	LANL

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				CO2 and CH4 Observations			on point to regional scales. The sensor can be deployed in remote places like the Arctic and also in arid regions in the Southwest. LANL is the first and only institution in the US to have this new portable remote monitoring ability. It is currently being deployed in the Four Corners area to look at the SW climate and we plan to use it for Chevron methane projects.	
171	1	12		Integrative mapping of soil heterogeneity at the microbial scale	Lab-Internal		Use of state-of-the-art lab facilities to develop the first integrated view of how soil physical, chemical and biological components interact from micron to meter scales to govern carbon and nitrogen biogeochemistry.	LBNL
186	16	12	7	U isotopic monitoring of Rocky Flat water samples.	WFO		Environmental monitoring of the Rocky Flats site in Colorado, a former weapons production facility, and LBNL analysis of U isotopic composition and concentration to identify, quantify and track anthropogenic U due to various sources at the site.	LBNL
187	17	12	7	Determination of Chromium Stable Isotope Ratios in Groundwater at the 100 BC-5 Operable Unit, Hanford, WA	WFO-Integrated Contractor	PNNL	The Hanford study involves analysis of the Cr isotopic composition of groundwater samples taken from a Cr contamination plume in the Hanford BC area along the Columbia River. The goal is to establish whether or not natural CrVI reduction is occurring in this area, and if so, to quantify the extent and rate of reduction.	LBNL
195	25	12		AmeriFlux Management Project	DOE-SC-BER	UCB, Oregon State University, University of Nebraska at Lincoln, ORNL, University of Virginia, Harvard University, University of Tuscia, ICOS Italy	Management and community support of the AmeriFlux Network--which at over 100 sites is the largest observation network of ecosystem evapotranspiration, carbon, and energy fluxes in the Americas--to ensure availability of high quality data to build effective models and multisite syntheses, while maximizing insight through robust, site-specific, independent research programs. This Project has advanced scientific data management.	LBNL
204	34	12		ARM	Multiple	ANL	Produce high precision, high accuracy observations of atmospheric mixing ratios of carbon cycle gases, to quantify variability, attribute GHG sources, and estimate fluxes of carbon, water and energy linked to land use and climate.	LBNL
206	36	12	7	Real Time Monitoring of Rates of Subsurface Microbial Activity Associated with Natural Attenuation and Electron Donor Availability for Engineered Bioremediation	DOE-SC-BER	UMASS	Development of novel, microbe-based sensor platform for quantifying changes in environmental states and parameters	LBNL
207	37	12	7	Low cost In-situ NMR Technologies for Monitoring Biological and Geochemical Processes in the Subsurface	WFO	Vista Clara, Inc	Utilization of borehole nuclear magnetic resonance imaging techniques for quantifying changes in the redox status of iron bearing minerals associated with fluctuating groundwater quality parameters	LBNL

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208	38	12	13, 2, 1, 4	Consolidated Sequestration Research Program	DOE-FE		Evaluating CO_2 injection, migration, trapping, and consequent groundwater displacement. Evaluating and characterizing cap-rock integrity to prevent impacts to underground sources of drinking water. Geologic sequestration field instrumentation and lab and tracer studies, monitoring, demonstrations, simulations, risk assessment, CO_2 sink, hydrologic impacts, petrophysics. Research areas: leakage risk assessment; induced seismicity.	LBNL
213	43	12	13, 11, 6	Application of Microearthquake (MEQ) Monitoring for Characterizing Enhanced Geothermal Systems	DOE-EERE		The overall goal is to gather high resolution MEQ data before, during and after stimulation activities at the EGS projects. This will include both surface and borehole deployments (as necessary and in conjunction with available boreholes) to not only use MEQ data for understanding the creation and monitoring of fracture stimulation of EGS reservoirs, but for using both active and passive monitoring of the fracture systems.	LBNL
219	49	12	13, 11, 4	Assessment of hydraulic fracturing efficiency through model-based analysis	WFO		Development of a new generation of decline curves analysis for gas reservoirs as a more representative tool of evaluating reserves.	LBNL
221	51	12	13, 11, 4	Numerical Studies for the Characterization of Recoverable Resources from Methane Hydrate Deposits	DOE-FE		Assessment of the gas production potential of natural gas hydrates deposits in oceanic and permafrost settings; development of computer simulation tools to describe the system behavior (flow, thermal, and geomechanical) during gas production from hydrates.	LBNL
222	52	12	13, 11, 4	LBNL-KIGAM Collaboration in the...	WFO		Supporting KIGAM in the design of a short term field test of gas production from natural oceanic gas hydrate deposits in the Ulleung Basin in the Korean East Sea; assessment of long term gas production potential from these deposits.	LBNL
224	54	12	13, 4	Modular Integrated Borehole	WFO-(BP)		Development and integration of borehole sensors and monitoring intstruments with novel deployment modalities. Evaluation of technologies to meet regulatory requirements for subsurface storage assurance.	LBNL
225	55	12	13, 11, 4	Citronelle Monitoring	WFO		Operation of a monitoring well for CO_2 storage operations at the Citronelle Dome field. This is a fully integrated demonstration of storage of anthropogenic CO_2 in an active oil field.	LBNL
232	62	12	13, 11, 4	ERT Testing, Thermal Monitoring, and Increase Waste Loading	DOE-EM		Assessment of advanced field methods for monitoring coupled THCM processes associated with radioactive waste storage in a salt cavern.	LBNL
234	64	12	13, 4	Oil Shale Extracting Monitoring	WFO		Advanced subsurface seismic monitoring, instrumentation development, deployment methods and integration of data	LBNL
240	70	12	2	Isotope geochemistry	DOE-SC-BES		Quantificiation of isotopic signatures of energy and enviromental fluid-rock interactions	LBNL
338	44	12		Sonar surveys in powerplant discharge	WFO		Using underwater sonar to track seasonal differences in fish movements in and out of a power plant heated discharge relative to external forcing factors such as ambient flow and	ORNL

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							temperature.	
339	45	12		Passive sensor studies; biosensors	Multiple		Use of semipermeable membrane devices, caged clams, and resident biota to evaluate changes in water quality. Long tradition of using various innovative methods for ecological evaluation.	ORNL
340	46	12		Environmentally Friendly Drilling/Sensorpedia	WFO- (RPSEA)	Houston Advanced Research Center, industrial partners (e.g., Chevron)	ORNL is using its proven Sensorpedia technology to acquire water and air data in real time during shale gas production in several locations across Texas. This effort will help decrease water contamination from flowback water.	ORNL
341	47	12		Standoff Detection of Explosive Residues (SDER)	WFO-Federal (DOD)	Pranalytica Inc.	The Oak Ridge National Laboratory (ORNL) proposes an approach for standoff detection of trace quantities of chemicals, explosives and homemade explosive (HME) components. The standoff detection of explosive residues spectroscopic technique offers an ideal method of detecting chemicals in water and air without the need of sample collection. SDER illuminates the target with multiple tunable quantum cascade lasers (QCLs) operated simultaneously, with tunable wavelength windows that match the mid-infrared (mid-IR) absorption peaks of the residue of interest.	ORNL
342	48	12		Application of Neutron Imaging and Scattering to Fluid Flow and Fracture in Engineered Geothermal Systems (EGS) Environments	DOE-EERE		The project aims to develop neutron imaging and scattering capabilities that will provide a unique means to address critical barriers related to rock mechanics, fluid mechanics and geochemical model development and validation related to geothermal energy production applications with a particular emphasis on Engineered Geothermal Systems. The current project focuses more specifically on developing experimental techniques to better understand fluid flow through fractured geological media and the hydraulic fracture process.	ORNL
407	19	12		Chemical Logging	DOE-EERE	n/a	Leveraging advanced sensor development (e.g., CW detection) in the development of a high-temperature downhole logging tool to quantify chemical species of interest in the wellbore fluid. This has strong applications in the interpretation of natural or manmade tracers used to understand natural or stimulated reservoirs and directly supports efforts to develop Enhanced Geothermal Systems.	Sandia
408	20	12		High-Temperature High-Speed Data Link	DOE-EERE	n/a	Single conductor electrical line is ubiquitous in the well service industry. This work aims to increase the data transmission rates currently available through enhanced downhole and surface electronics and alternative telemetry schemes.	Sandia
161	71	13		Multiple projects in Environment and Energy			LANL has numerous projects across the environmental and energy landscapes that deal with data collection, analysis, storage, visualization. Big data campaigns at LANL address the huge quantity of data now possible for the systems ranging from satellite remote sensing to bioinformatics	LANL
162	72	13		Chemical analysis of water and aquifer materials in support of 1)	Multiple		LANL has state of the art analytical facilities for characterization of water chemistry that can be used to understand impacts of energy production on water resources as	LANL

Master Project #	Lab Project #	Primary Topic	Secondary Topic(s)	Project Title	Sponsor & Office Name	Collaborating Institutions	Brief (2-3 sentence) project description	National Lab
				legacy contamination programs and 2) the uranium mining industry			well as the natural attenuation capacity of aquifers to remediate contamination. These capabilities are applied in the local EP program for cleanup of legacy waste as well as in a project to look at natural attenuation associated with in-situ recovery of uranium. A large portion of this funding is for the data collectin and analysis in support of the modeling and assessment of the chromium plume below Los Alamos National Laboratory	
343	49	13		National Hydropower Asset Assessment Program (NHAAP)	DOE-EERE		Provide and maintain a most up-to-date US hydropower database that includes information of existing hydropower facilities, infrastructures, future resources, hydrography, water availability, and environmental attributes to support assessment of untapped U.S. hydropower potentials	ORNL
409	21	13		National Geothermal Data System	DOE-EERE	n/a	Support the DOE GTP in the development of a national database for the collection and dissemination of data relative to the geothermal resource exploration, development and production.	Sandia
23	1	14	1, 15, 6, 5, 2,3,4	Water Use Optimization Toolset	DOE-EERE	ORNL, PNNL, SNL, Bureau of Reclamation, Western Area Power Administration, Exelon Hydro, California Department of Water Resources, Western Area Power Administration, Seattle City Light	Development and demonstration of an integrated set of advanced analytical tools for optimizing hydropower production, water use and environmental performance. Toolset allows hydropower operators and planners to improve water management, resulting in more energy, revenues, and grid services from available water, and to enhance environmental benefits from improved hydropower operations and planning while maintaining institutional water delivery and flood control requirements.	Argonne
26	4	14	1, 4,1,2,3	Energy Water Decision Support System	DOE-OE	SNL, PNNL, University of Texas, Electric Power Research Institute	"Development and application of an energy-water-power simulation system comprised of a series of dynamic and interacting models controlled through a graphical user interface. Each model addresses a specific physical or social system pertinent to water resource sustainability and potentially impacted by energy development and production and electrical transmission planning. The system has been used to examine a series of energy futures in the Western and Texas Interconnections to analyze the potential implications of water stress due to drought and climate change for transmission and resource planning."	Argonne
28	6	14	1, 13, 4, 6	Long-term experimental and management plan EIS for Glen Canyon Dam	Multiple	Grand Canyon Monitoring and Research Center	Analyze the environmental and socioeconomic impacts and costs of various alternatives of operating Glen Canyon Dam (GCD). The changes that alternatives have on dam flows will be examined for their effects on downstream resources and the capacity and energy generated by GCD and how that will affect customers that purchase power from GCD. Changes in power production at GCD will affect not only the power generated by	Argonne

