Energy-Water Nexus for Meeting the Clean Energy Needs of the Future

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February 24, 2023

College of Engineering Office of Engineering Research

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New Mexico State University

Context

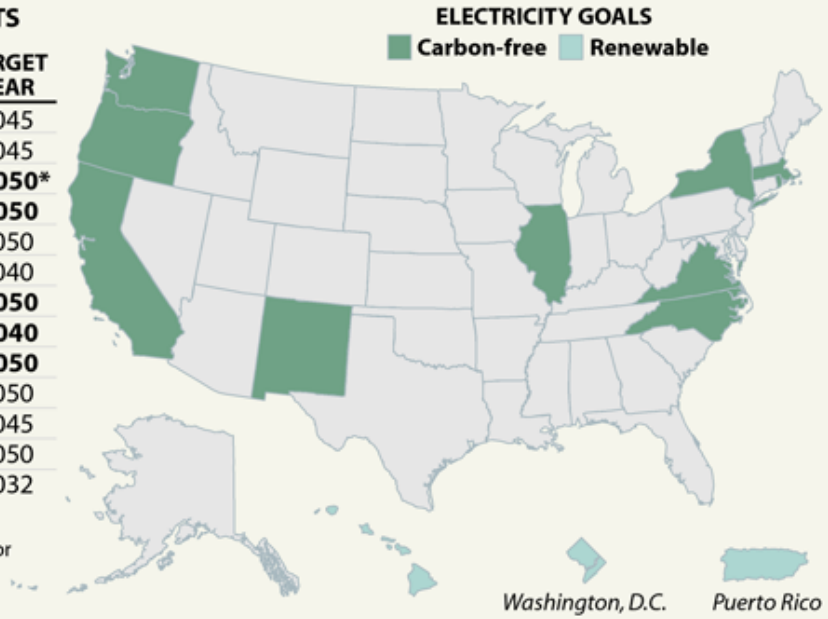
Expanding the '100 Percent' Club

Five states passed laws in 2021 that require a shift to 100 percent carbon-free electricity or net-zero emissions by mid-century. With the new additions, 11 states have these far-reaching climate laws, not including states that have set goals rather than requirements—like Maine and Nevada—and states that have taken action through executive orders rather than laws.

100 PERCENT REQUIREMENTS

	YEAR PASSED	TARGET YEAR
California	2018	2045
Hawaii	2015	2045
Illinois	**2021**	**2050***
Massachusetts	**2021**	**2050**
New Mexico	2019	2050
New York	2019	2040
North Carolina	**2021**	**2050**
Oregon	**2021**	**2040**
Rhode Island	**2021**	**2050**
Virginia	2020	2050
Washington	2019	2045
Puerto Rico	2019	2050
Washington, D.C.	2019	2032

*Illinois' law has a target year of 2045 for major energy provisions, but also lists 2050 as the final target year.



SOURCES: Advanced Energy Economy; NRDC; ICN research

PAUL HORN / Inside Climate News

President Biden's Actions to Tackle the Climate Crisis

President Biden campaigned on a bold vision of tackling the climate crisis with the urgency that science demands, by building a clean energy economy that benefits all Americans—with lower costs for families, good-paying jobs for workers, and healthier air and cleaner water for communities.

Since Day One, President Biden has delivered. After rejoining the Paris Agreement and restoring U.S. leadership on the world stage, President Biden created the first-ever National Climate Task Force, with more than 25 Cabinet-level leaders from across agencies working together on groundbreaking goals:

- Reducing U.S. greenhouse gas emissions 50-52% below 2005 levels in 2030
- Reaching 100% carbon pollution-free electricity by 2035
- Achieving a net-zero emissions economy by 2050
- Delivering 40% of the benefits from federal investments in climate and clean energy to disadvantaged communities

