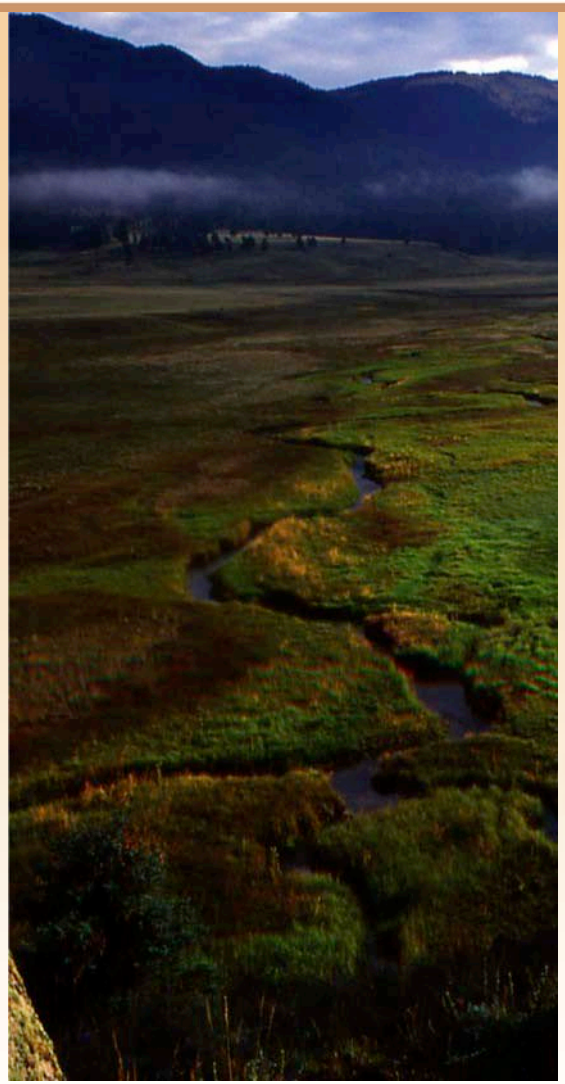
New Mexico EPSCoR



New Mexico EPSCoR

State EPSCoR Committee

03 October 2011

Bill Michener, PI/Director

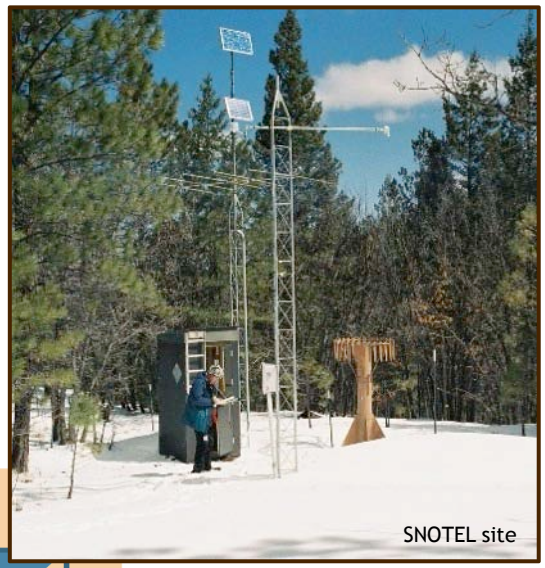
Mary Jo Daniel, Associate Director

Agenda for Today's Meeting

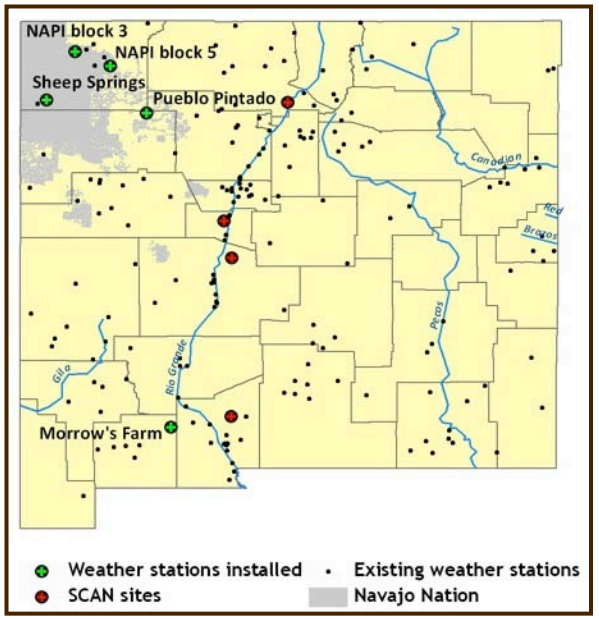
- Welcome, Introductions—Jack Jekowski
- Program Activities and Reverse Site Visit—Bill Michener and Mary Jo Daniel
- C2 Proposal Development—Bill Michener
  - Requests to Participate
- Lunch and Tour of Museum Exhibit—Jane Aubel
- RII 4 Proposal Development/Cost Share
- Timelines and Next Steps
  - Participants in CAREER Workshop

Objective 1: Enhance Climate and Hydrology Research Infrastructure

- Significantly upgraded and/or installed meteorological stations throughout NM, including 4 on the Navajo Nation
- Installed 4 NRCS SCAN sites in the Rio Grande basin
- Upgraded SNOTEL sites and installed Enhanced SNOTEL sites
- Installed a network of precipitation collectors in the Rio Hondo watershed for isotope sampling


SNOTEL site


Weather station near Farmington, NM



Objective 2: Improve Water Quality Monitoring in High Altitude Stream Environments

- Equipping a cargo trailer with water quality sensors to provide continuous, year-round water quality data at the Valles Caldera National Preserve (VCNP)
- The hydrology and water quality groups installed and instrumented a network of 34 shallow monitoring wells with continuous water level data-loggers and selected deployment of real-time nutrient and water quality analyzers
- Constructed and tested a prototype of an autonomous *in situ* iron sensor

Objective 3: Develop interdisciplinary socioeconomics and acequia research capacity

- Employed a full time hydro-meteorological technician
- Hydrologic instrumentation of acequias
- Field campaigns in acequias for gathering streamflow data

Flume installed in an acequia off the Rio Hondo to measure acequia flow

Objective 4: Provide Critical Gap Infrastructure for New Mexico Highlands University

- Upgraded the aquatic chemistry laboratory for water quality analysis:
  - Automated water chemistry analyzer
  - Ion Chromatograph
  - TOC Analyzer
  - Graphite Furnace Atomic Absorption
  - Water quality sonde
  - Undergrad and Grad student support
- Four graduate student research projects
- Four undergraduate research projects
- Four UROP research projects

Objective 5: [illegible]

- *Natural and Human Dynamics of Acequia Systems*
  - Sam Fernald, NMSU
- *Identifying the Most Relevant Spatial and Temporal Scales of Climate Change with Respect to Hydrologic Processes*
  - Amanda White, NMT (Post-doc)
- *The New Mexico STEM Higher Education Diversity Network*
  - Mike Pullin, NMT; Marnie Carroll, Dine College; Edward Martinez, NMHU