Master Project #	Lab Project #	Primary Topic	Secondary Topic(s)	Project Title	Sponsor & Office Name	Collaborating Institutions	Brief (2-3 sentence) project description	National Lab
							thermal power plants in the Western Interconnection but also their water withdrawal and consumption.	
40	18	14	13,5	Eastern Interconnection States' Planning Council Energy Zones Mapping Tool	DOE-OE	NREL, ORNL	Development of methodologies and web-based mapping tools that enable stakeholders to analyze and develop Clean Energy Zones in the Eastern Interconnection. Scope includes 39 states and 8 Canadian provinces. The tool includes water and energy resources to for development of clean energy generation facilities in the U.S. portion of the Eastern Interconnection. For each of these major categories, the resource data and information have been compiled, reviewed, and assembled into a geographic information system (GIS) database. The information in the database is being made accessible in a web-based EISPC Energy Zones Mapping Tool that will allow stakeholders to identify potentially suitable areas for developing clean energy resources or to determine potential Clean Energy Zones.	Argonne
69	2	14		Hydropower Prog Supt 01	Not Specified			INL
163	73	14		Water as a Latent Grid-Scale Energy Storage Resource	DOE-OE	AOC, Army Corps	Tapping the latent capability of run-of-river hydro: Control systems already exist for regulating the water flow through and generation by run-of-river hydro stations. Work with Army Corps of Engineers (ACE) who control a significant amount of run-of-river hydro, to develop a new river operating paradigm to meet the needs of all river users. Our role is to construct models of possible river operating procedures and restrictions and integrate them with our MPC algorithms to predict hydro performance for balancing fluctuating PV generation and the impact on the electrical grid.	LANL
164	74	14		Small modular reactor R&D Subtask advanced SMR licensing	DOE-NE	INL, ORNL	Identification and synthesis of hydrologic and geologic data that can support tools for site screening of small modular reactors (SMRs), in conjunction with ORNL's OR-SAGE siting tool.	LANL
165	75	14		Water for Gravity-Based Energy Storage	Lab-Internal	ORNL	Design and cost analysis of distributed, modular, Gravity-Based Energy Storage for Renewable Energy generation. Using water as the energy storage fluid, use renewable energy sources (wind, solar) to pump water to elevated storage, releasing energy on demand using reversible turbine technology.	LANL
166	76	14		Water System Optimization and Expansion Planning	DOE-Not Specified	University of Arizona	Research and development of advanced algorithms for the restoration and expansion of water systems relative to energy constraints	LANL
167	77	14		Tracers for Subsurface Interrogation	Multiple	Chevron, Uranium Mining Companies	LANL has experience using both nonreactive and reactive tracers to interrogate subsurface hydrologic and transport properties, including flow velocity, flow porosity, sweep efficiency, fracture surface area, diffusion processes/parameters, and reaction processes/parameters. LANL also applies environmental isotope tracers to understand challanging hydrology problems such as surface	LANL

Master Project #	Lab Project #	Primary Topic	Secondary Topic(s)	Project Title	Sponsor & Office Name	Collaborating Institutions	Brief (2-3 sentence) project description	National Lab
							water/groundwater interactions.	
168	78	14		Geochemical Monitoring of Surface Water and Groundwater for Gas and Oil Production Sites	Lab-Internal		LANL has been involved in assessing current state of knowledge and government regulation of surface water and groundwater monitoring of hydraulic fracturing and other oil and gas production sites including identification of gaps and recommendations to stakeholders/regulators.	LANL
169	79	14		Smart Grid Systems	DOE-Not Specified	New Energy and Industrial Technology and Development Organization (NEDO) of Japan, Los Alamos County through the Dept. of Public Utilities (DPU)	The project demonstrates smart grid technology and applications which contribute to international standards for energy solutions and minimize environmental impacts world-wide. Specifically, the project partners will show how to provide a high proportion of renewable energy on the electric grid to meet a community's residential needs, while making the grid more efficient and stable.	LANL
181	11	14	12	BLM – Energy-Water Monitoring Systems: Solar Installations in Arid Environments	WFO-Federal		Development of monitoring and modeling approahces to quanify the affects of large solar farm installations on Southern CA desert ecosystems and groundwater recharge	LBNL
182	12	14	12, 10	Russian River TMDL	WFO-State		Develop water quality monitoring of the Russian River Hydrologic Unit to gain an understanding of the complete watershed microbiome, determine which ares and sources of of potential pathogens are contributing to the microbial load, and thus inform the most effective remediation measures.	LBNL
183	13	14	12, 10	Pillar Point Source Tracking	WFO-University		Monitor and assess the microbial community composition, including pathogenic and fecal indicator species in specified areas of the Pillar Point Harbor in California for microbial source tracking to identify sources of fecal pollution.	LBNL
184	14	14	12, 10	BP Deep Sea Basins Project	WFO-University		Comparison of hydrocarbon degrading potential of microbes at different depths in major offshore oil-producing regions of the world to better understand the microbial response to oil spills.	LBNL
185	15	14	12, 10	DNA Everywhere	WFO		Develop DNA extraction capability in Haiti as a first step towards sampling human waste compost piles as a first step towards developing a more efficient and pathogen-free thermophilic composting process.	LBNL
229	59	14	4	LBNL CORE: Project 2	WFO-(Chevron)		Integrated reservior management, sensors and risk assessment	LBNL
344	50	14		Renewable hydrogen production from biomass pyrolysis aqueous phase.	DOE-EERE	ORNL, University of Tennessee, Georgia Institute of Technology, Pall corporation, OmniTech International, FuelCellEtc.	Investigate removal of organics from aqueous phase generated during biomass pyrolysis by transforming them into hydrogen, while simultaneously cleaning the water for recycle or discharge to environment. Study reduction in green house gas emissions and improvements in energy efficiency of the biofuel production process.	ORNL
410	22	14		S-CO2 Brayton Cycle	DOE-NE	n/a	Demonstrate the world's first S-CO2 power turbine (250kWe)	Sandia

Master Project #	Lab Project #	Primary Topic	Secondary Topic(s)	Project Title	Sponsor & Office Name	Collaborating Institutions	Brief (2-3 sentence) project description	National Lab
				Demonstration			and power equipment in order to develop controls and validate thermodynamic models of theoretical high conversion efficiency.	
411	23	14		S-CO2 10MWe Turbine	DOE-EERE	NREL	Use lessons from 250kWe S-CO2 turbine to build a commercially relevant 10MWe S-CO2 turbine for application to concentrating solar power plants.	Sandia
412	24	14		Passive S-CO2 Reactor with Dry Cooling	Lab-Internal	n/a	Build and analyze a natural circulation test loop using S-CO2 and dry air heat rejection	Sandia
413	25	14		Remote Well Solutions	WFO	n/a	Developing system that uses propane and PLCs to improve efficiency of creating electricity at remote sites. Remote sites are usually in the business of water treatment and water production.	Sandia
68	1	15		Water Security Test Bed 01	Not Specified		Development of a water infrastructure to evaluate water security and use.	INL
170	80	15		Very Small Modular reactors/Used Fuel Project	DOE-NE	INL	Small modular reactors (SMRs) may become replacement power sources for aging coal-fired power plants or additional power sources at existing plant sites. This project evaluates the engineering and siting issues that may occur should these SMRs be needed. LANL looks at the engineering of these reactors, as well as siting requirements, and the potential impacts of climate change, hydrology, and cooling.	LANL
250	80	15		Multimedia Assessment of California Low Carbon Transportation Fuels	WFO-State	University of California Berkeley and University of California Davis	The California Environmental Protection Agency has an expanding need to address the health and environmental impacts as well as the benefits from use of alternatives to fossil fuel in the transportation sector. This work addresses that need by providing and applying a life-cycle framework to study the health and water footprint to California's emerging low-carbon fuels.	LBNL
251	81	15		Environmental Assessment of Large-scale Artificial Photosynthesis	DOE-EERE	Joint Center for Artificial Photosynthesis	Modeling and assessment of commercial-scale artificial photosynthesis facilities, accounting for impacts on energy, climate, water resources, and ecosystems.	LBNL
253	83	15		Guiding LBNL low-carbon technology development with life-cycle energy and impacts analyses	Lab-Internal	Joint Center for Artificial Photosynthesis, Joint Genome Institute, Molecular Foundry (LBNL)	Develop and apply new analytical capabilities and collaboration frameworks to bridge gaps between basic, applied, and analysis research in emerging energy technology areas. Assist researchers in complementary, cross-divisional work to analyze the environmental (especially carbon cycle), human health and other impacts of their technology, and when possible, improve their net benefit and viability in the marketplace.	LBNL
345	51	15		Technology Development for the DOE Groundwater and Soils Remediation Program	DOE-EM	Dupont, Stony Brook University, UCOR	Program uses best science and technical resources to identify problems and find solutions that reduce life-cycle technical risk and uncertainties across the DOE complex through a leveraged and integrated program. Applied research, defined as systematic study to gain knowledge or understanding necessary to determine the means by which a recognized and specific need may be met, is used to provide technology, methodologies, and strategies to achieve the vision.	ORNL

Master Project #	Lab Project #	Primary Topic	Secondary Topic(s)	Project Title	Sponsor & Office Name	Collaborating Institutions	Brief (2-3 sentence) project description	National Lab
346	52	15		Investigation of Correllation Between Flexible Dispatch for Renewables Integration and Hydropower Cost and Reliability	DOE-EERE	Corps of Engineer, Bureau of Reclamation	ORNL will collaborate with federal and non-federal hydropower partners to develop a framework for measuring the reliability impacts and costs of operating hydropower and river systems more flexibly to integrate variable renewables	ORNL
347	53	15		Roadmapping and Advanced Sensor Systems Development for Hydropower and Water Control Flow Measurement	DOE-EERE	PNNL, Corps of Engineer, Bureau of Reclamation	ORNL, PNNL, and partners will establish value modeling tools to accelerate the fleet-wide deployment of accurate flow rate measurement in US. Dams and powerhouses. Will also include a research roadmap to solve the difficult problem of accurately measuring turbulent flow in short converging turbine intakes.	ORNL
348	54	15		Recovery of Uranium from Seawater	DOE-NE	BNL, PNNL	Develop advanced adsorbants for recovery of uranium from seawater	ORNL
349	55	15		Small Hydropower Innovation Collaboration	DOE-EERE		Hydropower industry leaders (the National Hydropower Association, developers, and consultants) and DOE program findings from the New Stream Reach Development Project have highlighted the prevalence of opportunities for small hydropower development. Innovation and program support for such development can be enhanced through cooperative efforts with industry thought leaders to accelerate small hydropower development through the pathway from potential to feasible to operational (PFO).	ORNL
14	14			Sensor Network Development	DOE-FE			Ames
72	5			Climate Change 21	Not Specified			INL
83	16			Fractional Hydrothermal	Not Specified			INL

HIGHLIGHTS (to be considered for use as sidebar within report)

LIST OF HIGHLIGHTS
1. Water-Energy Research Highlights

ATTACHMENT 1a. Argonne, Water Energy Research Highlight

Life cycle water consumption for natural gas electricity generation

The impact of natural gas fuel source on the life cycle water consumption across different natural gas power plant types was evaluated and is shown in Figure 3.

