

## Preview of Award 1301346 - Annual Project Report

### Cover

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PD/PI Name:	William K Michener, Principal Investigator Mary Jo Daniel, Co-Principal Investigator
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Signature of Submitting Official (signature shall be submitted in accordance with agency specific instructions)	William K Michener

### Accomplishments

#### \* What are the major goals of the project?

The overarching goal of *Energize New Mexico* is to position New Mexico to help lead the nation in harnessing and promoting sustainable energy resources, cultivating a well-qualified STEM workforce, and developing a sustainable culture of innovation and entrepreneurship. The project **mission** is two-fold: (1) develop the research infrastructure that will enable New Mexico to address fundamental basic and applied research questions related to improving energy extraction efficiencies and promoting sustainable resource development; and (2) develop the human resources necessary to improve the state's research competitiveness in sustainable energy development, STEM education, and workforce and economic development capacity.

The project is organized into thirteen components, each of which is associated with a strategic priority and specific objectives, provided in the Strategic Plan. Below are listed each component's Strategic Priority.

**1. Bioalgal Energy Development:** Implement innovative new technologies that will support next generation biofuel production, pioneer the production of bio-crude oil from highly stable algal extremophiles with lower-lipid contents, and provide new knowledge in algal ecology, physiology, agriculture and biomass process engineering. The team and infrastructure will enable interdisciplinary training for graduate and undergraduate students statewide and support new interactions among universities, national laboratories, and industry in the state.

**2. Solar Energy Research:** Forge a research collaboratory and invest in spectroscopic instrumentation that will enable us to: (1) explore the potential of solar energy in reducing atmospheric CO<sub>2</sub> to methanol, an alternative transportable fuel; (2) develop a solar-driven water oxidation process that uses inexpensive catalysts to generate H<sub>2</sub>, a high-energy fuel that does not emit C; and (3) design more efficient organic solar photovoltaic cells.

3. Osmotic Power Development: Further develop osmotic power, and, if viable, extract clean energy from “waste products,” thereby off-setting the disposal cost and lowering the carbon footprint of the oil and gas industry.

4. Uranium Transport and Site Remediation: Improve laboratory capabilities to: enable faster, more sensitive analyses, including low-level speciation and isotopic measurements; conduct research to improve our understanding of U biogeochemistry and occurrence; and develop tools for predicting and controlling U mobility in the environment.

5. Geothermal Energy Resources and Sustainability: Develop geothermal energy as a viable and sustainable resource in NM based on new understanding of the underlying natural hydrothermal systems and of the practical limitations and human technologies involved in its application.

6. Social and Natural Science Nexus: Develop a cutting-edge multidisciplinary model that links natural and human systems based on a systems dynamics (SD) modeling framework and detailed water, energy, environment, and socio-economic budgets.

7. Diversity: Have 50% representation by women and underrepresented minorities in all EPSCoR-supported programs.

8. Workforce Development: Increase student access to and engagement in research at the K-12, undergraduate and graduate levels, improve post-doc and STEM faculty effectiveness, and equip faculty with tools and skills to become creative entrepreneurs.

9. Cyberinfrastructure: Make it easier for scientists, educators and the public to discover, acquire, and use data, information and learning modules developed and acquired by NM EPSCoR.

10. External engagement: Expand informal science education networking and engage the public via multiple modalities.

11. Evaluation and Assessment: Implement a comprehensive assessment plan using both quantitative and qualitative methods to evaluate success of NM EPSCoR programs.

12. Sustainability: Create and enhance inter-institutional collaborations such as federal lab-university, university-university, and informal science education partnerships that lead to programmatic sustainability.

13. Management: Ensure accountability, assign responsibility, promote engagement, include diverse participants, and facilitate communication and coordination among the project components.

**\* What was accomplished under these goals (you must provide information for at least one of the 4 categories below)?**

Major Activities: Research activity in Year 1 has focused on hiring team members, especially students, purchasing major equipment, fostering collaborations, and establishing team norms through regular virtual and face-to-face meetings. A Mentoring and Training Plan, a required activity for the research and CI components, has been approved by the Management Team and made available on nmepscor.org. In this section we describe progress on the other research and CI activities specified in the Strategic Plan.

Bioalgal Energy: Work has progressed on installation of the algal turf scrubber (ATS) at Eastern NM Univ; the site will be operational before the end of year 1. We conducted biomass productivity tests for *Galdieria sulphuraria* outdoors at the NM State Univ testbed and tests for *Chlorella sorokiniana* during the late-fall and winter months. At UNM, we purchased and installed UPLC2 as the

core of the UNM SEED facility and purchased and installed a HPLC with autosampler, diode array detector and fraction collector for UNM/NM Consortium collaboration. We also grew algae in alginate and silica gels and compared photosynthesis between growth conditions. We are also establishing important collaborations with Santa Fe Community College on multi-style bioreactor testing.

Solar Energy: The team has begun addressing the use of nanoparticle ZnS to catalyze reduction of CO<sub>2</sub>. Team members have compared progress and fine-tuned research plans as they relate to heavy atom effects in conjugated polymers designed for solar cell applications and for understanding excited state processes in photoexcited conjugated polymers. Photon counting and solar quantum yield measurements via silicon diode array instrumentation was discussed to further quantify photochemical efficiencies. Efforts are moving forward toward forging a research collaboratory between UNM and NM Tech. In the remainder of Year 1 we will extend the research collaboratory concept by inclusion of a new team member from NMSU. Additional spectroscopic laboratory equipment (lasers, detectors, etc.) will be purchased in this time frame for the planned magnetophotoluminescence experiments, which will be directed toward understanding the origin and fate of photogenerated triplets relevant to solar energy conversion processes.

Osmotic: We identified an oil field near Eunice, NM as the test site for produced water and collected two sets of water samples. Initial analyses of water samples is in progress and should be completed by the end of year 1. A membrane osmometer was designed and fabricated for the measurement of achievable osmotic gradients. The team is currently measuring the gradients of NaCl solutions with different salinities. The results will be used to calibrate thermodynamic models (under development) used to predict osmotic gradients of given ionic compositions. After research and discussion, the team has decided to use TFC hollow fiber membranes (HFM)/module. This approach has a short development time and is more easily scalable for commercial applications. We have collaborated with Dr. Qiang Wei from NMHU who has expertise in fabrication and characterization of hollow-fiber membranes and will develop processes for HFM fabrication and characterization at NMT; processes should be ready for use by summer 2014.

