THE PETROLEUM RECOVERY RESEARCH CENTER

NEW MEXICO INSTITUTE OF MINING AND TECHNOLOGY

ROBERT BALCH - DIRECTOR

JENNIFER RANEY – DEPUTY DIRECTOR

AUGUST 3, 2026

What Is the Impact of the PRRC?

Created by New Mexico Statute: NMSA 1978, Article 9 as a division of New Mexico Tech: Primary Duty: "to engage in theoretical and practical research into the recovery of petroleum and other energy resources"

Primary Focus today is: ***Produced Water and Sustainability***
Traditional hydrocarbon research
Other Energy – Geothermal and Nuclear
Carbon Management and Critical Minerals

The PRRC has Impact

Jobs: PRRC currently contributes to 106 jobs in the state including 35 staff, 13 supported Faculty at NMT and 58 Students funded on research projects in FY26

To the State: Funded research supports entities across the state with a 5-year average budget of $ **$11,950,255** per year including funds allotted to partner universities, national labs, and companies in the state. The PRRC's research portfolio* has projects positively impacting both San Juan and Permian basin communities. PRRC Researchers enjoy a high profile in a wide range of research areas

University Support: The PRRC supports the university and contributed an average of $ **$2,692,872** per year over the last 5 years to NMT including: overhead and direct support and student contracts and faculty Support. We actively train students for careers in sustainable energy development.

Petroleum Recovery Research Center Economics

PRRC Metrics FY26

- Research portfolio of **$134,466,422**
- 35 Active projects including:
  - Industry Projects
  - Critical Minerals
  - Geothermal
  - Produced Water Cleanup
- Actively engage with companies
- Active partner's with the states research universities and National Labs
- Average Annual Expenditures of $11,950,255
- Over 250 Papers, Reports, and Presentations FY 25
- High ROI, about $5 external Dollars spent for every $1 of State funds