- *Bridging the Gap Between Data and the 6-12 Science Classroom*
  - Matthew Nyman, UNM
- *Applications of Distributed Temperature Sensing for Climate Change Research in NM*
  - Jevon Harding, NMT (Graduate Student)

Objective 6: Provide Critical Infrastructure Gap Seed Awards to NM's non-PhD granting universities

- The Whiskey Creek Educational Watershed: A Collaboration between Dine College and NM Tech
  - Marnie Carroll, Diné College
- Late Pleistocene to Holocene Paleoclimate of Northern New Mexico: a Multidisciplinary Science Educational Endeavor
  - Edward Martinez, NMHU

Whiskey Creek, looking East from Navajo Route 12

Wallace Lake, Las Vegas National Wildlife Refuge

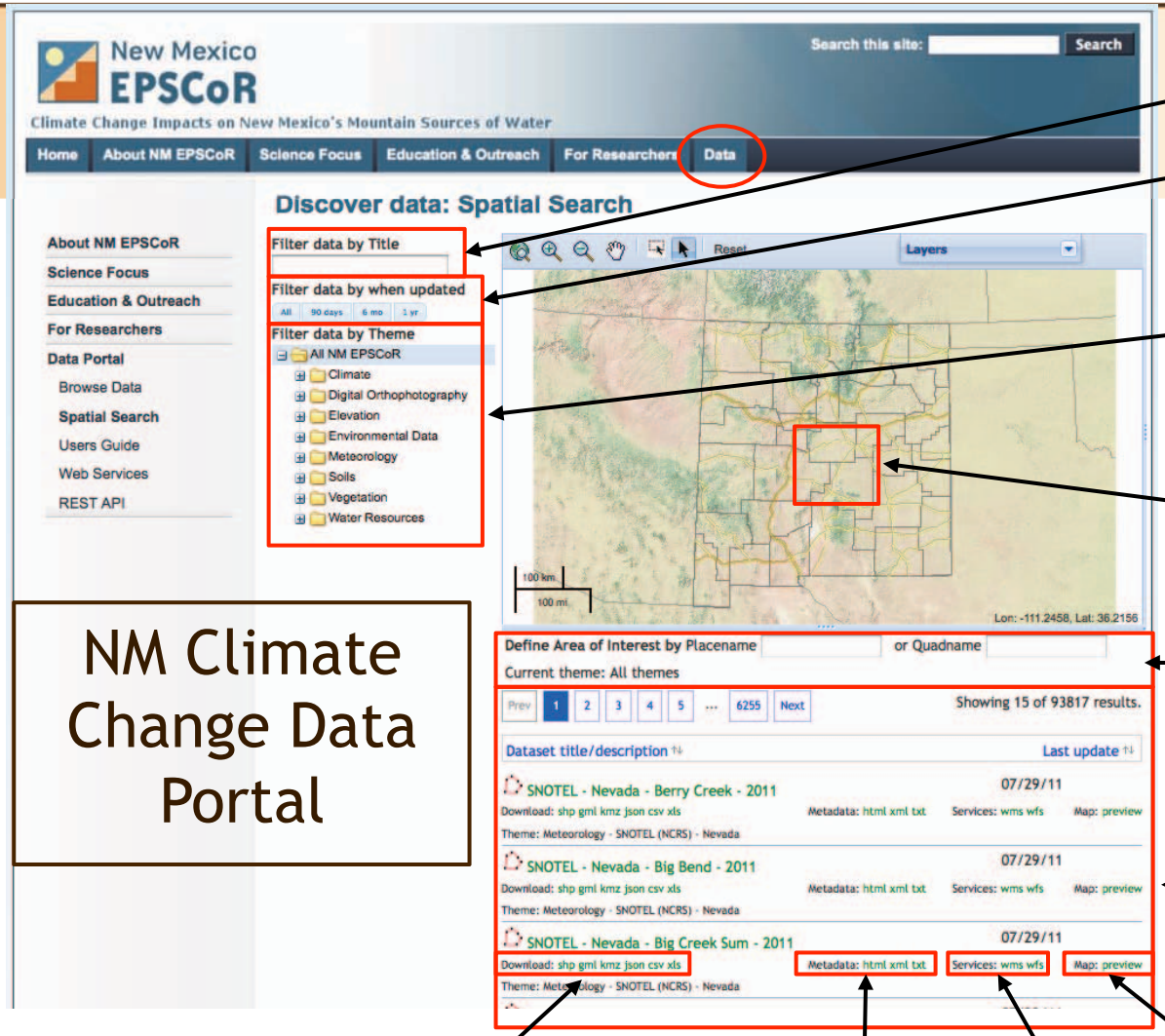
Newest Infrastructure Seed Awards (Sept. 2011)

- Synergistic effects of climate change and invasive species on native fauna in a highland aquatic ecosystem
  - Jesus Rivas, NMHU
- Tracing the Impacts of Prehistoric Climate Change: Eastern New Mexico's Water Resources across the Pleistocene-Holocene Transition
  - David Kilby, ENMU
- Bringing Climate Research to UNM Los Alamos: Development and Infrastructure Improvement for the Environmental Science Program
  - Donald Davis, UNM Los Alamos

Objective 7: Cyberinfrastructure

- NM EPSCoR Program portal established and maintained with regular updates from NM EPSCoR Staff
  - News
  - Events
  - Focus Areas
  - Data
  - Connections to social media and mailing list

http://nmepscor.org/



NM Climate Change Data Portal

Search by text in title

Search by update date

Select by thematic category

Spatial search by map location

Spatial search by place/quad name

Result of data product search

Multiple download formats

Multiple metadata formats

Available web services

Interactive live data preview

Objective 8: Enhance Diversity in EPSCoR Program

- Diversity embedded in all elements of EPSCoR Program
  - UROP
  - Summer Teacher Institute
  - Junior Faculty Leadership Workshop
- Revised NM EPSCoR Diversity Plan to support leadership development of women and URM
  - Innovation Working Groups
  - Seed Award Proposals
  - Encouraged to make presentations at science meetings
  - Formed Diversity Leadership Team
- Best Practices for Faculty Diversity Guide
- Tri-State Diversity Strategic Plan

Objective 9: Enhance Teacher Professional Development

- Annual Summer Teacher Institute
  - 5-day field course, Valles Caldera National Preserve
    - Engaged in experiential learning and field research
    - Worked with EPSCoR water quality scientists
  - Saturday sessions through school year
  - Developed classroom materials
  - Student/Class Field Trips
  - Teachers from 18 Northern NM districts have participated
  - Classroom support by "Circuit Riders"

2011 Summer Teacher Institute participants conduct water quality experiments at the VCNP

Objective 10: Undergraduate Research Opportunity Program (UROP)

- Focused on underrepresented minority students, recruited from NM non-PhD granting schools
  - 10 students per year in teams of 2 with faculty mentor
    - Students have been from 9 different institutions
    - 2011 Cohort: 70% URM and 60% female
  - One week introductory classes and workshops at NMT
  - 8-week summer research experience
  - Culminates in a research conference