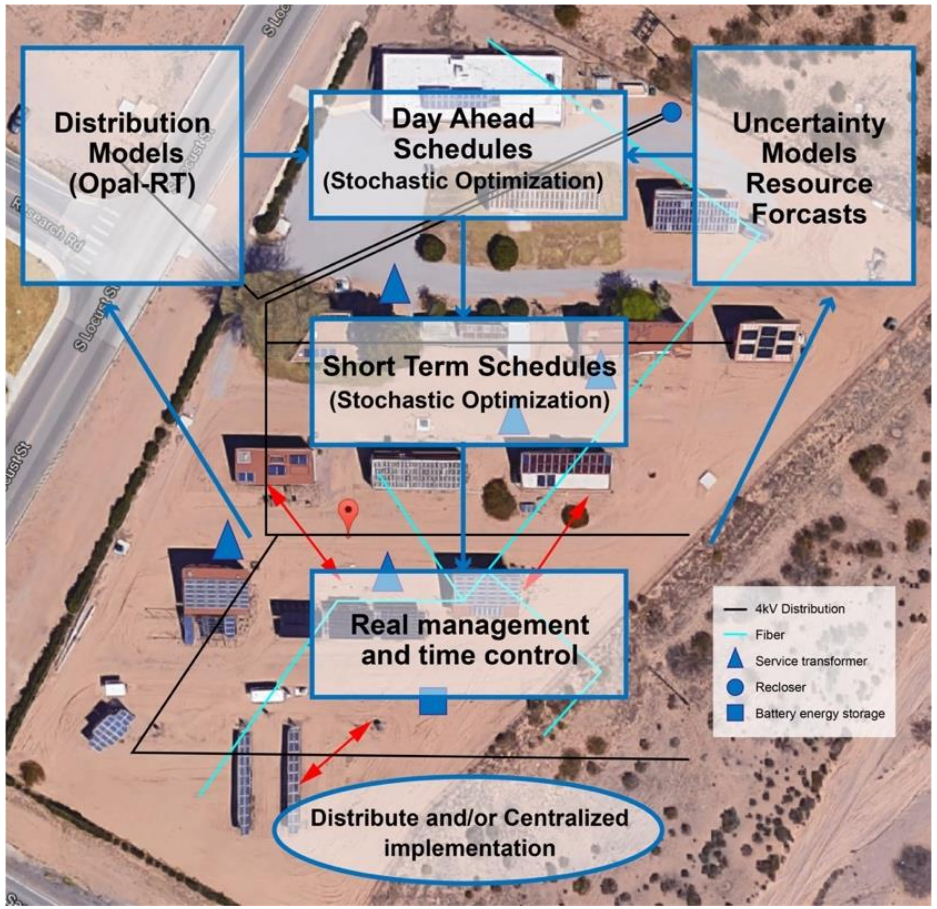
History

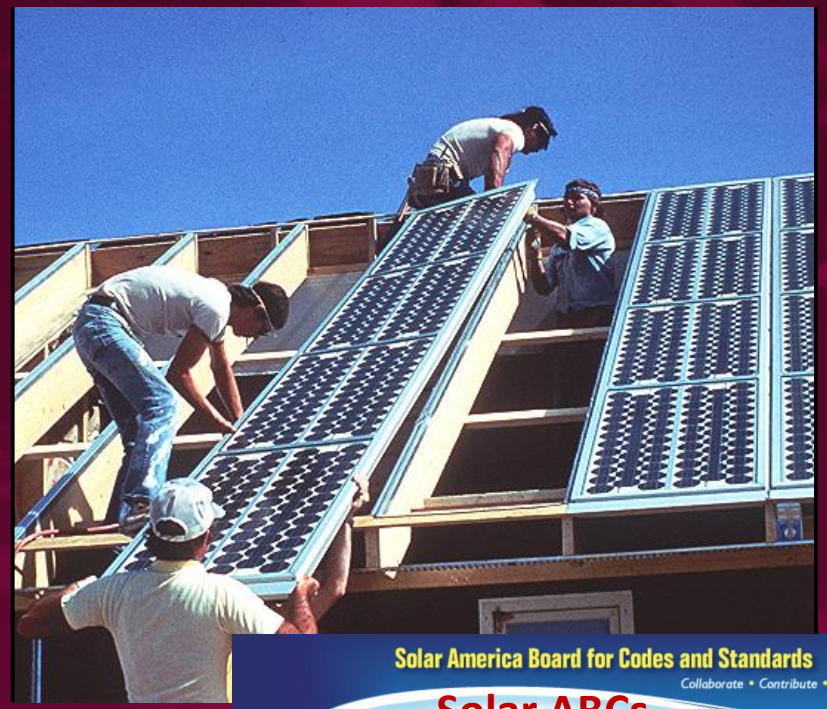
- Established early 1980's by U.S. Department of Energy
  - One of five experimental residential centers.
    - Southwest Regional Experiment Station (SWRES) (New Mexico); Southeastern Regional Experiment Station (SERES) (Florida); Northeastern University, …
- Southwest Regional Experiment Station (SWRES)
  - 3-acre testing and evaluation facility
- SWRES Mission: Provide technical engineering in support of safe, reliable photovoltaics to:
  - U.S. DoE Photovoltaic Program
  - Photovoltaic Industry
  - Designers, Installers, Inspectors, and Users of Systems

Southwest Regional Experiment Station

SouthWest Technology Development Institute - SWTDI

- Original 1978 DOE PV Program
  - Residential PV Demo
  - 4 kV distribution network
  - PV and Storage
  - Can be islanded
  - ‘Real’ Testbed for future distribution

