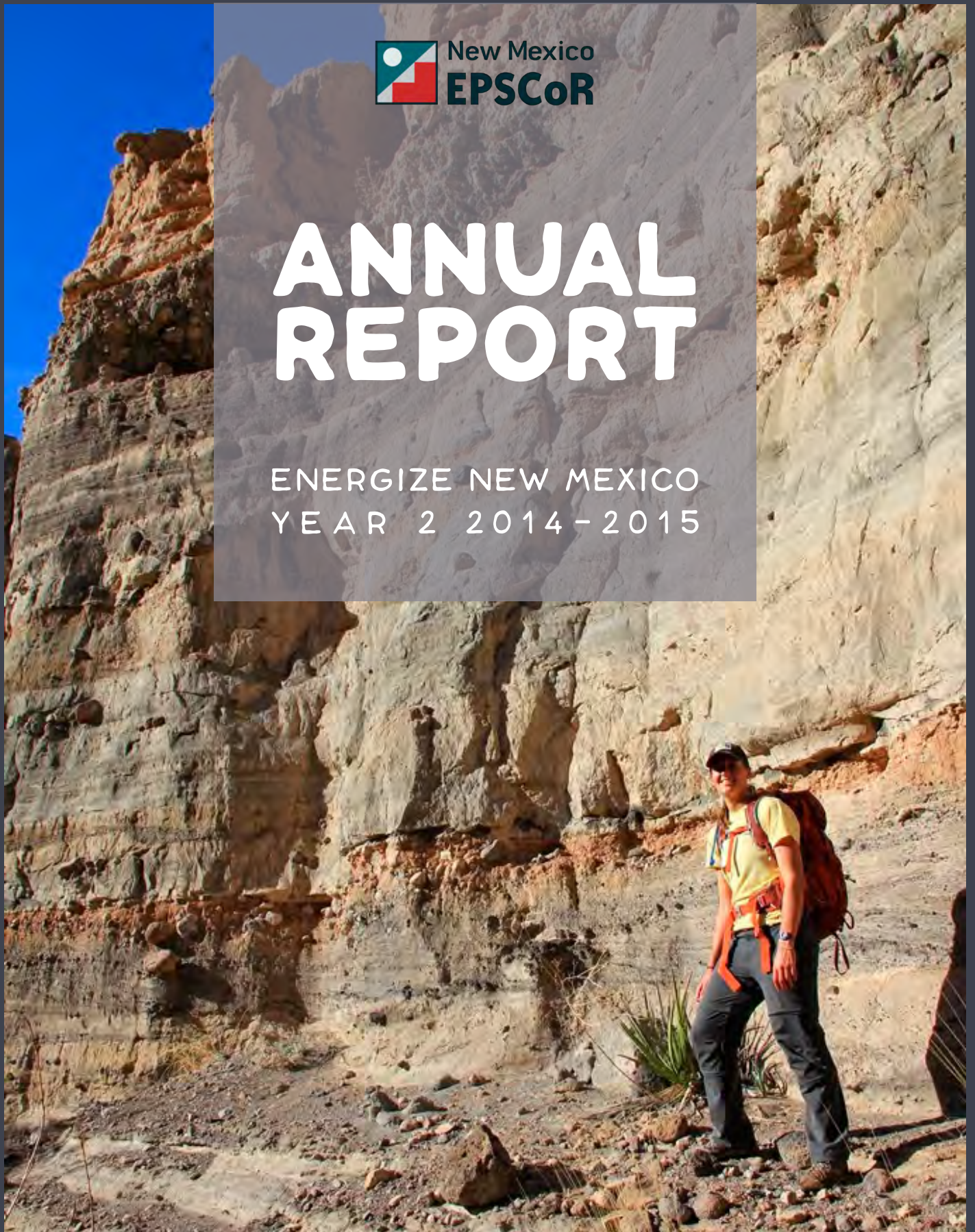




New Mexico  
**EPSCoR**

# ANNUAL REPORT

ENERGIZE NEW MEXICO  
YEAR 2 2014-2015



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## FROM THE DIRECTORS

In Year 2, over 200 faculty, students, and staff of NM EPSCoR's *Energize New Mexico* project worked together to meet and exceed our annual objectives. Together we continued efforts towards achieving our vision for New Mexico as leading the nation in harnessing and promoting sustainable energy resources, cultivating a well-qualified STEM workforce, and developing a sustainable culture of innovation and entrepreneurship.

As this report shows, *Energize New Mexico* student and faculty researchers had a very productive year, generating numerous publications and making presentations at professional meetings across the state and throughout the nation. Collaborations across project components expanded, as did partnerships with other academic institutions and with industry. Researchers have also been working with educators from museums and science centers to inform the public about their work, helping to foster an ecosystem that supports and values scientific research. Reaching into elementary, middle and high school classrooms, NM EPSCoR is contributing to the education of current and future citizens.

New Mexico has received over \$108 million in NSF EPSCoR funding since 2001, benefiting thousands of New Mexicans, and we continue to build on those prior investments. Impacts from research can often take years to be realized, so we include in this report a brief glimpse at some of the recent achievements resulting from the EPSCoR project that concluded in 2013.

Information about achievements, upcoming events, special programs and other opportunities will be disseminated through our website and mailing list. We invite you to connect with us on [nmepscor.org](http://nmepscor.org).

Dr. Bill Michener, Director

Dr. Mary Jo Daniel, Associate Director



Director Bill Michener



Associate Director Mary Jo Daniel

# OVERVIEW

## THE EXPERIMENTAL PROGRAM TO STIMULATE COMPETITIVE RESEARCH

The New Mexico Experimental Program to Stimulate Competitive Research (NM EPSCoR) is a multi-faceted, multi-institutional program aimed at improving the research, human resources, and cyberinfrastructure required for New Mexico to achieve its energy, education, and workforce development potential. NM EPSCoR was established in 2001, and the current grant (RII4) began in 2013. In that short time, NM EPSCoR has contributed approximately \$108 million to New Mexico in direct EPSCoR awards and co-funded awards.

The overarching mission of EPSCoR on the national level is to assist the NSF in its statutory function “to strengthen research and education in science and engineering throughout the United States and to avoid undue concentration of such research and education.” NM EPSCoR is achieving this mission by making the state more competitive in securing NSF funding.

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## **ENERGIZE NEW MEXICO: YEAR 2**

Year 2 of the *Energize New Mexico* grant began on June 1, 2014 and officially ended on May 31, 2015. Building on the successes of Year 1, the project invested in more equipment and personnel at participating universities, including hiring more diverse faculty and students. Each component achieved at least 95% of their Year 2 goals in the *Energize New Mexico* strategic plan, and several components are ahead of schedule.

NM EPSCoR’s web team spent a most of Year 2 evaluating, analyzing, and redesigning the main website, [nmepscor.org](http://nmepscor.org) to be more accessible and user-friendly. Several other EPSCoR states have used the newly designed website as a model for their own sites, and our web developers are leading the way in creating a new, dynamic reporting portal for all EPSCoR jurisdictions.

Members of the NM EPSCoR office, including co-PI Mary Jo Daniel, Education Coordinator Selena Connealy, and Diversity Coordinator Chelsea Chee, conducted numerous visits across the state to research, tribal, and community college campuses, providing information about collaboration and funding opportunities, STEM education efforts, and current research.