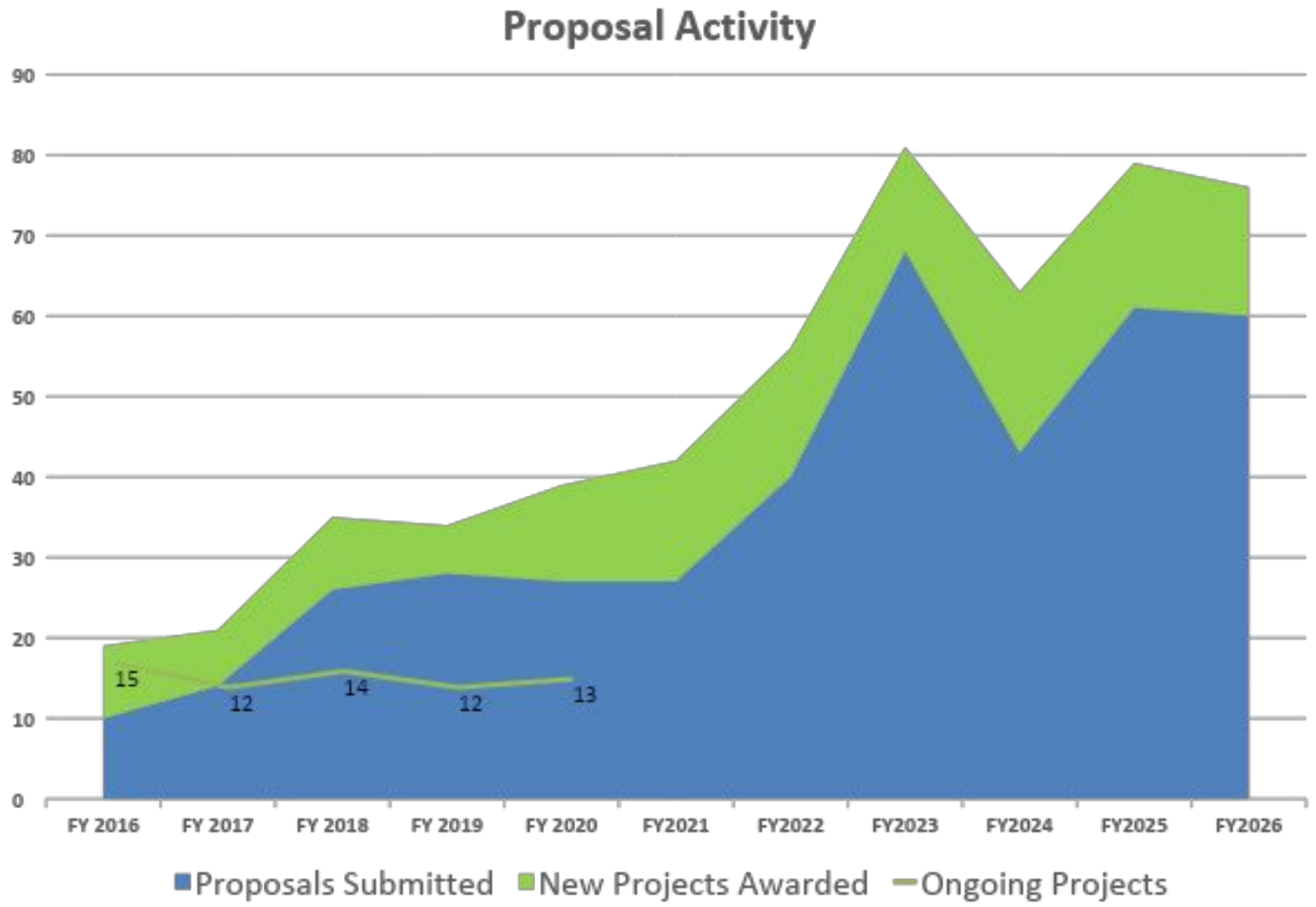
PRRC Supports NMT - FY 26

Total Support to NMT of
$6,591,989.39

- $2,848,640 in direct support (Overhead, Institutional Support fees, Students, Faculty)
- Other support - staff salaries and fringe of $3,743,349.39

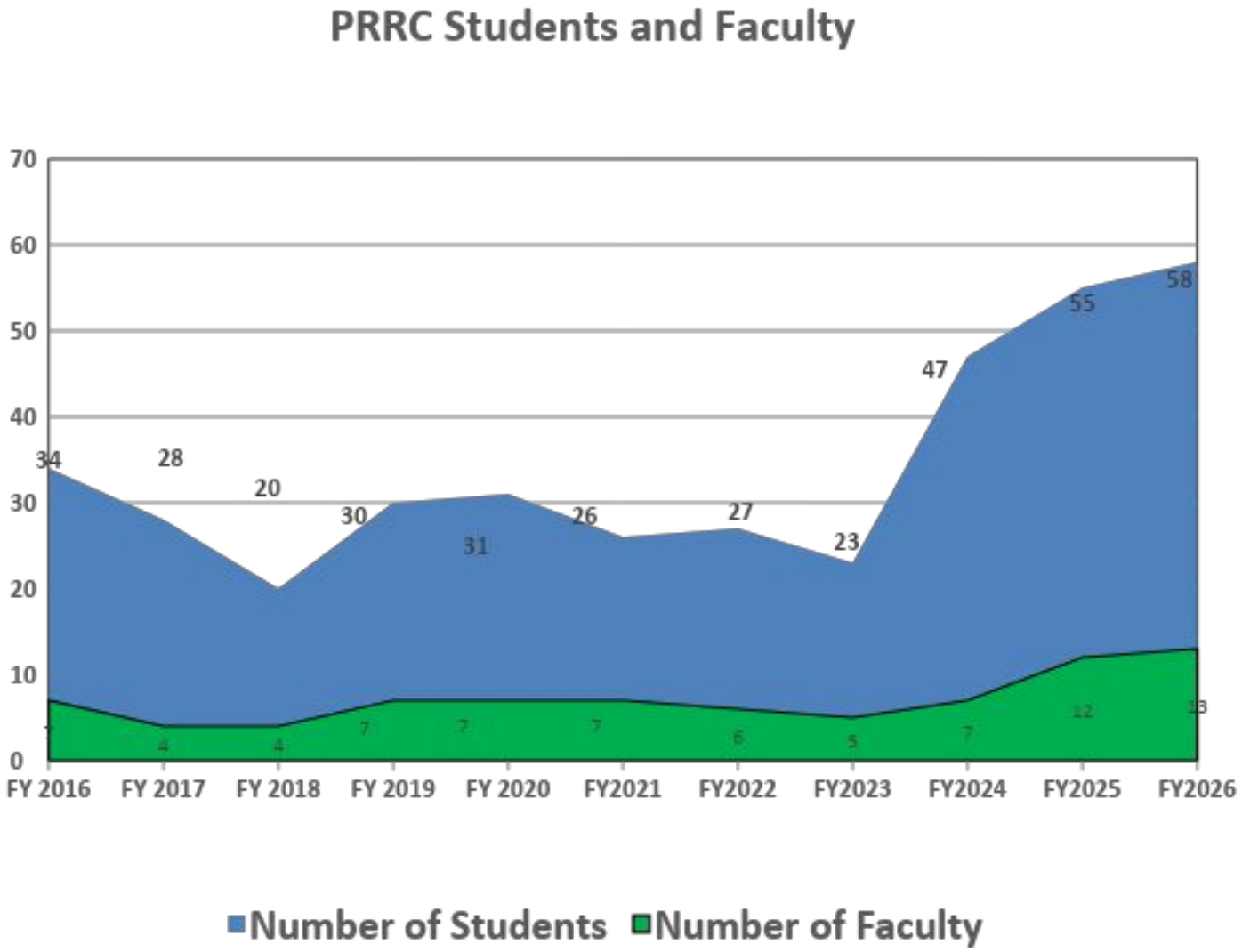
Direct Institutional Support FY26	
Overhead	$ 1,059,379
Students	$ 1,037,109
Faculty	$ 506,707
Institutional Support Fund	$ 100,000
Physical Plant	$ 100,000
ISD	$ 39,967
OnePetro	$ 5,477
Total	$ 2,848,640
* Fixed Costs - $245,444 / year	