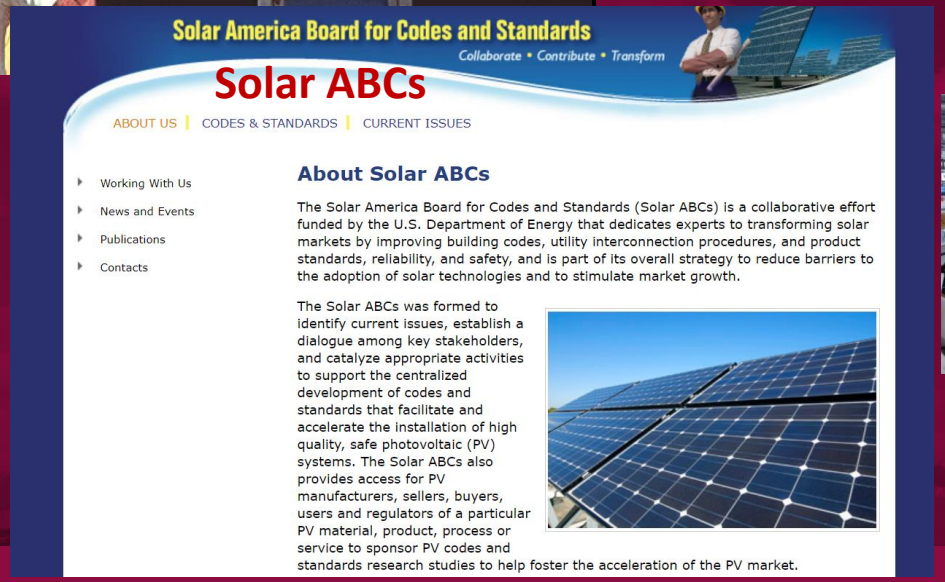




Codes and Standards are essential to Safety

Funded by USDOE, SWRES led the US and Worldwide coordination of Codes and Standards for worldwide Photovoltaic installations.

- PV array testing
- System Acceptance testing
- Proprietary testing – PV modules, inverters, storage systems.



John Wiles participated as author for the PV section of the National electric code. Made presentation on PV and the NEC to over 8000+ individuals over 20 years.

Workforce Development and Outreach

Students and Staff installing panels at the NMSU Health Center.

(Carrying the long edge of the panel is then Director, Andy Rosenthal)

At its peak SWRES employed 10 professionals and as many as 15 students/year.

- Many solar professionals in NM cut their ‘solar’ teeth at SWRES
- 5 companies
- Numerous graduates in leadership positions at National Laboratories and industry
- Each year SWRES assisted 5- 10 organizations with the installation and monitoring of PV systems and provided training in the US and Latin America

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Leveraged SWTDI Facility - Selected
(2013 – present)

- **CREST: Interdisciplinary Center for Research Excellence in Design of Intelligent Technologies for Smartgrids Phases I & II**
  - *Collaborative research to explore transformations of existing electricity distribution infrastructures into interconnected intelligent microgrids*
    - *2014 onwards - Award from the National Science Foundation, $10.0M*

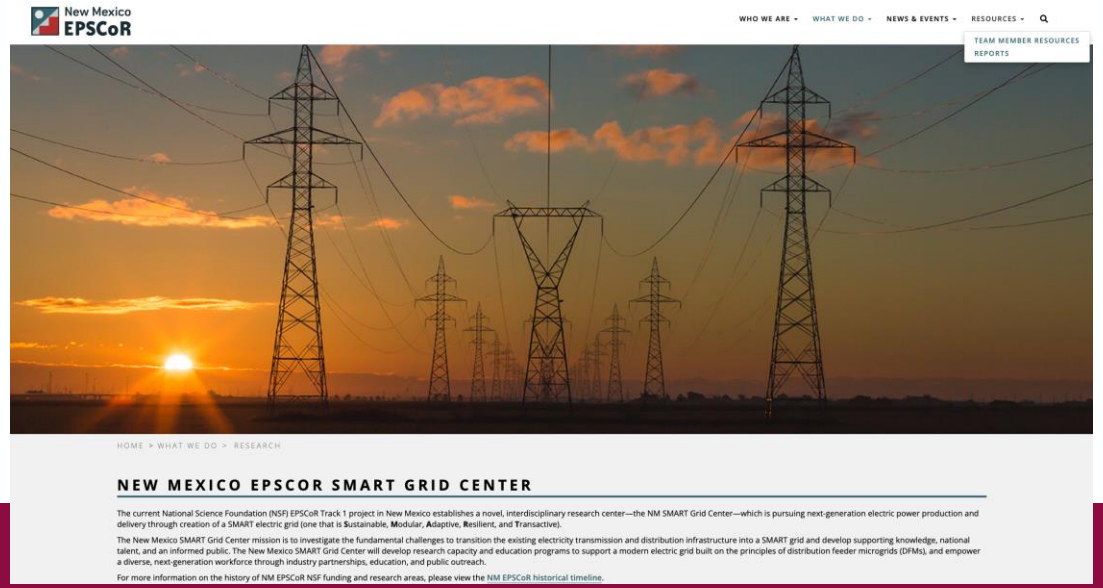
Co-Directors: Enrico Pontelli & Satish Ranade