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# ACHIEVEMENTS OF THE RII3 GRANT

The third round (RII3) of New Mexico EPSCoR funding, Climate Change Impacts on New Mexico's Mountain Sources of Water, ended in 2013 but results from our research teams continue to make an impact on the state's infrastructure. As a result of NM EPSCoR's investments, New Mexico's meteorological and hydrological observational network is now on a par with other western states. NM EPSCoR provided information and education about climate change science to thousands of New Mexicans and accepted a leadership role in developing computational interoperability standards that allow for wider use and sharing of climate data. Here are some recent publications, achievements, and outcomes from the RII3 grant:

- Data from the NM EPSCoR weather station on the Valles Caldera National Preserve was compiled by New Mexico Tech. Live and archived data can now be [viewed online](#)—data from NM EPSCoR research and equipment specifically is collected in “Hidden Valley” on the map.
- In November 2014, research on ecosystems and acequias (local irrigation ditches) by Bill Fleming, José Rivera, and two EPSCoR funded graduate students, Amy Miller and Matt Piccarello, was published in the *International Journal of Biodiversity Science, Ecosystem Services & Management*. The paper, “[Ecosystem services of traditional irrigation systems in Northern New Mexico](#)”, explains how Fleming, Rivera, and their team developed a system to rate ecosystem health along the banks of acequias on the Rio Hondo using GIS and field methods. The evaluation and rating system provide “scientific support for the protection of traditional irrigation as an important cultural and ecosystem landscape of value to the broader society.”
- Water Quality team members at UNM—Cliff Dahm, Roxanne Candelaria-Ley, Chelsea Reale, Justin Reale, and David Van Horn—published their EPSCoR research in the journal *Freshwater Biology*. The paper, “[Extreme water quality degradation following a catastrophic forest fire](#),” focuses on water affected by the 2011 Las Conchas fire in the Jemez Mountains. According to their findings, sensors recorded a high level of particulates and degraded water quality in runoff coming from the burned areas and flowing into the Rio Grande. The team concluded that the low water quality after the fire carries “significant implications for the ecosystem health of this crucial river that supplies water to cities and agriculture,” and that “sudden, dramatic changes to [mountain watersheds] from severe forest fires... are very likely to be among the strongest impacts of global change and river ecosystems” in the western United States.



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# COMMITMENT TO DIVERSITY

Diversity is a key component of all *Energize New Mexico* program activities. NM EPSCoR's Diversity Team created a Diversity Strategic Plan in 2014, and the Team regularly reviews progress, with a vision to have New Mexico's STEM population mimic the state's general population. The mission in the Diversity Strategic Plan is 50% representation by women and underrepresented minorities (F/URM) in all supported programs by May 31, 2018 with priority placed on STEM Advancement Program (STEMAP) undergraduates.

The Diversity Team plans to achieve this through three objectives:

1. Retain undergraduates through enhanced mentorship capabilities of all STEMAP research faculty with 75% participation rate once a year;
2. Retain undergraduates through an enhanced NM EPSCoR support system of 45 to 50 STEMAP students by May 2018; and
3. Connect with 75 F/URM undergraduates a year for STEMAP, UVMN, and research.

To date, the Team is hitting their marks. In Year 2, NM EPSCoR achieved the diversity goal in all groups except faculty. All STEMAP research teams and 11 faculty have participated in faculty mentor trainings. 9 of 11 STEMAP 2014 students were retained throughout the year with three staying engaged into the next year. NM EPSCoR has 46 undergraduate participants, 52 STEMAP applications, 2 UVMN applications, and over 75 recruitment effort attendees. The statewide All Hands Meeting included a session that actively engaged attendees in small-group, interdisciplinary, structured discussions of implicit biases, diversity issues, and possible solutions.

NM EPSCoR Diversity Coordinator Chelsea Chee (*pictured, left*), in partnership with AISES, initiated "Natives in STEM," a project involving the creation and distribution of images and videos of Native American STEM professionals to K–12 classrooms and communities on Native lands. Chelsea's preliminary efforts will receive feedback from focus groups in Year 3.



Diversity Coordinator Chelsea Chee





Collaboration, conversation, and updates at the 2015 All Hands Meeting

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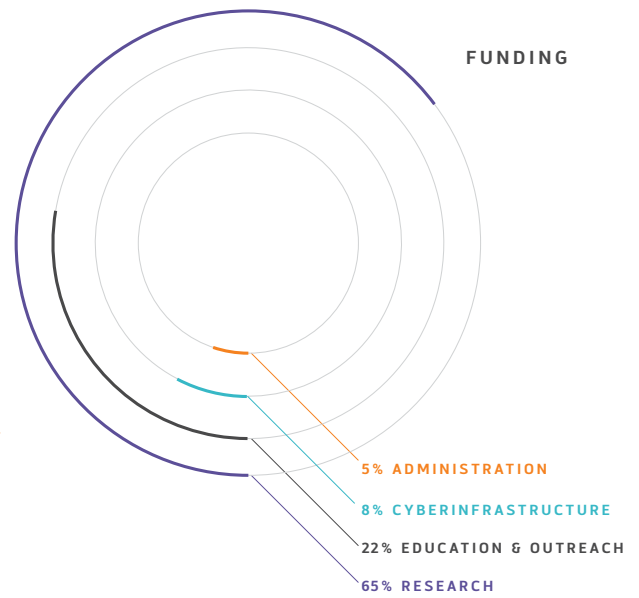
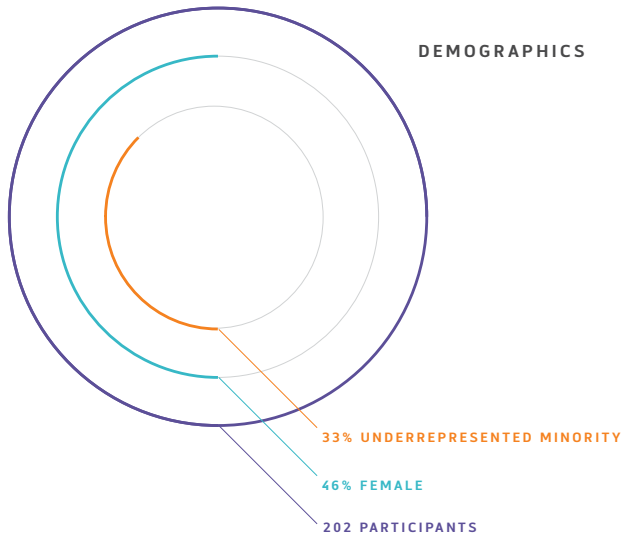
## COLLABORATION: AT THE HEART OF *ENERGIZE NEW MEXICO*

*Energize New Mexico* encourages and supports collaborative efforts across institutions and disciplines. The Research, Cyberinfrastructure, Diversity, Workforce Development, and External Engagement teams initiated new and strengthened existing collaborations within New Mexico and beyond to support and extend research and education efforts.

In Year 2, 50 institutions were involved in collaborations with NM EPSCoR, including 5 minority-serving institutions, 2 tribal colleges, 2 national laboratories, and 10 industry partners. NM EPSCoR's Education Coordinator Selena Connealy is now the co-chair of the Math and Science Advisory Council that provides input to the New Mexico Public Education Department. Co-PI Mary Jo Daniel serves on a statewide STEM Collective Impact team, providing policy language for proposed legislation related to STEM education efforts. Both women also serve on the board of the New Mexico Partnership for Math and Science Education.

In addition to external collaborations, project synergies are developing among colleagues across university departments and between components within *Energize New Mexico*. Specific partnerships can be found under each science component later in this report.