The results of this analysis show that the addition of water consumption for fuel production adds incrementally to the total life cycle impact; the effect, however, is much smaller than that of the power plant type. In most cases, the variability in water consumption from the fuel type is less than the variability in water consumption for the same power plant type.
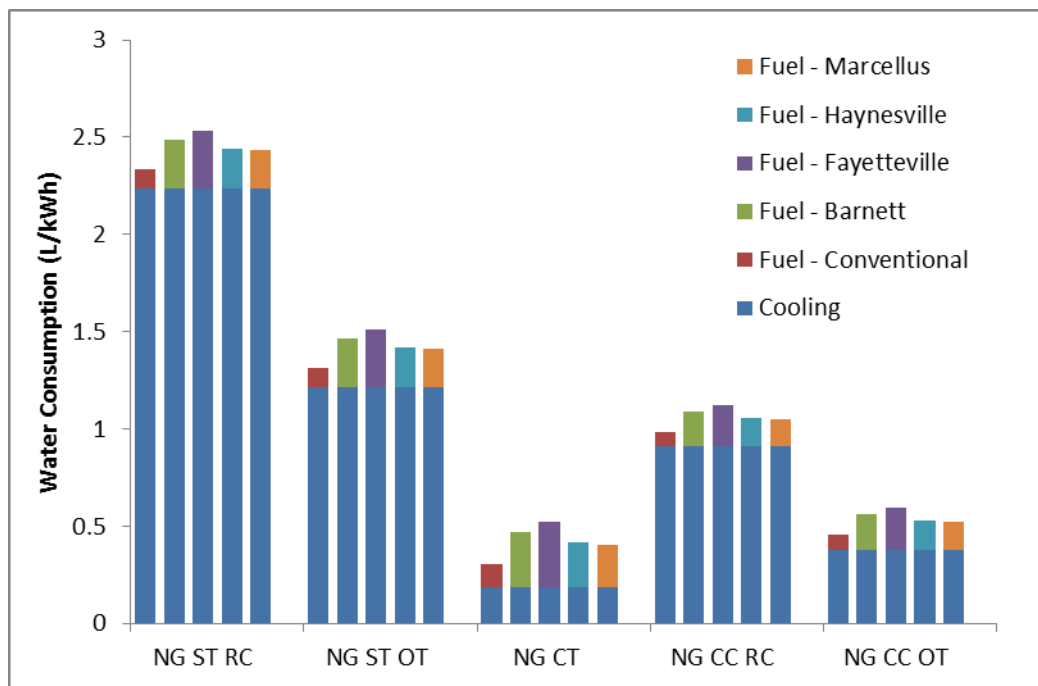
NG ST RC = Natural Gas, Steam Turbine, Recirculating Cooling, NG ST OT = Natural Gas, Steam Turbine, Once Through Cooling, NG CT = Natural Gas, Combustion Turbine, NG CC RC = Natural Gas, Combined Cycle, Recirculating Cooling, NG CC OT = Natural Gas, Combined Cycle, Once Through Cooling

Figure 3. Impact of Natural Gas Fuel Source and Power Plant Type on Life Cycle Water Consumption for Electricity Generation.

Quantifying the Environmental Costs of Managing Brines Extracted from Deep Saline Aquifers Used for Carbon Storage

A number of recent studies have begun to look at the benefits of extracting brine from deep saline aquifers used for storing CO_2. Advantages of extracting brine include: Improved reservoir control, Increased storage capacity, higher injectivity, lower risk, and reduced area of review. These benefits, however, must be balanced against the costs of managing the extracted brine. A **hybrid life cycle assessment** (LCA) approach was used to estimate the environmental performance of the evaluated extracted water management strategies. Hybrid life cycle assessment combines a traditional process based life cycle assessment approach with an economic input-output life cycle assessment (EIO-LCA) approach.

Extracted Brine Management Options

Reuse
- Reuse of extracted water without treatment is the ideal management option
- Reuse options without treatment
  - Injection for enhanced oil recovery
  - Hydraulic fracturing or drilling fluid
  - Enhanced geothermal systems makeup water
  - Injection for hydrological purposes
  - Cooling water

Treatment
- Treatment may be necessary but can be expensive
- Treatment systems that remove salts
  - Reverse Osmosis
  - Multi-Stage Flash
  - Multi-Effect Distillation
  - Mechanical Vapor Compression

Disposal
- Disposal is the least preferable, but it is often the cheapest option
- Most treatment systems generate a concentrated waste stream that must be disposed
- The primary disposal option is injection into a permitted disposal well
- Evaporation is also an option
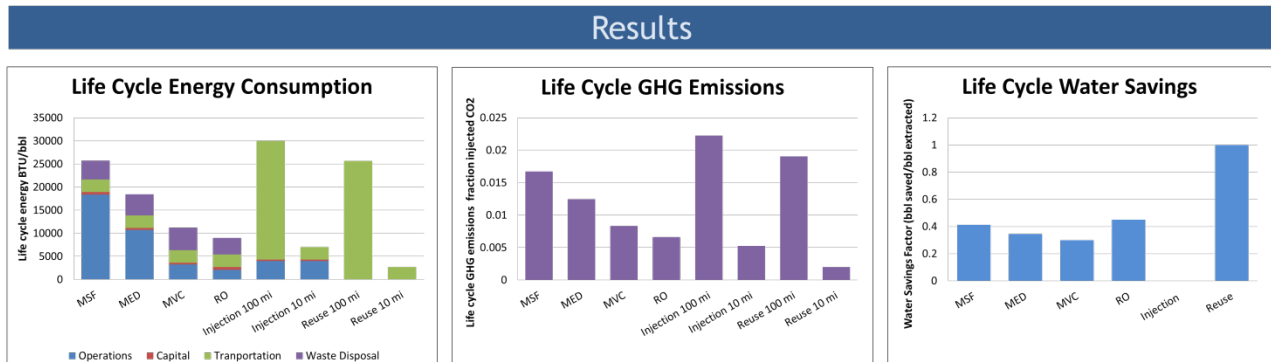
Results

MSF = multi-stage flash, MED = multi-effect distillation, MVC = mechanical vapor compression, RO = reverse osmosis. Results for treatment systems represent the average of multiple systems from multiple sources. Treatment based on feed with similar properties to seawater. All transportation assumed for 12in pipeline at flow rate of 100,000 barrels/day (3,000gpm). All disposal by injection in a saltwater disposal well. GHG emissions are shown as a fraction of the volume of CO_2 sequestered assuming an equal volume of brine is displaced. 1 barrel (bbl) = 42 gallons = 0.159m^3

ATTACHMENT 1b. Brookhaven National Laboratory, Water-Energy Research Highlight

Topic #4: Energy-Water Modeling for Long-term Planning for New York City

- Utilizes MARKAL (MARKet ALlocation) family of models – an integrated energy, environment and economic methodology, to examine market potential for energy technologies over a short-, medium- and long-term horizon under alternative policy scenarios
- Captures whole energy-water system in New York City with detailed technology and interconnected subsystems modeling
- Utilizes a bottom-up approach to represent and characterize technology specific portfolios – highlights synergies, offsets (fuel switch) and feedback effects
- Facilitates urban Planners in selecting cost effective technology mix over the entire system based on life cycle accounting by 1) Involving all relevant stakeholders in the planning process and 2) Formulating a framework for continuous improvement and monitoring
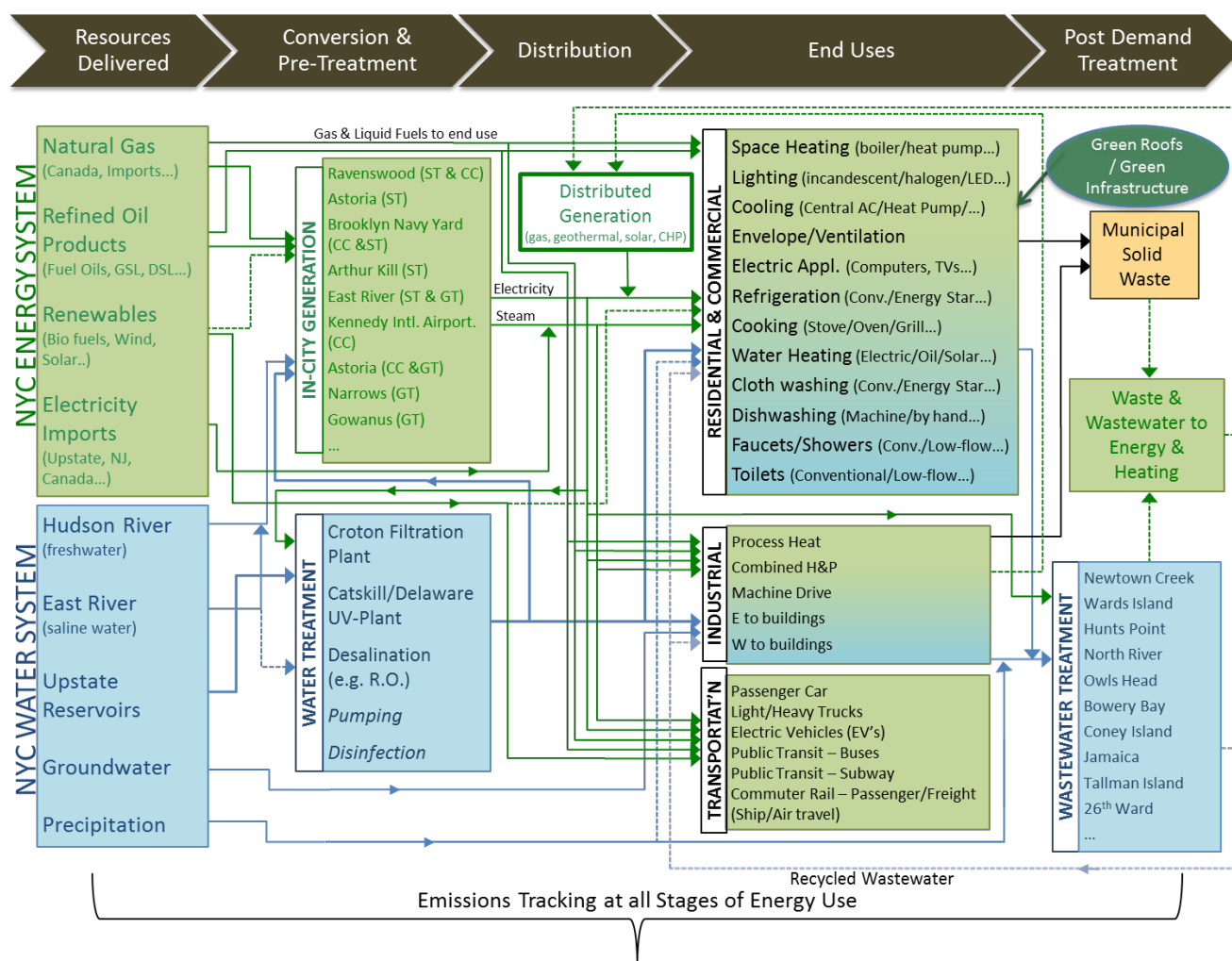
Topic #4: A Regional Earth System Model of the Northeast Corridor: Analyzing 21st Century Climate and Environment

- Building a Northeast Regional Earth System Model (NE-RESM) that improves understanding and capacity to forecast the implications of planning decisions on the region's environment, ecosystem services, energy, and economy through the 21st century.