Proposal Activity has increased



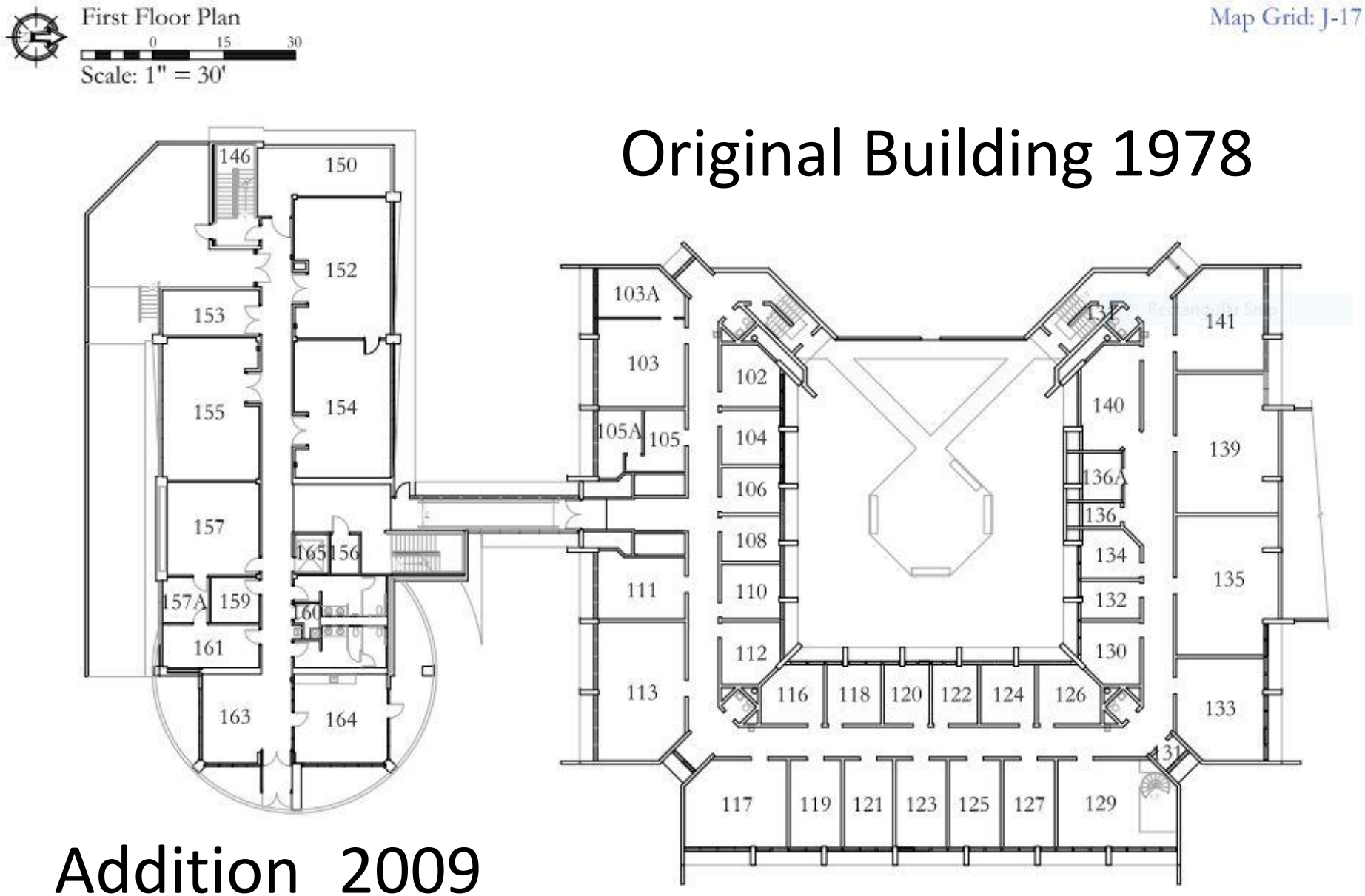
Fiscal Year	Won Awards	Value $million
2016	9	0.5
2017	7	0.7
2018	9	1.9
2019	**6**	**19.3**
2020	**12**	**21.8**
2021	**15**	**18.1**
2022	**16**	**9.3**
2023	**13**	**7.5**
2024	**20**	**69.5**
2025*	**18**	**22.1**
2026	**16**	**3.2**