# YEAR 2 METRICS



Total Followers

# 1,251

New Mexico EPSCoR can also be found on Flickr, YouTube, and nmepscor.org.



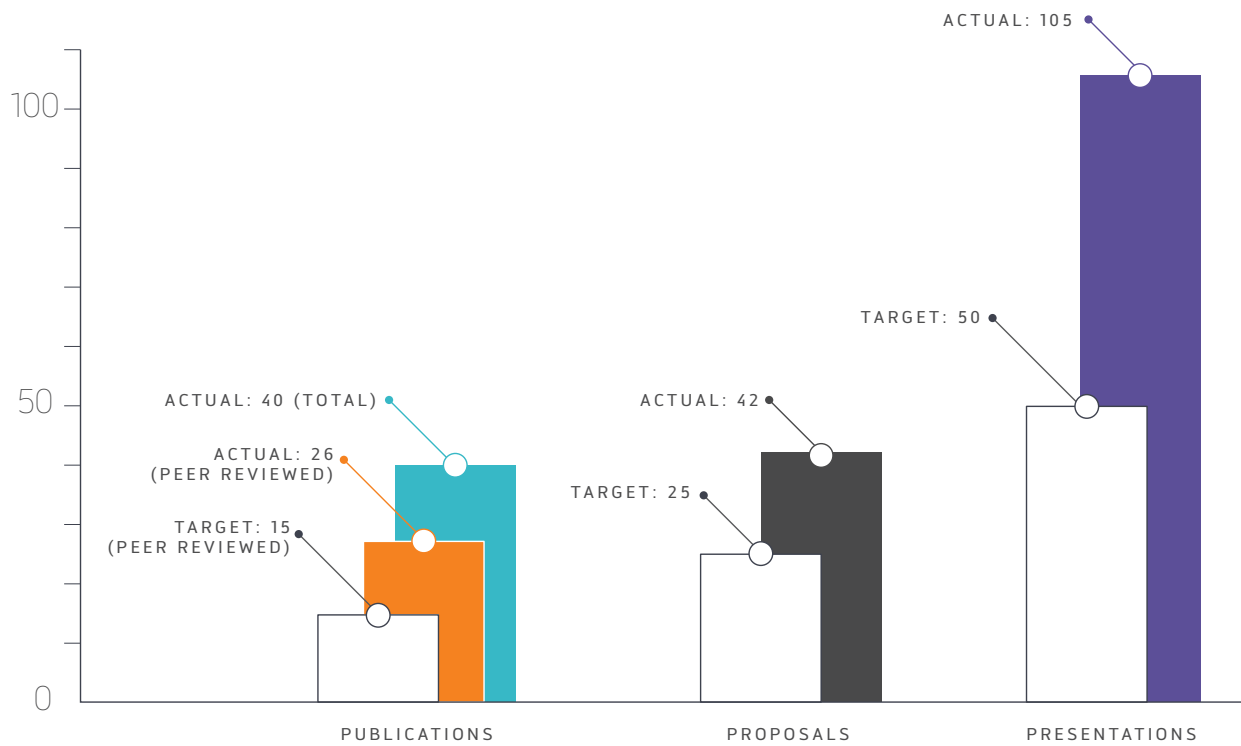
**224**  
Current Likes for our Facebook page



**307**  
Followers of our Twitter account @nmepscor



**720**  
Unique subscribers to our three email listservs



## AWARDS

### DAVID HANSON, UNM

2014 Kavli Fellow for the Japanese-American Frontiers of Science Symposium

### KARL KARLSTROM, UNM

University of New Mexico 60th Annual Research Lecturer

### LINNEA ISTA, UNM

Celebration Imagination 2014 Innovation Award

### HONGMEI LUO, NMSU

Bromilow Award for Teaching Excellence; Bromilow Award for Research Excellence

### MICHAEL HEAGY, NMT

New Mexico Tech 2014 Distinguished Researcher Award

### SELENA CONNEALY, NM EPSCoR

2014 Service to Science Award from the New Mexico Teachers Association

### SAUL RUIZ, NMHU

SACNAS Poster Award

### NMAS RESEARCH SYMPOSIUM POSTER WINNERS

Brittney Sloughy-Massengale, ENMU

Chaitanya Kukulta, NMSU

Maria Repasch, UNM

Nadia Mabrouk Mujynya, SFCC

### SUPERCOMPUTING CHALLENGE CLIMATE CHANGE AWARD

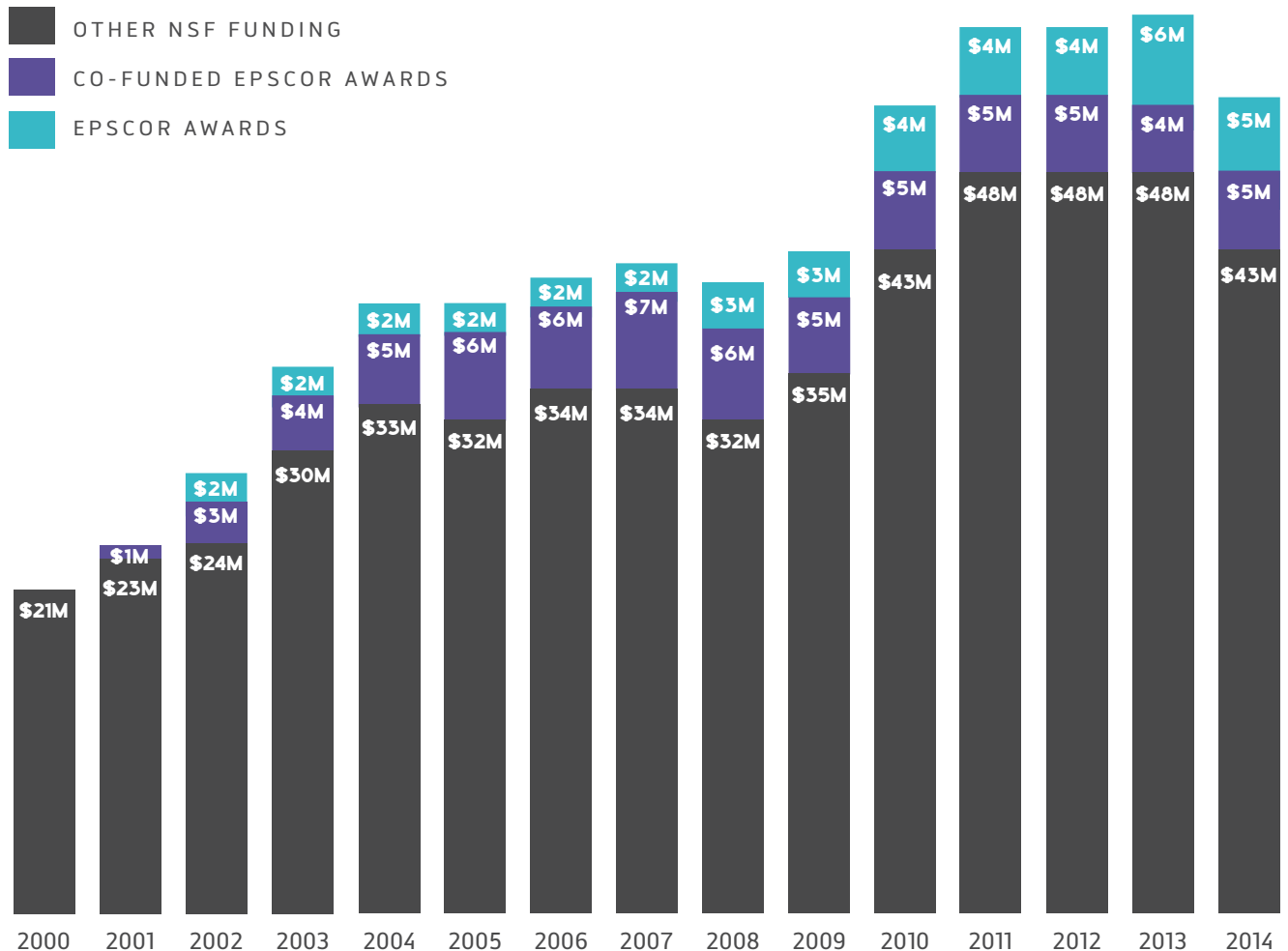
Team 88, Miyamura High School, Gallup, NM

