NM SMART Grid Center
ANNUAL REPORT
YEAR 3

New Mexico EPSCoR

September 2020 - August 2021

Cover image: Roof solar thermal panels at Santa Fe Community College Smart & Microgrid Training Center

NM EPSCoR is Committed to Diversity & Inclusion

The diversity of the people of New Mexico has been a source of innovation and creativity throughout our state's history. NM EPSCoR respects and values diversity of all types, including race, ethnicity, national origin, age, gender identity, sexual orientation, education, socioeconomic status, ability, and more.

We see diversity as a source of strength, and we strive to create an inclusive, collaborative, and equitable environment where everyone can realize their full potential. NM EPSCoR particularly acknowledges the acute need to remove barriers to the recruitment, retention, and advancement of talented students, faculty, and staff from historically excluded populations that are currently underrepresented.

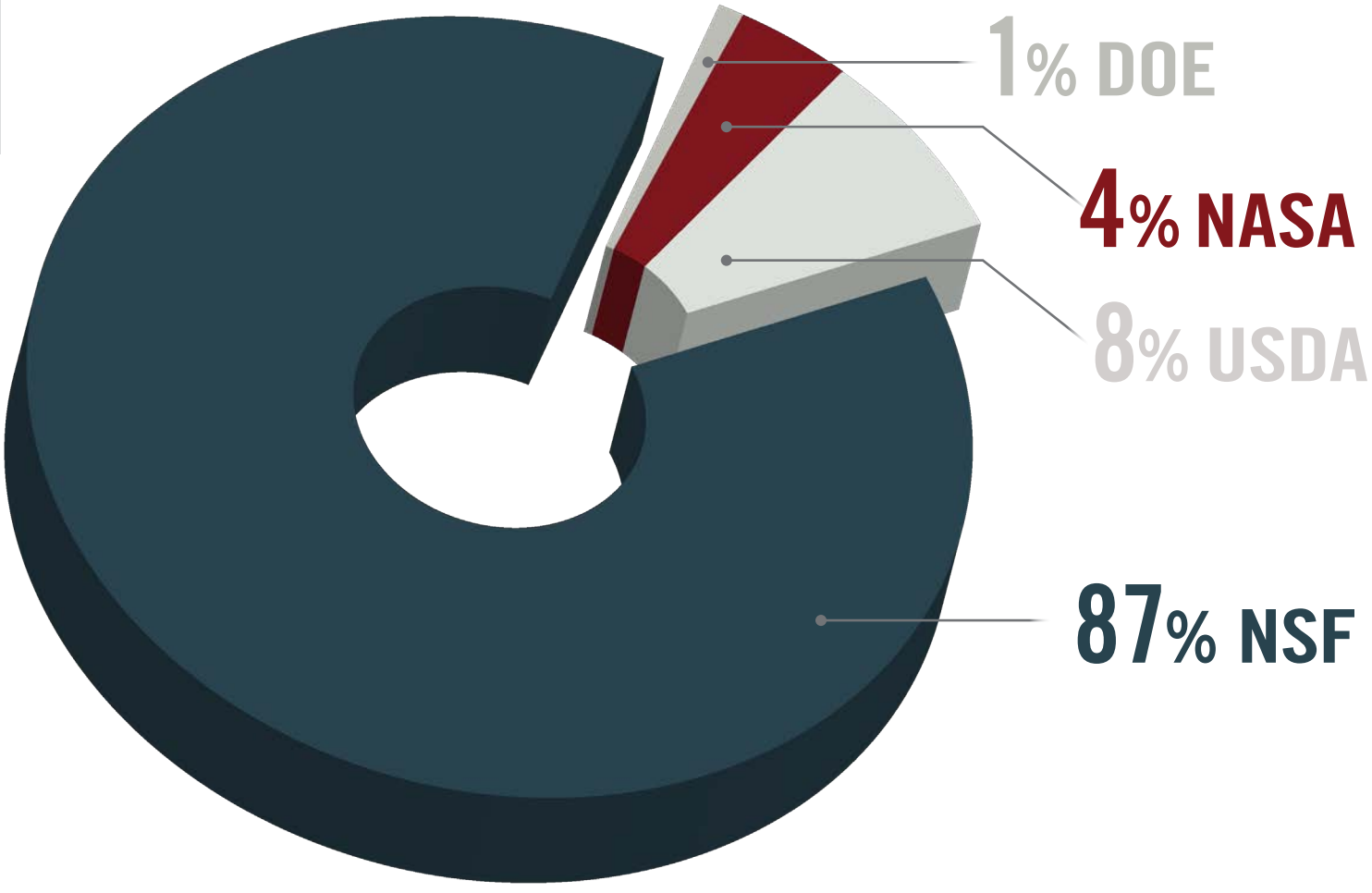
TABLE OF CONTENTS

New Mexico
SMART Grid Center

NM EPSCoR OVERVIEW

New Mexico's Established Program to Stimulate Competitive Research (NM EPSCoR) was established in 2000 and is funded by the National Science Foundation (NSF) to advance the state's capacity to conduct scientific research while cultivating a diverse, well-qualified STEM workforce.

EPSCoR eligibility has resulted in over **$207 million** in federal investment in New Mexico since 2000



THE DETAILS

Amount NSF EPSCoR has contributed to New Mexico in direct and co-funded awards since 2000

$182 million

NM EPSCoR since 2000...