Uranium: Purchase and installation of an ICP-MS at NM Tech is underway and should be completed by the end of Year 1. HPLC upgrades will be completed once the ICP-MS purchase is completed. Work has begun on U speciation methods that employ HPLC separation of U species coupled to ICP-MS for detection. The focus is on applying a well-characterized size-exclusion chromatography method for the analysis of organic matter to the separation of organic matter-uranium complexes from other, smaller inorganic U species. We anticipate useful results from this effort by the end of Year 1. The team is evaluating several study sites, working in collaboration with the NM Environment Department. A database of NM uranium mining and processing sites was collected and imported into a geographic information system to assist with field site selection. For the aeolian uranium transport component of the project, various types of dust samplers were evaluated and the Big Spring Number Eight dust trap was selected as the primary sampler.

Geothermal: A magneto-telluric (MT) system has been ordered and is expected to arrive before the end of Year 1. Training of faculty and students in the proper use of the equipment will begin as soon as possible. The team has identified several systems that show immediate promise for new analyses, exploration, and drilling: Pueblo of Jemez, Socorro Magma Body, Caballo Geothermal Prospect near Derry/Kerry, Rincon, Truth or Consequences, and Silver City/Lordsburg. Projects in each of these areas are in development. We also are working to develop the concept of “hydrothermal windows”, a concept that shows promise as a new exploration tool. Several papers document degradation of groundwater quality caused by mixing of endogenic fluids in the aquifer and fault systems; work in New Mexico is ongoing on this topic. New water analyses are planned in the next months for key areas of the Jemez River drainage, T or C geothermal waters, and springs that we recently sampled from Acoma and Laguna Pueblos. We have compiled a geothermometer database for New Mexico hot springs based mainly on earlier hydrochemical modeling. We are working with the CI team to produce data products that are open access and readily usable by other scientists.

Social & Natural Science Nexus: In order to develop a cutting-edge multidisciplinary model that links human and natural systems much of the initial work must focus on data availability, links, and modeling structure. Year 1 focused on basic groundwork including identifying potential data sources for the human, energy, infrastructure and regulatory data; room prep for the experimental lab, and research of equipment. Linking this award with the previous RII project, we hosted a statewide workshop to develop strategies for generating a working statewide water budget. Experts, researchers, and water managers from community, state and federal governments in the fields of hydrology, geology, geohydrology, civil engineering, water planning, remote sensing, geography, and meteorology attended the workshop to set the stage for a number of project activities. The remainder of Year 1 will focus on assembly of available data; the development of the database structure in collaboration with CI; identification of major data holes; the completion of the experimental lab facilities; outreach to other groups to develop a collaborative working group; development of a draft survey; and ongoing outreach to state agencies, policy makers, and stakeholders.

Cyberinfrastructure (CI): The existing data storage and modeling portal was improved through enhancements to the underlying data management and publication system, including implementation of an improved internal metadata model within Gstore. By the end of Year 1, additional improvements to the Gstore platform will include improved collection management and representation through the publication of ISO 19115-2 Data Series metadata records for those collections and publication of composite Open Geospatial Services representing collections of data indexed in specialized “tile indices”. Our DataONE Tier 1 member node should be complete by the end of Year 1 and populated with data objects cached on the shared data storage system managed by UNM’s Research Storage Consortium, of which both EDAC and DataONE are members. EDAC staff conducted a “soft” review of existing lab notebook technologies. This review included both “turnkey” commercial and open source solutions and frameworks (such as Drupal) to identify potential capabilities that may be aligned with the requirements to be defined in

consultation with the project's CI-Team.

**Specific Objectives:** Diversity: We are on track to complete Year 1 activities in our Strategic Plan related to diversity. We hired a Diversity Coordinator who attended the AISES national conference and has met with leadership (President, President-Elect, Deputy Director) of SACNAS. The Diversity Coordinator is working with these organizations to gather resources that can be shared with project personnel to support diversifying STEM as well as providing opportunities to support URM students and faculty in the project. The Diversity Coordinator has provided leadership to the Diversity Team, which has met regularly to monitor progress on diversity goals, draft a researcher/student mentoring plan that was approved by the Management Team, and update data on faculty diversity in NM. NM Alliance for Minority Participation (AMP) student researchers participated in the NM EPSCoR/NM Academy of Science Joint Annual meeting in November 2013. In addition, the UNM Co-Lead of the Geothermal Energy component (Crossey) is co-PI on the currently funded NM AMP award (#1305011) and connects our activities to that project. We expect to broaden the scope of our collaboration with AMP in future years.

Three Diversity Innovation Working Groups (D-IWG) have been funded and are scheduled to be held in the end of Year 1 or beginning of Year 2:

*Leveraging the Afterschool Community and STEM Stakeholders in New Mexico to Reach and Engage Under-Represented Student Populations in Science, Technology, Engineering and Mathematics (STEM) Fields.* Lead: Armelle Casaus, New Mexico Voices for Children; Co-I's: Phyllis Baca, Santa Fe Community College; Susan Brown, NM State University.

*Development of Primary to Bachelor's STEM Education Pathways for Underrepresented Populations of Northern New Mexico Using Sustainable Technologies Curricula.* Lead: Stephen Gomez, Santa Fe Community College; Co-I's: Luke Spangenburg, Santa Fe Community College; David Hanson, University of NM.

*Determining the Drivers of STEM Educational Success in New Mexico: Creation of the First Long Term Educational Research (LTedR) Site.* Lead: Jose Herrera, Western NM University; Co-I's: Marcy Osgood, University of NM; Michele Shuster, NM State University

An individual from a non-research institution leads each of the D-IWGs in collaboration with faculty from a research institution. The D-IWGs will bring together groups of 10-15 researchers and educators to focus on one aspect of the challenge of increasing diversity in STEM in New Mexico. They have identified specific, concrete outcomes, progress towards which will be monitored by our external evaluator.

Evaluation and Assessment: We have executed a contract with Minnick and Associates to provide external evaluation for the project. Minnick has completed an Evaluation Plan (attached), based on the activities, milestones, and metrics identified in the Strategic Plan. He attended initial workshops and activities that are included in our Workforce Development and External Engagement components to make observations that provide a context for his

evaluation. He has also worked with Dr. Gary Olson to administer the Collaboration Wizard instrument to gather baseline data for tracking changes in collaboration among project participants, especially across components, over the course of the project. The External Advisory Committee held their initial meeting in October 2013. Their recommendations and our responses are included in the Changes section of the RPPR.

Sustainability: Three new faculty members have been hired in areas of critical need for New Mexico. The University of New Mexico was able to use the available budget to hire two Hispanic faculty members in Civil Engineering. Both are contributing to the Uranium research group; one will also work with the Geothermal team. One of these newly hired faculty members will be using the UPLC2 purchased by the Bioalgal group and will help them to characterize the growth conditions and water quality in their algal research. NM State University used the faculty start-up funds to hire an analytical chemist who is working in the Osmotic and Bioalgal components. This is the kind of synergy between groups that is a goal of the project. NMSU and NM Tech plan to complete their faculty hires in Year 2.