PRRC Student and Faculty support



- Support an average of **42** students per year over last five years
- Provide summer salary to an average of **9** faculty per year over last five years
- Students and faculty from many departments/Divisions on campus, including:
  - Petroleum Engineering
  - Chemical Engineering
  - Materials Engineering
  - Electrical Engineering
  - Civil and Environmental Engineering
  - Earth and Environmental Science
  - Chemistry
  - Computer Science
  - Engineering Management
  - Math
  - Physics
  - Mineral Engineering

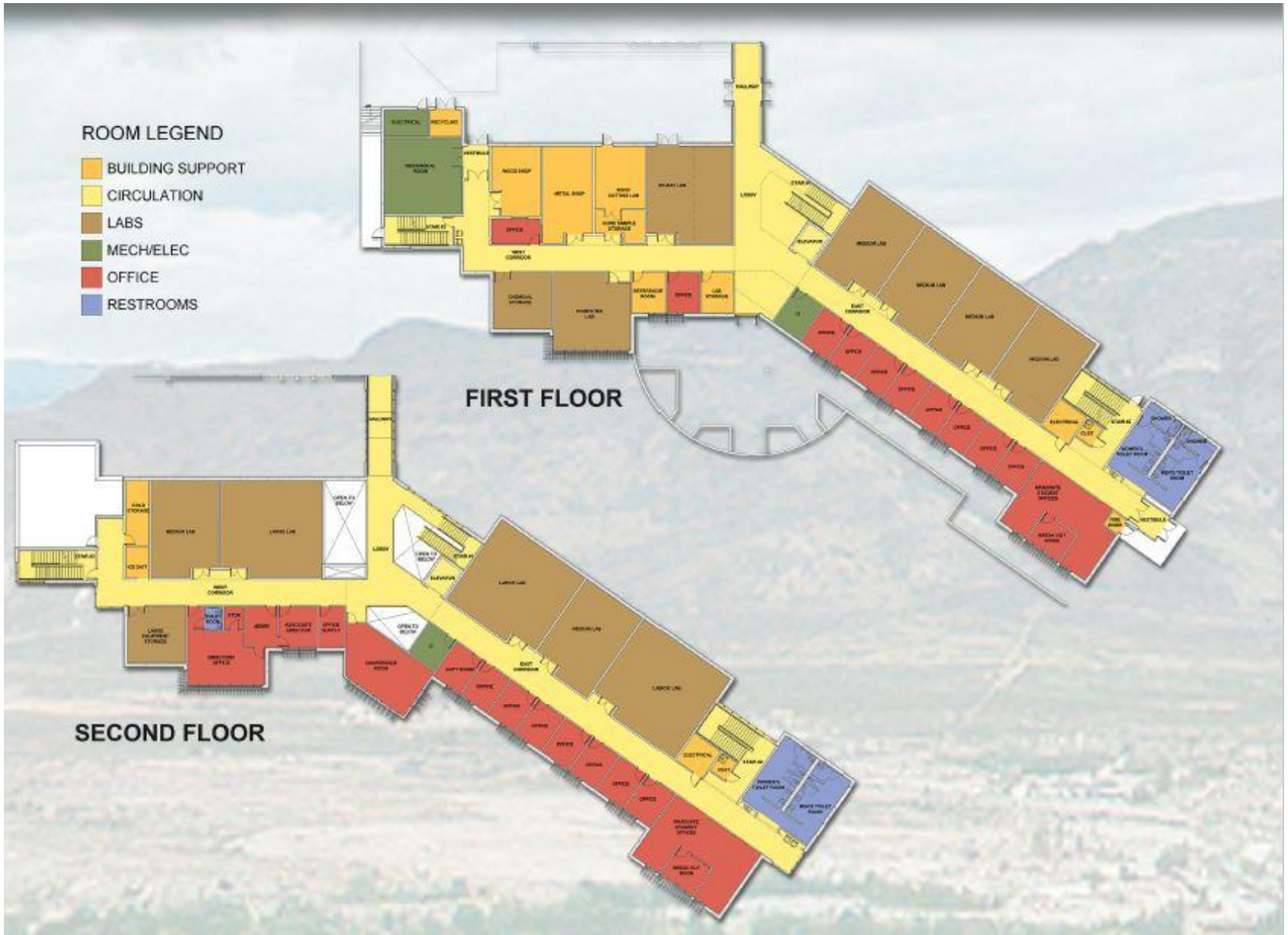
Kelly Hall Today



Current Totals

- 20 Labs
- 30 Offices
- 3 Shops
  - Machine
  - Woodworking
  - Core Prep
- Chemical Storage
- Library
- 2 Conference rooms
- Classroom
- Computer Lab
- Server Room