25
NM higher ed. institutions directly involved

33
university faculty hires supported

1,867
project participants

$7.2M
scientific & computing equipment purchased

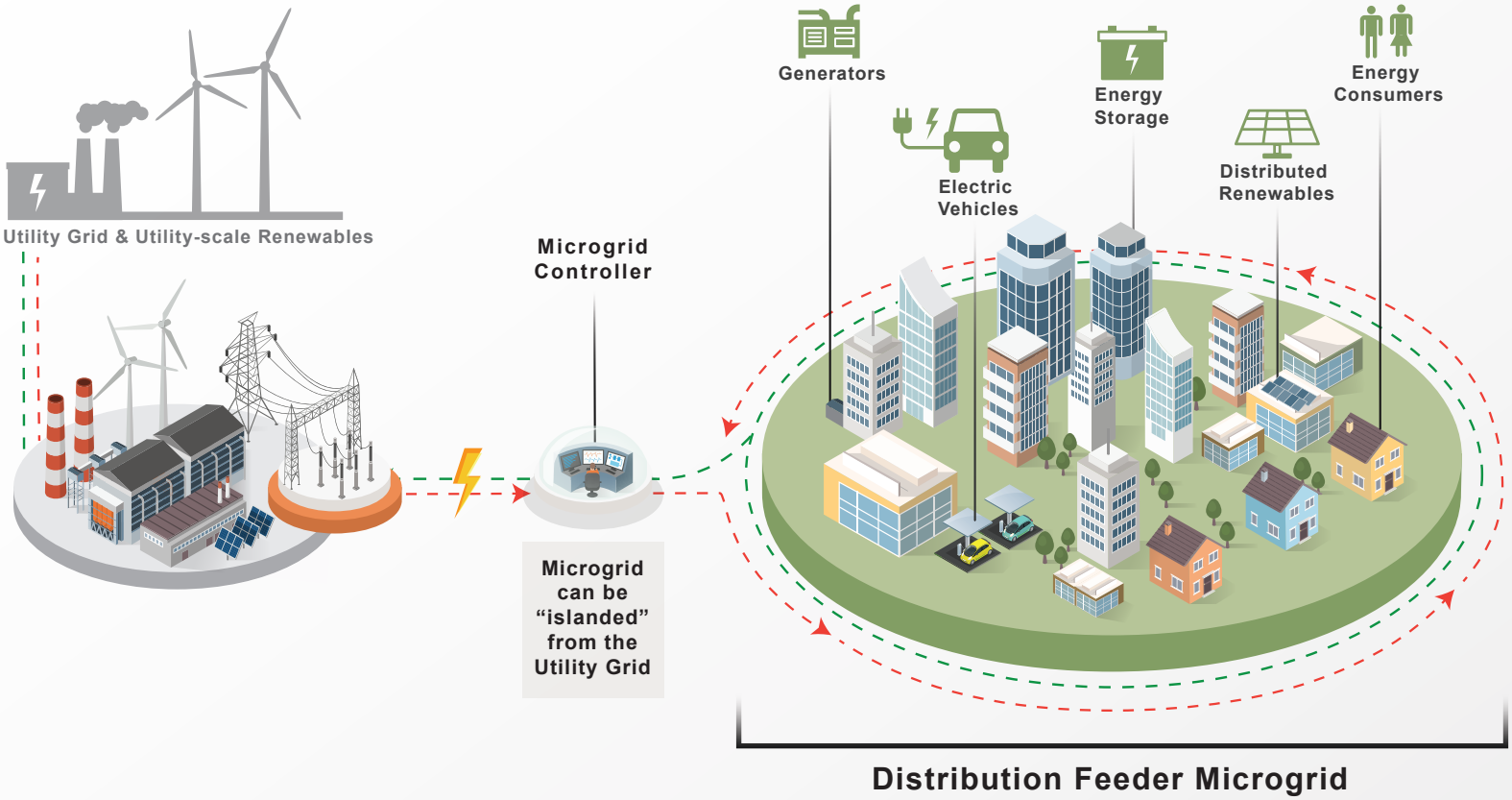
*all numbers are as of 9.2021

NM SMART GRID CENTER OVERVIEW

The *NM SMART Grid Center* is a 5-year, $20-million research and human infrastructure project investigating the fundamental challenges to transition existing electricity transmission and distributed energy infrastructure into a SMART (Sustainable, Modular, Adaptive, Resilient, Transactive) grid.

Our mission is accomplished by developing research capacity and education programs to support a modern electric grid, building on the principles of **Distribution Feeder Microgrids (DFMs)** with a focus on architecture, networking, decision-support, and deployment, and by empowering a future workforce through industry partnerships, education, and public outreach.

Distribution Feeder Microgrid



THE DETAILS*

	project participants	peer-reviewed papers published or accepted	additional extramural funding awarded to project participants
YEAR 3	201	144	$57 MILLION
YEAR 2	171	73	$30 MILLION
YEAR 1	138	19	$7.9 MILLION

*project cumulative totals

DFMs will enable us to retrofit existing utility infrastructure in a way that allows entire sections of communities to operate with or without power supplied by a central utility.