Ericson Gordo

Nashat Khalaf

Tyler Strangeowl

Teacher: Rowena Dolina



# SCIENCE

## SUSTAINABILITY AND INNOVATION

New Mexico is known as the “Land of Enchantment”—a place of great beauty, abundant natural resources, and rich cultural diversity. However, New Mexico is a dry environment and faces severe challenges as it tries to grow its economy and conserve water resources at the same time. These challenges are exacerbated by population growth and climate change.

So how can New Mexico realize its energy development potential in a sustainable manner? The six science components in the *Energize New Mexico* project are working on answering this question by achieving their own strategic goals based on sustainability, efficiency, and resource utilization while minimizing risk to water and the environment. Specifically, the science teams are studying how to increase efficiency of resource utilization & extractive technologies, and whether water and environmental resources can sustain extractive energy development with little to no risk.





1.) Grad student John Roesgen examines algae at the UNM Biology lab; 2.) Students at NMSU set up algal-based wastewater treatment system; 3.) Outdoor algae cultivation beds at ENMU

## BIOALGAL ENERGY

Algal biomass has the potential to contribute significantly to new renewable fuel standards if solutions can be found for several biological and techno-economic problems. For large scale, outdoor production of algal biomass, supplying light, CO<sub>2</sub> and nutrients introduce their own unique issues. *Energize New Mexico's* Bioalgal Energy component is looking for solutions that make use of non-traditional organisms and non-potable water in order to generate knowledge about algal biology and scaling biofuels production from cells to large reactors.

Several findings resulted from Year 2 research. At UNM, the team is pursuing novel ways to culture cells while maintaining photosynthetic function. The team found thinner gels are better at maintaining photosynthetic function of encapsulated living algae cells, and that encapsulated polycultures of alga and bacterium generate electricity better than monocultures of each and liquid polycultures.

The NMSU team demonstrated regrowth of liquid-phase *Galdieria sulphuraria* after hydrothermal liquefaction processing (HTL). HTL converts algae into a liquid biofuel that can be used directly as energy or as materials to help fuel wastewater decontamination and utilization. *G. sulphuraria* also demonstrated removal of contaminants and a decrease in quantity of oxygen used by microorganisms in primary-settled wastewater. Based on these findings, the NMSU bioalgal team recently completed deployment of an algal-based wastewater treatment system for pilot-scale demonstration at the Las Cruces Wastewater Treatment Facility, providing new research opportunities for other faculty and students at NMSU, UNM and ENMU, under EPSCoR support.



1) Graduate students on an adventure on the Rio Grande; 2) NMT PhD student Jeff Pepin explores southern New Mexico; 3) Component co-lead Laura Crossey

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## GEOTHERMAL ENERGY

Geothermal energy exploration and utilization has the potential to become important to New Mexico's energy future, but human technologies applied to natural geothermal systems for energy production can cause profound changes to surface features, possibly leading to a net loss of groundwater. *Energize New Mexico's* Geothermal Energy component addresses not only the potential of hydrothermal systems to create sustainable energy, but also the economic implications of such systems by partnering with local communities.

In Year 2, the Geothermal team worked towards a better understanding of underlying hydrothermal systems in New Mexico by locating and mapping blind systems (see *Locating*, pg. 13) and creating a statewide database of these systems. Team members received training on the EPSCoR-funded, state-of-the-art Zonge Magnetotelluric (MT) system, and a test site was located just south of Socorro, NM. The MT system helps the team detect possible geothermal structures underground and allows for estimation of geothermal reservoir temperatures at various depths.

*Energize New Mexico* funding also allowed for an inter-institutional graduate level course, "Geothermal Energy: Tectonic Setting, Exploration, Production and Sustainability," providing a unique opportunity to combine research with education as students were actively engaged in the component's research activities.



# LOCATING & MAPPING BLIND GEOTHERMAL SYSTEMS

## On Location with the Geothermal Team

New Mexico is endowed with relatively high heat energy flow and permeable, fractured bedrock, giving rise to numerous low temperature geothermal systems. However, developing geothermal energy as a sustainable resource in New Mexico requires a better understanding of the underlying, or “blind” natural geothermal systems.

In Year 2, the geothermal energy component team developed a methodology for locating blind geothermal systems using trace element concentrations combined with solute transport theory. Shari Kelley and Mark Person (NMT) assembled a statewide geochemical database, focusing on two trace elements, lithium and boron, often found in high concentrations within geothermal systems.

Preliminary findings reveal elevated lithium concentrations along the Rio Grande Rift near the Bosque Del Apache Bird Sanctuary, and in the southern Albuquerque Basin. The team plans to continue research along the projected flow path to determine the availability of additional existing geochemical data while developing complex, 3D models to test their hypotheses on the underground origins of the geothermal heat.