2011 UROP Participants

Objective 11: Graduate Research Training

- Fund students in hydrology, biology, chemistry, earth and planetary sciences & natural resources
  - Number of graduate students has increased from 10 to 21
  - Number of undergraduates has increased from 20 to 44
- Interdisciplinary Modeling: Water-Related Issues and Climate Change
  - 3 week workshop summer 2010—Tri-State Consortium
  - 7 students from NM (3 instructors from NM)
- Funded student professional development
  - CUAHSI HIS training
  - Introduction to Climate Modeling Workshop
  - Fall GSA & AGU
  - Parallel Programming and Cluster Computing

Objective 12: NSF Day

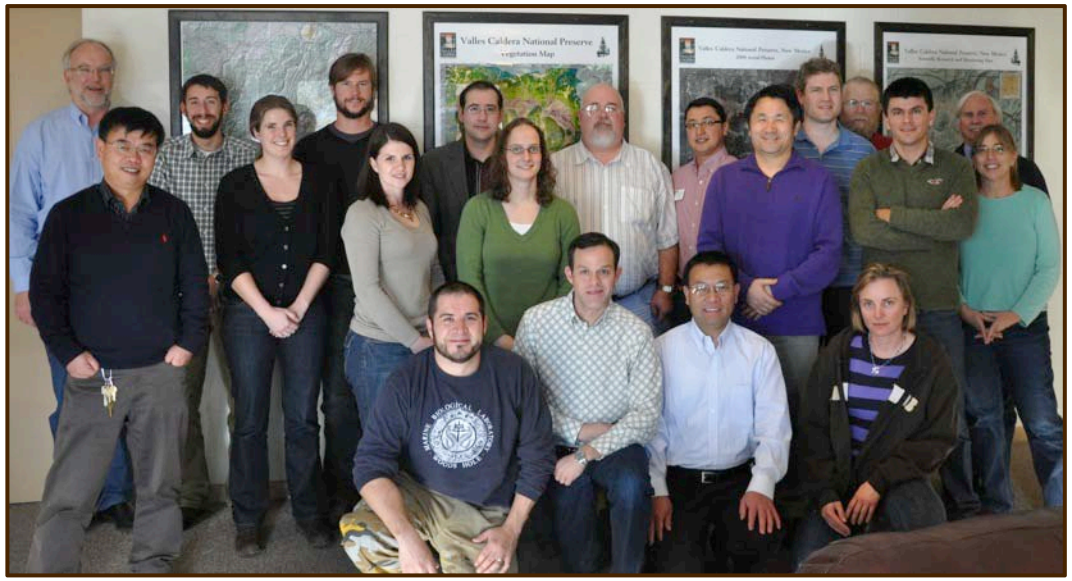
- March 17, 2011
- >150 Participants
- 9 NSF Programs
- Sessions Included:
  - NSF Proposal and Merit Review Process
  - Proposal Writing
  - Concurrent Directorate Sessions
  - Session for Community and Tribal Colleges

NSF Day participants listen to the Welcome speaker

Attendees of the Education session share a laugh

Objective 13:Junior Faculty Leadership Program

- Intense 3-day program offered annually
- Expanded to include Tri-State partners
- Very highly rated by participants
- Evaluation results used to improve content each year

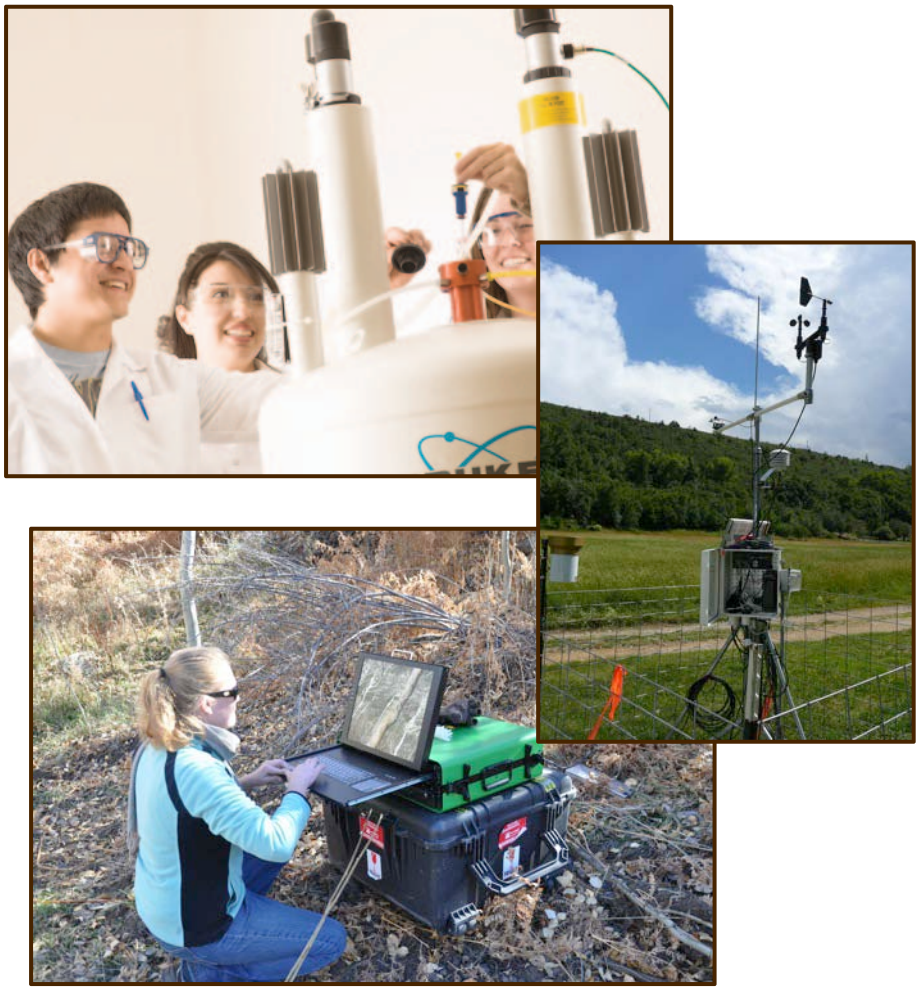


Objective 14: Public Outreach and Communication

- "Degrees of Change: New Mexico's Climate Future" opened May 2011
  - 800 sq. ft. exhibit
  - Features "Magic Planet" dynamic earth processes projection
  - New prototype "Ambient Table" uses visualization technology
  - Focuses on EPSCoR research and researchers

NM EPSCoR Successes

- Research Infrastructure
  - Hydrologic and meteorologic observation network on a par with other Western states
  - Upgraded chemistry laboratories at NMHU and NMT providing enhanced research and education opportunities for students
  - Real-time, continuous water chemistry monitoring network