- **New Mexico EPSCOR Smart Grid Research Center (SMART)**

2018 - Award from the

National Science Foundation, $24.0M

Statewide effort



Rebranding and Moving to the upgraded IDEAL facility

IDEAL: Integrated Digital Enterprise Accelerator Lab

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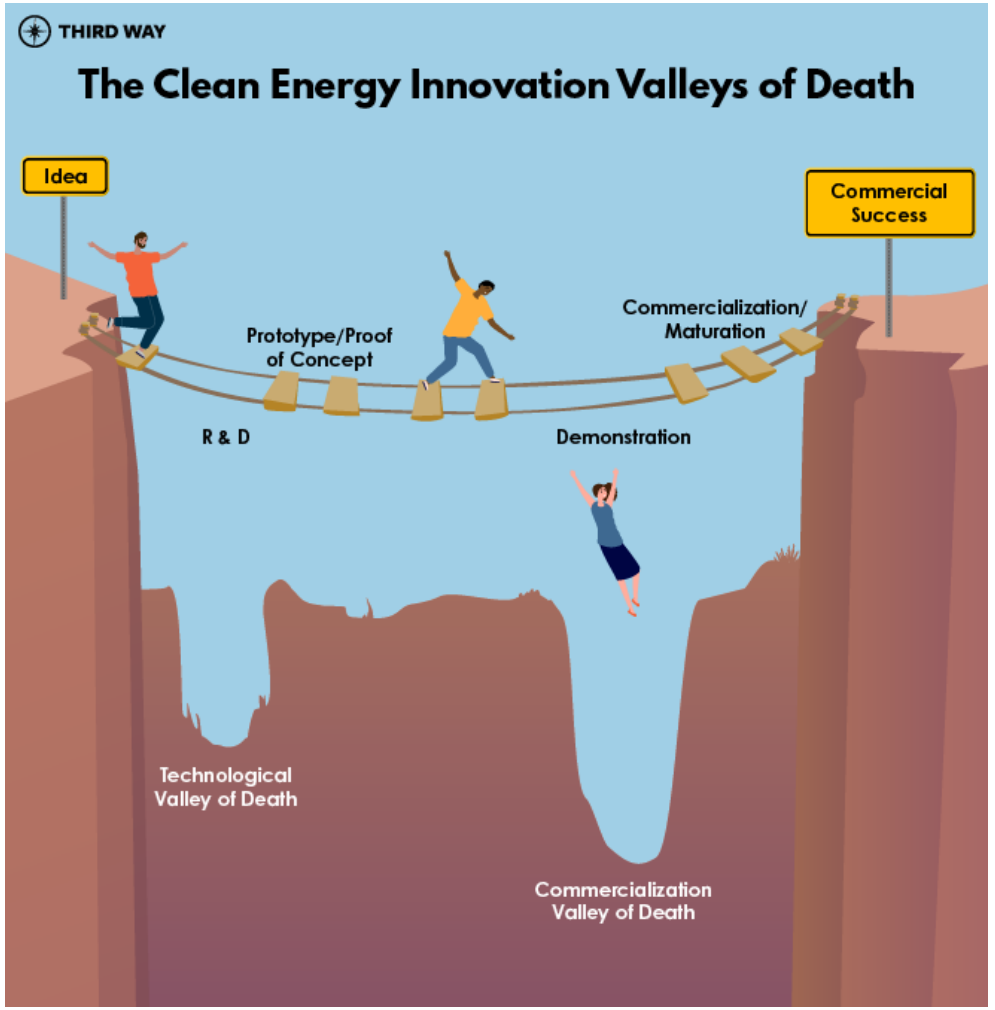
U.S. Lacks Large-scale High-value Demonstration Sites

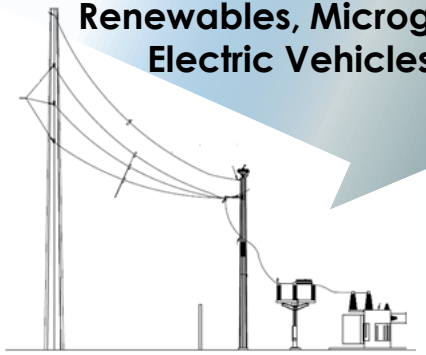
- Limits technology commercialization and validation at scale
- Economic and regulatory structures are not aligned
- Technologies often *inapplicable* to rural and dispersed environments (including military installations)
- Demonstration sites need to blend tech-to-market with resiliency & ability to mitigate disaster & threat risks.



