



COLORADO HIGHER EDUCATION COMPETITIVE RESEARCH AUTHORITY

University of Colorado:Colorado State University:University of Northern Colorado:Colorado Schools of Mines:State of Colorado

March 1, 2016

Honorable Members of the House and Senate Education Committees
State Capitol
200 East Colfax
Denver, CO 80203

Re: Annual Report of the Colorado Higher Education Competitive Research Authority
(CHECRA)

Dear Senators and Representatives:

Colorado Revised Statute §23-19.7-103(3) requires the Colorado Higher Education Competitive Research Authority (CHECRA), housed at the Colorado Department of Higher Education, to report annually to the Education Committees of the Colorado House of Representatives and Senate on research projects funded by the CHECRA in the previous calendar year. This letter reports on activities and projects funded in calendar year 2015.

The CHECRA was created to provide a source of matching funds for National Science Foundation (NSF) and other federal grants that require or benefit from a state match. CHECRA funding has helped to bring significant research dollars to Colorado. The following projects received CHECRA funding in 2015:

1. In 2014, the NSF awarded the University of Colorado a grant to continue and expand its Soft Materials Research Center into a full Materials Research Science and Engineering Center (MRSEC), one of the NSF's most prestigious awards. This Center focuses on liquid crystal frontiers, an area where the University of Colorado is among the leading authorities, and work related to DNA nano-science. The CHECRA has pledged \$400,000 per year for six years; 2015 was the second year of funding.
2. The NSF had awarded a MRSEC grant to the Colorado School of Mines in 2008. CHECRA provided a cost share of \$400,000 for 6 years, with the final payment in 2014. In 2015, the School of Mines requested a supplemental 7th year of funding at fifty percent (\$200,000), to match a 7th year of "ramp-down" funding received from NSF. The School of Mines noted that the additional funding would enable Mines to pursue new opportunities to sustain the

Center. The Center is focused on investigating emerging renewable energy materials, such as the next generation of solar panels and fuel cells. It is the first NSF-funded center dedicated solely to renewable energy technologies. The CHECRA agreed to the request and provided a one-time supplemental payment of \$200,000 in 2015.

3. The Accelerating Innovation Research – Research Alliance (AIR-RA) project at Colorado State University, funded by NSF, is advancing research in cadmium telluride photovoltaics with the vision of making PV electricity a major source of energy. The CHECRA made the first of three payments of \$136,000 toward this project.
4. The Center for Multiscale Modeling of Atmospheric Processes (CMMAP) at Colorado State University received its final of five payments of \$150,000 in 2015. CMMAP, which has received continued funding from NSF, is a partnership of research and educational institutions, government agencies, and industry aimed at developing a new kind of global atmospheric model. In addition to research, the Center has focused on educating and training a diverse population (specifically women, underrepresented minorities, and individuals with disabilities) in climate and Earth System Science; and knowledge transfer through the sharing of information with other modeling centers and the Colorado Governor’s Energy Office.
5. The University of Colorado, the Colorado School of Mines and Colorado State University are part of the Institute for Advanced Composites Manufacturing Innovation, a consortium of 122 companies, nonprofits, universities, and research laboratories who are partnering with the federal government to create a manufacturing hub focused on U.S. leadership in next-generation materials. Recognizing the importance of this large initiative, as well as the number of players involved, CHECRA is providing a very limited cost share of 200,000 per year for 5 years, beginning in 2015.
6. A project at Colorado School of Mines called Water Quality and Supply Impacts from Climate-induced Insect Tree Mortality and Resource Management in the Rocky Mountain West received the fourth of five payments of 75,000 in 2015. This five-year effort funded by NSF is studying water resource changes resulting from the mountain pine beetle epidemic.
7. The Colorado School of Mines Re-inventing the Nation’s Urban Water Infrastructure (ReNEWIt) Engineering Research Center received its final payment of \$400,000 from the Authority in 2015. With this grant from the NSF, the School of Mines joins leading universities in tackling the acute water problems and needed infrastructure changes facing the West.
8. The CHECRA provided cost shares for a number of Major Research Instrumentation (MRI) grants from NSF in 2015. These grants provide higher education institutions with major instrumentation that supports the research and research training goals of the institution and that is also used by other researchers regionally or nationally. The CHECRA Board determined that these grants play a significant role in encouraging collaboration among institutions in Colorado and beyond in areas of common research interest that positions researchers to compete for additional federal research grants. Following are the awards and amounts CHECRA provided:

University of Northern Colorado: a single crystal x-ray diffractometer / \$93,783

University of Northern Colorado: a high performance computing cluster for multidisciplinary research and education / \$59,978

Colorado School of Mines: coupled optical and scanning microscopy facility / 64,858

University of Colorado Boulder: Shared Supercomputer by the Rocky Mountain Advanced Computing Consortium / \$140,000

University of Colorado Boulder: Infrared scanning near-field optical microscope (IR s-SNOM) for broadband nano-imaging and –spectroscopy / \$80,000

Colorado State University: Combined Spinning Disc Confocal/Atomic Force Microscopy System / \$95,000

Colorado State University: Ship-based C-Band Polarimetric Radar / \$125,000

Attachments to this report (Attachments B- XXXX) include detailed information on each of these projects. In addition to the millions of dollars in federal funding coming into the institutions and the state and the impressive scientific results achieved under the projects, all of the research centers funded by CHECRA have many additional positive benefits to Colorado. As noted in the attached appendices, these benefits include support for graduate and undergraduate students, outreach to K-12 students and teachers, and economic development benefits from spin-off technologies and companies.