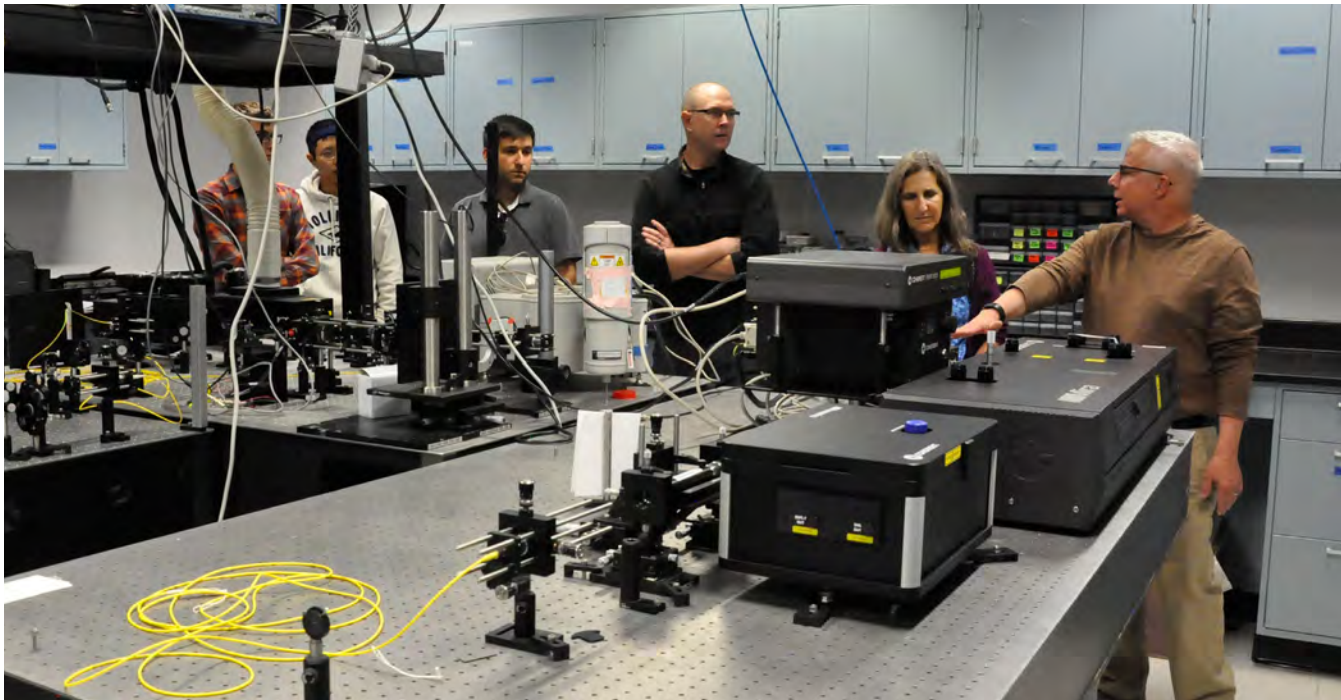


## SOLAR ENERGY

In 2014, the U.S. installed solar photovoltaic (PV) capacity for the year reached a record 6,201 megawatts, making last year the largest for solar energy installations. However, several challenges remain before widespread adoption of solar energy is possible. *Energize New Mexico* is addressing three challenges: energy storage during dark periods, more effective and efficient solar energy processes and devices, and transportable solar fuel alternatives (such as methanol) to fossil fuels.

In Year 2, Solar team members addressing solar fuel alternatives developed an approach to converting CO<sub>2</sub> in the atmosphere to methanol and hydrogen fuel (formic acid) through solar-driven water oxidation. The team investigated the nanoparticle Zinc sulfide (ZnS) as a promising catalyst for this process due to its abundance, low cost, low toxicity, and other properties that enable the photoreduction of CO<sub>2</sub> to formic acid. This study is the first to experimentally examine the photocatalytic differences between two ZnS minerals, wurtzite and sphalerite.

Spectroscopic lab equipment, including lasers at UNM's Center for High Technology Materials (*pictured below*) were purchased using NM EPSCoR funds. Collaboration between NMT and UNM is further strengthening inter-institutional relationships and enhancing our capacity to employ time-resolved spectroscopy to achieve research goals.



Component co-lead Martin Kirk (far right) talks about the equipment purchased through EPSCoR funding at the Center for High Tech Materials





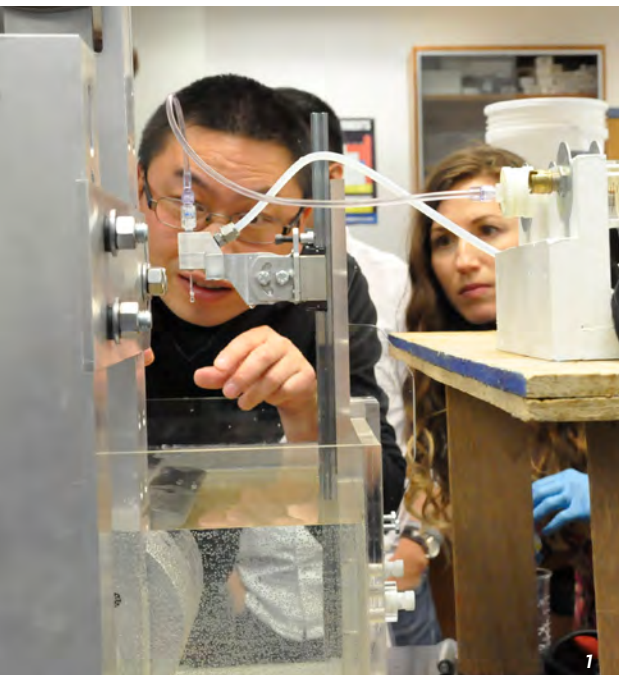
1) Graduate students from NMT and UNM sample water from a pond near the Jackpile Mine; 2) Undergrad Claudia Roldan (left) & grad student Cherie Devore are all smiles after a long day in the field; 3) Grad student Cherie Devore collects sediment samples from the Rio Paguato on Laguna Pueblo

## URANIUM TRANSPORT & SITE REMEDIATION

Uranium in New Mexico is located primarily in the Grants mineral belt, along the south margin of the San Juan Basin in the northwest part of the state. New Mexico no longer mines uranium, but concerns remain about surface and underground contamination, especially on Native American lands. The *Energize New Mexico* Uranium Transport & Site Remediation team focuses on understanding how uranium reacts to and interacts with the environment, as well its molecular mobility. The team conducted a great deal of field research in Year 2 in the Navajo Nation and on the Pueblo of Laguna. Batch experiments, sequential extractions, advanced microscopy & spectroscopy, and chemical analyses were employed to characterize sediments sampled from both locations.

The team collected and analyzed samples from an area in the Navajo Nation known to have high uranium concentration in nearby spring water used by small communities (mine workers used to wash their hands in the spring). Soil samples show an elevated presence of uranium, with dissolution and desorption shown as the primary mechanisms related to mobility of uranium molecules in the area.

Dust traps for studying uranium wind transport were installed on Laguna Pueblo, and soil and water samples were collected from all locations. Testing revealed high uranium in surface water as it passes the Jackpile-Paguato mine, with a decreased concentration as the water travels south. This is most likely due to the differences in sediment composition.



1) Qiang Wei and Cassandra Sanchez examine membrane materials at NMT; 2) Co-lead Frank Huang explains the PRO process; 3) Oil fields in southeast New Mexico

## OSMOTIC POWER DEVELOPMENT

Produced water refers to water generated as a byproduct of drilling for oil and gas. New Mexico alone generates about 28 billion gallons of produced water annually, and most of it is discarded as wastewater due to the high concentration of inorganic and organic matter in the water called total dissolved solids (TDS). The Osmotic Power team (now in collaboration with the Bioalgal and Uranium teams) is trying to cut down on discarded wastewater by using produced water to generate clean energy through a process called pressure retarded osmosis (PRO). The Osmotic team continues its collaboration with the Apache Corporation to obtain high TDS water for analysis and testing in the PRO system.

In Year 2, the Osmotic team is nearing completion and implementation on design and fabrication of hollow fiber membranes (HFM), a key component of the PRO system that increases the efficiency of the PRO process. The team assessed the design requirements of the membranes and developed technical performance metrics and benchmarks. Effects of parameters, such as salt rejection and water flux, on the quality and performance of the membranes were also studied.

The team collaborated with California company Trevi Systems, and gained new knowledge about how to produce clean water from brackish water or wastewater at a lower cost and lower energy use. Optimization of the membrane materials continues, and selected designs will be prototyped using a custom-made 3D printer. Working prototypes may be adopted by Trevi Systems in the future.



# MEMBRANE FABRICATION & CHARACTERIZATION WORKSHOP

Innovative Ideas with the Osmotic Power Development Team

Fifteen students and five faculty from NMT, NMHU, and EMNU congregated at NMT's Environmental Engineering Lab June 9–11, 2014 to learn the basics of membrane fabrication and characterization.



Student participants were divided into small, faculty-led groups in order to learn how to properly cut and test the various membrane materials. Membranes were characterized using a scanning electron microscope to determine porosity and morphology, and a high-powered camera to determine contact angles that can be used to repel water. This intensive workshop was designed to establish and nurture a vibrant research infrastructure in New Mexico for osmotic power development. In addition to conducting experiments and collecting data, students created daily PowerPoint presentations to share their processes and findings with the larger team.