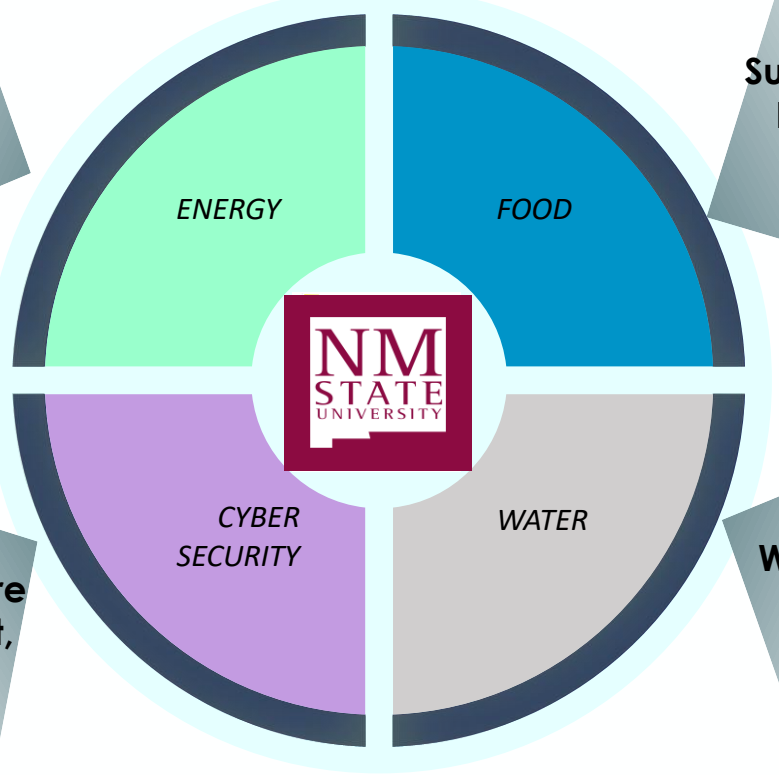
IDEAL:

Integrated Digitally-networked Enterprise Accelerator Laboratories

Grid Modernization, Renewables, Microgrids, Electric Vehicles

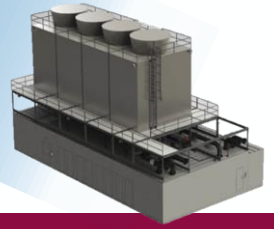


Sustainable, Energy Efficient, Indoor Food Production



Hardware/Software Security and Trust, Digital Forensics

Water Desalination and Treatment



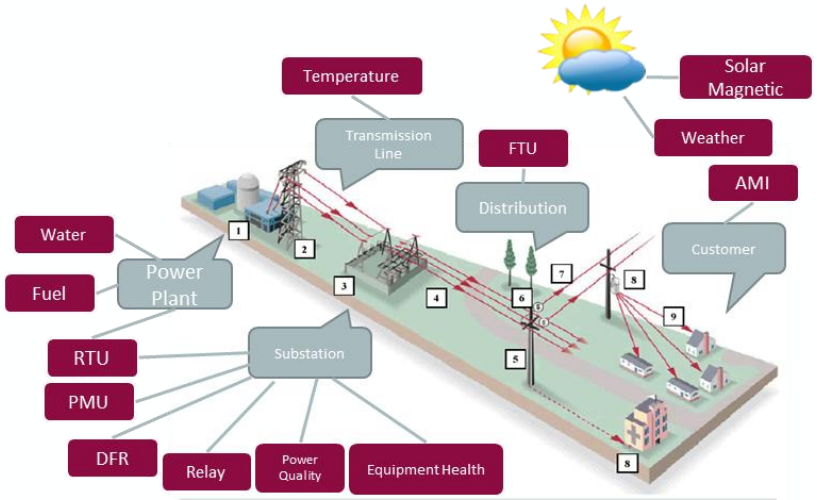
Microgrids and Electrification: What are the Opportunities?

- Jobs ! Jobs ! Jobs !
- Meeting ETA requirements
- Better quality of life for consumers

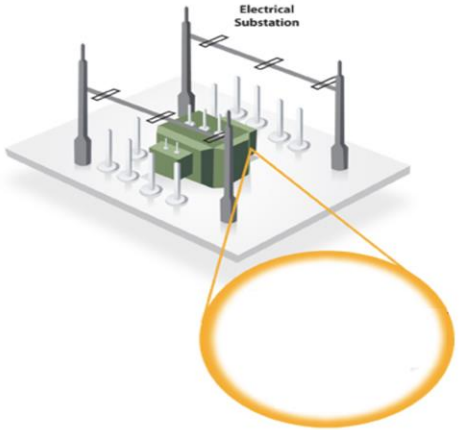
What areas are needed?