- Major advances include: coupling of meso-scale atmospheric physics and chemistry models to a terrestrial-aquatic ecosystem model; geospatial modeling of energy and anthropogenic emissions and biotic source/sinks at improved temporal resolutions; a linked ecosystem services accounting tool; and meso-economic input-output model to evaluate the impacts of ecosystem services constraints on sub-regional economies.
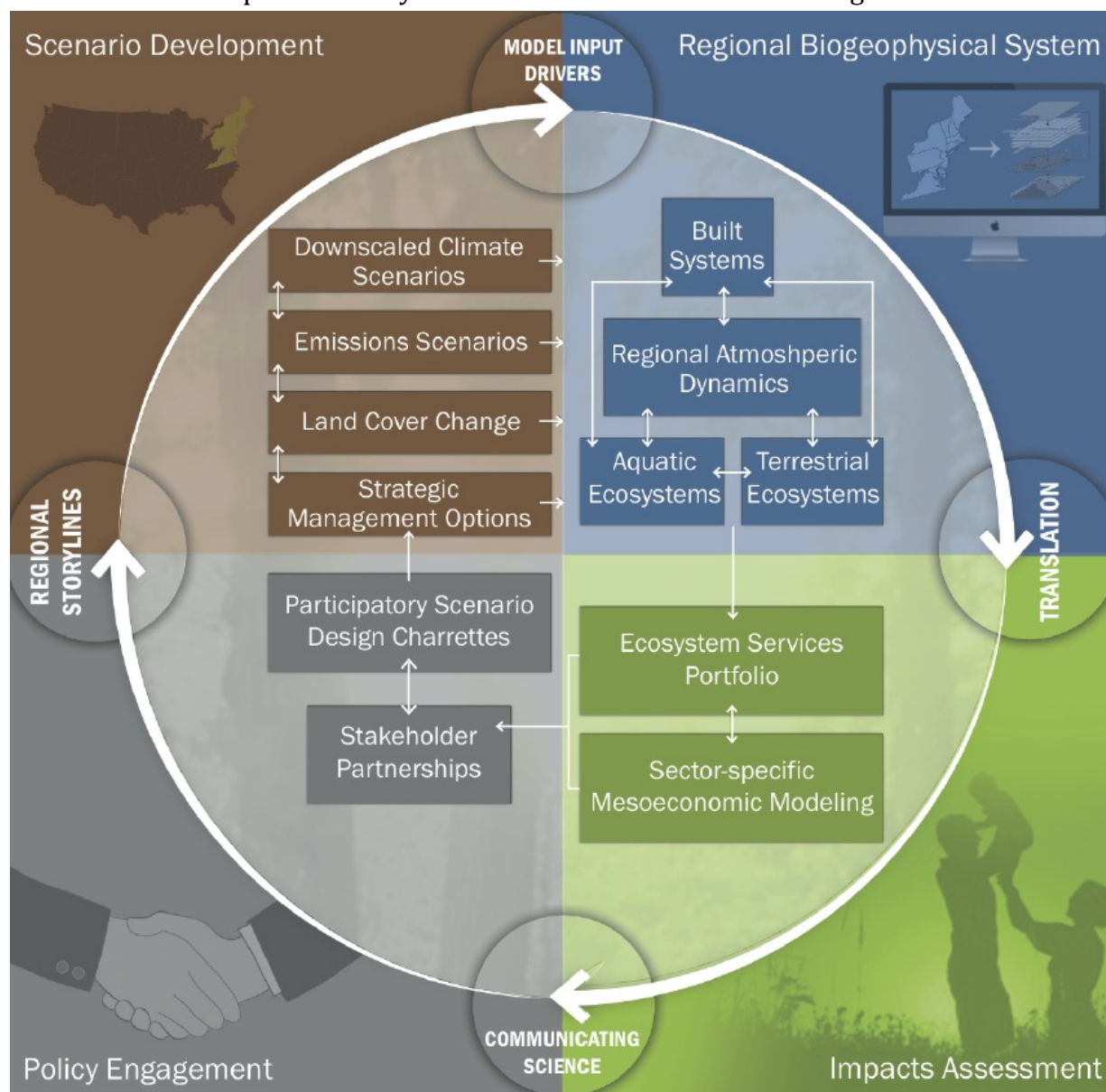
Topic #9: U.S.-China Low-Carbon EcoCities and Promoting Near-Zero Energy Cities and Industrial Zones in India

- Develop Eco-City plans, policies and enabling strategies facilitating effectively deploying U.S. energy efficient and renewable energy technologies.
- Share lessons learnt through joint training, workshops and exchange visits, in an effort to leapfrog burgeoning cities to advanced infrastructure consuming lower energy and providing environmental sustainability.
- With DOE technical assistance, cities are devising policies and strategies to deploy EE&RE in identified zones, districts and projects; including green buildings, distributed renewable energy and smart grid, transportation, industries, water supply and sanitation and solid waste disposal.

ATTACHMENT 1c. Lawrence Livermore National Lab, Water Energy Research Highlights

Detection and Attribution of Regional Climate Change with a Focus on the Precursors of Droughts (C. Bonfils)

c. ENSO-like pattern (17.6%, av=0.0°C) and ENSO-like PC
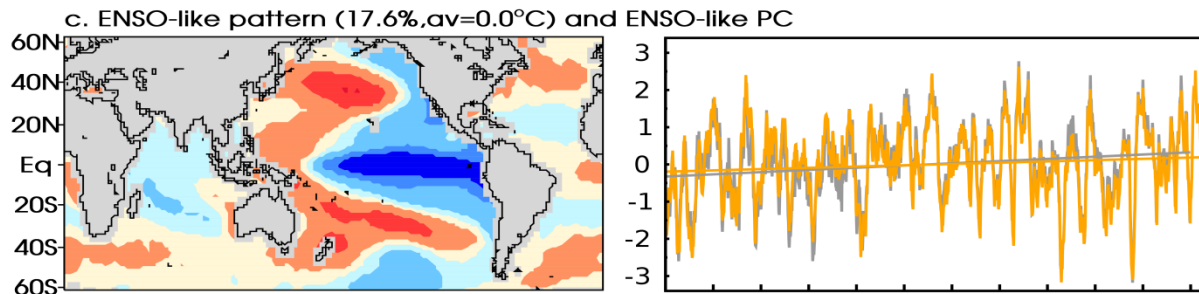
How will ENSO-driven teleconnections evolve in response to global warming? La Nina phase: cooler/drier eastern Pacific and expansion of subtropical dry zones
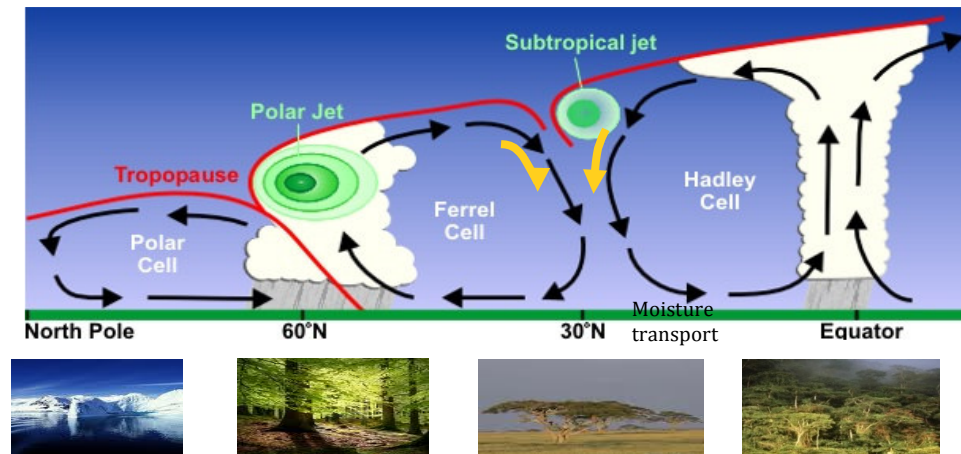
Alternative drought initiators in a warming world: Intensification of the current zonal wet-dry patterns (thermodynamical argument); Latitudinal redistribution of global precipitation (dynamical argument); Reduction in local soil moisture and P recycling (land-atmosphere argument)

Cloud and Aerosol Research (S. Klein)
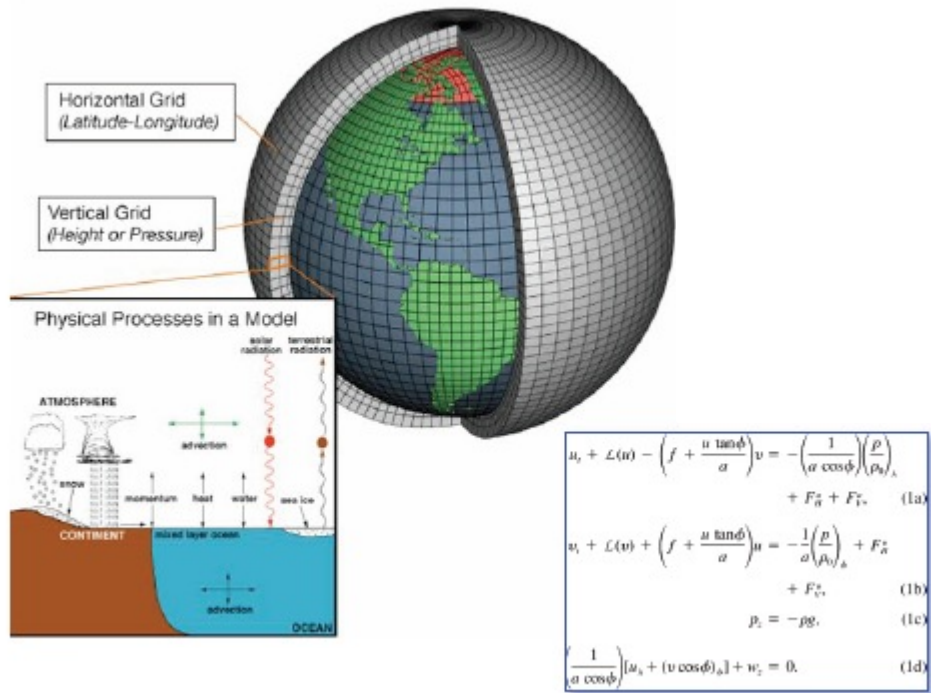
Clouds and aerosols are responsible for many of the uncertainties in the projections of future climate. Small changes in clouds can dramatically impact the amount of global warming. Also, the emissions of aerosols by human activities affect temperatures and air quality. Furthermore, clouds and aerosols are hard to model. The fundamental processes occur at scales much smaller than the resolution of climate models (microns to meters vs. 200 km). The simplified representations are not faithful to the true nature of these complex processes.
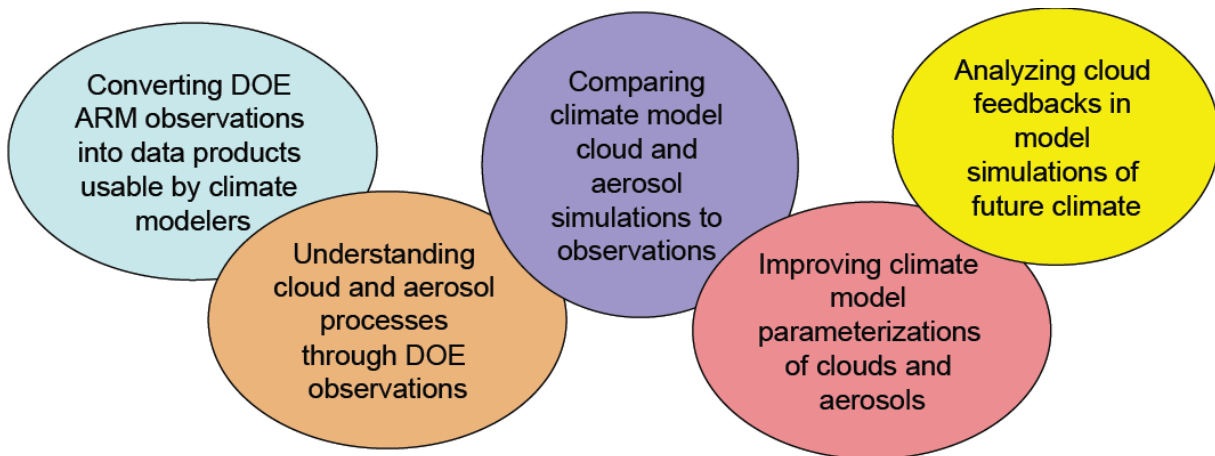
Our goal is to reduce these uncertainties, particularly by improving the representation of clouds and aerosols in the global climate models through the linked activities listed above.