At the time of this report, eight Infrastructure Seed Award (ISA) proposals to increase the capacity of Primarily Undergraduate Institutions to provide research experiences to their students are under review. Selection of the first two ISAs will be made in March with anticipated start dates for the one-year \$50,000 awards in April. Future annual reports will report on outcomes of these awards.

Interdisciplinary Innovation Working Groups (I-IWGs) are scheduled to begin in Year 2; the call for proposals will be released at the end of Year 1.

Teacher Professional Development, led by the Informal Science Education Network (ISE Net), was also included in our Sustainability plan—extending the benefits of EPSCoR investments to future generations. The first Teacher PD workshop will be held in June 2014.

Management: The Strategic Planning session was held August 19-20, 2013. The External Advisory Board reviewed the draft Strategic Plan and NSF approved the final version in October 2013. The Strategic Plan has guided the development of our External Evaluation Plan, this annual report, and the Management Team uses it to monitor progress during quarterly meetings. The State EPSCoR Committee also reviewed the Strategic Plan at their fall meeting; they are scheduled to meet again in May 2014.

Each of the component teams has met regularly, although the frequency varies based on the team's need and pace of progress. The Co-PI (Daniel) participated in at least one of each component's team meeting in the first six months of the project. Each component reports on their progress during the quarterly Management Team meetings and identifies challenges and new opportunities that have arisen. The CI development group has identified a liaison to each of the research teams to ensure effective two-way communication about data needs and cyber-related support.

At the time of this report, the PI and/or the Co-PI have completed the following

campus visits: UNM (home institution), New Mexico Tech, NM State University, Western NM University, and Navajo Technical University. A visit to Eastern NM University is scheduled for April 2, 2014. In addition, the Diversity and Education Outreach Coordinators have visited Northern NM College, NM Highlands University, Santa Fe Community College, San Juan College, Luna Community College, Western NM University, NMSU Grants, and Southwestern Indian Polytechnic Institution (SIPI). The Co-PI has also hosted webinars about NM EPSCoR opportunities and programs which were attended by participants from several of these institutions as well as UNM-Taos, UNM-Valencia and Mesalands Community College. NM EPSCoR programs are becoming well known throughout the state.

**Significant Results:** In this section we report on additional research accomplishments and leveraging of NSF programs.

**Bioalgal:** Initial studies have led to three publications (reported in RPPR):

- Nutrient removal rates from settled raw sewage water by *Galdieria sulphuraria*
  - Continued development of molecular markers in support of accurate tracking of algal species composition in outdoor photobioreactor systems
  - Bio-crude oil composition from hydrothermal liquefaction of algal biomass
- Studies of the composition of PBR contaminants at the NMSU testbed via FlowCAM methodology, including analysis of two culture collapse events, are on-going. We also successfully encapsulated algae in both silica gels and alginate and measured photosynthesis in each. Members of the group have submitted two inventions (reported in Products section).

**Solar Energy:** We have used a combination of transient absorption and emission spectroscopies to show that charge-separated interligand charge transfer excited state lifetimes can display a remarkable and non-periodic dependence on the heteroatoms of the donor. The results are explained in terms of heteroatom dependent singlet-triplet energy gaps and anisotropic covalency contributions to the donor-metal bonding scheme that control rates of intersystem crossing. This work has been submitted for publication to *Inorganic Chemistry*, and will form the basis for new heavy atom studies in conjugated polymer and bulk heterojunction polymer studies that are currently underway as part of this effort.

**Geothermal:** Significant results in the form of papers and abstracts resulted from the early stages of building the Geothermal team. Because these publications pre-date the start of this award, they are not included in this report, but they form the foundation for the collaborative approach that will continue and will be expanded throughout this project.

#### Leveraging NSF Awards

As mentioned above, our diversity efforts are leveraging the NM Alliance for Minority Participation award (#1305011), combining efforts to provide opportunities for students to communicate their research. The Geothermal group has also built part of their research efforts on prior NSF supported awards, especially the Hydrologic Sciences Program (NSF EAR 0538304 and

0838575) and Long- Term Ecological Research (NSF-DEB-0620482) at the Sevilleta National Wildlife Refuge. The Earth Data Analysis Center (EDAC) that maintains our data infrastructure is becoming a DataONE member node (OCI-083094) and continues to participate in the CI Working Group that was initiated with our previous Track 2 award (EPS-0918635) and continues in the current award (IIA-1329469). The NM Informal Science Education Network has received additional funding through an NSF subaward (DRL-123743). The Geothermal and CI teams are using and building upon infrastructure investments from the previous RII Track 1 award (EPS-0814449).

**Key outcomes or Other achievements:** All project components are on track to complete Year 1 activities as listed in the Strategic Plan. At the time of this report, a few activities are slightly behind schedule generally due to hiring timelines and time needed to purchase and install large equipment. However, there are plans in place to get on schedule and the Management Team will continue to monitor progress on all components. The PI and Co-PI will develop remediation plans for any components that are unable to meet remaining Year 1 targets. Specific delays related to hiring personnel are noted in the Changes section of the RPPR.

Numbers of publications and presentations for each research theme are presented in the "Dissemination" section of the RPPR.

### \* What opportunities for training and professional development has the project provided?

#### Participants

Participant data is provided in Template B, sent to the program officer. We currently have 121 participants. Of those who provided demographic data (N=97), 49% are female and 29% are underrepresented minority (URM), including disabled. In Year 5 of our previous award (baseline), we had 163 participants of which 42% were female and 25% were from underrepresented groups. Our 7-member External Advisory Board is 57% female, with one Native American member.

In April 2014, we will host a one-day workshop for all project students that provides Responsible Conduct of Research Training as well as an introduction to NM EPSCoR data management. Students will have the opportunity to interact with their peers across institutions and disciplines, strengthening the research effort. We believe this has the potential for creating and discovering new intra-project synergies.

The Social and Natural Sciences Nexus (SNSN) team will also offer an online workshop in early April 2014. The intent of the workshop is to bring all SNSN graduate research assistants up to speed on the project and to begin to develop the collaboration between RA's at different institutions.

#### Workforce Development

##### **Growing Up Thinking Computationally**

Growing Up Thinking Computationally (GUTC) made a great deal of progress towards achieving its strategic priority: to increase student access to and engagement in STEM education and research in K-12. Three hundred and thirty-two students participated in GUTC activities. Forty-two percent participated in the afterschool clubs, 21% participated through school day classes that integrated the full GUTC curricular units, and 38% participated through GUTC courses offered at the Supercomputing Challenge Kickoff Conference. Overall, 74% of student participants were from historically underrepresented groups in STEM and Computing. Forty-six percent of participants were female; twenty-six percent of student participants were from socio-economically disadvantaged families. Students ranged from 5th through 8th grade with the majority of students in seventh grade.