New Building – Completion Fall 2026



Facilities

- 10 Labs
  - 1 High Bay
- 29 Offices
- 2 Student areas
  - Communal
  - Breakout rooms
- 3 Shops
  - Machine
  - Woodworking
  - Core Prep
- Chemical Storage
- 2 Conference rooms
- Computer Lab
- Server Room

New PRRC Footprint

Notes on the New Facility

- Smaller footprint
- More efficient layout
- Fewer but larger/more flexible labs
- Communal Student Spaces
- Aging facilities in Kelly
  - >50% working fume hoods
  - HVAC issues/mismatch
  - Plumbing issues
  - Inadequate Electrical

Research Group Capabilities

Petrophysics and Surface Chemistry

Research Chemist: Dr. Sai Wang

- Focuses on surface and interfacial properties of crude oils
- wettability alteration
- crude oil/brine/rock interactions
- the stability of asphaltenes

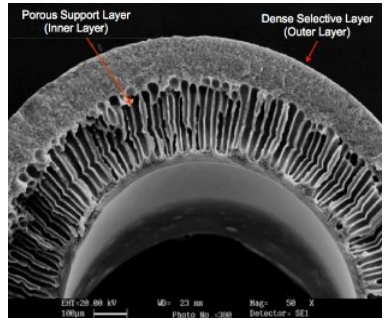
Capabilities

- Asphaltene-Instability-Trend (ASIST) Predictions
- Asphaltene Deposition Tests
- Wettability Measurements
- Crude Oil analyses:
  - Refractive index, density
  - Viscosity as a fuction of temperature
  - Compositional analyses
- Water Analyses
  - pH, conductivity, alkalinity, major ions, TOC

Produced Water and Petroleum Engineering

Research Scientist: Dr. Jianjia Yu

- Pursues advanced methods in membrane technology for produced water treatment.
- hollow fiber membranes using a two-stage nanofiltration process.



Capabilities

- Analysis of porous media
  - Porosity
  - Surface area
- Nanoparticle generation and quantification
- Organic composition analysis
- Hollow fiber membrane fabrication
- Gas chromatograph
- TOC analysis
- Bench and pilot scale testing

Research Group Capabilities

Reservoir Sweep Improvement Group

Section Head: Dr. Randall Seright

Develop methods to prevent fluid channeling through reservoirs and to reduce excess water and gas production during oil recovery

Polymer Flooding

- Polymer rheology in viscometers and in porous media over a very wide range of concentrations, salinities, and shear rates/velocities
- Tests in porous media with permeability from 1 to 15000 md, in all wettabilities,

Gel Treatments

- Excess water production problems, especially those involving fractures.
- Placement and sizing procedures for gel treatments.
- Laboratory studies extensively characterizing the flow properties of gels in fractures and porous media

Gas Flooding Processes and Flow Heterogeneities

Section Head: Dr. Sai Wang

The Gas Flooding and Flow Heterogeneities Group pursues CO_2 and EOR related research

- Carbon sequestration or storage in geologic formation, focusing on oil, gas, coal-bed and water aquifer formation.
- Improving conformance control and sweep efficiency in CO_2 flooding.
- Understanding and managing injectivity changes associated with water alternating with gas injection (WAG).
- Improving the modeling capability of CO_2 foam-enhancing processes and WAG injection.

Research Group Capabilities

Reservoir Evaluation/Advanced Computational Technologies (REACT)

Section Head: Dr. William Ampomah

- Reservoir characterization studies utilizing data at all scales, to support reservoir simulation models
- Field and regional scale geologic modeling using well and seismic data

Capabilities

- Reservoir characterization
- Construction of geologic models
- Reservoir simulation
- Enhanced oil recovery project planning
- Regulatory impacts on site planning
- Produced water management
- Development of computer and web application software and hardware

Alkali Surfactant Polymers (ASP)

Research Scientist: Dr. Guoyin Zhang

Surfactant Flooding

- Develop and formulate high-efficiency surfactants for ASP flooding and SP flooding
- Develop novel surfactant formulations that can be used in low pH environments, such as CO_2 floods
- Develop uses of chemical EOR for soil remediation.

Lab Analyses

- Interfacial tension measurement.
- Fluid rheology measurement in a viscometer and in porous media.
- Surfactant/oil/brine phase behavior tests.
- Chemical retention in porous media.
- Evaluation of oil recovery efficiency by coreflooding.