Capacitive Deionization (M. Stadermann)
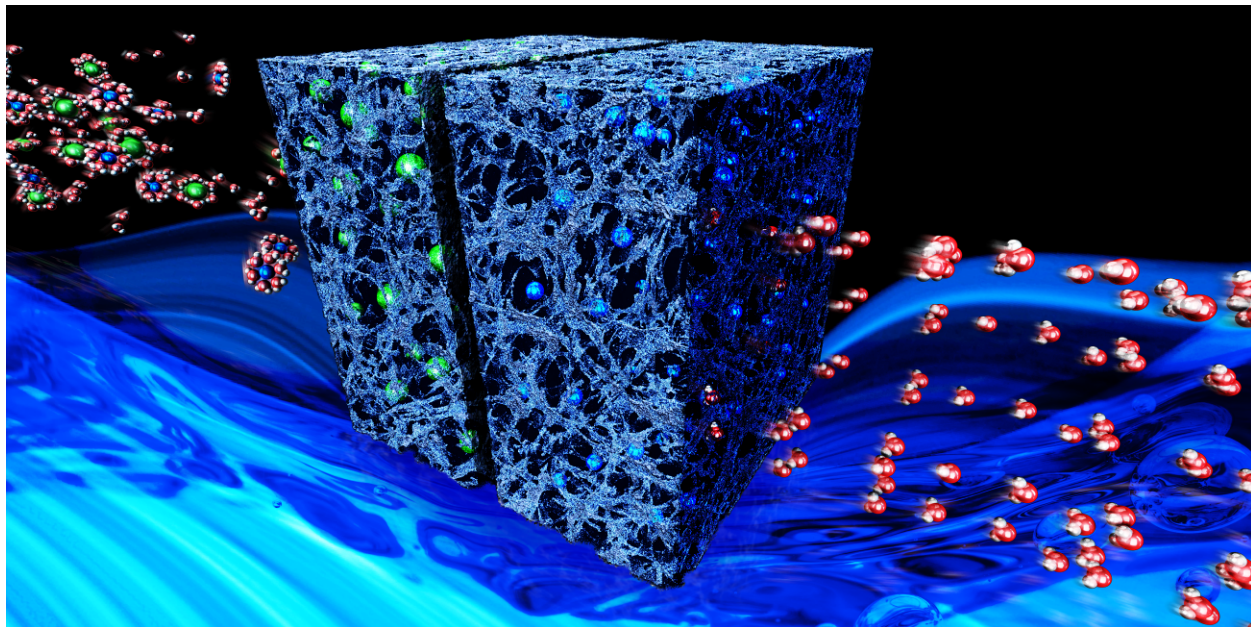
New carbon materials and electrode geometries have enabled a capacitive deionization (CDI) method with a 20-fold rate increase, improved energy efficiency, and an expanded concentration range. This new method will make CDI competitive with reverse osmosis, especially for brackish waters.

Water and Energy Flow Charts

Estimated United State Water Flow in 2005:
410000 Million Gallons/Day
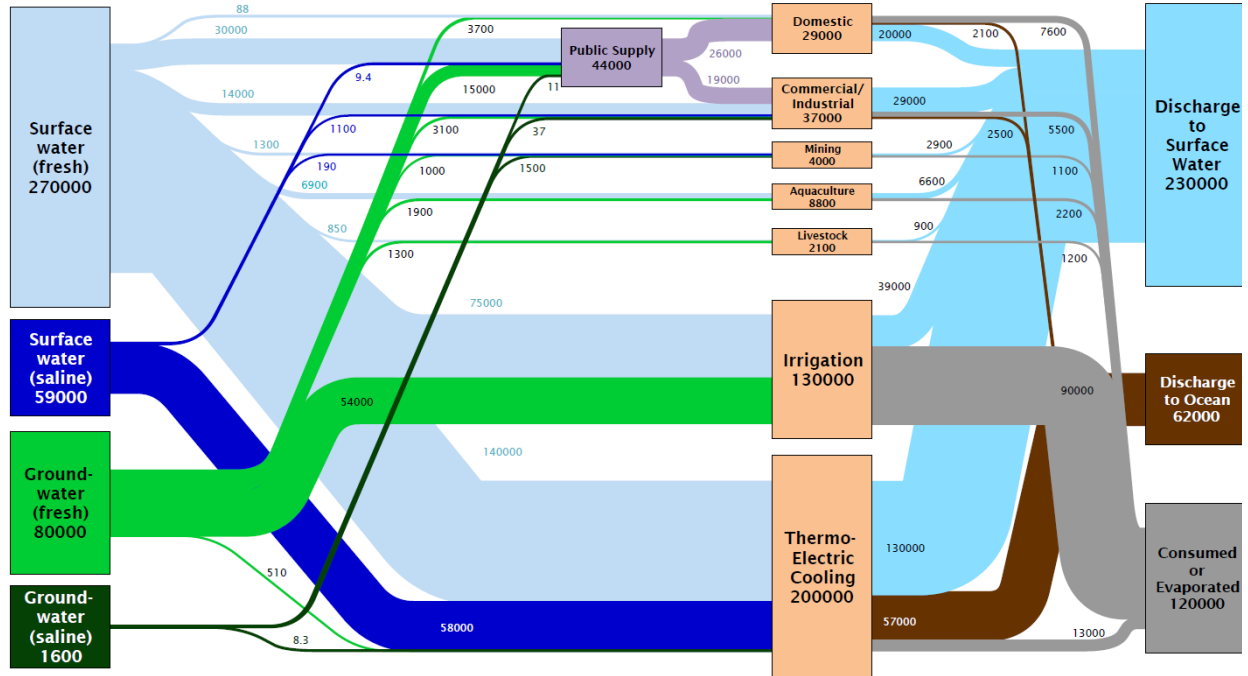
Based on the methodology used to create LLNL's signature Energy Flow Charts (http://flowcharts.llnl.gov), this graphical depiction of the Nation's water use indicates the relative withdrawals from different water resources (surface and ground, fresh and saline), the use of water in various economic sectors (including power plant cooling and resource extraction), as well as discharge back to surface waters. The graphic was created from USGS 2005 water data, and has been replicated for each of the 50 US states.

ATTACHMENT 1d. Los Alamos National Lab, Water Energy Research Highlight

Climate-Land-Energy-Water Nexus (CLEW): Analysis of Energy Development, Snowmelt, Flow, and Water Supply in the Upper Colorado River Basin Under Future Climate Change

Inter-dependent processes and demands in the Climate-Land-Energy-Water Nexus

The Upper Colorado Basin model domain
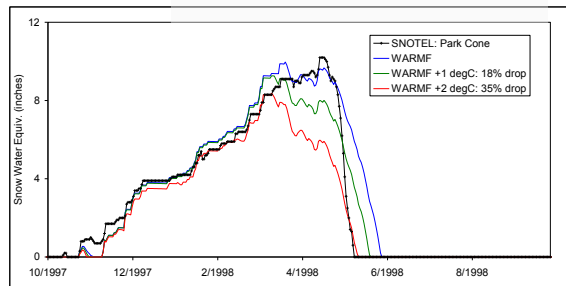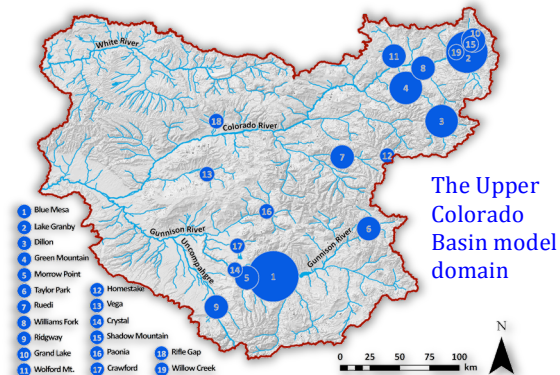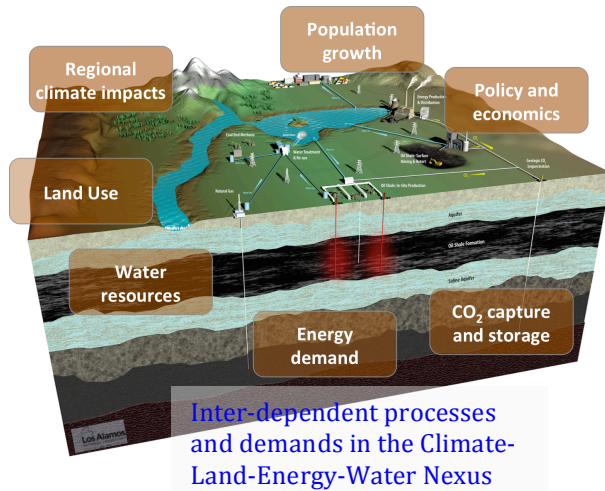
Snow pack predictions for climate change scenario with the Watershed Analysis Risk Management Framework model (WARMF)

Warmer Climate: New Demand and New Storage for Power Production

- Reservoir storage increases electricity generation.
- Larger reservoirs allow peak river flows to be stored for future low flow periods.
- Regional climate change (~2 °C) reduces river flows.
- Capturing CO_2 increases water consumption.
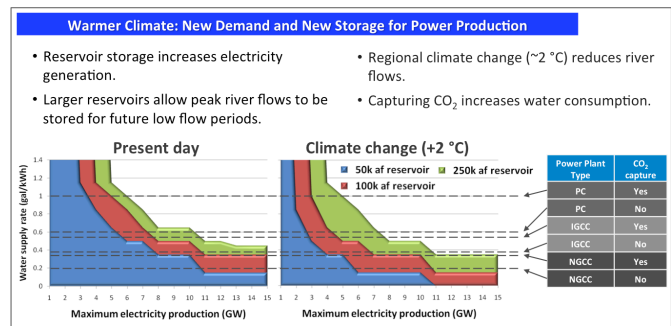
Simulated capacity requirements to meet potential new power plant cooling demand. Under warmer climate, larger capacity is needed for equivalent demand to insure reliable supply during long dry periods.