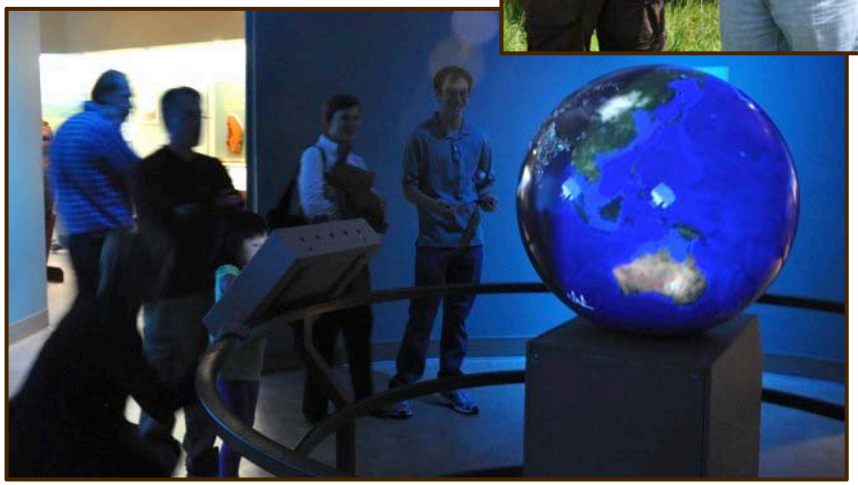


NM EPSCoR Successes

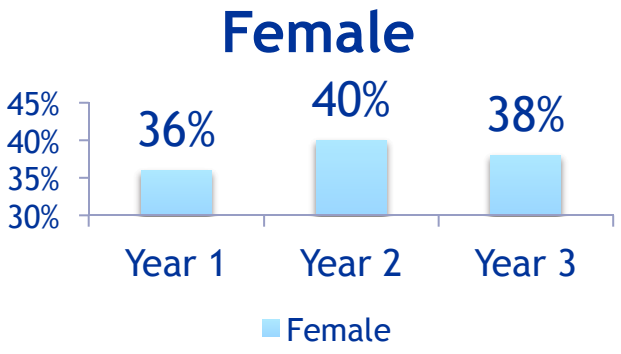
- Cyberinfrastructure
  - Scalable infrastructure for flexible data/information delivery
  - Leadership role in developing interoperability standards for Western Tri-State Consortium
  - Coordination between researchers for enhanced data management and sharing

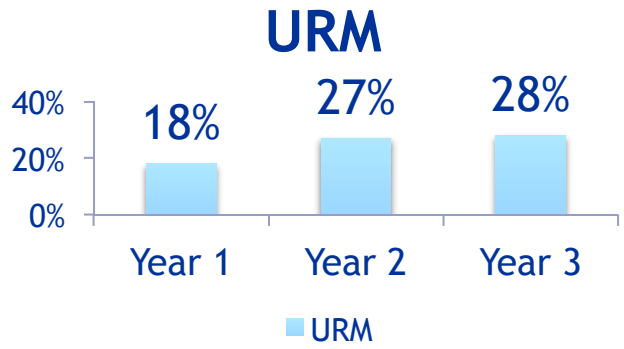
NM EPSCoR Successes

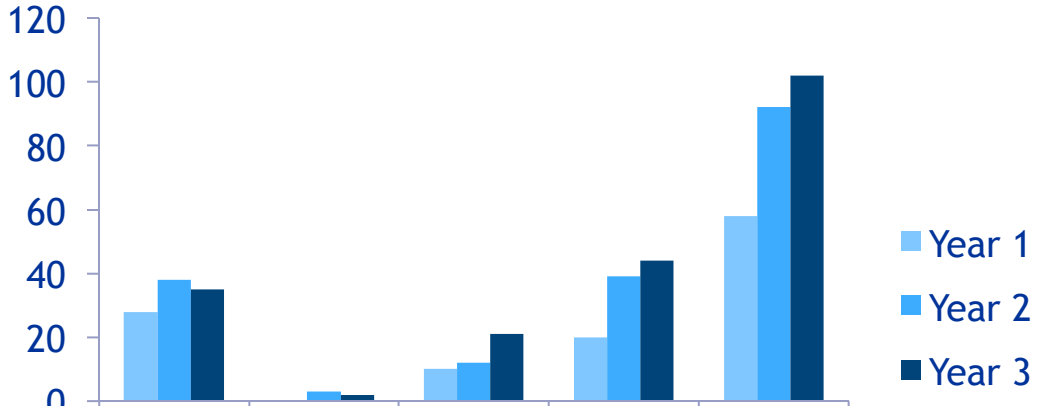
- Human Infrastructure
  - Teachers from 27 schools in Northern NM received professional development in experimental field methods and climate science
  - 30 undergraduate students in UROP with EPSCoR mentors
  - “Degrees of Change: New Mexico’s Climate Forecast” opened; 250,000 annual visitors
  - Best Practices Guide for Faculty Diversity created and approved by the Council of University Presidents



Participants in NM EPSCoR RII3







	Faculty	Post Docs	Grad Students	Undergrad	Total
Year 1	28	0	10	20	58
Year 2	38	3	12	39	92
Year 3	35	2	21	44	102

Project Timeline (original proposal)

Research
Install climate stations
Upgrade chemistry labs
Deploy hydrometeorological stations and water quality sensor systems
Infrastructure seed grant program
Multi-scale model development
Innovation working groups

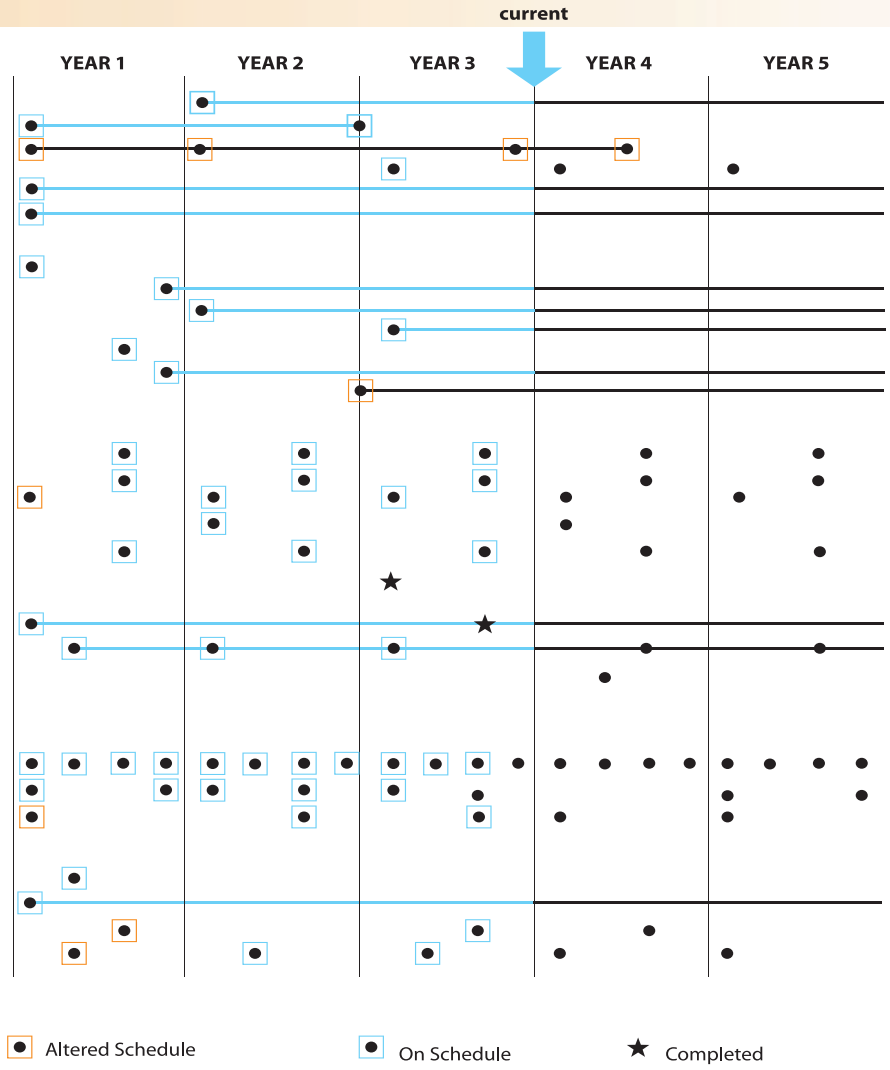
Cyberinfrastructure
Define internal data storage standards
Establish core data ingest services
Establish core data delivery services (OGC WxS)
Establish data delivery SOAP services
Establish portal framework
Publish content into portal
Develop analytic and visualization service for portal