Growing Up Thinking Computationally (GUTC) also offered summer, fall, and spring professional development workshops for teachers. Twelve teachers participated in GUTC professional development workshops during the first year of the project. Eighty-three percent were female and 25% were underrepresented minorities.

These activities--teacher professional development workshops and afterschool clubs--expose participants to and engage them in the use of computational models for scientific inquiry and research, thereby addressing workforce preparation issues. We developed two new curricular units with a focus on explicitly introducing computer science concepts during the first two weeks of the unit. Within each 12-week unit students investigate a local problem, gather data, modify or build a computer model, and run experiments using the model as a virtual test bed. Fourteen GUTC clubs met over 13 weeks each semester at 12 school sites across Northern New Mexico. A team consisting of a regular school day teacher acting as the club leader and a visiting STEM professional, software/IT professional, or master STEM teacher serving as the GUTC facilitator, led each club. Typically the activities offered at a club meeting included a short introduction to STEM or computing content, a hands-on activity and a computational modeling activity. Three club implementations took place during the regular school day as part of Technology or Integrated Science classes. The Fall Career Connections Conference and Field trip was held on October 25th at the New Mexico Museum of Natural History and Science. GUTC club members heard from several STEM professionals who use computational modeling and simulation in their work, visited the "Start Up" exhibit at the Museum, and took part in whole group participatory simulation on the water resources theme. The Spring Career Connections Conference and Field trip is planned for March 7th, 2014. The Fall Roundtable took place on December 13th at Santa Fe Community College. GUTC club members were distributed across several classrooms at the College to ensure that students met students from other clubs. Club members demonstrated their projects and shared ideas before an audience consisting of STEM professionals, community members, facilitators, club leaders, family members, and fellow students in a symposium setting. The Spring Roundtable is scheduled for May 8th, 2014.

### **Faculty Leadership and Professional Development Institute (FLPDI)**

The Faculty Leadership and Professional Development Institute held its initial meeting in September 2013 at which the 16 participants from 9 undergraduate institutions focused on Micromessaging to Reach and Teach Every Student™ from the National Alliance for Partnerships in Equity (NAPE). The interactive daylong workshop was based on research across multiple disciplines and provided a professional learning community of peers and access to equity experts. Undergraduate faculty learned how to transform their classrooms to meet the learning needs and styles of every student. The focus of this equity workshop was to translate research into practice for STEM educators through active learning, small- and large-group activities, reflection journal prompts, and scenario-based learning. Four subsequent online follow-up sessions have enabled participants to identify their own implicit biases, develop a project to discover and analyze bias in their classrooms and implement appropriate interventions. Two additional online sessions are scheduled in March and April 2014. Proposals for Community College/University colleague research teams are currently being solicited; the first projects will be selected by the end of Year 1.

### **STEM Advancement Program (STEMAP)**

Because of the June start date of the award, the STEM Advancement Program (STEMAP) was not offered in Year 1. Applications for the first cohort of 10 STEMAP undergraduate students to participate in summer research projects are currently being accepted and reviewed. Five research projects have been identified in which the selected students will participate:

- Encapsulating Living Cells for Biofuel and Bioproducts
- Visualizing Function in Live Cells for Bioenergy Applications
- Assessing Uranium Contamination on the Navajo Reservation
- Solar Energy Research in New Mexico: Always in an Excited State!
- Algae for Energy: Algal Cultivation and Extraction Research

To date, we have received 33 applications from eleven primarily undergraduate institutions.

### **Institute for Creative and Cultural Entrepreneurship (ICCE)**

The Institute for Creative and Cultural Entrepreneurship has focused on creating a market analysis and strategic plan for the Institute. This has led us to identify the market opportunity to create a creative entrepreneurship accelerator. Toward this end, we have attracted a core of 22 mentors/visiting faculty who will work with participating entrepreneurs and serve as lecturers. We have nearly completed plans for the hotel/classrooms /dates/prices. We are developing our marketing plan and continue to attract faculty/mentors. We are creating a pool of investors who will guide entrepreneurs in their financing, possibly even proving investment. The first Institute will be held in fall 2014. We are also developing plans for "thinking like an entrepreneur" workshops for faculty researchers.

### Honors and Awards

The Afterschool Alliance and the Noyce Foundation recognized Project GUTS (the program upon which GUTC was modeled) with one of two inaugural Afterschool STEM Impact Awards in computer science and engineering.

The New Mexico Network for Women in Science in Engineering (NMNWSE) honored Phyllis Baca of Santa Fe Community College with the Seventh Annual IMPACT! Award in recognition of her passion to present STEM opportunities to low-income students, especially women and Hispanics.

### **\* How have the results been disseminated to communities of interest?**

Project personnel have generated 21 publications in Year 1 (see table below), some of which were submitted before the start of this award but which provide essential foundational information for project activities. Of the 21 publications, eight were supported by the current award (EPSCoR Acknowledged), one of which is awaiting publication. Our target for Year 1 was 8 publications. At least two additional publications are in preparation at the time of this report so we expect to exceed our target for peer-reviewed publications.

### Publications

Research Component	Publications	EPSCoR Acknowledged
Bioalgal Energy	11	5
Solar Energy	1	1
Osmotic Power	0	
Uranium Transport & Site Remediation	0	
Geothermal Energy	9	2
Social and Natural Science Nexus	0	
<b>TOTAL</b>	<b>21</b>	<b>8</b>

External Engagement: The Informal Science Education Network (ISE Net) is our primary vehicle for disseminating

NM EPSCoR research to the public and engaging learners of all ages in STEM. The ISE Net has held several organizational meetings in which they have laid the foundation for connecting their institutions with NM EPSCoR researchers in order to provide appropriate, relevant public programs and, eventually, museum exhibitions that will communicate NM EPSCoR research. The ISE Net has a meeting scheduled in March 2014 that includes NM EPSCoR researchers and they will present a session at the May All Hands Meeting that will use informal learning theory and activities to help researchers engage the public.

The ISE Network has acquired additional funding through the National Center for Science and Civic Engagement (subaward to #DRL-123743) that will enable them to exceed the goals originally proposed. By leveraging these additional funds, they will bring national experts in informal learning to build capacity of the Network members as well as support additional ISE/researcher collaborations.

The NM EPSCoR State Office has also completely redesigned the project's website (nmepscor.org) to make project information available to participants and the public. The Public Information Specialist maintains a blog on the website to which the Education Outreach and Diversity Coordinators contribute. She sends out a monthly newsletter to our listserv that summarizes and connects to the blog postings. We also use social media—Facebook and Twitter—to communicate project activities broadly.