LANL constructed an integrated framework to assess the impacts of climate change and variability on energy production and water demand in the upper Colorado River (UCR). The framework analyzed the interactions between climate, land, energy, and water (CLEW) processes. For example, projected climate change impacted annual snow pack development (extent, depth, time of melting), which affected vegetation through evapotranspiration, which influenced regional hydrology, ultimately impacting water availability for unconventional fossil fuel development. The framework was extended to model energy resiliency and response to climate change including developing new storage capacity to manage reduced and irregular UCR flows. The framework also incorporated present and future water rights in order to understand long-term management of the UCR while balancing impacts of climate change and water demands for energy and municipal use.

High-Performance Computing Model for Basin-Scale, Coupled Surface-Subsurface Hydrologic System

Coupled surface-subsurface flow system

Ponding depth and flow paths in plan view of surface systems

Flow paths in vertical transect of coupled system
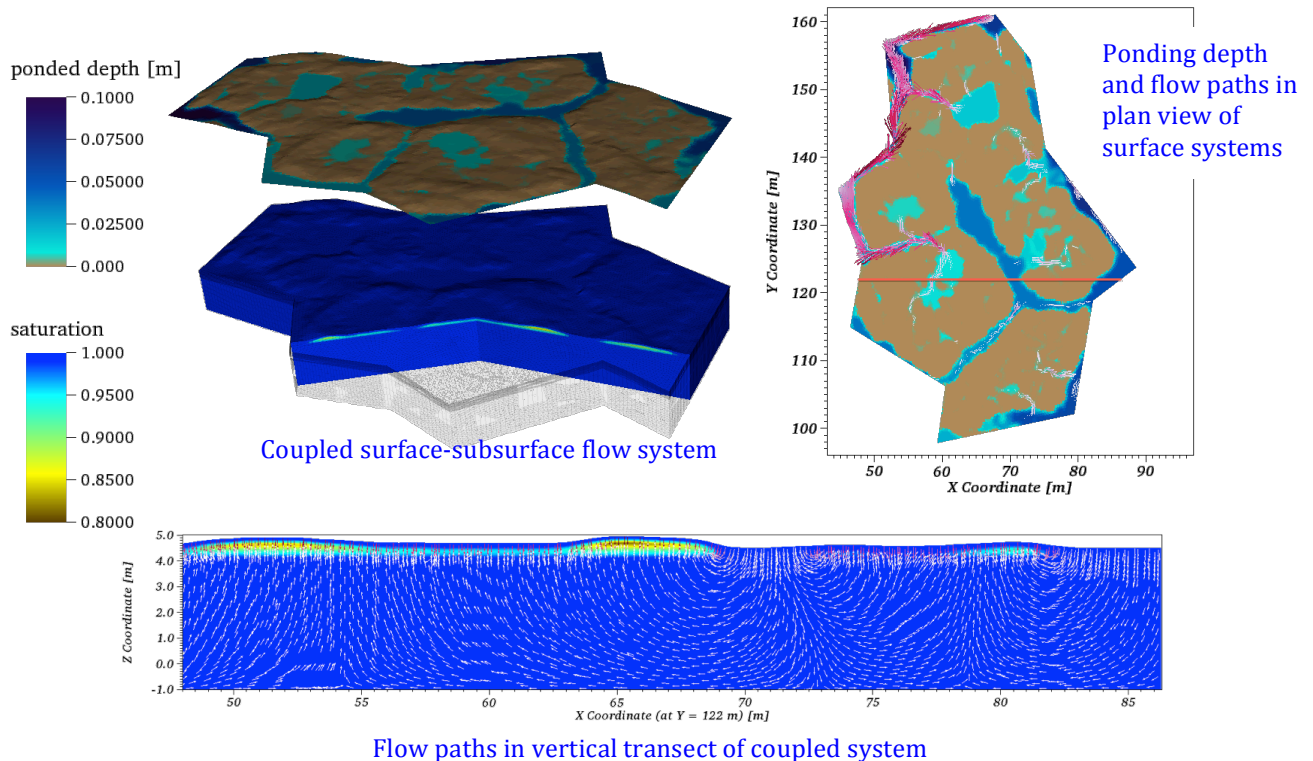
Watersheds that supply surface water and groundwater to critical energy infrastructure are potentially vulnerable to changing climate. In many watersheds, future water availability will be affected not only by surface and subsurface water flows but also by the state of the surface vegetation, which responds in turn to climate and hydrological processes. It is thus important to understand and quantitatively represent these complex feedbacks and interactions among hydrological and surface ecological processes if reliable assessments of future water availability are to be made. LANL Laboratory Directed Project "Predicting Climate Impacts and Feedbacks in the Terrestrial Arctic" is developing advanced software tools to model the coupled dynamics of surface and subsurface hydrological systems at the scale of individual watersheds. The project has developed an extensible and highly parallel modeling framework that enables new processes and process feedbacks to be added and tested quickly with reduced development effort. This improved flexibility is anticipated to lead to improved representations of the internal eco-hydrological dynamics of critical watersheds.

How will climate-warming change our forested watersheds?

As the climate warms and the prospect of intense drought grows, what will happen to land surface vegetation and the benefits it provides in relation to clean, reliable water supply in the subsurface and rivers? At the core of the energy-water nexus is the set of complex and highly interdependent interactions between climate-landcover-energy-water (CLEW) processes. These interactions are not well understood and are poorly represented in existing models aimed at predicting the impacts of climate change on water resources and management for energy production. In a recent Nature Climate Change paper, Williams et al. (2013) developed a forest drought-stress index (FDSI) for the southwestern United States using a comprehensive tree-ring data set representing AD 1000–2007. The FDSI is approximately equally influenced by the warm-season vapor-pressure deficit (largely controlled by temperature) and cold-season precipitation, together explaining 82% of the FDSI variability. Correspondence between the FDSI and measures of forest productivity, mortality, bark-beetle outbreak and wildfire validate the FDSI as a holistic forest-vigor indicator. Importantly, warm-season vapor-pressure deficit correlates more strongly with southwestern forest-fire area than does any other drought-related climate metric. If the vapor-pressure deficit continues increasing as projected by climate models, mean forest drought-stress by the 2050s will exceed that of the most severe droughts in the past 1,000 years. These results foreshadow 21st century changes in forest structures and compositions unfamiliar to modern civilization. While widespread tree mortality due to wildfire or severe drought may increase stream runoff, it may also lead to flooding, landslides, and erosion, which negatively impact reservoirs and other infrastructure. Basic science understanding of CLEW interactions and feedbacks, along with the development of predictive models that capture this knowledge, will inform watershed management and adaptation measures to address climate change impacts on landuse, energy, and water resource development.
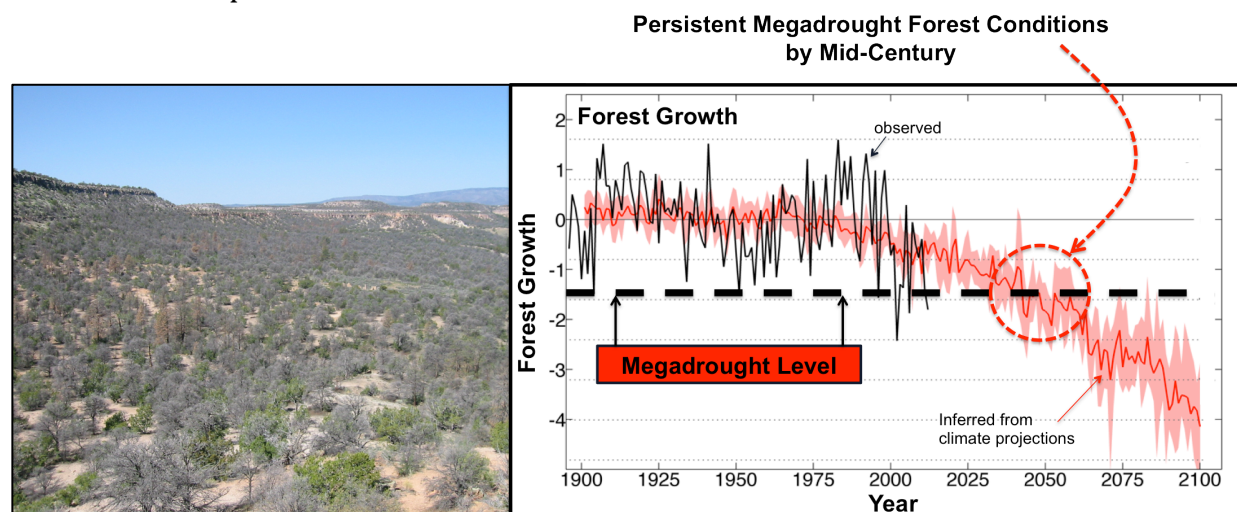
Piñon pine mortality in New Mexico due to drought (left). On right, observed (black line) and predicted (red CMIP3 model ensemble mean values) forest growth represented as a forest drought stress index (FDSI). Positive values indicate less drought stress and negative values indicate more drought stress. The thick black dashed line indicates the FDSI of the most severe 50% of years during the 1572-1587 megadrought. Climate predictions indicate persistent megadrought forest conditions by mid-century. **Williams et al. 2013, Temperature as a potent driver of regional forest drought stress and tree mortality. *Nature Climate Change* 3:292-297.**

Produced Water Treatment

Schematic of Produced Water Treatment System
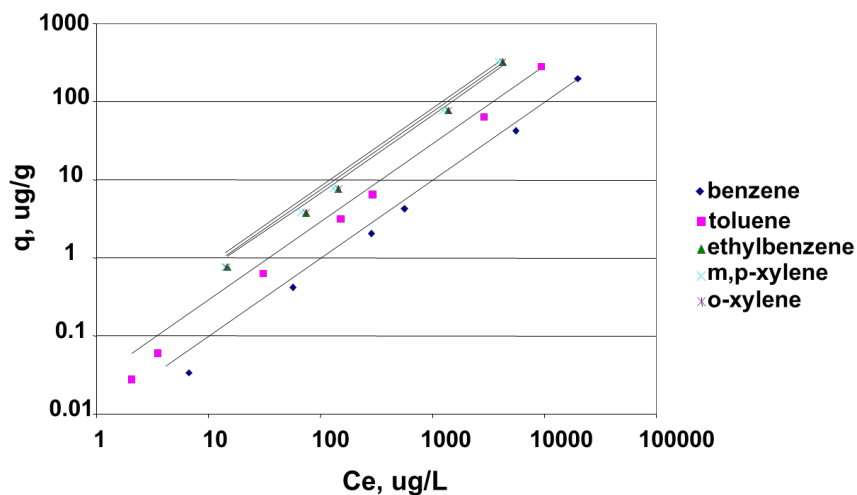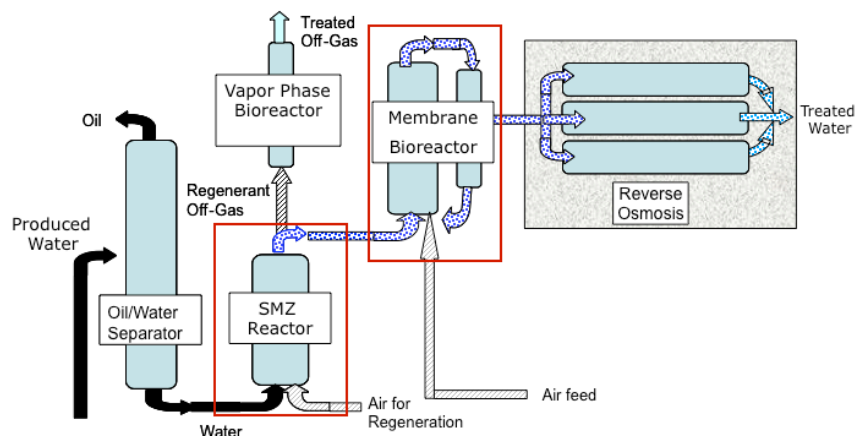
Linear Removal of VOCs from produced water using an SMZ adsorption reactor