Future workshops will build on this gained knowledge of membranes. All participants indicated interest in continued work on osmotic power development. This workshop was an important step towards expanding New Mexico's research capability.

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## SOCIAL & NATURAL SCIENCE NEXUS

The energy industry is important to the economy of New Mexico, yet development is often constrained by socioeconomic issues and environmental impacts on water resources. The Social & Natural Science Nexus component team is creating innovative ways of using System Dynamics (SD) modeling to increase understanding of the behavior of complex systems like the interaction of water, the environment, energy, and people.

An experimental economics lab was completed at UNM (*pictured, below*) using *Energize New Mexico* funding. More data collection for the SD model continued in Year 2, including development of a framework for fossil fuel energy production and a preliminary SD model for the San Juan Basin in northwestern New Mexico. Data was gathered and transformed to be compatible with the modeling effort, and existing algorithms have been developed for incorporation into the SD model. In partnership with the Office of the State Engineer, creation of a statewide, dynamic water budget is well underway, which will also be incorporated into the final SD model.



Component co-lead Janie Chermak talks about the benefits of the new Economics Lab at UNM with NSF Program Officer Audrey Levine

# EDUCATION & OUTREACH

## INFORMAL SCIENCE AND ENTREPRENEURS

Part of *Energize New Mexico's* vision includes creating a well-qualified STEM workforce while promoting a culture of innovation and entrepreneurship. The NM EPSCoR Workforce Development Plan provides activities that engage and support learners at all educational levels, leading to a diverse future in Science Technology, Engineering, and Mathematics (STEM). In addition to the training university students will receive through their participation in the interdisciplinary research teams, NM EPSCoR is forming partnerships that enhance STEM education at all academic levels, and develop the state's environment for entrepreneurship, furthering bolstering New Mexico's STEM workforce.

Greater educational success in STEM enables New Mexicans to take advantage of well-paid employment opportunities and increase our research competitiveness. Supporting cultural entrepreneurs creates new, innovative business ventures that will contribute to the state's economic base.



# NEW MEXICO INFORMAL SCIENCE & EDUCATION NETWORK

The importance of informal, non-classroom exposure to learning opportunities in STEM cannot be overstated. Experiences provided by parents, friends, and informal educators inspire and expose students to the wonder and possibility of science in everyday life. NM EPSCoR is proud to sponsor the New Mexico Informal Science Education Network (NM ISE Net) in order to provide opportunities and resources for informal educators (including the Summer Teacher Institute) to work together to impact science teaching, science learning, and science awareness throughout the state.

NM ISE Net is NM EPSCoR's primary vehicle for disseminating NM EPSCoR research to the public and engaging learners of all ages in STEM. In Year 2, the Network focused on building their capacity to effectively communicate science to the public. This included participation in the "Reflecting the Practice" coaching workshop facilitated by the [Lawrence Hall of Science](#); the workshop provided training and tools to improve the practice of informal science educators, and facilitated the formation of a Community of Practice of informal science institutions and practitioners in New Mexico. NM ISE Net is systematically linking members of their communities not only to other informal education institutions, but also to academic research efforts, faculty presentations, and the New Mexico Public Education Department.

1) Educators from the National Museum of Nuclear Science give a dry ice demonstration; 2) T-rex skull from Mesalands; 3) ISE Net participants enjoy hands-on activities at meetings





1-3) Teachers create hands-on experiments and activities for their classrooms with the help of ISE Net Museums; 4) The 2014 Teacher Institute participants

## SUMMER TEACHER INSTITUTE

Science teachers and their students wrestle with energy concepts at nearly every grade level. What is energy? Where does New Mexico’s energy come from? Is energy from the sun different from the energy that powers our everyday lives, from our cars to our bodies? The Framework for K–12 Science Education ([National Research Council, 2012](#)) provides a foundation for K–12 teaching and learning about energy as a crosscutting concept across the disciplines. Educators from five NM ISE Net institutions used the Framework to develop and present the first *Energize New Mexico* Teacher Institute, held in Albuquerque on June 9–13, 2014.

In order to facilitate future implementation, teachers attended the Institute as part of a school team that included principals. Twenty-six elementary school teachers from three school districts increased their conceptual understanding of energy and learned strategies for exploring energy with their students. Highlights from the week include the construction of roller coasters and waterwheels, exploration of New Mexico’s energy resources, and children’s literature connections. The Institute opened the door to ideas merging informal science education with formal, standards-based classroom education, and encouraged teachers to “think outside the box” when it comes to teaching and learning about energy.

Institute participants are supported by NM ISE Net educators throughout the school year, and all participants attended the New Mexico Science Teachers Association conference in Fall 2014.

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## POST-DOC LEADERSHIP WORKSHOP

Just after the start of the new year, NM EPSCoR welcomed 20 post-docs to the Sevilleta National Wildlife Refuge for an intensive three-day program designed to enhance the professional skills of post-doctoral scholars in STEM disciplines. NM EPSCoR brought experts from around the country to lead workshop sessions on meeting facilitation, communicating science, writing proposals, career planning, entrepreneurship, mentoring, and more. A member of the Board of the National Postdoctoral Association attended the entire workshop and provided a wealth of resources to the participants. NM EPSCoR researcher Johanna Blake participated in this year's workshop; she kindly wrote the following about her experience:

*I personally found several workshop sessions to be extremely useful. These included a session on facilitating productive meetings... [and] the opportunity to practice their communication to the media through mock interviews for television, radio and print. I practiced a mock television news interview with David Marash, an accomplished journalist. Another particularly useful session... was facilitated by Dr. Gary Smith from UNM, where we learned how to better run a class session through activities rather than the classic lecture style. I think I speak for my postdoctoral colleagues when I say this was time well spent in the beautiful desert of New Mexico.*



Participants of the 2015 Post-Doc Leadership Workshop at the Sevilleta National Wildlife Refuge





Finalists of the 2014 Creative Startups Accelerator each take a turn during the demo night held at iExplora!

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## CREATIVE STARTUPS

The Institute for Creative and Cultural Entrepreneurship (ICCE) was launched to fill the void in support for entrepreneurs building new ventures in the creative economy. Market research in Year 1 led to the launch of Creative Startups in Year 2. Creative Startups is the first accelerator designed by and for creative entrepreneurs. Over 40 successful business owners in creative fields were tapped and engaged as mentors, and new curriculum modules were completed and tested in Summer 2014. The 10 modules included leadership of new ventures, financing for startups, marketing and branding, and legal issues. In its first year, Creative Startups received 60 applications from entrepreneurs in various creative fields—80% were submitted by women- and/or minority-owned startups. 12 finalists were chosen (9 women/minority-owned) for the 2014 Creative Startups Accelerator cohort.

After participating in the 10 online modules, the cohort began a week-long “Deep Dive” in which 30+ mentors and community leaders joined the cohort to provide advice, deliver technical assistance, and network with the entrepreneurs, while community events brought nearly 200 people to network and engage in the startup ecosystem. Across the board, the 2014 Accelerator had a positive impact on participating startups.

ICCE continues to grow the ecosystem of resources for creative entrepreneurs, including partnering to bring two international programs to Albuquerque: Creative Mornings and 99U/Behance.