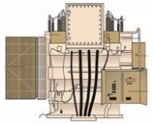
- Electrical Engineering
- Communications and Networking
- Cybersecurity, Computer Science
- Markets, Economics, Insurance
- Customer Service, Field Service

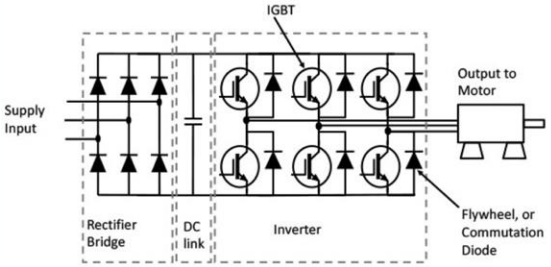
What will we do at IDEAL:



Modified from Duke Energy
https://www.progress-energy.com/florida/home/safety-information/storm-safety-tips/restoration.page?



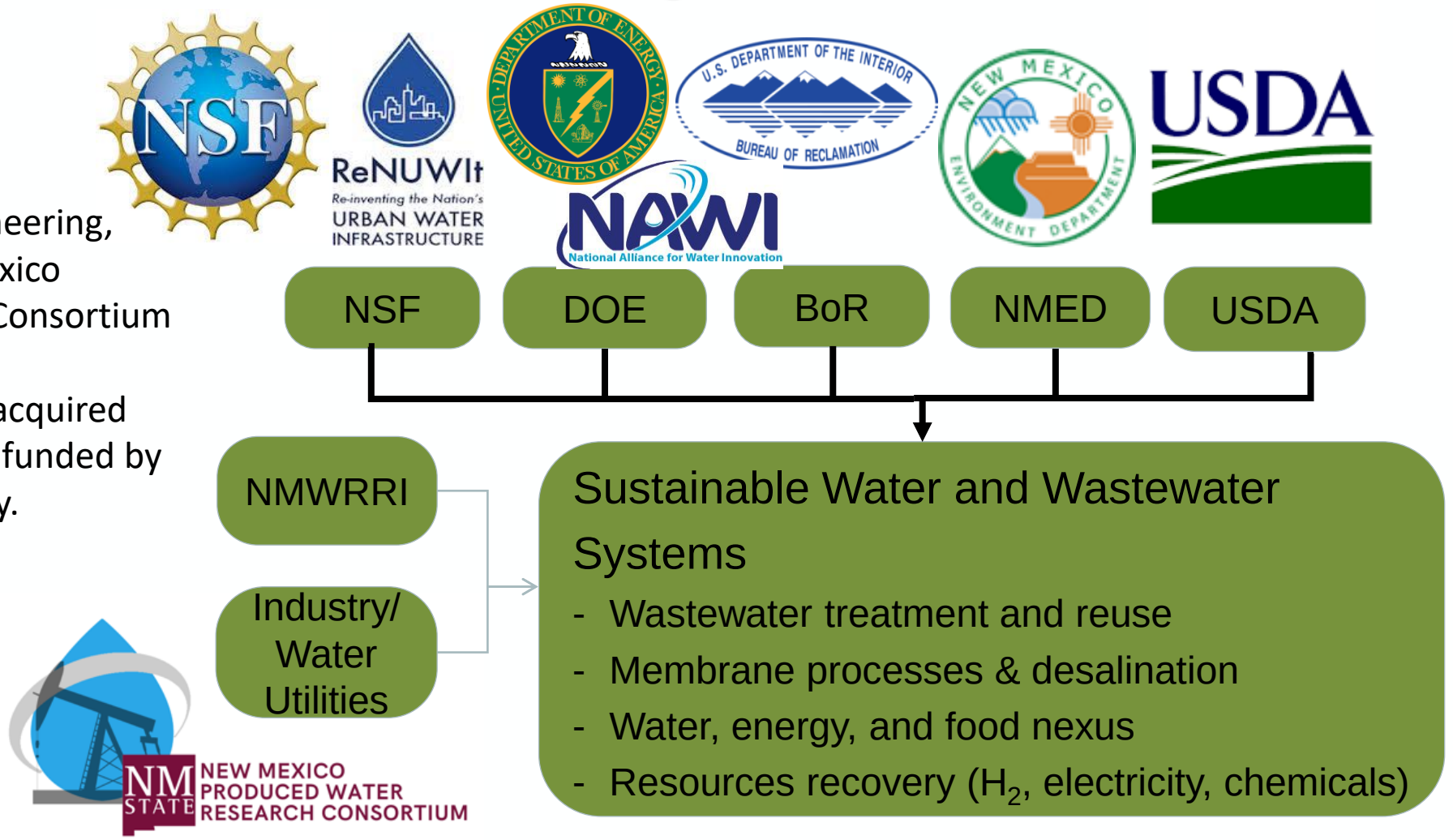




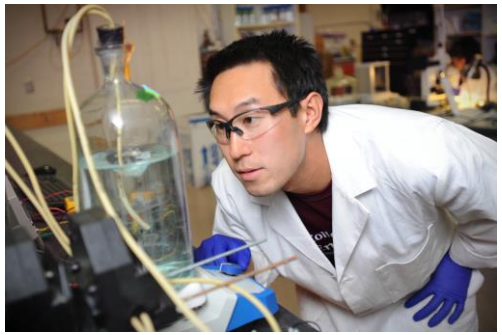
Funded Research Programs – Pei Xu

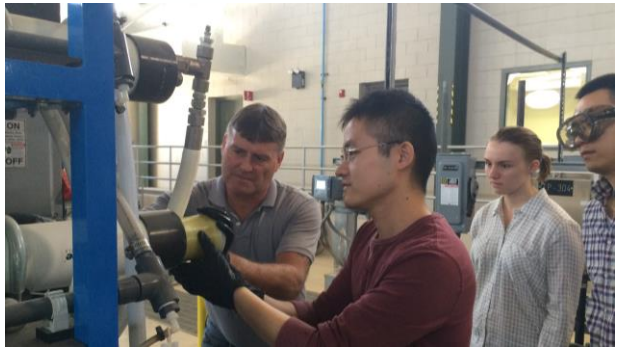
Professor Pei Xu, Civil Engineering, Research Director, New Mexico Produced Water Research Consortium

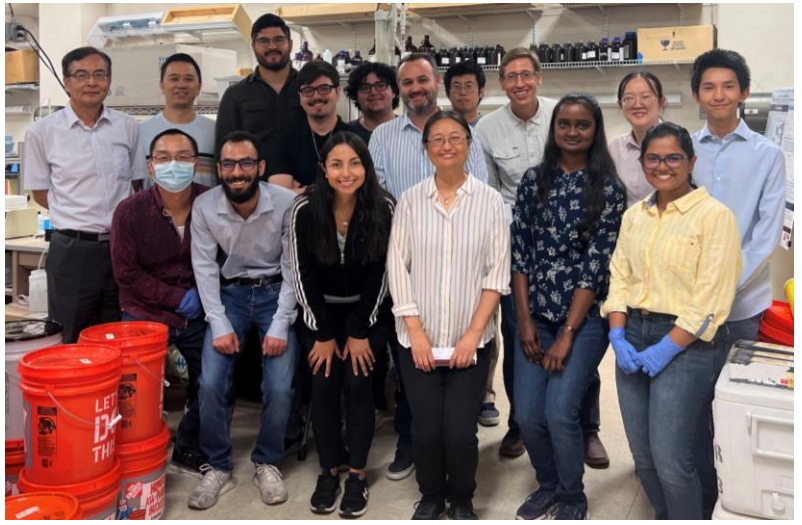
As PI and Co-PI, Dr. Xu has acquired over $20M research grants funded by NSF, DOE, BoR, and industry.