Treatment of oil and gas produced water (PW) can be complex. Removal of organic constituents prior to desalination is critical to prevent system fouling and release of volatile organic compounds to the atmosphere. The patented technology was developed by Los Alamos National Laboratory researchers and their partners through DOE Small Producer (now RPSEA) R&D funding. Recently, treated oil and gas PW, and water from hydraulic fracturing, have gained value as fresh water resources have become scarce during drought conditions. The technology now is in demand to create an alternative water source for drilling and hydraulic fracturing use. POC: Jeri Sullivan, ejs@lanl.gov, 505-667-2889

Oil and Gas Produced Water used as a cultivation medium for biofuel algae
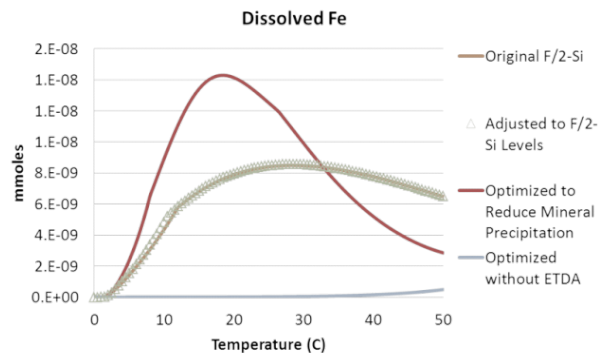
Produced water from oil and gas operations contains useful constituents for cultivation of marine algae for biofuel production. Salts, potassium, iron, manganese, bicarbonate, and other constituents provide valuable nutrients for algae cultivation. Some pretreatment is needed to remove petroleum compounds and excess metals that are toxic to the algae, including copper. The National Alliance for Advanced Biofuels and Bio-products (NAABB) consortium recently tested the use of produced water in field cultivation of *Scenedesmus* and *Nannochloropsis* algae. Photos courtesy of Eldorado Biofuels and Jeri Sullivan, Los Alamos National Laboratory. POC Jeri Sullivan, ejs@lanl.gov, 505-667-2889

ATTACHMENT 1e. Lawrence Berkeley National Lab, Water Energy Research Highlights

Integrated Earth System Model

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Crop-based biofuels represent an important linkage in the water-energy nexus. Biofuels offer the near-term possibility of low-carbon liquid transportation fuels, yet their production is constrained by water availability and alters regional hydrological fluxes. To explore this tradeoff, we used the iESM model to examined two future climate stabilization scenarios that meet identical 21th century atmospheric forcing targets using different policy strategies. In one scenario, a tax on all carbon emissions (Universal Carbon Tax (UCT)) led to modest afforestation and relatively little biofuel use. In the alternative scenario, the carbon tax was applied only to fossil fuel and industrial carbon emissions (Fossil fuel and Industrial Carbon Tax (FFICT)), leading to widespread expansion of cropland to accommodate biofuel production. Cropland expansion in this latter scenario led to a generally more reflective surface with reduced fluxes of both sensible and latent heat – flux changes that were enhanced by atmospheric feedbacks (see figure) that reduced the near-surface demand for water vapor. These changes varied significantly in magnitude by region, with relatively small changes in the tropics compared to the Boreal zone. These results point to the important hydrological and climate effects of converting natural vegetation to cropland for biofuel production. Future improvements in the model representation of next generation bioenergy crops may reveal a more nuanced story in

regions where bioenergy crops replace traditional crops. Perennial crops such as miscanthus and willow tend to have longer growing seasons and deeper roots and therefore an enhanced ability to access soil moisture.
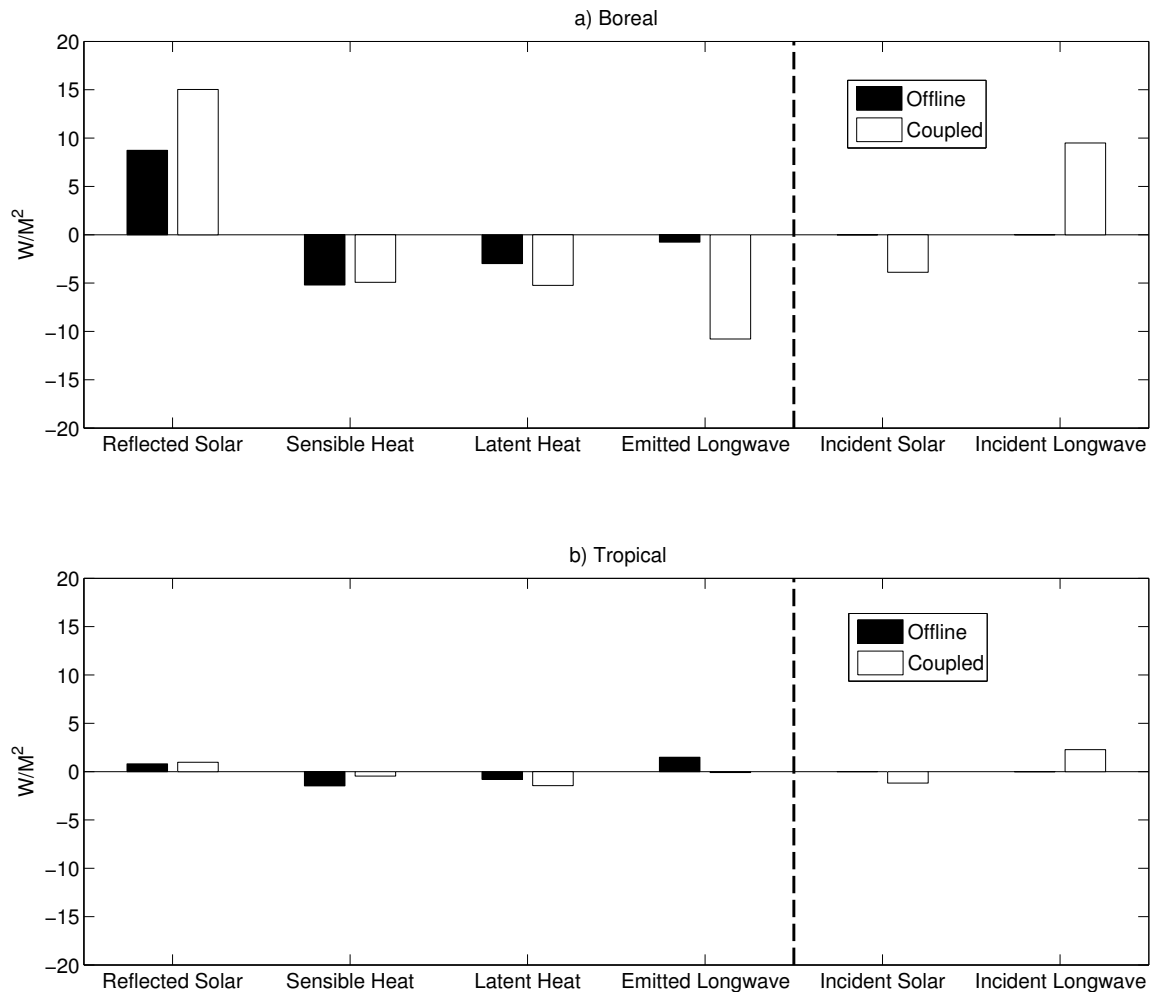

Figure caption: Changes in the regional land surface energy budget for (a) boreal ecosystems and (b) tropical ecosystems between the UCT and FFICT scenarios (FFICT minus UCT) for the final simulation decade (2090–99) obtained from both offline land model simulations and fully coupled earth system simulations that include atmospheric, oceanic, and sea ice feedbacks. All fluxes are positive upward such that a negative value for incident solar radiation designates an increase in insolation in the FFICT scenario relative to UCT. To the right of the dashed line are terms of the surface energy budget that are held fixed in the offline simulations.

Citation:
Jones, A. D., Collins, W., Edmonds, J., Torn, M., Janetos, A., Calvin, K., et al. (2013). Greenhouse gas policies influence climate via direct effects of land use change. *J of Climate*, *26*(11), 3657–3670. doi:10.1175/JCLI-D-12-00377.1

California Electricity System
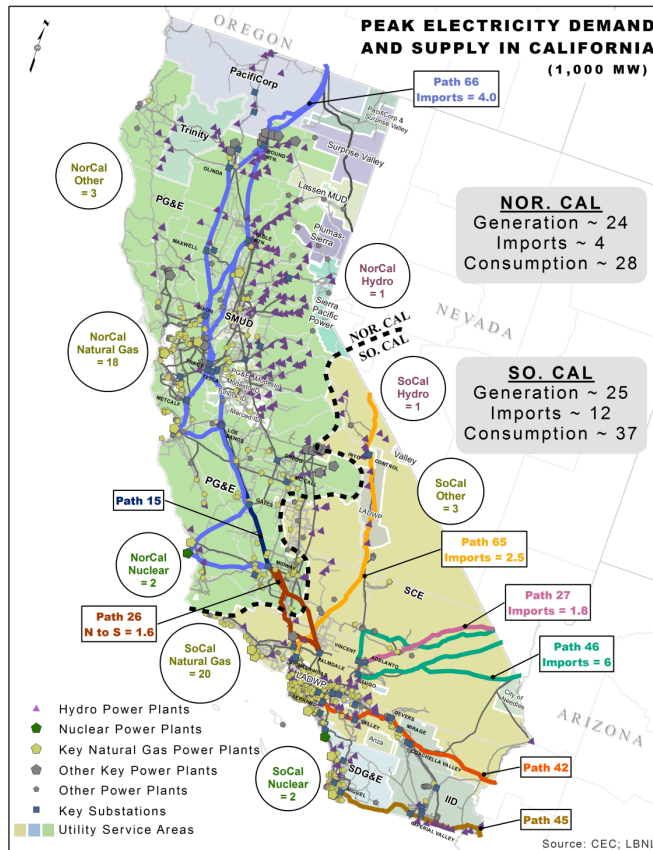
This figure summarizes the LBNL's efforts to quantify California's electricity grid on a typical hot summer afternoon. Load reaches ~50GW with generation coming largely from in-State natural gas plants (60%), nuclear, hydro, geothermal, renewable 10%, and imports (30%). Transmission line capacity constrains imports from the north (path 66) and east (paths 27, 42, 46, 65). It also limits north south movement of electricity within the State (path 26). High temperatures decrease transmission and generation capacity, and increase wildfire risk.