# STEM ADVANCEMENT PROGRAM

The STEM Advancement Program (STEMAP) engages students from New Mexico regional universities, community colleges and tribal colleges in the research funded by NM EPSCoR. STEMAP gives undergraduates from these non-research universities the opportunity to work in the labs of NM EPSCoR researchers, an opportunity these students may not otherwise have access to. The nine-week commitment involves one week of training and eight weeks of research, followed by a final conference at which the students present their research. In return, the students receive a stipend, housing and food allowances, and 3 hours of independent study credits from NMT. Students also receive support during the academic year with additional opportunities to build skills in STEM research and communication.

On June 2, 2014, eleven undergraduates from seven New Mexico Primarily Undergraduate Institutions (PUIs) reported to NMT to begin their STEMAP participation. The program ended July 30, 2014 with student presentations to 50+ researchers, faculty, friends, family, and NM EPSCoR staff at the Sevilleta National Wildlife Refuge. Three STEMAP students, Tim Torres, Aysha McClory and Saul Ruiz, accepted invitations to present their research at the 2014 SACNAS Conference, and several participants are now pursuing STEM degrees. Testimonials of the 2014 STEMAP students can be seen on the [NM EPSCoR YouTube Channel](#).



1) STEMAP 2014 participants and leaders; 2) Devon Bruce and Claudia Petr in the lab studying conversion of CO<sub>2</sub> to solar fuels

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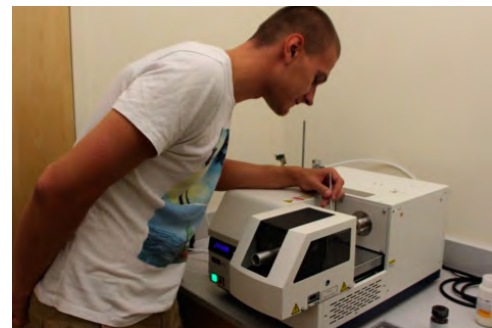
## SEED GRANT AWARDS

The intent of the Infrastructure Seed Grant (ISG) program is to increase the access of undergraduate students, especially women and members of underrepresented groups, to research experiences by increasing non-PhD granting institutions' capacity to provide these experiences for students. The ISG may be used to purchase research and teaching equipment related to specific NM EPSCoR research areas and to pay for student researcher salaries, research supplies and student conference travel. Two ISG awards were implemented in Year 2.

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### New Mexico Highlands University

At New Mexico Highlands University (NMHU), the ISG award was used to acquire instrumentation for analysis of the temperature and heat-energy transfer of materials, and for obtaining large crystalline samples of materials. This involved differential scanning calorimetry (DSC), a method that can be used to measure a number of characteristic properties of materials for understanding phase (gas-liquid-solid) changes and whether materials can store energy in a certain phase. Two faculty members, two graduate students, and two undergraduate students are involved in research related to charge transfer materials and metal organic frameworks with luminescent properties. The team has submitted three proposals to NSF and one to the Department of Energy that will employ instrumentation acquired through this award. The instrumentation is also included in laboratory components of Physical and Analytical Chemistry courses at NMHU.



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### Santa Fe Community College

The Santa Fe Community College (SFCC) ISG provided funding for sensors used by students focused on monitoring the commercial-scale photobioreactors at the SFCC Biofuels laboratory. Students study how pH, operating temperatures, chlorophyll content and other parameters affect the maximum algae production and biomass densities. The new sensors allow students and faculty to replicate growth conditions optimized in a lab setting to determine if they can be scaled up to industrial production levels. Capturing data in real time under continuous operation allows researchers to determine the performance of the photobioreactors and optimizes long-term microalgal biomass productivity.





## FACULTY LEADERSHIP & PROFESSIONAL DEVELOPMENT

For two days in September 2014, the Faculty Leadership and Professional Development Institute (FLPDI) continued to work with new curriculum from *Micro-messaging to Reach and Teach Every Student™* from the National Alliance for Partnerships in Equity (NAPE).

Undergraduate faculty from 12 institutions learned to use research-tested pedagogy that improves enrollment, retention, and completion of girls and underrepresented populations in STEM courses. An online follow-up session furthered the discussion of how culture shapes our biases and beliefs about people, often without our realization.

## GROWING UP THINKING COMPUTATIONALLY

Growing Up Thinking Computationally (GUTC) provided support in the classroom and after-school clubs for middle school students, and offered professional development for teachers during the 2014–2015 school year. In total, 327 students participated—45% were female, and 64% were from underrepresented groups.

Through activities, GUTC engaged participants in the use of computational models for scientific inquiry and research, and introduced two curricular units: Sustainability & Biofuels, and Geothermal Energy. In each 12-week unit, students investigate a problem, gather data, create a computer model, and run experiments using the model as a virtual test bed.



# CYBER- INFRASTRUCTURE

## ENABLING COLLABORATION

Through *Energize New Mexico*, NM EPSCoR is making it easier for scientists, educators, and the public to discover, acquire, and use data. Cyberinfrastructure (CI) plays a critical role in *Energize New Mexico*, enabling collaboration across all project components, and creating a simple process to discover and use the learning modules and data developed by NM EPSCoR. Each *Energize New Mexico* component has a CI team liaison to better support research and data management efforts so research findings can be included in the EPSCoR data portal.

The new data portal developed during Year 2 provides a streamlined interface for discovering and accessing data products and services for datasets and educational materials integrated into the data portal. Data management, analysis and visualization tool descriptions were integrated into a searchable database available through the NM EPSCoR website. NM EPSCoR also became a DataONE Tier 4 member node in May 2015, allowing data and publications to reach a wider audience, receive recognition and credit, and enhance collaborative opportunities.

1) Software Carpentry Workshop, organized by Karl Benedict and Dave Hanson; 2) Hays Barrett (left), Benedict, and John Savickas (right) show the server room to NSF Program Director Audrey Levine; 3) EDAC Director Shirley Baros updates the team; 4) The Earth Data Analysis Center (EDAC) at UNM houses the EPSCoR server.



# YEAR 2



1) 2014 STEMAP participants attend SACNAS Conference with Diversity Coordinator Chelsea Chee (center right); 2) Winners of the NMAS Science Teacher Award; 3) Alice Loy (right) and colleagues celebrate Creative-Startups Demo Night; 4) Jose Cerrato (center right) speaks with (L to R) Johanna Blake, Laura Crossey, and NSF EPSCoR Program officer Audrey Levine; 5) Bioalgal outdoor cultivation raceways at NMSU; 6) Software Carpentry Workshop; 7) Grad student John Roesgen works on cultivating algae in the UNM Bioalgal lab



8) 2014 STEMAP participant Shaina Willie presents her summer research project in July 2014; 9) Winners of the 2014 NMAS Research Symposium poster competition; 10) A packed house for the 2015 All Hands Meeting at NMT; 11) Keynote address at the 2014 NMAS Research Symposium; 12) Teachers make a waterwheel for the 2014 Summer Teacher Institute; 13) Students in the geothermal graduate class have an adventure on the Rio Grande; 14) Johanna Blake (Uranium team) demonstrates new equipment at UNM

# THE FUTURE

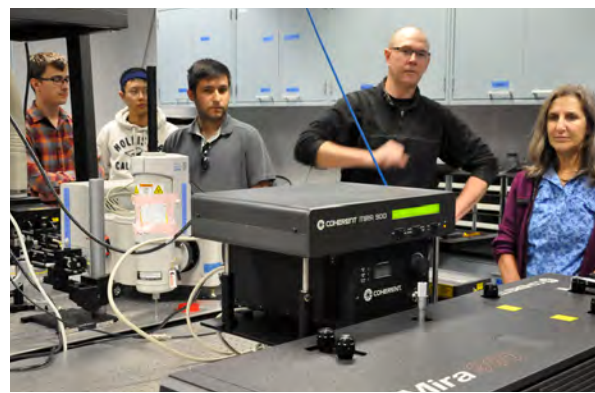
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## A GLANCE AT YEAR 3