Research Group Capabilities

Outreach and Engagement

Section Head: Jennifer Raney

- Go-Tech - Oil and gas production, price, and well activity, provided in a quick, accurate, and easy-to-use format. **15 million page views in FY 25.**
- Water quality data for ~9,400 oil and gas wells in NM, water volume data for over 75,000 wells

Capabilities

- Outreach and Public engagement
  - Work with Legislators, Tribes, Communities
- Student involvement and industry connections
- Provide site-specific information to leaders
- Present basic PRRC research in lay terms
- Identify and engage with affected communities
- Engage with Native American Tribal leaders
- Mapping and data analysis

Industry Services

Section Head: Khadir El-Kaseeh

- Provide support to industry partners and engage with companies on projects of all durations
- Provide regulatory support to operators seeking permits

Capabilities

- Build teams from within PRRC to rapidly respond to projects sought by industry partners
- Serve as a liaison with companies and service companies on a daily basis
- Seek opportunities in private sector
- Support other research groups with staff expertise in:
  - Seismic processing and interpretation
  - Simulation and geologic modeling
  - Permits and regulatory issues

Active Research Portfolio

Large Active Research portfolio (FY 26 including cost share/partners)

- **35** active projects in:
  - Produced Water
  - Enhanced Oil Recovery (CO_2, Polymers, Alkaline surfactants)
  - Industry Funded Work
  - Geothermal
  - Critical Minerals
  - Federal Priorities
- Projects span all research areas at the PRRC and include projects for US Federal Government, State of New Mexico and many private companies
- Partners include Universities, National Labs, Geologic Surveys, and Private Companies

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FY 2026 Successful Federal Proposals

16 Successful Proposals and Acquired Funding FY 2026 ($3.3 million)

Agency	Program	Project Title	PI	Funding Request	Acquired Date
Arpa-E	Federal	Adsorptive Vacuum Membrane Distillation for Simultaneous Extraction of Magnesium, Lithium and Ammonia from Produced Water	Jianjia Yu	$ -	2025/07
Arpa-E	Federal	Selective Extraction of Magnesium, Ammonia and Lithium from Produced Water (SE-MALi)	Jianjia Yu	$ -	2025/07
TEF Engine development funds	State	NSF Engines: San Juan-Rio Grande Energized Watershed Engine	Lique Coolen/Jianjia Yu	$ 52,937	2025/07
SNL	Federal	Leaching while fracking for ore bodies using supercritical CO2 foam with chelator functionalized nanoparticles	Robert Balch	$ 189,000	2025/07
EMNRD	State	Data for the Energy Transition, Economy, Climate Change, and Technologies (DETECT)/Comprehensive Energy Transition Strategy (CETS) Phases II and III	Jean-Lucien Fonquergne	$ 499,999	2025/12
NMED	State	Extraction of high-purity water and lithium from brackish water via integrated membrane processes	Jianjia Yu	$ 1,580,762	2025/12

6 Federal Proposals funded for a total of $2,322,698

- **Not including $17 million in** reinstated federal projects
- **No DOE awards in 2026** while federal program was under review

10 Industry Proposals funded for a total of $951,852 (next slide)

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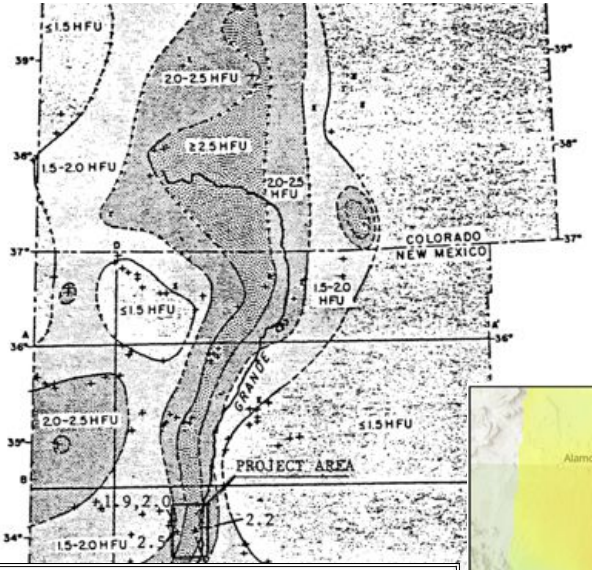
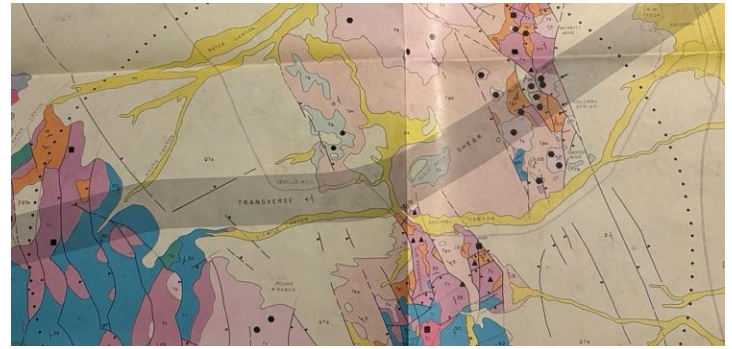
FY 2026 Successful Industry Proposals