Education
Summer Institute for Teacher Professional Development
Undergraduate Research Opportunities Program
Climate change course/workshops
Graduate Summer School in Regional Climate Modeling
Junior Faculty Leadership Training
Hold NSF Day

Public Outreach and Communication
Develop climate change exhibit
Public outreach activities
Town Hall Meeting

Management
Management Team meetings
State EPSCoR Committee
CUP meeting

Evaluation and Assessment
Baseline assessment of public perception (Korn&Assoc.)
Independent E&A (Minninck&Assoc.)
AAAS review
External Advisory Committee



Results of NSF and EAB/AAAS Reviews

- NM EPSCoR has done well so far! But…
- Where are the data?
- Where are the publications?
  - Reminder: Next IWG proposal deadline is December 1, 2011
- NSF Highlights
  - Communicate the impacts/outcomes of your work to a wide audience—think visuals!
- Burn rate
  - All equipment should be purchased in year 4
  - Plans for any carry-over funds from previous year(s) should be in current year budget--in alignment with Statement of Work

Tri-State Consortium

- Tri-State Meetings
  - 2009: Boise, ID—100 participants
  - 2010: Incline Village, NV—165 participants
  - 2011: Santa Ana, NM—200 participants
- Tri-State IWGs
  - 6 held across all components
- Tri-State Graduate/Faculty Training
  - Interdisciplinary Modeling, HIS, Climate Modeling, Parallel Programming and Cluster Computing

C2: Inter and Intra Campus Connectivity

- Focus on non-PhD granting institutions: 2 Hispanic Serving Institutions and one Tribal College
  - Western NM University
  - Navajo Tech
  - Northern NM College

- Developing educational materials that incorporate 3-D capabilities of NM “Education Gateways”
- Outreach to High Schools with Supercomputing Challenge

Key RII 3 Next Steps—Ongoing Work

- Publish, publish, publish
- Final equipment purchases and installation
  - (NMSU and NMT)
- Continue research activities per Strategic Action Plan
- Submit IWG proposals (Dec. 1)
- Continue to increase diversity of participants
- EPSCoR National Meeting: October 24-27, 2011
- Junior Faculty Leadership Workshop: Jan 4-6, 2012
- Tri-State Annual Meeting: April 3-5, 2012
- Teacher Summer Institute, UROP Program – summer 2012
- Graduate Interdisciplinary Modeling Course– summer 2012

EPSCoR New/Developing Initiatives

- Town Hall Meeting
  - Connect research and policy
  - Involve multiple stakeholders
- FastForward New Mexico
  - Workshops connecting CI with small entrepreneurial business
- Connecting Data & Models with K-12 Education
  - Working with pre-service and in-service educators
  - Cyberlearning Summit
- New Training for Stakeholders
  - Navajo and other tribes on use and maintenance of meteorological stations

Reverse Site Visit Team

- Bill Michener – PI/PD, NM EPSCoR
  - Professor, University Libraries, UNM
- Mary Jo Daniel– Associate Director, NM EPSCoR
  - Adj. Asst. Professor, College of Education, UNM
- Sam Fernald - Hydrology, Acequia Interdisciplinary Science
  - Professor, New Mexico State University
- Laura Crossey – Water Quality
  - Professor, Earth and Planetary Sciences, UNM
- Karl Benedict – Cyberinfrastructure Lead
  - Director, Earth Data Analysis Center, UNM
- Linda LaGrange (State Committee Observer)
  - Dean of Graduate Studies, NM Highlands University

EPSCoR RII4 Proposal

- Research: Energy, Water, Environment Nexus
  - SEC decision following AAAS recommendations:
    - Builds on current project (RII 3)
    - Increased focus on building capacity of regional and tribal colleges
    - Strongly integrative cyberinfrastructure component
    - Extend and expand current efforts on building STEM pipeline
    - New and related workforce development activities

S&T Plan: Energy-water-environment nexus

S&T Plan: Energy, Water, Environment

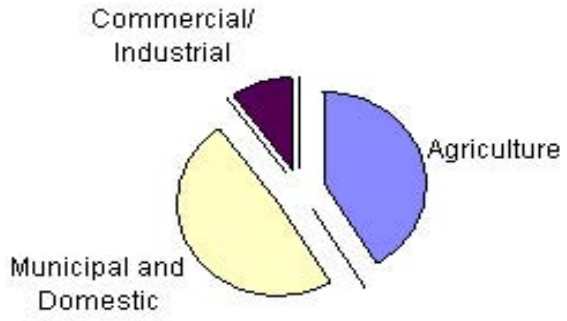
- Energy
  - Oil and gas; renewable energy sources such as biofuels, wind, solar; hydrogen; fuel cells; conservation; clean coal; etc.
- Water
  - Hydrology; sensors; modeling; watershed and aquifer sustainability; groundwater issues; conservation; water quality; desalination; use of brackish and produced water, etc.
- Environment
  - Climate change; remote sensing; ecosystem modeling; impact of forest thinning; atmospheric modeling; soil, air, air and water remediation; etc.
- Socioeconomic
  - Choice; cost trade-offs; individual based modeling; scenario-building and forecasting; etc.