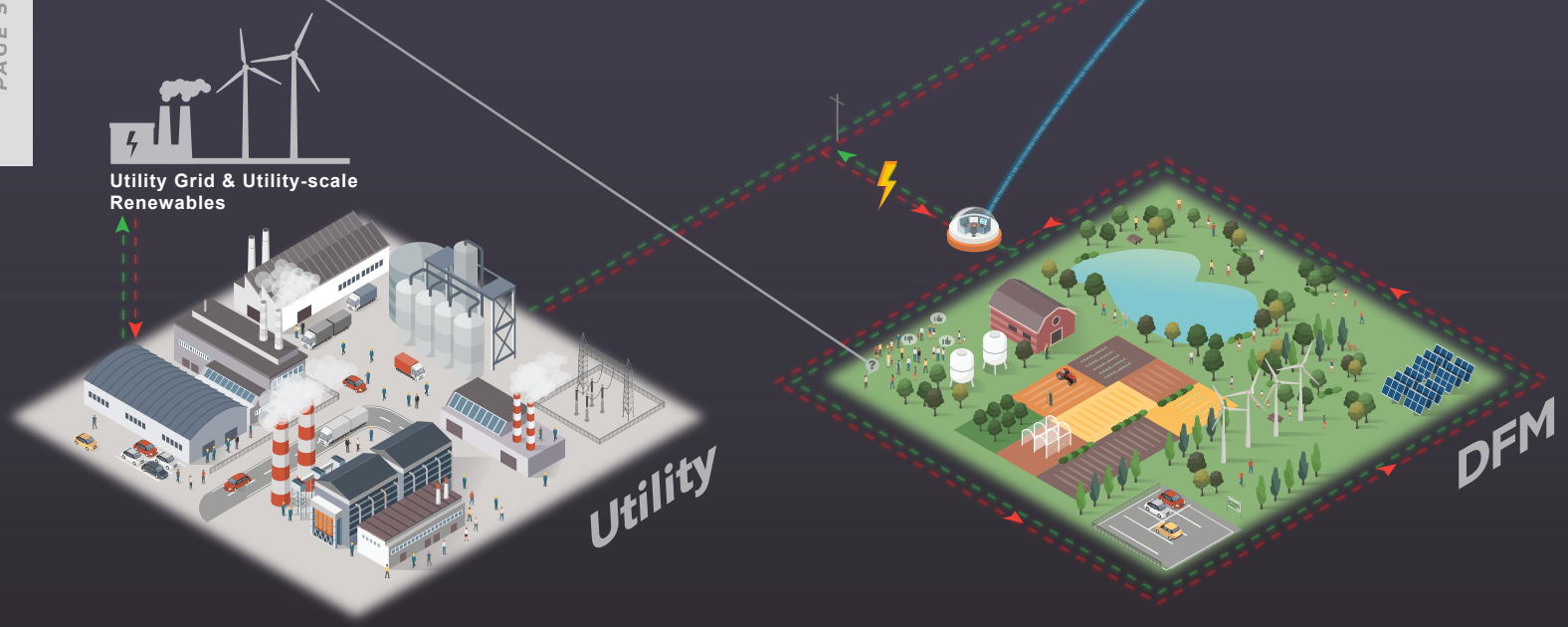
RESEARCH TEAMS

Architecture Team

The Architecture Team is creating a comprehensive framework for distribution feeders to evolve into managed microgrids. In Year 3, Team engineers created optimized models for distributed energy resources in DFMs and fault detection algorithms allowing for reliable microgrid operation even if a microgrid's communication system is compromised. Team economists surveyed 4,500 individuals in the four-corners states on their willingness to pay for a microgrid that has the potential to reduce disruption of service, building on a previous survey from 2019.

Networking Team

The Networking Team is creating scalable and secure communication systems for DFM frameworks developed by the Architecture Team. In Year 3, researchers completed work on a theoretical communications network, further refined data transmission models for 5G and smart grid applications, and created an operational device authentication scheme that requires significantly less energy, communication, and computational resources.



Cyberinfrastructure

In Year 3, the Cyberinfrastructure Team designed and implemented a new web page and on-boarding process for accessing high performance computing resources. Additionally, Team members developed workflows for linking research publications to their respective datasets and a process for integrating project datasets into public repositories and archival preservation systems.

Decision Support Team

Harnessing the power of machine learning, data mining, and artificial intelligence, the Decision Support Team is designing robust automated and computer-aided decision-making tools for DFM systems. In Year 3, the Team developed a novel data expression technique enabling researchers to collect critical power usage information without compromising user privacy. Significant headway was made on optimizing dataset processing as well as creating a tool capable of detecting data anomalies and classifying them in real-time.

Deployment Team

The primary focus of the Deployment Team is to test the models and technologies developed by the other research teams in simulations and diverse testbeds. In Year 3, Team members at NMSU began transforming their existing testbed into a flexible AC/DC microgrid, exponentially expanding research capabilities. UNM researchers verified the performance of optimization models and controllers with new simulation equipment at the Mesa del Sol testbed.

YEAR 3 HIGHLIGHTS

Researchers funded by a project seed award demonstrated, for the first time, a direct relationship between the visual structure of sprites—powerful electrical discharges which appear as luminous flashes in the clouds above severe thunderstorms—and the amplitude of their electrical currents. This advancement in lightning physics will enable engineers to devise better infrastructure protection mechanisms and will contribute to grid resilience.

Deployment Team researchers began construction of a functioning direct current (DC) microgrid that supports distributed power sources and the bidirectional flow of energy. Coined “DC Street,” this test site will allow researchers to test their smart grid innovations in a real-life setting.

HUMAN INFRASTRUCTURE

Developing the human resources needed to create, maintain, and build future electrical infrastructure requires a multi-pronged approach—one that reaches diverse students, faculty, teachers, industry, and entrepreneurs. Here is what NM EPSCoR did in Year 3 to build New Mexico's human infrastructure.