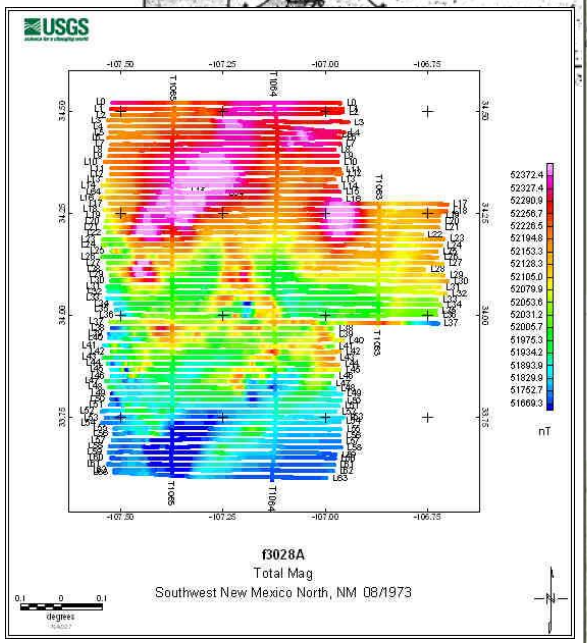
Targa	**Industry**	**Additional Reservoir Simulation to Support increased Injection Volume Bull Moose AGI #001 Well in Texas**	**George El-kaseeh**	**$ 20,000**	**2025/08**
Chevron	Industry	Laboratory Evaluation of Asphaltene Deposition (LEAD) in Tubing Systems	Sai Wang	$ 82,000	2025/09
Targa	Industry	Feasibility Analysis to Assess Interference that could be Introduced by Injection in the Bottom of the Cherry Canyon formation in Red Hills Site, AGI #002	George El-kaseeh	$ 50,000	2025/09
Targa	Industry	Copperhead AGI#2 MRV	George El-kaseeh	$ 90,000	2025/12
Targa	Industry	Bull Moose AGI#2 MRV	George El-kaseeh	$ 90,000	2025/12
MPLX	Industry	Pre-Feasibility Study to Evaluate Location and Subsurface Suitability for Acid Gas Injection for 1. Near Hayfield Ridge Amine, Dagger Lake Amine Treating, Bell Lake Amine and Pelham; 2. Tornado Gas Plant and Secretariat Gas Plant	George El-kaseeh	$ 30,000	2025/12
General Atomics Uranium Resources (Rio Grande Resources)	Industry	Environmentally Conscious Optimization of In Situ Leaching (ECO-ISL) for Uranium Recovery in New Mexico	Jason Simmons	$ 289,852	2025/12
HyTerra Ltd. and Renaissance Philanthropy	Non-Profit	Estimation of in-situ hydrogen generation rates from pre-Cambrian rock samples extracted from HyTerra and legacy wells in Mid-Continent Rift based on their mineralogy and elemental chemistry	Robert Czarnota	$ 60,000	2026/04
Targa	Industry	Support “Authorization to Inject” Application for the Grizzly AGI #001 Well (Location: TBD) in Texas	George El-kaseeh	$ 120,000	2026/04
Targa	Industry	Scope of Work to support “Authorization to Inject” Application for the Camp Viejo AGI #002 Well (Location: TBD) in Yoakum County, Texas	George El-kaseeh	$ 120,000	2026/05
FY 2026 Total*		*** This does not include $17 million in reactivated pending projects that has been credited in other years**		**$ 3,274,549**	
FY 2025 Total				**$ 22,317,646**	
FY 2024 Total				**$ 69,481,512**	
FY 2023 Total				**$ 7,471,911**	
FY 2022 Total				**$ 9,252,522**	
FY 2021 Total*				**$ 18,095,102**	
FY 2020 Total **				**$ 21,808,023**	
FY 2019 Total **				**$ 19,365,875**	
FY 2018 Total				**$ 1,918,301**	