Energy as a growth area in New Mexico

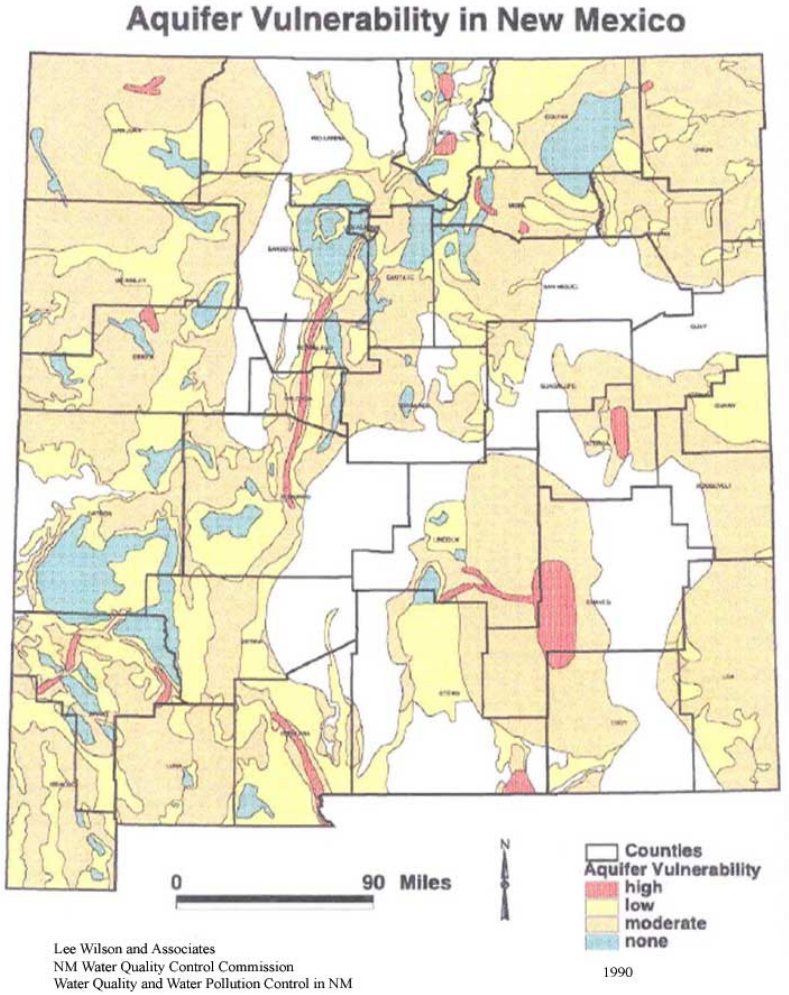
Projected Water Demand in New Mexico

AF Per Year	Agriculture	Municipal and Domestic	Commercial/ Industrial	Total
Year 2000	2,765,879	307,716	208,382	3,281,977
Year 2040*	3,054,937	644,846	278,260	3,978,043
Absolute Increase 2040 over 2000	289,057	337,130	69,878	696,066
Percentage Increase 2040 over 2000	10%	110%	34%	21%

Distribution of Consumption Increases



New Mexico Aquifer Vulnerability



Algal Biodiesel

- Development of biofuels is well underway in NM
- Has potential to be a major economic driver
- Requires large amounts of saline water from aquifers

Competition for water limits energy development, and affects and is affected by environmental issues

- The energy-water-environment nexus is a national concern and encompasses many interdisciplinary grand scientific and societal challenges
- We must develop an understanding of the complex interdependencies among energy, water, environmental, and socioeconomic systems, and apply science, socioeconomic approaches, and engineering to create sustainable systems.

The Planning Process

- Fall 2011 – Stakeholder planning meetings
  - Sept 19 – science questions to be addressed
  - Oct 21 – research infrastructure and CI
  - Nov 21 – education, outreach, and workforce development
- Dec 2011 – Establish Proposal Steering Committee
- Jan – July 2012 – Proposal writing and additional workshops
- June 2012 – AAAS Review
- July 2012 – NSF RFP Released (tentative)
- July 2012 – Revisions to proposal based on AAAS Review and RFP
- Aug 2012 – External Review by Tiger Team
- Aug – Sept 2012 – Final revisions, budgeting, and processing
- Oct 2012 – Proposal to G&C for compliance checking
- November 2012 – submit proposal