1 SUPPORT WORKFORCE DEVELOPMENT

2 INCREASE DIVERSITY IN STEM

3 ENGAGE THE PUBLIC

SUPPORT WORKFORCE DEVELOPMENT

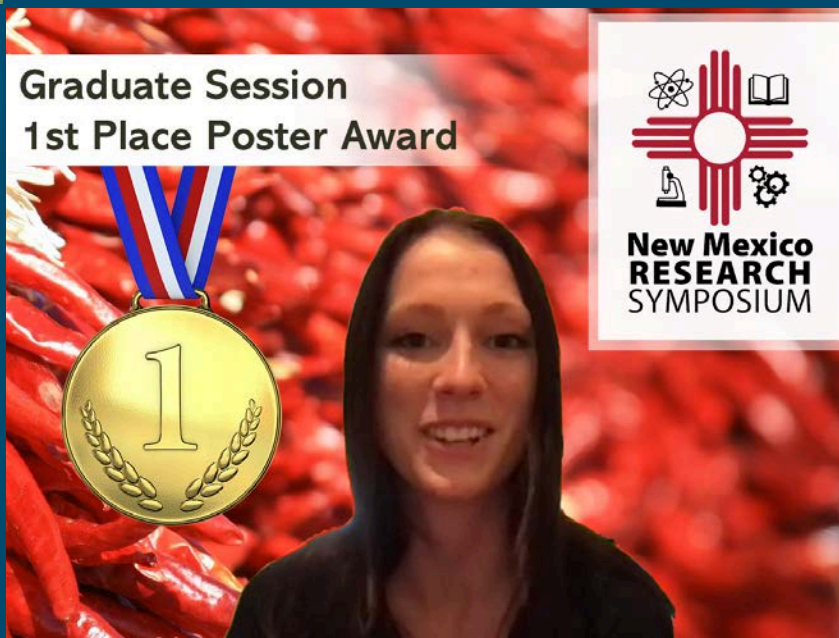
In Year 3, the NM SMART Grid Center supported research computing skills through three Carpentries workshops, one Carpentry instructor training, and two new certificate programs at SFCC. Team members facilitated collaboration between two- and four-year colleges, state agencies and industry through a two-day Distributed Energy Summit. In May 2021, five $50K Infrastructure Seed Award projects were awarded to support innovative smart grid research at NMT, NMSU, UNM, and NM Highlands University.

INCREASE DIVERSITY IN STEM

Successfully increasing diversity in STEM requires approaches that target both individuals and the larger systems in which they function. This year, 75% of the students who participated in the project's undergraduate summer research program (STEMAP) identified as female or from an under-represented minority group and over half of the 37 individuals who attended project-funded Carpentries workshops also belonged to these groups. In Year 3, NM EPSCoR recognized two project faculty with Excellence in Mentoring Awards, Caitano da Silva (NMT) and Satyajayant (Jay) Misra (NMSU), both of whom were nominated by mentees specifically for their dedication to creating inclusive research environments.

ENGAGE THE PUBLIC

In project Year 3, student researchers from nine New Mexico institutions participated in a virtual New Mexico Research Symposium hosted by NM EPSCoR. Symposium abstracts were published in the 2020 issue of the *New Mexico Journal of Science*, a peer-reviewed journal of the New Mexico Academy of Science. Outreach partner, Explora Museum, trained a second cohort of Science Communication Fellows and led a virtual Science Fiesta that engaged more than 3,000 participants from across the state.



New Mexico EPSCoR

Advancing Collaborative Research Excellence in New Mexico

NM EPSCOR STATE OFFICE

1312 Basehart SE
Albuquerque, NM 87106
P: 505-226-3942
F: 505-246-6007
www.nmepscor.org

New Mexico EPSCoR is funded by the National Science Foundation (NSF) award #OIA-1757207. Any opinions, findings, conclusions, or recommendations expressed in the material are those of the author(s) and do not necessarily reflect the views of the NSF.