New Mexico EPSCoR

NM SMART Grid Center
ANNUAL REPORT YEAR 1

September 15, 2018—August 31, 2019

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SMART Grid Center

NM EPSCoR OVERVIEW

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

> **Since NSF EPSCoR was established in New Mexico in 2000, NSF science and engineering support to universities in the state has nearly doubled.**

millions of dollars

70	
60	
50	
40	
30	
20	
10	

1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017

NSF Science & Engineering Funding to New Mexico

*ARRA funding
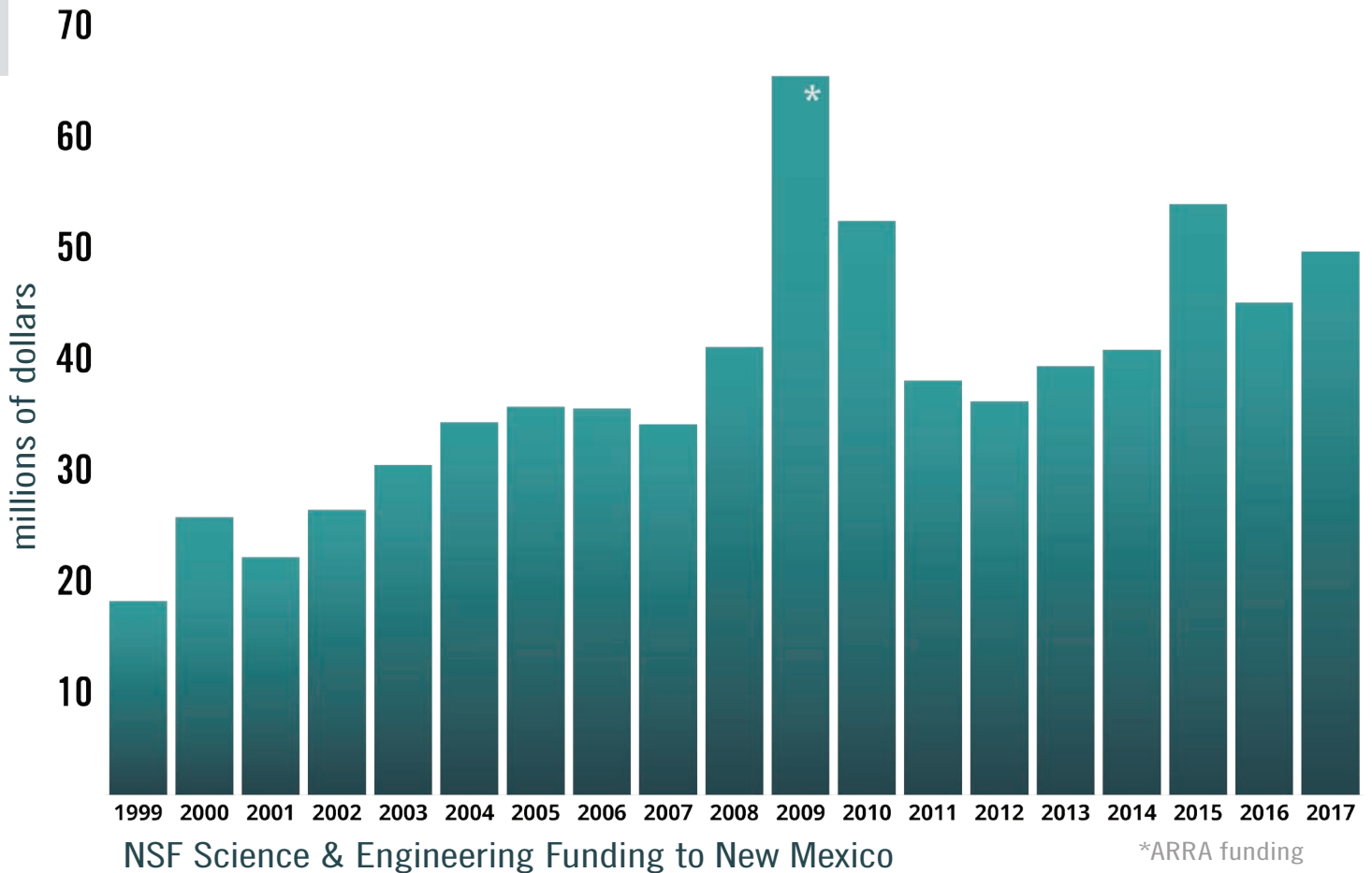
THE DETAILS

$183 million

The amount EPSCoR has contributed to New Mexico in direct and co-funded awards since 2001

Since 2001, museum exhibits funded by NM EPSCoR have engaged **OVER 2,000,000 PEOPLE**

&

74,000 STUDENTS & TEACHERS from New Mexico have been reached by NM EPSCoR supported education programs