Several project participants have made presentations about their work, summarized in the table below. Our target for Year 1 conference presentations, seminars, and posters was 30; we have already exceeded that number and more presentations are scheduled during the remainder of Year 1.

#### Presentations

Component	Presentations
Bioalgal Energy	13
Solar Energy	3
Osmotic Power	1
Uranium Transport & Site Remediation	0
Geothermal Energy	4
Social and Natural Science Nexus	1
Diversity	4
Workforce Development	8
Cyberinfrastructure	5
<b>TOTAL</b>	<b>39</b>

EPSCoR Template D, External Engagement, sent separately to the Program Officer, indicates the reach of some of these presentations. Nearly 900 individuals have been engaged in outreach activities so far. Since attendee data were not collected for all presentations, this number likely underestimates the number of individuals who

have been informed about and involved in NM EPSCoR activities.

In addition to the presentations included above, UNM members of the Geothermal team were highlighted in a promotional video that was shown to thousands of geoscientists at the Annual 2013 GSA meeting; the video is available on the GSA website.

**\* What do you plan to do during the next reporting period to accomplish the goals?**

In Year 2, we will follow our Strategic Plan for all components.

1. **Biological Energy:** We will continue our focus on optimizing biological productivity, improving cultivation practices, and enhancing energy return on investment and wastewater utilization. This includes assessing productivity of strains cultivated in the outdoor system and assessing photosynthetic function in different environments. Fabrication of equipment for additional outdoor cultivation will be completed and training and use of equipment purchased in Year 1 will expand. Our work in year 2 will also include a focus on process engineering to improve cultivation practices. We will also further develop collaborations with municipalities, industry and other institutions to support this work.
2. **Solar Energy:** In Year 2 we will expand the Solar Team to include additional faculty and students from NMSU. Our work on the use of nanoparticle ZnS to catalyze reduction of CO<sub>2</sub> will focus on exploration of dye photosensitizers for ZnS catalysts and we will continue our work to develop stable bulk heterojunctions from a single polymer system.
3. **Osmotic Power:** We will continue our work to assess the design requirements of membranes and membrane modules. Using equipment purchased in Year 1, hollow fiber membranes will be produced for characterization and PRO testing. A newly hired post doc will guide the research and provide mentoring to the cadre of undergraduate students contributing to the research.
4. **Uranium Transport and Site Remediation:** Training and analysis of samples using the ICP-MS purchased in Year 1 will expand and allow for continued measurement of U speciation. Study site(s) for groundwater contamination will be further characterized and evaluation of Aeolian transfer of U contamination will be initiated.
5. **Geothermal Energy:** Team members will be trained in the MT system and other equipment purchased in Year 1 so measurements of MT signature and resistivity of identified sites can be undertaken. We will characterize the waters and gases in the selected systems, measure the systems' temperatures, and assess the influence of geothermal systems on potable water quality. We will also use radiometric and cosmogenic dates of fault systems to evaluate the longevity of geothermal systems and begin development of 2D and 3D hydrothermal computer models.
6. **Social and Natural Sciences Nexus:** Work will continue to build a systems dynamics (SD) infrastructure as well as a statewide water budget and a database of relevant data sources. We will collaborate with the other NM EPSCoR teams to integrate their research into the database and the integrated decision support system.
7. **Diversity:** The Diversity Innovation Working group(s) will meet and results of their work will be shared broadly. We will continue to monitor project diversity data and use project meetings as opportunities to share strategies for enhancing diversity.
8. **Workforce Development:** Activities begun in Year 1 will continue. The academic year component of STEMAP will be implemented in Year 2 as will the first Post-doc workshop. Planning for the graduate student externships will position us to initiate that program in Year 3, as planned.
9. **Cyberinfrastructure:** We will continue to develop and enhance our integrated data storage and modeling portal, connecting with the research teams to support their work. We will also finalize an "online lab notebook" system

that will enable teams to share work efficiently.

10. External Engagement: The Informal Science Education Network will continue to meet and develop programs to communicate EPSCoR research. The program website will be updated and revised as needed, based on usage analytics.

11. Evaluation and Assessment activities will continue as planned. A front-end study will be conducted to inform exhibit development.

12. Sustainability: New faculty hires will be completed and teacher professional development workshops facilitated by the NM ISE Net members will be held. The first round of Interdisciplinary Innovation Working Groups (I-IWGs) will be funded and a second round of Seed awards will be solicited.

13. Management: The management plan will continue as implemented in Year 1.

### Supporting Files

Filename	Description	Uploaded By	Uploaded On
NMR14_Evaluation_Plan_2014_0301.pdf	External Evaluation Plan for NM EPSCoR, Energize NM	William Michener	02/28/2014
NM_EPSCoR_EAC_Oct2013_report_final.pdf	External Advisory Committee Report October 2013	William Michener	02/28/2014
EAC_Oct2013_response.pdf	NM EPSCoR Response to EAC Report	William Michener	02/28/2014

## Products

### Journals

Hanson, D., and Timlin, J. (). Carbon capture efficiency in *Nannochloropsis salina* and implications for the sustainability of algal biofuels. *Photosynthesis Research*. .

Status = SUBMITTED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Person, M., Crossey, L., Phillips, F., Kelley, S., Karlstrom, K. (). Evidence for Long-Time Scale (> 103 years) Changes in Hydrothermal Activity Induced by Seismic Events. *Geofluids*. .

Status = SUBMITTED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Crossey, L., Karlstrom, K. (2014). An analysis of geothermal and carbonic springs in the western United States sustained by deep fluid inputs. *Geobiology*. 12 83.

Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Scott P. Fulbright, M. Kristen Dean, Greg Wardle, Peter J. Lammers, Stephen Chisholm (2014). Molecular diagnostics for monitoring contaminants in algal cultivation. *Algal Research*. 2014 .

Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: <http://dx.doi.org/10.1016/j.algal.2013.11.008>

Sudasinghe, N., Dungan, B., Lammers, P. J., Albrecht, K., Elliott, D., Hallen, R., and Schaub, T. (2014). High Resolution FT-ICR Mass Spectral Analysis of Bio-oil and Residual Water Soluble Organics Produced by Hydrothermal Liquefaction of the Marine Microalga *Nannochloropsis salina*. *Fuel*. 119 44.

Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: <http://dx.doi.org/10.1016/j.fuel.2013.11.019>

Kumar, S., Mukherjee, M.M., Varela, M. (). Modulation of bacterial multidrug resistance efflux pumps of the major facilitator superfamily. *International Journal of Bacteriology*.

Status = AWAITING\_PUBLICATION; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Kumar, S., Floyd, J.T., He, G., Varela, M.F. (2013). Bacterial antimicrobial efflux pumps of the MFS and MATE transporter families: A review. *Recent Research Developments in Antimicrobial Agents & Chemotherapy*. 7 .

Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; ISBN: 978-81-308-0465-1

Person, M. (2013). Offshore fresh groundwater reserves as a global phenomenon. *Nature*. 504 72.

Status = PUBLISHED; Acknowledgment of Federal Support = No ; Peer Reviewed = Yes ; DOI: [10.1038/nature12858](https://doi.org/10.1038/nature12858)

Selvaratnam, T., Pegallapati, A.K., Montelya, F., Rodriguez, G., Nirmalakhandan, N., Van Voorhies, W., Lammers, P.J. (2014). Evaluation of a thermo-tolerant acidophilic alga, *Galdieria sulphuraria*, for nutrient removal from urban wastewaters.. *Bioresource Technology*.

Status = AWAITING\_PUBLICATION; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: [10.1016/j.biortech.2014.01.075](https://doi.org/10.1016/j.biortech.2014.01.075)

Yan, J. (2013). Algal Turf Scrubber for Treating Dairy Manure Effluents and Producing Sustainable Biofuel. *New Mexico Journal of Science*. 47 19.

Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Roy JN, Babanova S, Garcia KE, Cornejo J, Ista LK, Atanassov P (2013). Catalytic biofilm formation by *Shewanella oneidensis* MR-1 and anode characterization by expanded uncertainty. *Electrochimica Acta*.

Status = AWAITING\_PUBLICATION; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: [10.1016/j.electacta.2013.07.075](https://doi.org/10.1016/j.electacta.2013.07.075)

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Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Jason W. Ricketts, Karl E. Karlstrom, Alexandra Priewisch, Laura J. Crossey, Victor J. Polyak and Yemane Asmerom (2014). Quaternary extension in the Rio Grande rift at elevated strain rates recorded in travertine deposits, central New Mexico. *Lithosphere*. 6 (1), 3.

Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: [10.1130/L278.1](https://doi.org/10.1130/L278.1)

Karl E. Karlstrom, John P. Lee, Shari A. Kelley, Ryan S. Crow, Laura J. Crossey, Richard A. Young, Greg Lazear, L. Sue Beard, Jason W. Ricketts, Matthew Fox & David L. Shuster (2014). Formation of the Grand Canyon 5 to 6 million years ago through integration of older palaeocanyons. *Nature Geoscience*.

Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1038/ngeo2065

Williams, A.J., Crossey, L.J., Karlstrom, K.E., Newell, D., Person, M., Woolsey, E. (2013). Hydrogeochemistry of the Middle Rio Grande aquifer system — Fluid mixing and salinization of the Rio Grande due to fault inputs. *Chemical Geology*. 351 281.

Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.chemgeo.2013.05.029

Yipeng Zhang, Mark Person, John Rupp, Kevin Ellett, Michael A. Celia, Carl W. Gable, Brenda Bowen, James Evans, Karl Bandilla, Peter Mozley, Thomas Dewers and Thomas Elliot (2013). Hydrogeologic Controls on Induced Seismicity in Crystalline Basement Rocks Due to Fluid Injection into Basal Reservoirs. *Groundwater*. 51 (4), 525.

Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1111/gwat.12071

## Books

### Book Chapters

Kumar, S. and Varela, M.F. (2013). Molecular mechanisms of bacterial resistance to antimicrobial agents. *Microbial pathogens and strategies for combating them: science, technology and education* Mendez-Vilas, A.. Formatex Research Center. <http://www.formatex.info/microbiology4/vol1/522-53>. 522.

Status = PUBLISHED; Acknowledgement of Federal Support = No ; Peer Reviewed = No ; ISBN: 978-84-939843-9-7.

Floyd, J. T., Kumar, S., Mukherjee, M.M., He, G.X., and Varela, M.F (2013). A review of the molecular mechanisms of drug efflux in pathogenic bacteria: A structure-function perspective. *A review of the molecular mechanisms of drug efflux in pathogenic bacteria: A structure-function perspective* 3. Shankar, P.. Research Signpost. Kerala, India. 15.

Status = PUBLISHED; Acknowledgement of Federal Support = No ; Peer Reviewed = No ; ISBN: 978-81-308-0529-0.

## Thesis/Dissertations

### Conference Papers and Presentations

Leonard, Daniel (2013). *Effect of ZnS crystal structure and hole-scavenger solvent on the photocatalyzed reduction of bicarbonate to formate*. New Mexico Academy of Science/ NM EPSCoR Joint Meeting. Albuquerque, NM.

Status = PUBLISHED; Acknowledgement of Federal Support = Yes

Woolsey, E. (2013). *Using subsurface thermal data, isotopic tracers, salinity, earthquake hypocenters and high performance computer modeling to characterize deep regional flow systems within the Albuquerque Basin and underlying crystalline basement*. Penrose Conference. Park City, Utah.

Status = PUBLISHED; Acknowledgement of Federal Support = Yes

**Other Publications**

Person, M., Kelley, S., Pepin, J., Phillips, F., Timmons, S., Murphy, M. (2013). *Assessment of the Sustainability of Geothermal Development Within the Truth or Consequences Hot--Springs District, NM*. New Mexico Bureau of Geology Open-File Report 551: Summary of a 1-year study to assess the subsurface flow patterns and the sustainability of the Truth or Consequences geothermal system.

Status = PUBLISHED; Acknowledgement of Federal Support = Yes

**Technologies or Techniques**

Nothing to report.

**Patents****Inventions**

Invention Title: Engineered Stable Microorganism/Cell Communities, Provisional Application

Description: New approach for creating stable communities of cells and single celled organisms. Tracking number 2014-034-01

Inventor(s): David Hanson, Plamen Atannasov, John Roesgen, Linnea Ista

Invention Title: PHOTOSYNTHETICALLY OXYGENATED WASTE TO ENERGY RECOVERY APPARATUS AND METHOD OF USE

Description: The present invention relates to waste to energy systems, specifically, to systems utilizing algae adapted for growth at low pH values (0-5) to convert carbon, nitrogen and phosphorus in the waste into biomass and processing the biomass into energy products. The term waste refers to municipal waste water or sewage, animal waste streams (dairy, feedlot, swine, poultry, aquaculture, mariculture) and food-waste. Energy products refer to liquid and gaseous fuels and their precursors. Examples of known acidophilic algal and cyanobacterial genera includes but is not restricted to Arthrospira (Spirulina), Oscillatoria, Synchechococcus, Mastigoclasus, Chroococcus, Chlamydomonas, Chlorella, Chorycystis, Dunaliella, Eremosphaera, Hormidium, Stichococcus, Stichococcus, Zygonium, Cyanidium, Cyanidioschyzon, Pleurococcus, Galdieria, Eunotia, Surella, Nitzschia, Pinnularia and Euglena (1).