Looking forward, Year 3 of *Energize New Mexico* will provide additional opportunities for cutting edge, transformative research and education at institutions around the state. The Bioalgal team will continue to implement innovative new technologies that support biofuel production and provide new knowledge in algal ecology, agriculture, and biomass engineering. The Solar Energy team, using the equipment at the Center for High Technology Materials, will characterize nanoparticle catalysts to better understand and eventually design more efficient photovoltaic cells. Once the membrane fabrication is complete, the Osmotic team will use the custom membranes in the PRO system and evaluate power generation. The Uranium team is expanding into western New Mexico to study groundwater contamination with the Navajo Nation, Laguna Pueblo, and Sandia National Laboratories. Characterization of underground systems will continue with the Geothermal team, and MT systems will be deployed in new selected sites to collect data for the statewide database. The Social & Natural Science Nexus team will complete the dynamic water budget, and data from the other research components will be incorporated into the new SD model linking natural and human systems. The CI team will also help collect, store, and disseminate research findings and data to the community at large.

NM EPSCoR will also begin designing and developing innovative museum exhibitions to showcase that research for public audiences. *Energize New Mexico* will soon sponsor new exhibits for the New Mexico Museum of Natural History & Science, ¡Explora! Science Center & Children's Museum, and the National Museum of Nuclear Science & History.





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## ACKNOWLEDGMENTS

We would like to thank the following people for their assistance in preparing this report:

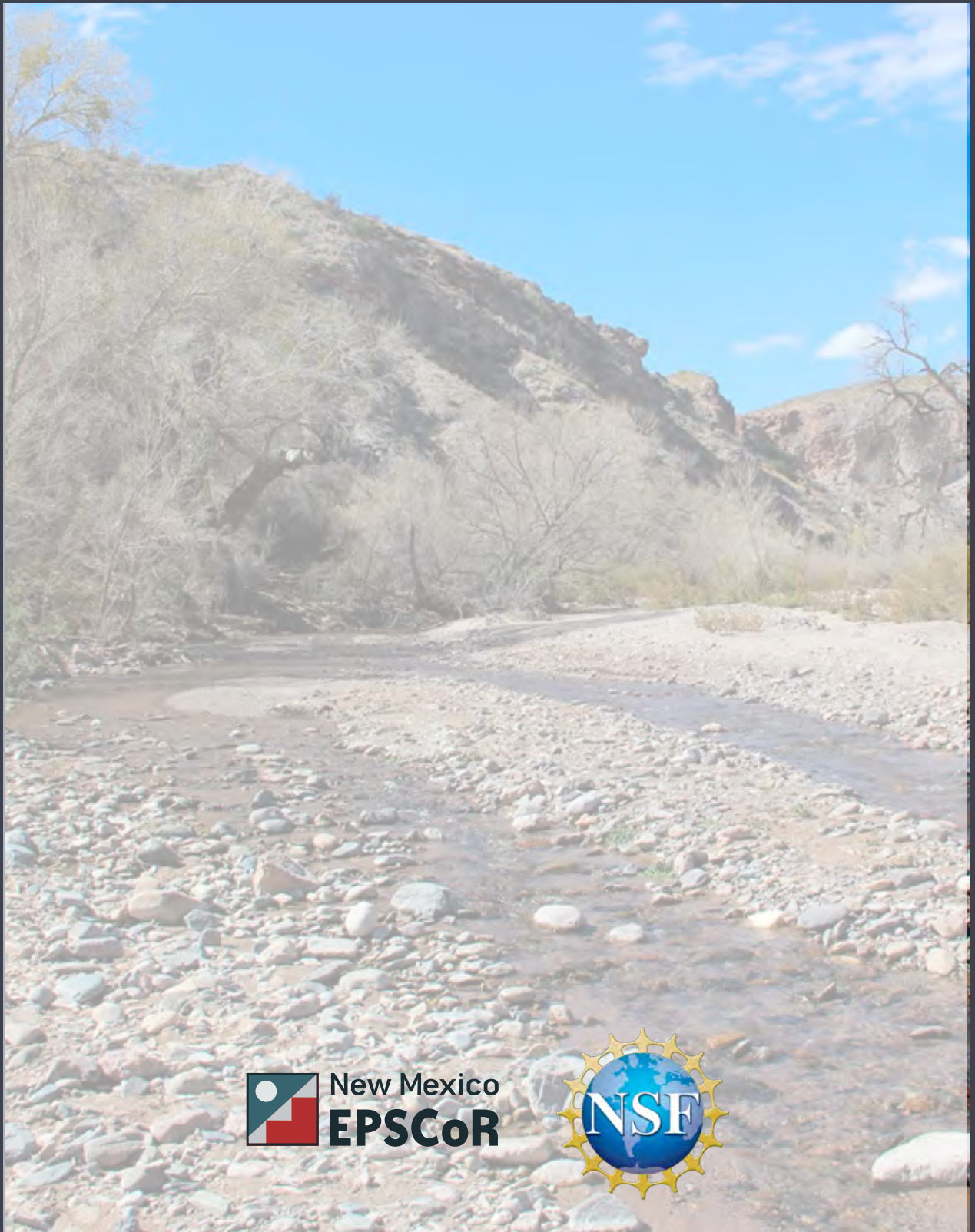
Mary Jo Daniel	Alice Loy	Laura Crossey	Audrey Levine
Selena Connealy	Chris Allen	Chelsea Chee	Johanna Blake
Kirk Minnick	STEM 2014 students	And all participants for your reporting and photos!	

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## ACRONYMS

<b>AISES</b>	American Indian Science and Engineering Society
<b>CO<sub>2</sub></b>	Carbon dioxide
<b>ENMU</b>	Eastern New Mexico University
<b>GUTC</b>	Growing Up Thinking Computationally
<b>HFM</b>	Hollow fiber membranes
<b>HTL</b>	Hydrothermal liquefaction
<b>ICCE</b>	Institute for Creative & Cultural Entrepreneurship
<b>ISG</b>	Infrastructure Seed Grant
<b>MT</b>	Magnetotelluric
<b>NM EPSCoR</b>	New Mexico Experimental Program to Stimulate Competitive Research
<b>NMHU</b>	New Mexico Highlands University
<b>NM ISE Net</b>	New Mexico Informal Science Education Network
<b>NMSU</b>	New Mexico State University
<b>NMT</b>	New Mexico Tech
<b>NSF</b>	National Science Foundation
<b>PI</b>	Project Investigator
<b>PRO</b>	Pressure-retarded osmosis
<b>PV</b>	Photovoltaic
<b>RII</b>	Research Infrastructure & Improvement
<b>SACNAS</b>	Society for Advancement of Chicanos and Native Americans in Science
<b>SFCC</b>	Santa Fe Community College
<b>STEM</b>	Science, Technology, Engineering & Math
<b>STEMAP</b>	Science, Technology, Engineering & Math Advancement Program
<b>UNM</b>	University of New Mexico
<b>URM</b>	Underrepresented minorities
<b>UVMN</b>	Undergraduate Visualization & Modeling Network (Track 2)
<b>ZnS</b>	Zinc Sulfide





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