Some highlights of these benefits to Colorado include:

- The [University of Colorado] Symposium brings together hundreds of students, researchers, and professionals from universities, national laboratories and industry to exchange ideas and best practices in all areas of cyberinfrastructure.
- CMMAP [at CSU] reached over 20,000 K-12 students and teachers through the activities of the Little Shop of Physics (LSOP) in more than 40 school visits, science workshops and the LSOP annual open house.
- ... Through our summer teacher training workshops for K-12 teachers in Adams County and Denver Public Schools the [School of Mines] REMRSEC trained over 30 teachers to become proficient in delivering lessons on renewable energy topics that fit the state-mandated curriculum and are age appropriate for a specific grade. The Center also hosted 20 dyslexic students from grades 3-6 to enhance their proficiency in science and engineering concepts.
- ...the REMRSEC ran a research experiences for undergraduates program that provided quality research experiences for 24 undergraduate students from around the country. This program is an excellent recruiting tool to attract the best and the brightest future scientist and engineers to finish their educations in Colorado and hopefully remain here to bolster the scientific workforce.
- Because UNC is a comprehensive institution of higher education, integrating modern instrumentation into research and learning opportunities is highly valued. The single-crystal X-ray diffractometer will be central to the development of several courses that

address a variety of students to maximize the impact of the instrument. The XRD will provide research and educational experiences for undergraduates, graduate students, postdoctoral fellows, and high school teachers and students, many of whom will be trained to gain hands-on experience with crystallography.

- The [CU Center] conducted Family Science Evenings in partnership with a local Boulder community center and Arrupe Jesuit High School, a Denver urban high school that serves economically disadvantaged families... To date, four programs have been conducted at Red Oak serving 75 individuals, many of who are repeat attendees. At Arrupe High School in 2015 we conducted 2 evening programs and had a tremendous turnout in attendance from the Arrupe families. In a school with a student population of 350 there were more than 150 participants at each event

During calendar year 2015, the Authority received a single distribution of Limited Gaming Funds of \$2.1 million. Interest earnings on those funds totaled \$18,430, for a total income of \$2,118,430 in 2015. Payments to institutions are shown in the table in Appendix A. Total expenses were \$2,123,969.

Please contact me if you have any questions.

Sincerely yours,



Lt. Gov. Joseph A. Garcia
Chair

Attachments: Appendix A: CHECRA Expenses
Appendix B: University of Colorado MRSEC
Appendix C: School of Mines Renewable Energy MRSEC
Appendix D: Colorado State University AIR-RA
Appendix E: Colorado State University CMMAP
Appendix F: Colorado School of Mines Water Quality and Supply
Appendix G: Colorado School of Mines School of Mines Reinventing the Nation's Urban Water Infrastructure
Appendix H: MRI Awards

Appendix A: CHECRA Expenses 2015

	Disbursements	Obligations*	
Colorado State University			
NSF Center for Multiscale Modeling of Atmospheric Processes (CMMAP)	150,000		
AIR-RA program	136,000		
MRI: Ship-based C-Band Polarimetric Radar		125,000	
MRI: Combined Spinning Disc Confocal/Atomic Force Microscopy System		95,000	
Colorado School of Mines			
Renewable Energy Materials Research Science and Engineering Center	200,000		
Engineering Research Center - Reinventing America's Urban Water Infrastructure	400,000		
NSF WSC Category 2 Collaborative	75,000		
Institute for Advanced Composites Manufacturing Innovation	100,000		
MRI: Coupled Optical and Scanning Microscopy Facility		64,858	
University of Colorado - Boulder			
Soft Materials MRSEC		400,000	
MRI: Shared Supercomputer		140,000	
MRI: Infrared scanning near-field optical microscope		80,000	
University of Northern Colorado			
MRI: Acquisition of a Single Crystal X-Ray Diffractometer	93,783		
MRI: Acquisition of a High Performance Computing Cluster	59,978		
Total Obligated and Disbursed to Institutions in 2015	1,214,761	904,858	
Other Expenses	4,350		
Total Obligated and Disbursed	\$1,219,111	\$904,858	\$2,123,969

**due to processing delays, these payments were disbursed in 2016*