From Fundamental Laboratory Study to Field Demonstration Testing

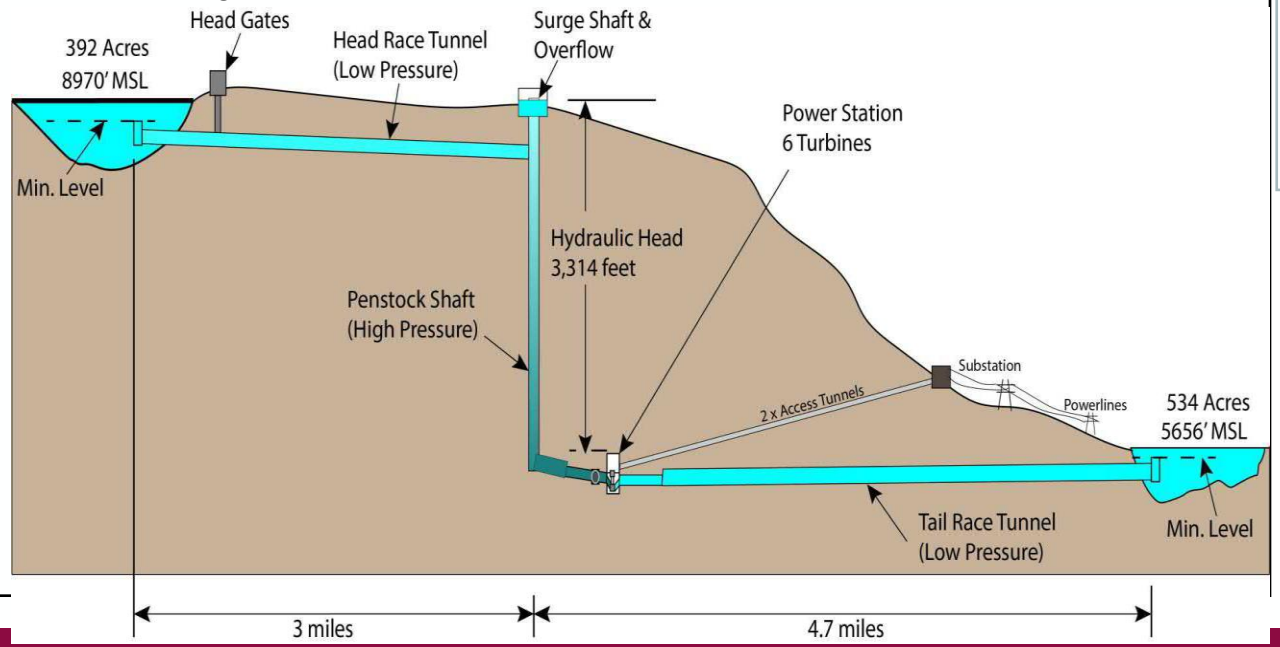






Carrizo Pumped Storage Hydropower: Seasonal Storage for Fully Decarbonized Grids

The Carrizo Four Corners Pumped Storage Hydro Center Project (“Carrizo” or “Project”) will be the largest seasonal duration energy storage facility in the U.S. when completed with 1,500 MW nameplate,70 hours of duration, and over 103,000 MWh net energy storage capacity. The Project is located entirely on Navajo Nation lands in the Four Corners area and extends across the N.M./AZ border. It will become a key regional resource for the southwest to implement reliable and low-cost highly decarbonized grids.

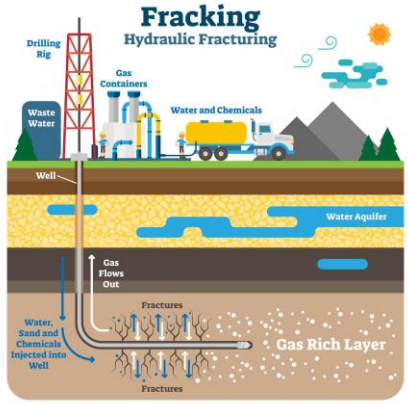


Profs. Fengyu Wang, Di Shi, Olga Lavrova, Jay Misra

- ❖ Geotechnical, tunneling, and excavation planning
- ❖ Environmental permitting studies and hydrodynamic studies
- ❖ Transmission feasibility and wheeling studies

Potential DOE Project

Make NMSU a driver in innovation and integration for our



OCED NEWS

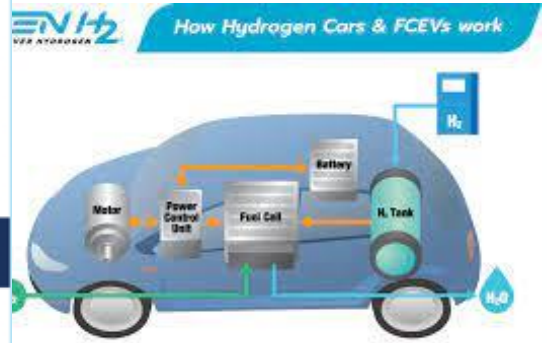
February 23, 2023

DOE Announces $2.5 Billion to Cut Emissions and Deliver Economic Benefits to Communities Across the Nation

Scaling Carbon Capture Technologies Will Boost Job Creation, Reduce Harmful Pollution, and Strengthen American Energy and Economic Security

WASHINGTON, D.C. — The Biden-Harris Administration, through the U.S. Department of Energy (DOE), today announced $2.52 billion in funding for two carbon management programs to catalyze investments in transformative carbon capture systems and carbon transport and storage technologies. Funded by President Biden's Bipartisan Infrastructure Law, the two programs—Carbon Capture Large-Scale Pilots and Carbon Capture Demonstration Projects Program—aim to significantly reduce carbon dioxide (CO_2) emissions from electricity generation and hard-to-abate industrial operations, an effort critical to addressing the climate crisis and meeting the President's goal of a net-zero emissions economy by 2050.

The new programs will help accelerate the demonstration and deployment of carbon management technologies, supporting the Biden-Harris Administration's efforts to create good-paying manufacturing jobs, reduce pollution to deliver healthier communities, and reinforce America's global competitiveness in the clean energy technologies of the future.



rgy in the four corners
M; NM as a hydrogen

THANK YOU !
Recent investment in
Clean Energy and Grid Modernization