1,600
project participants

$7,200,000
scientific & computing equipment purchased

27
university faculty hires supported

25
NM higher education institutions directly involved

2.5:1
return on investment in the last five years
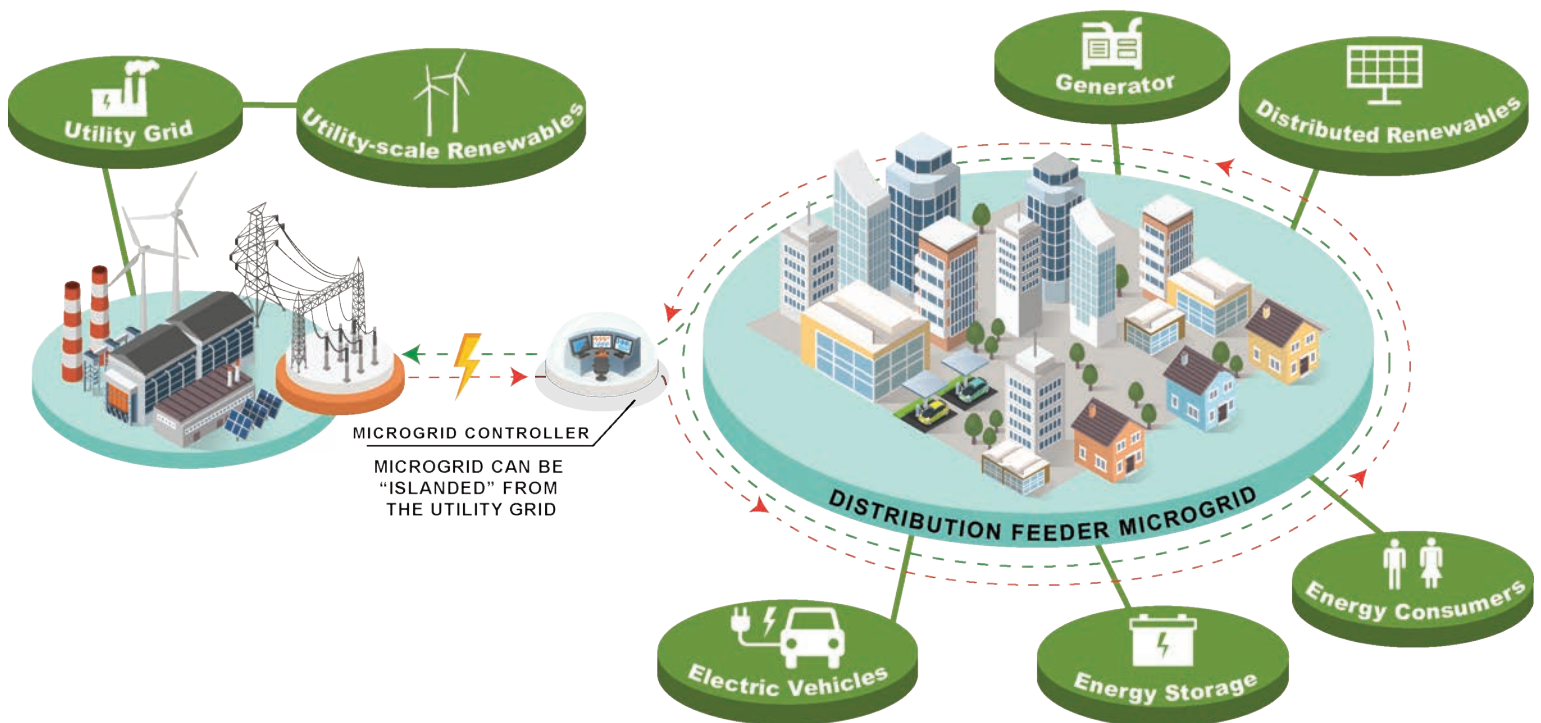
35,490
minutes of educational media shown on public television and online

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 will be accomplished by developing research capacity and education programs to support a modern electric grid built 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 Concept