Inventor(s): Peter Lammers

**Licenses****Websites**

Title: NM EPSCoR: Energize NM

URL: <http://www.nmepscor.org>

Description: Completely re-designed website to disseminate project information.

**Other Products**

Nothing to report.

**Participants**

What individuals have worked on the project? **REDACTED**



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**Name****Location**

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**Have other collaborators or contacts been involved? Y**

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## Impacts

### What is the impact on the development of the principal discipline(s) of the project?

Much of the Year 1 activity has focused on purchasing and installing equipment, hiring needed personnel, and setting the foundation for research activities. At the time of this report, there has been little time to realize the many potential impacts of the research on the scientific disciplines. However, a few can be identified:

Bioalgal: Publications based on initial work have added to knowledge about nutrient removal rates by *Galdieria sulphuraria*, development of molecular markers in outdoors photobioreactor systems, and bio-crude oil composition from hydrothermal liquefaction of algal biomass.

Solar: We have developed new ways for metal-ligand control of photoprocesses which suggest that heteroatom effects can be utilized to further modify excited state lifetimes in a controlled manner. The photodriven semiconductor substrates of ZnS have moved from the nanoparticle solution phase to ultra high vacuum thermal deposition with highly controlled layering of semiconductor material to  $100 \text{ nm} \pm 5 \text{ nm}$ .

Osmotic: Measurements of osmotic pressure for highly saline waters will be completed by the end of Year 1. This type of data is very sparse in the literature, so the results will greatly enhance the field's knowledge base.

Social and Natural Science Nexus: We have established the base conditions for developing a statewide water budget and have identified the key collaborators including researchers and stakeholders.

The Growing Up Thinking Computationally (GUTC) program is adding to our understanding of best approaches to integrate Computer Science concepts and practices into the K-12 curriculum.

### What is the impact on other disciplines?

Nothing to report.

### What is the impact on the development of human resources?

#### Institutional Engagement

Through the Faculty Leadership and Professional Development Institute (described in Accomplishments), we have engaged nine primarily undergraduate institutions (2 and 4 year) in RII activities. In addition, at the time of

this report we have received student applications for the STEMAP program from eleven PUIs, including community colleges. The two Seed Awards that will be made in the spring of Year 1 will engage two PUIs in research and education activities and the Diversity IWGs will also engage non-research institutions. By the end of Year 1, we will have involved students and/or faculty from at least four 4-year undergraduate institutions (including 1 tribal institution) and ten 2-year institutions.

Energize New Mexico has been designed to encourage and support collaborative efforts across institutions and disciplines. The Research, CI, Diversity, Workforce Development and External Engagement teams have initiated new and strengthened existing collaborations within the jurisdiction and beyond to support and extend our research and education efforts. The number of collaborations and collaborators are reported in EPSCoR Template C, Collaborations. Some of the collaborations that will enhance our research efforts include:

Members of the Geothermal team are partnering with geothermal companies and consultants to develop NM guidelines for geothermal exploration and to develop new geothermometers/exploration tools to identify 'blind' geothermal systems. They are also establishing additional connections with researchers at Sandia National Laboratories to bring geophysical remote sensing and Los Alamos National Laboratory to bring geophysical modeling expertise to the collaboration. The collaboration has resulted in one proposal submitted and others in the planning stages.

The Geothermal team is collaborating with an experienced magnetotelluric scientist, Prof. Gary Egbert of Oregon State University, to develop familiarity with the system from field deployment to data processing and interpretation.

The Osmotic Power team is collaborating with Apache Corporation to obtain high TDS produced waters. In the fall of 2013, the Osmotic research team toured Apache's water flooding operation in Eunice, New Mexico. The field visit allowed the team to understand the practices in the oil fields; this knowledge is essential for the implementation of PRO in the field. The team also collected samples of produced water and makeup water for analysis at the NMSU/ENMU labs and for testing of the PRO system at NMT.

The Osmotic Power team is also working with an expert in the fabrication and characterization of hollow-fiber membranes (HFM), Dr. Wei, from NM Highlands University. Dr. Wei's experience with the pioneer of the Pressure-Retarded Osmosis (PRO) system, Statkraft, will significantly strengthen our research capability in power generation using PRO.

The Bioalgal Energy Team has arranged with the USDA in Maricopa to get enzymes, metabolites, plasmids, and protocols for studying Rubisco and Rubisco activase function. These resources are hard to come by and will facilitate pursuing questions about Rubisco function in algae. This team is also collaborating with Dr. Ru Zhang at the Carnegie Institute; her new high throughput genotyping tool for *Chlamydomonas reinhardtii* will be used for a cell density based experiment in which cultures are grown in her Photon Systems Instruments bioreactors. The reactors are the same ones we have included in our budget, so we will also use this experiment to ensure the reactors suit our needs.

The Uranium Team has met several times with representatives of New Mexico's Environment Department to identify uranium contamination sites as possible field sites to both take advantage of related state and federal efforts and to generate data that will be optimally useful to the state and area residents.

In addition to these external collaborations, there are several project synergies developing between project components and between colleagues within institutions, across departments. Examples include:

The Geothermal Team is sharing data (uranium and arsenic measurements) from field sites of mutual interest, including Laguna and Acoma pueblos and Cibola National Forest, with members of the Uranium team.

The Bioalgal Team is collaborating with the Geothermal Team to develop a proposal/project focused on using geothermal waste heat from the Truth or Consequences Spa district to grow bio-algae.

A New Mexico Tech student is bridging the Bioalgal and Osmotic Teams to study the ability to grow algae in water waste from the osmotic power component.

The Osmotic team has grown to involve 12 undergraduates and 7 faculty members across six disciplines in conducting research.

Finally, the inter-institutional, interdisciplinary teams that form the basis of Energize New Mexico are spawning new research collaborations. Members of four of the Energize New Mexico research teams, with colleagues from within and beyond the current project, have developed pre-proposals in response to the recent DOE EPSCoR funding opportunity announcement. Each proposal involves at least two NM research institutions. While only one proposal can be submitted from the jurisdiction, these discussions are laying the conceptual and organizational foundations for additional proposals that will extend and sustain the impact of Energize New Mexico.

### **What is the impact on physical resources that form infrastructure?**

**Bioalgal:** The cultivation testbed at NMSU will receive Algenol Biofuels' horizontal photobioreactors before the end of Year 1. A UPLC2 system has been installed in the Center for Biomedical Engineering (CBME) as a core resource of the UNM SEED facility, bringing new chromatography and metabolomics capabilities to NM. New HPLC-based lipid production screening capabilities are now available as part of the UNM/NMC collaboration. A new LED light bank is available for growing algae in vertical bioreactors at UNM.

**Solar:** Building a new "EPSCoR Spectroscopic Laboratory" that features a new magnetophotoluminescence spectrometer are now underway as part of the \$16M UNM Chemistry and Chemical Biology renovation.