New Mexico EPSCoR

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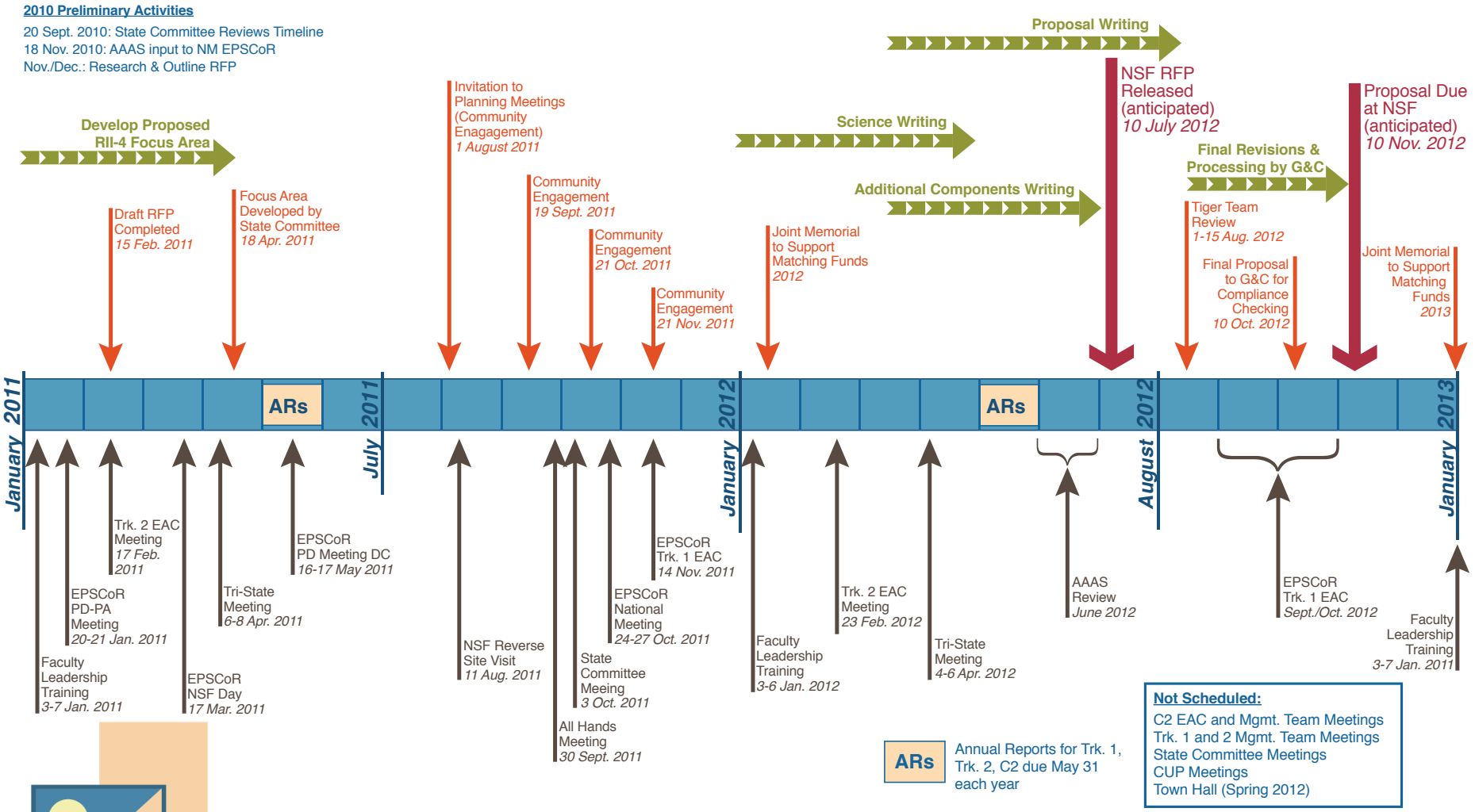
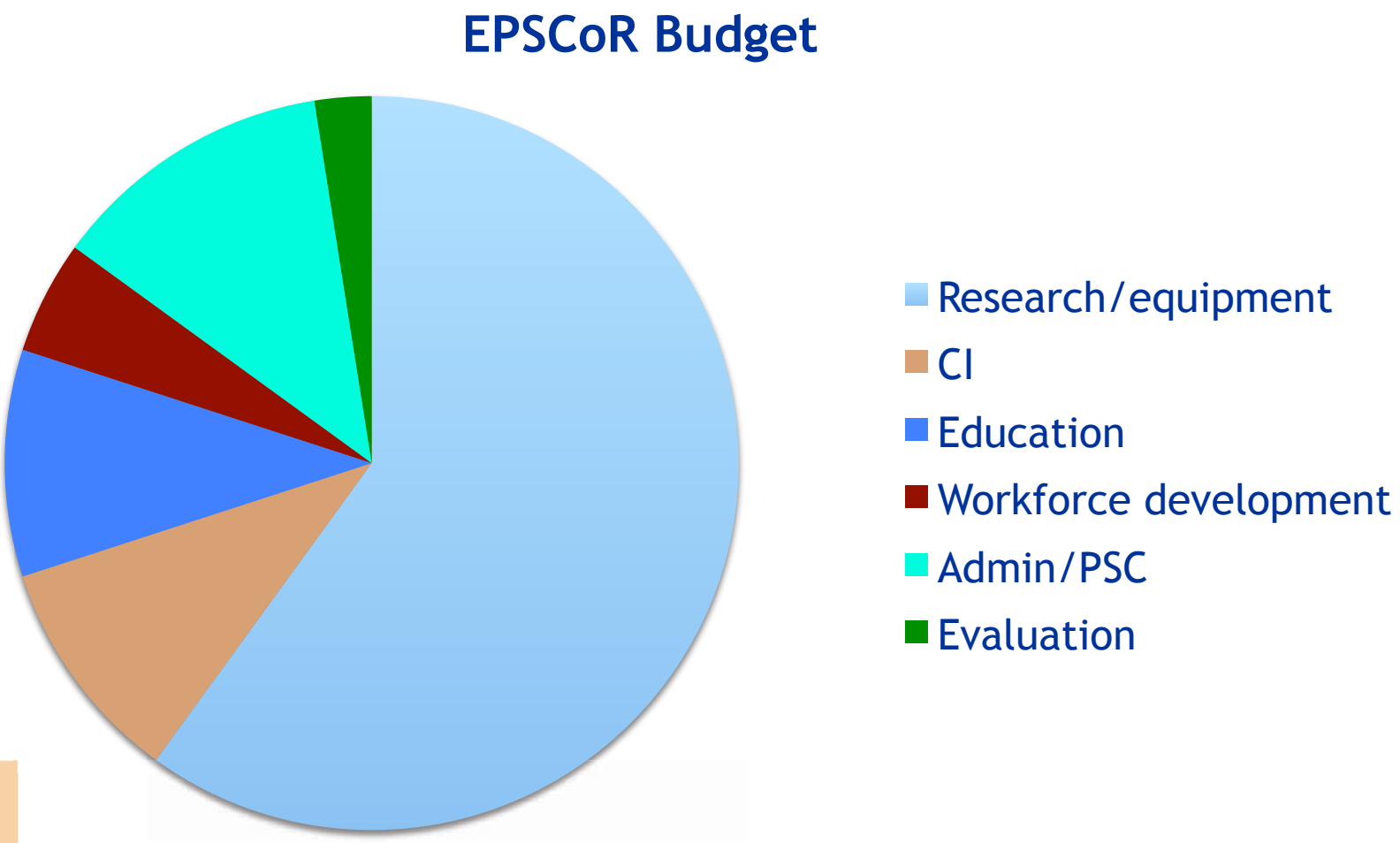


The Proposal Steering Committee

- 12 members +/-
- Expertise
  - Subject area expertise
    - research, CI, education, outreach, workforce development
  - Writing talent and organizational abilities
- Diversity
  - Institutional
    - Major research universities
    - Regional universities and colleges
    - National labs
    - ….
  - Gender, racial, and ethnic diversity

Funding scenario ($20-24M)



Eligible research expenditures

- Research equipment
- Laboratory upgrades
- Field experimental facilities
- Faculty start-up packages
- Undergraduate, graduate and post-doc support
- Miscellaneous
  - Faculty salary for administrative activities
  - Training and professional development
  - Travel, supplies, etc.
  - …

20% match ($4M)

- State of New Mexico
  - A non-recurring appropriation from the State General Fund
  - A Memorial expressing the State's appreciation for NM EPSCoR
- Private/Public Sector support
- Various cost-share options available to Universities and other Institutions of Higher Education in New Mexico that would benefit from enhanced research infrastructure
  - Salary and wages and FB for any EPSCoR staff that are supported
  - Reduced IDC rates
  - University and foundation contributions to picking up RAs, GRAs, Post-docs
  - University cost-share on faculty start-up packages
  - Contributions of equipment
  - Faculty release time

Science White Papers

- Refine and prioritize questions
  - Identify related activities that might be supported
- Identification of lead writer and key contributors to develop a 3-6 page white paper on the topic
  - Title
  - Authors/contributors and affiliations
  - Background / introduction (1 page)
  - Focal questions (2-3 pages)
    - Relevance of questions to energy-water-environment nexus (0.5 page)
    - Capacity to enhance competitiveness for NSF funding (0.5 page)
  - Other people/institutions that can/should be brought in as partners (appendix)
- Identify others to invite to next meeting to identify research infrastructure and CI needs

Bioalgae/Biofuels

- Writers:
  - Lead Writer: Peter Lammers NMSU
  - Tom Bowles NM CAC
  - Juchao Yan EMNU
  - Robert Parameter, Valles Caldera
  - NMSU:
    - Adrian Hanson
    - Carlos Ochoa
    - Shuguang Deng
    - Tanner Schaub
    - Wiebke Boeing
    - Sudha Murthy
    - Andres Cibilis
    - Doug Cram
  - UNM
    - David Hanson
    - Andrew Schulter

- Focus Areas:
  - Process
  - Water, Waste, Sustainability
  - Scaling of integrated multifuel network energy

Bioalgae/Biofuels (continued)

- Preliminary Questions
  1. Process development to maximize lipid production while minimum energy and water use.
  2. How can bio systems be improved for bio energy production?
  3. What biofuel source makes most sustainable (land, water) by products in addition to energy?
  4. How do we provide solutions for water, nutrients, and $CO_{2\ for}$ sustainable algal-bio fuels?
  5. How to control and minimize the effects of bio waste on environment (air, water, soil)? Which technology converts waste into bioenergy?
  6. What is the efficient way to extract and convert agal biomass to biofuels and co-product?
  7. Monitoring chemical composition of algal feedstock and to produce fuel.
  8. What are technical regulatory and resource constraints to scaling-up algal agronomy?
  9. Evaluate different biofuels, algae, range, ag, forestry, carbon dioxide flux, water use of yield, environment with direct or indirect benefits workforce develop.
  10. Agriculture/forest/range lands potential for generating biofuels; understand and quantify water and energy components involved.
  11. Productivity and stability of algae monoculture vs polyculture
  12. Water sources for algae and implications for feedstock quality
  13. Relationship between scale and economics of pro and by-pro

Geothermal

- Preliminary Questions
  1. New Mexico mostly low temperatures (less the 80 degrees) geothermal resources. How can these resources be best used from an economic and technical perspective? Are there synergies with other renewables such as bio algae?
  2. Cation and silica base geothermometers frequently over estimate deep reservoir temperatures. Can we develop a new geothermometer for low temperature New Mexico's systems?
  3. How does the geologic framework of New Mexico geothermal systems impact production, resource evaluation, and aquifer vulnerability? What are the legal implications for geothermal water development?
  4. Are there synergies between brackish water development or carbon dioxide sequestration with low temperature geothermal?