California Water System

Supply in North and East
Demand in South and West

Moderately-sized reservoirs
Store winter precipitation as Sierra
snowpack
Complex east-west and north-south
distribution system combining rivers,
canals and storage reservoirs

The California water supply network is a complex mixture of private, public, local-, state- and federal-government facilities. The higher Sierra Nevada mountain area supplies a significant portion of the surface water supplies. We count on winter precipitation as snowpack, and regulating the snowmelt over the spring and summer to the distribution system. The state and federal water delivery systems stretch across the entire Central Valley and incorporate a large portion of the river systems, jointly managed by the California Department of Water Resources and the US Bureau of Reclamation to meet agricultural demands, urban demands, and environmental flow.

## Water Energy Model Architecture - Feedback loops, Climate Linkages
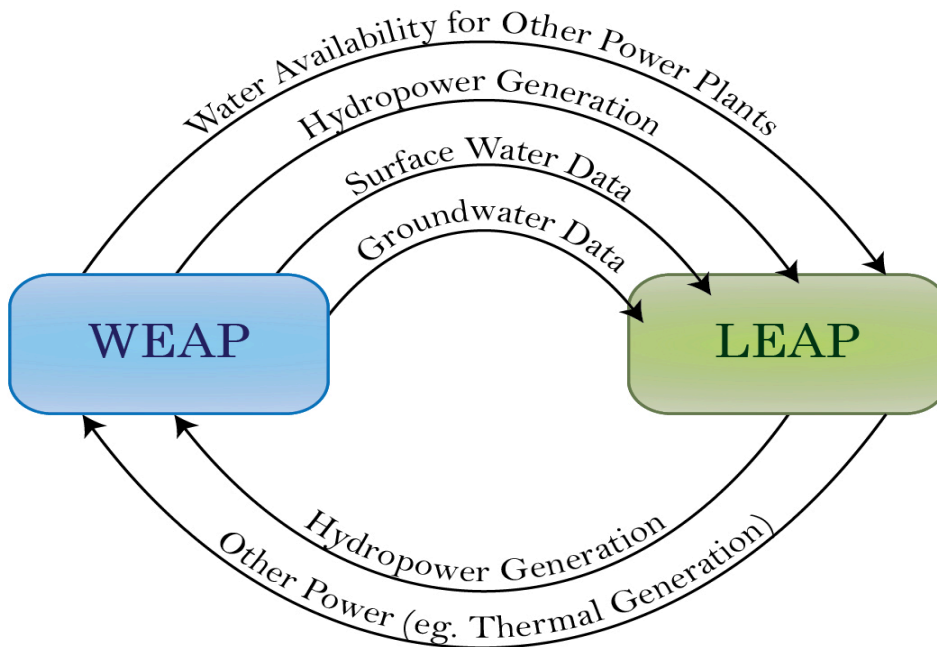
One of LBNL's water-energy modeling architectures is the integration of two widely-used water (WEAP) and energy (LEAP) models. This figure shows the model-component links. Examples of the linkages include water for cooling thermal power plants, generating hydropower and satisfying urban and agricultural needs, and electricity for pumping, treating and heating water.

ATTACHMENT 1f. Pacific Northwest National Lab, Water Energy Research Highlight

Building Energy Demand and Electricity Operations Models
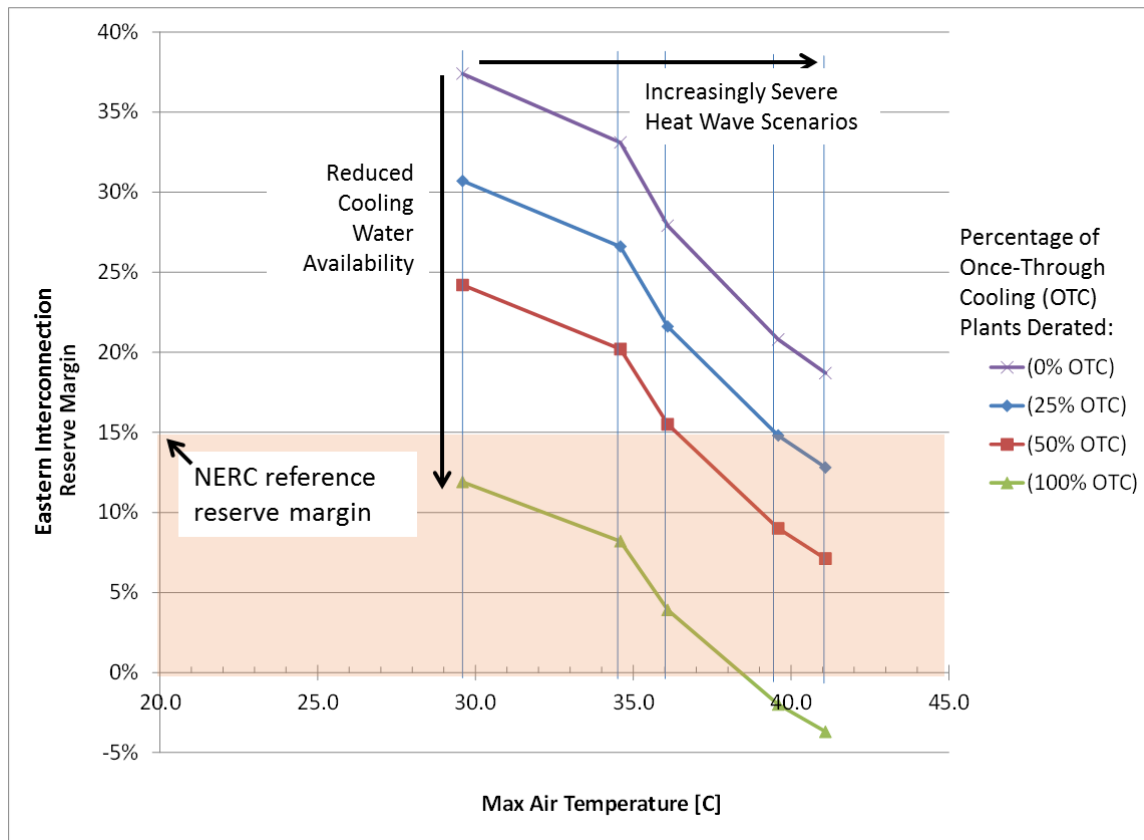
Caption: The electrical reserve margin is shown for the Eastern Interconnection under increasingly severe heat waves and reduced cooling water availability scenarios as simulated by PNNL's Building Energy Demand and Electricity Operations Models. The combination of more intense heat waves and less available cooling water can severely impact grid reliability due to the combination of higher electricity demands, deratings of combustion turbines due to high air temperatures, and deratings of power plants reliant on once-through cooling (OTC) systems. Major reliability problems emerge under severe regional heat waves when one-quarter or more of plants with OTC experience deratings. SOURCE: Kintner-Meyer et al., in preparation.

Simulated near-surface winds and storm surge
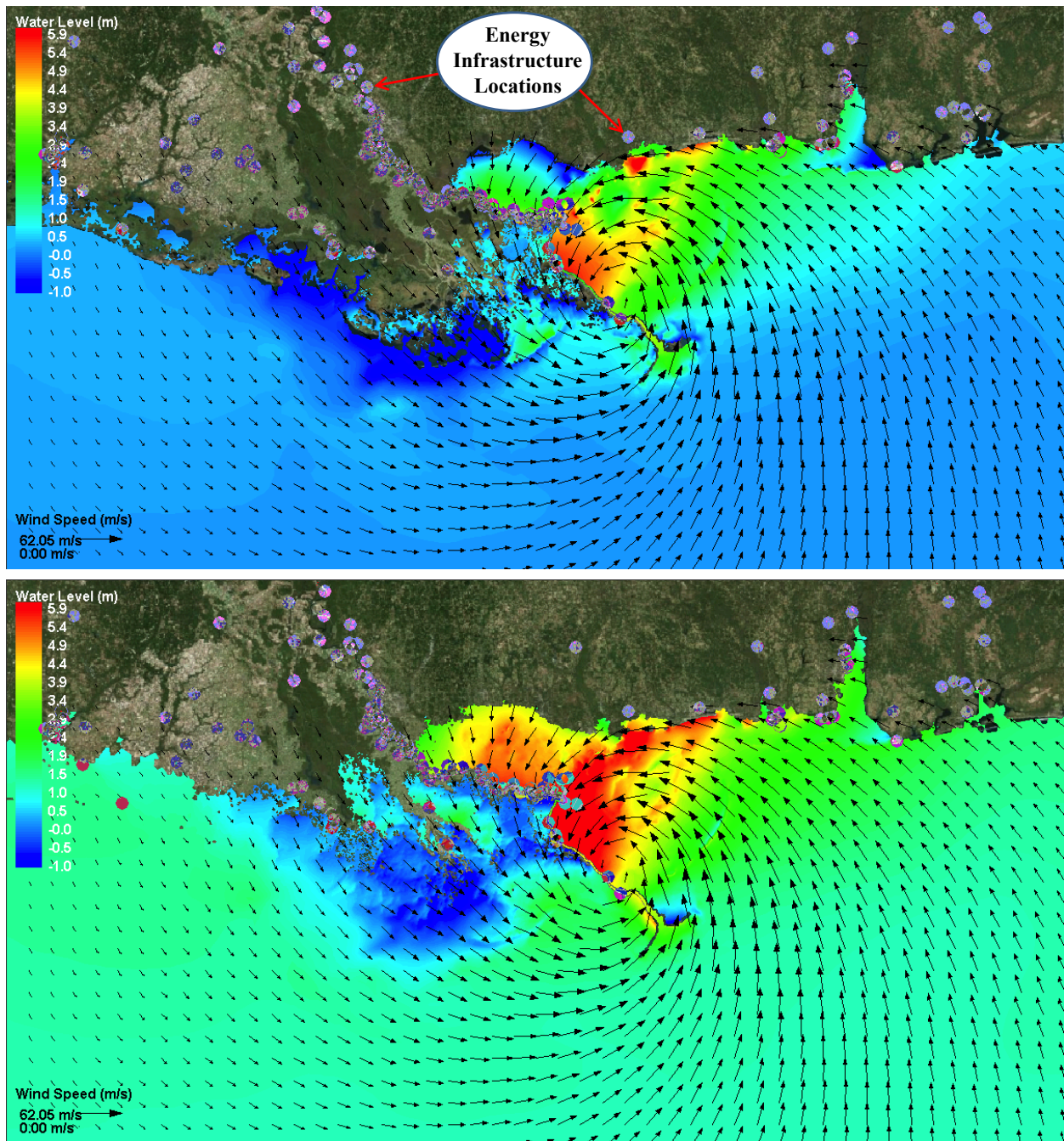
Caption: Simulated near-surface winds (arrows) and storm surge (colorbar) induced by a Katrina-like hurricane in the Gulf of Mexico for (top panel) current conditions and (bottom panel) with one meter of sea level rise and regionally-varying land subsidence of 0-2.25 meters, consistent with projections for the year 2100. Grey dots indicate the locations of energy facilities, and show that sea level rise and land subsidence are increasing the exposure of energy facilities to storm surges. SOURCE: Yang et al., 2013, submitted