Utility Grid · Utility-scale Renewables · Generator · Distributed Renewables

MICROGRID CONTROLLER

MICROGRID CAN BE "ISLANDED" FROM THE UTILITY GRID

DISTRIBUTION FEEDER MICROGRID

Electric Vehicles · Energy Storage · Energy Consumers

THE DETAILS

NM SMART Grid Center YEAR 1 Sep 15, 2018–Aug 31, 2019

120
project participants

$7.9 MILLION
proposal funding awarded to
project participants

19
peer-reviewed papers
published or accepted

"Distribution Feeder Microgrids could enable us to retrofit existing utility infrastructure in a way that allows entire sections of a city 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 1, a major accomplishment was developing a model for day-ahead solar energy scheduling to inform microgrid design. Team members specializing in economics also developed and deployed a survey to measure consumers' willingness to participate in energy conservation or management programs.
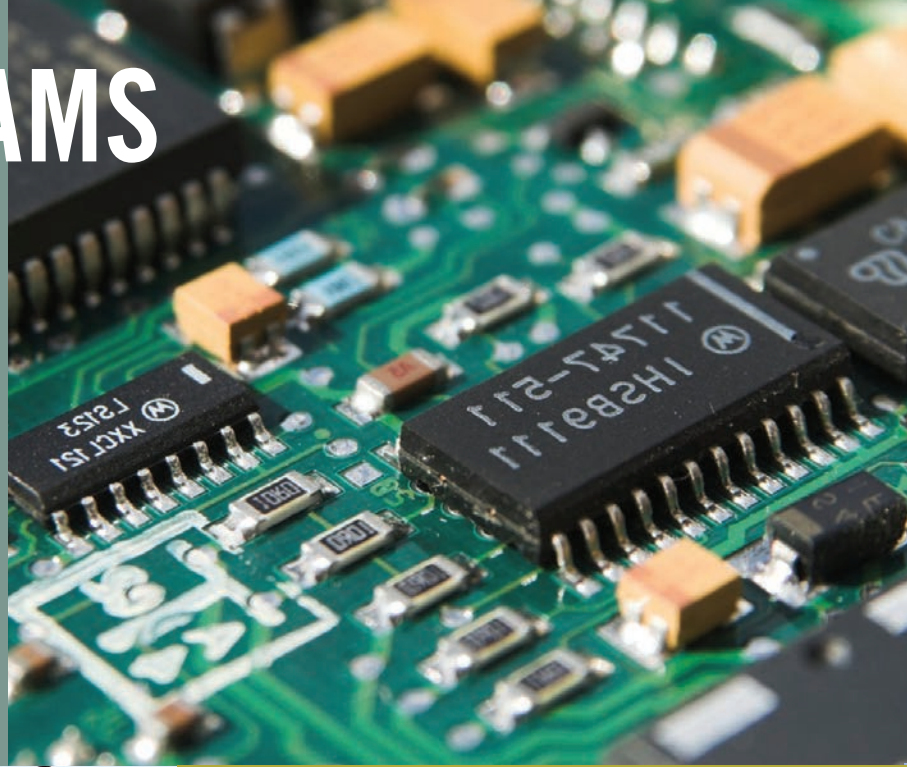
Networking Team

Smart grid technology depends on a massive amount of information exchange. Efficiency in these communications is paramount, and members of the Networking Team successfully designed a networking infrastructure capable of accommodating higher information demands of smart grid devices, while reducing data lag times. Research into user privacy and security is also underway with major advances expected in project Years 2 and 3.

Decision-Support Team

Like humans, computers are subject to information overload. Success for both lies in the ability to find and extract relevant information from a sea of noise. In their first year of collaboration, Decision-Support team members created game-changing computational algorithms that will better inform human and artificial intelligence-based operating decisions within smart grids.

Cyberinfrastructure

In Year 1, the Cyberinfrastructure Team assessed NM SMART Grid Center resource needs and purchased additional high-performance computing capabilities, including over 650 TB of storage. The supplementary storage will increase capacity while satisfying team members' computational demands. Technical training for project participants will begin once the new computing resources are installed. Team members also completed a digital preservation plan to guide information retention protocols for data generated from project activities.

Deployment Team

The primary focus of the Deployment Team is to test project developed models and simulations at actual test sites, or testbeds. In Year 1, Deployment Team members installed essential hardware and computing materials to be used for on-site hardware-in-loop (HIL) simulations at the Mesa del Sol testbed in Albuquerque. Upgrades to additional NM SMART Grid Center testbeds in Las Cruces and Santa Fe are planned in the years to come.

YEAR 1 RESEARCH HIGHLIGHTS

Decision-Support team members created algorithms able to forecast solar power generation on a minute-by-minute timescale. Previously established algorithms were limited to forecasting on hour intervals.

Named Data Networking (NDN) research conducted by Networking team members introduced an alternative Internet framework capable of handling smart device communications more effectively and efficiently.

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 1 to build New Mexico's human infrastructure.

1 SUPPORT WORKFORCE DEVELOPMENT

2 INCREASE DIVERSITY IN STEM

3 COMMUNICATE THE RESEARCH

Support Workforce Development

In Year 1, NM EPSCoR enabled the hiring of three university faculty, funded training for six Software/Data Carpentries instructors, and updated Santa Fe Community College (SFCC) AAS and AS degrees to include coursework related to microgrids and smart grids. Additionally, in June 2019 two **Infrastructure Seed Award Proposals** were awarded $50K each to explore next-generation mobile networks and lightning disruption, as they relate to smart grid technologies.

Increase Diversity in STEM

Research shows diverse teams perform better. NM EPSCoR Workforce Development activities **target groups under-represented in STEM**. For example, Carpentries instructors held four workshops reaching 85 participants. Of those students, 42% were from an under-represented minority group, and 45% were female. Mentors are also key to attracting and retaining diverse students. In Year 1, Drs. David Mitchell and Satyajayant (Jay) Misra were awarded the NM EPSCoR **Excellence in Mentoring Award** by mentees, who cited their career guidance and devotion to inclusion.

Communicate the Research

This year our outreach partner Explora hosted the 2019 New Mexico Science Fiesta, a family science event attended by nearly 4,000 people, and a Teen Science night that attracted more than 550 teens who explored exhibits and chatted with NM SMART Grid Center team members. In addition, our **New Mexico Academy of Science Research Symposium** was held in October 2018 and over 60 researchers presented to 110 attendees from 15 institutions from across the state.

A.Carr/Explora

NM EPSCOR STATE OFFICE

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