**Geothermal:** A major infrastructure acquisition of the Geothermal team is a Zen magnetotelluric (MT) system from Zonge International. This system will be the first of its kind in NM or in a NM academic setting.

**Osmotic:** The process for Hollow Fiber Membrane (HFM) fabrication and characterization is unique among the research universities in New Mexico. This development will greatly enhance our research ability in not only osmotic power generation, but also other membrane-related areas.

**Social and Natural Sciences Nexus:** An experimental economics lab is nearing completion at UNM.

### **What is the impact on institutional resources that form infrastructure?**

Nothing to report.

### **What is the impact on information resources that form infrastructure?**

We have defined a structured approach to data management through early and repeated interactions between the project science and education teams and the CI development group. These interactions are producing the specifications for the various CI products and are allowing for the establishment and communication of data management practices across the project that will streamline both the research and integration of research products into the data management system and project portal.

We have acquired an OpenStack server platform and related (10 Gb) network hardware that will be used as an initial experimental platform for the development and deployment of a cloud computing and data object store model that will be used to host some of the project infrastructure. EDAC's share of the enterprise storage system managed by UNM's research storage consortium has been expanded to provide storage in support of the OpenStack platform. Both of these infrastructure components will be installed in UNM's Center for Advanced Research Computing as the beginning of a geographically replicated infrastructure for both data storage and processing in support of the EPSCoR project and others. An additional 45 TB of usable storage will be deployed as a local cache for generated data products and source data to accelerate data services and streamline data delivery through the EPSCoR data portal and other applications (e.g. the NM RGIS system, the Tri-State EPSCoR

consortium) that use the Gstore platform.

### **What is the impact on technology transfer?**

Two patent applications have been submitted.

### **What is the impact on society beyond science and technology?**

Results of studies of *Galdieria sulphuraria* for nutrient removal from urban wastewaters will help communities develop energy-efficient and sustainable technologies to manage urban wastewaters.

The Geothermal group completed a study of the sustainability of geothermal development for the city of Truth or Consequences, a city that relies heavily on tourism related to their hot springs. The city will use this information to make resource management decisions and establish relevant policies.

The NM Informal Science Education Network (ISE Net) is systematically linking the members of their community to both academic research efforts and the state's Public Education Department.

Participants in the Faculty Leadership and Professional Development Institute have become aware of and explored the roots of their biases and are applying their understanding to making their undergraduate courses more inclusive and supportive of diversity.

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## **Changes**

### **Changes in approach and reason for change**

The General Programmatic Terms and Conditions (PTC) related to reporting have been addressed throughout the body of the RPPR and in the EPSCoR Reporting templates that have been submitted separately to the Program Officer. There are no Jurisdiction Specific Terms and Conditions on this award.

Attached is the Evaluation Plan from our external advisor, Minnick and Associates. His first annual evaluation report is due July 1, 2014.

Our External Advisory Committee (EAC) held its initial meeting in October 2013. Their report and our response to their recommendations are attached. Since our response, we have made additional progress in addressing several of their recommendations, as described below.

*Recommendation: Integration of Workforce Development and External Engagement activities with science teams:... , the plan needs clearer articulation of how their efforts directly support and further the research by the six teams.*

In addition to discussion of this topic at quarterly Management Team meetings, the GUTC program for middle school students has begun collaborating with the Solar research team, using their expertise to develop curricular materials and activities for the clubs. Researchers are sharing information about their research at meetings of the Informal Science Education Network and working with museum partners to offer public programming. The External Engagement team is also guiding development of the agenda for the first statewide "All Hands Meeting" so that it will include a focus on effective public communication by scientists.

*Recommendation: The well-designed and effective plans for Diversity now should be rolled out to the science and workforce development programs for implementation.*

As described in the Accomplishments section, our Diversity Team has been very active and is sharing information with project participants regularly. Our Diversity Coordinator works very closely with the Workforce Development

team to gather and disseminate information. There will be a focus on Diversity efforts at the All Hands Meeting as well.

*Recommendation: Subsequent meetings: form and degree of engagement... In addition, the advisory board would benefit by having some direct engagement with some of the research teams, their junior participants, and stakeholders...*

In order to facilitate interaction of the EAC members with a broad range of project participants, we have accelerated the time of their next meeting to coincide with the first statewide All Hands Meeting in May 2014. This meeting will provide opportunities for the EAC to discuss the project with faculty, postdocs, students, and staff in structured sessions as well as informally. The EAC will then convene for additional deliberations on the following day.

*Recommendation: Consider developing a mechanism where the undergraduate and graduate students can meet and network with each other to share data and information about different aspects of their work.*

In addition to the All Hands Meeting, we have scheduled a day in April 2014 for all students to focus on both Responsible Conduct of Research and an introduction to EPSCoR data management. We plan to continue partnering with the NM Academy of Science to provide a venue for students to share their work with each other and with the community of scientists.

#### Changes in Management

One co-lead for the Uranium component, Ulmer-Scholle, left her institution before the award was made. Her replacement (Pullin) was approved by the NSF Program Officer at the start of the award.

A co-lead of the CI Team (Coonrod) is not able to participate in the project due to demands of her new position as Dean of Graduate Studies. A replacement for her on the CI Team has not been identified. The CI "liaisons" in each research component ensure that the CI Team is responsive and engaged with all of the research components.

#### **Actual or Anticipated problems or delays and actions or plans to resolve them**

There have been no significant changes to the Strategic Plan since it was approved by NSF.

#### **Changes that have a significant impact on expenditures**

At the start of the award, we notified our Program Officer that the chemistry faculty member on the Solar Team from NMSU had accepted an appointment at another institution. NMSU's contribution to the Solar team's work was been delayed while a faculty member with the expertise needed by the solar team was identified. As of February 2014, this new team member has begun contributing to the Solar team.

A postdoctoral researcher for the Osmotic team was originally budgeted for Years 1, 2, 4, and 5 at NM Tech. However, due to the difficulty of finding a qualified candidate during the fall of 2013, the position will remain open until May 2014. A well-qualified candidate has been identified; we anticipate filling the position by the start of Year 2.

The second faculty hire at NMSU for which start-up funds were budgeted in Year 1 will not occur until Year 2.

We have expended or obligated 81% of Year 1 funds. We will expend the remaining 19% as equipment purchases are finalized, including items associated with new faculty hires, and other personnel hiring is completed.

#### **Significant changes in use or care of human subjects**

Nothing to report.

**Significant changes in use or care of vertebrate animals**

Nothing to report.

**Significant changes in use or care of biohazards**

Nothing to report.

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**Special Requirements**

**Responses to any special reporting requirements specified in the award terms and conditions, as well as any award specific reporting requirements.**