- Lead Writer:
  - Mark Person NMT
- Writers:
  - Laura Crossey UNM
  - Janie Chermak UNM
  - Karl Karlstron UNM
  - Caiti Steele NMSU
  - John Wilson NMT

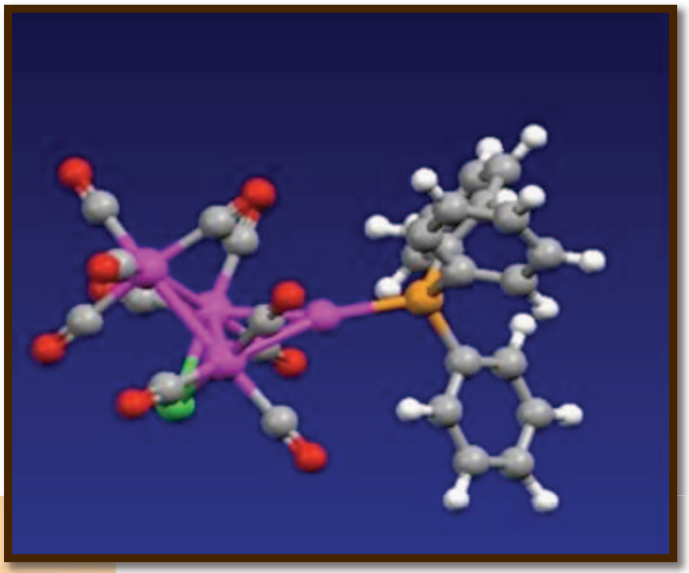
Solar

- Lead Writer:
  - Caiti Steele NMSU
- Writers:
  - Ken Boykin NMSU
- Others to Invite:
  - Olga Lavrova UNM

- Preliminary Questions
  1. How can energy solar driven processes; photochem be used to promote sustainable clean energy?
  2. Where are optimal locations for solar panel installation? (in state) + (US)
  3. What are the impacts of under development on water resources? (future)
  4. How can New Mexico science contribute to U. extraction processing? Dealing with legacy?
  5. What is the environmental and socioeconomic legacy of U. mining?
  6. How can we use dairy wastewater for energy and fertilizer development?
  7. What is the impact of rural local solar PV/thermal use on water resources eg. higher transmission cost of line power vs on site PV generation, including ecosystem function in the wild land urban interface.
  8. How can solar energy be used for carbon dioxide mitigation?
  9. How can we exploit New Mexico's solar potential and support US-made solar panels
  10. How much and how quickly can wind and solar energy production reduce need for coal generated electricity and its use of water?
  11. Is there a strong role for solar ponds for energy production? How can this technology be optimized to also minimize impacts of water and environments?

Photochemistry

- Lead Writer:
  - Michael Haegy NMT
- Writers:
  - Plamen Atimasov UNM
  - Aaron Collins SNL



- Preliminary Questions
  1. How can oil and gas produced water be turned into an economic resource instead of a waste management issue?
  2. The state of produced water from oil and gas production impacts of resources and the environment but is poorly understood. What fundamental and applied research is needed to address this gap?
  3. What is the most robust and efficient water treatment process for recycling produced water?
  4. Is it possible to clean up produced water for other uses in an economically feasible way?
  5. Will water issues constrain oil and gas development?

Water and Gas

- Lead Writer:
  - Jan Hendrickx NMT
- Writers:
  - Frank Huang NMT
  - Laura Crossey UNM
  - Bruce Thompson UNM
- Others to Invite:
  - Robert Balch NMT, PRRC

- Preliminary Questions
  1. Change in water supply from surface ground water, does this mean more dependence on sustainable energy sources (eg wind/solar)?
  2. How can New Mexico become more robust against climate change by optimally combining ragland management for cattle production and energy generation (eg solar)?
  3. How can low-heated micro hydropower be produced for energy in ag irritation systems?
  4. How can the impacts of modern hydrofracting be initiated?

Socioeconomics and Overarching Questions

- Lead Writers: Janie Chermak UNM, Sam Fernald NMSU
- Writers: Frank Ward NMSU, Subhasish Mazumdar NMT, Ram Acharya NMSU, Vince Tidwell, SNL, Mike Pullin, NMT, Edward Martinez, NMHU, Bill Hudspeth UNM, Cliff Dahm, UNM
- Preliminary Questions

1. Socio ecological landscape resilience to interactions of water as resource for consequences, local energy production
2. What are the energy costs and environmental impacts of extracting transporting, provisioning and treating water in New Mexico?
3. How can we monitor estimate and/or model the impact of energy production of water availability quality?
4. How to promote information flow across New Mexico communities to facilitate environmental monitoring optimal energy usage under constraints climate change predictions for New Mexico and collaborative research for the above?
5. What are the characteristics of a scientific CI?
6. What are the economic and ecological impacts of technological transitions in energy, conservation, and waste?
7. In the face of increasing resources scarcity and climate change how do we create energy and water sufficiency with social and environmental health?
8. Strategies to mitigate the impact of climate change induced water shortage.
9. What WEE policy measures can be taken to reduce economic and environment vulnerabilities to climate change?
10. What are the sustainable alternatives for New Mexico communities as energy and water resources are exploited in a climate-changing world when the physical and social science are considered simultaneously and with feedback?
11. What full life cycle implications of energy extraction processing production on environment, water economy and how does life cycle evolve with climate change?
12. What new sensing technologies should be developed to better monitor resources availability, usage, and quality?
13. How can the public ensure efficient progress sound policies. Re: WEE measures are enacted?
14. How do we evaluate policies?

Next steps

- Science white papers
  - September 28: First draft of white paper sent to team reviewers
  - October 3: Revisions back to lead writer
  - October 10: Draft to full development team
  - October 12: Final comments to lead writer
  - October 16: Final draft to EPSCoR Office (mjdaniel@unm.edu)
- Fall 2011 – Stakeholder planning meetings
  - Oct 21 – research infrastructure and CI
  - Nov 21 – education, outreach, and workforce development
- Dec 2011 – Establish Proposal Steering Committee
- Jan – July 2012 – Proposal writing and additional workshops

Thank you!