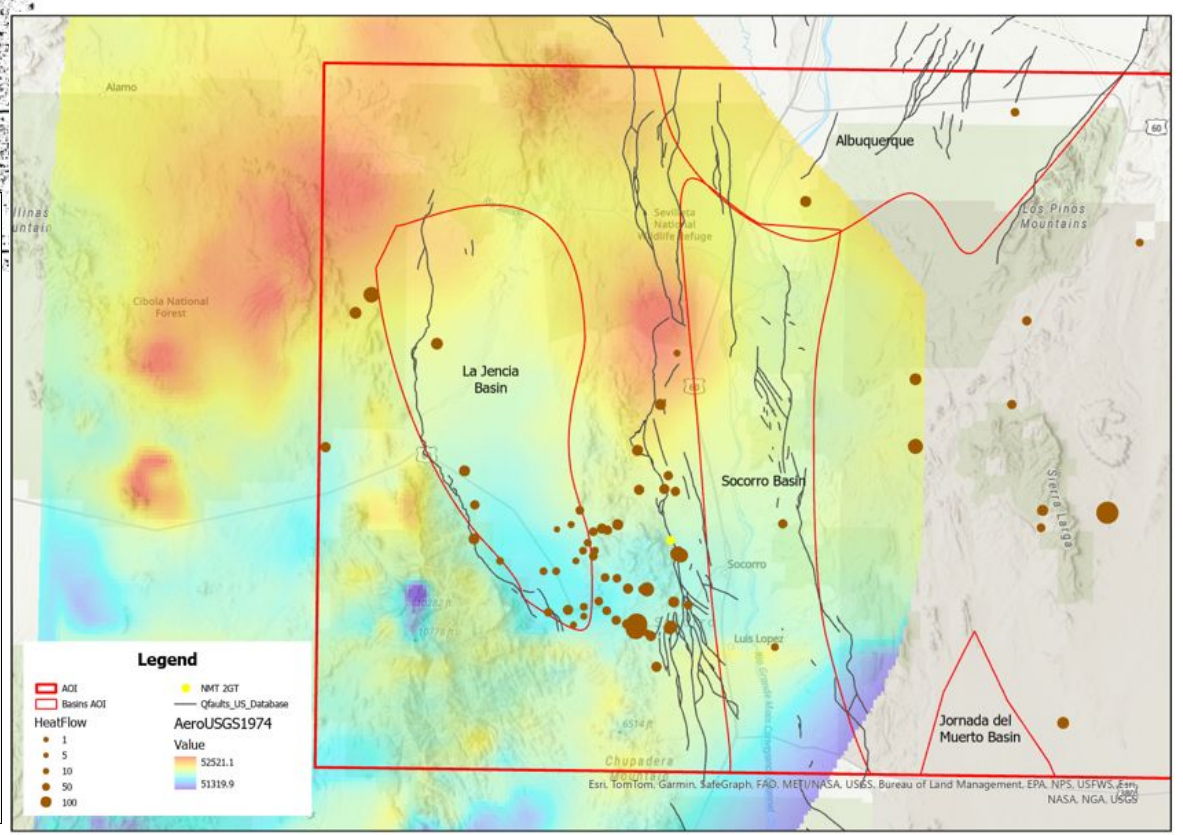
New Focus Areas – Geothermal and Critical Minerals

- Using legacy data and **O&G tech and skills** to identify new prospects
- Industry focus: Attract funding to drill characterization wells





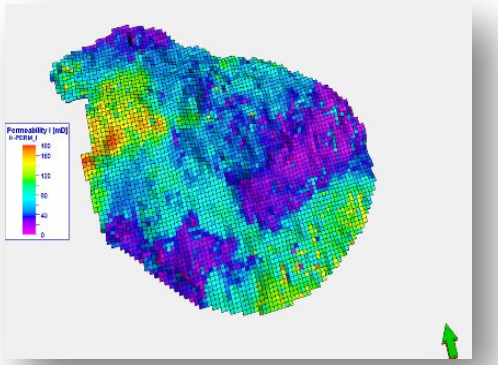




Industry Projects

- Hands-on experience for early career staff
- Generate economic activity through hiring subcontractors for drilling and other purposes
  - $13 million wells drilled in Farmington on Federal $$
  - Several $35 million well drilled in Permian basin by partner, 4 more in process in New Mexico
  - 2 million tonnes/yr CO_2 storage permitted for midstream partners
- Wide network and numerous industry partnerships
  - Major and Independent oil companies
  - Tallgrass (Hydrogen)
  - Service Companies
  - Targa Midstream (CO_2)
  - Coolsky Energy Solutions
  - PESCO Produced Water

A Sample of Industry Projects



- **Enhanced Oil Recovery (EOR): CO2, Surfactants, ASP**
  - Hilcorp Pilot North Slope Alaska – Very successful Polymer flood pilot
  - Alkaline Surfactants – Ongoing work at Daqing Field
  - CO2: Floods for both CO2 EOR and depleted Reservoir CO2 storage in Texas and New Mexico
- **Acid Gas Disposal / CO2 Storage**
  - Involved with midstream companies in New Mexico and Texas on permitting, well design, tax credit applications
  - 8 wells drilled, 3 in progress
  - 2 million tonnes/yr CO_2 storage permitted for midstream partners
- **Wettability, water control, Asphaltene control**
  - Regular work with Chevron, ongoing projects last 17 years
- **Nano Technology and Water management**
  - Seven projects on nano filters (hollow fiber membranes)
  - Inexpensive produced water cleanup
  - Mining of critical minerals from produced brine

Energy Transition Leadership

State of New Mexico
Energy, Minerals and Natural Resources Department

Michelle Lujan Grisham, Governor
Melanie Kenderdine, Cabinet Secretary
Ben Shelton, Deputy Cabinet Secretary
Erin Talyor, Deputy Cabinet Secretary

FOR IMMEDIATE RELEASE:

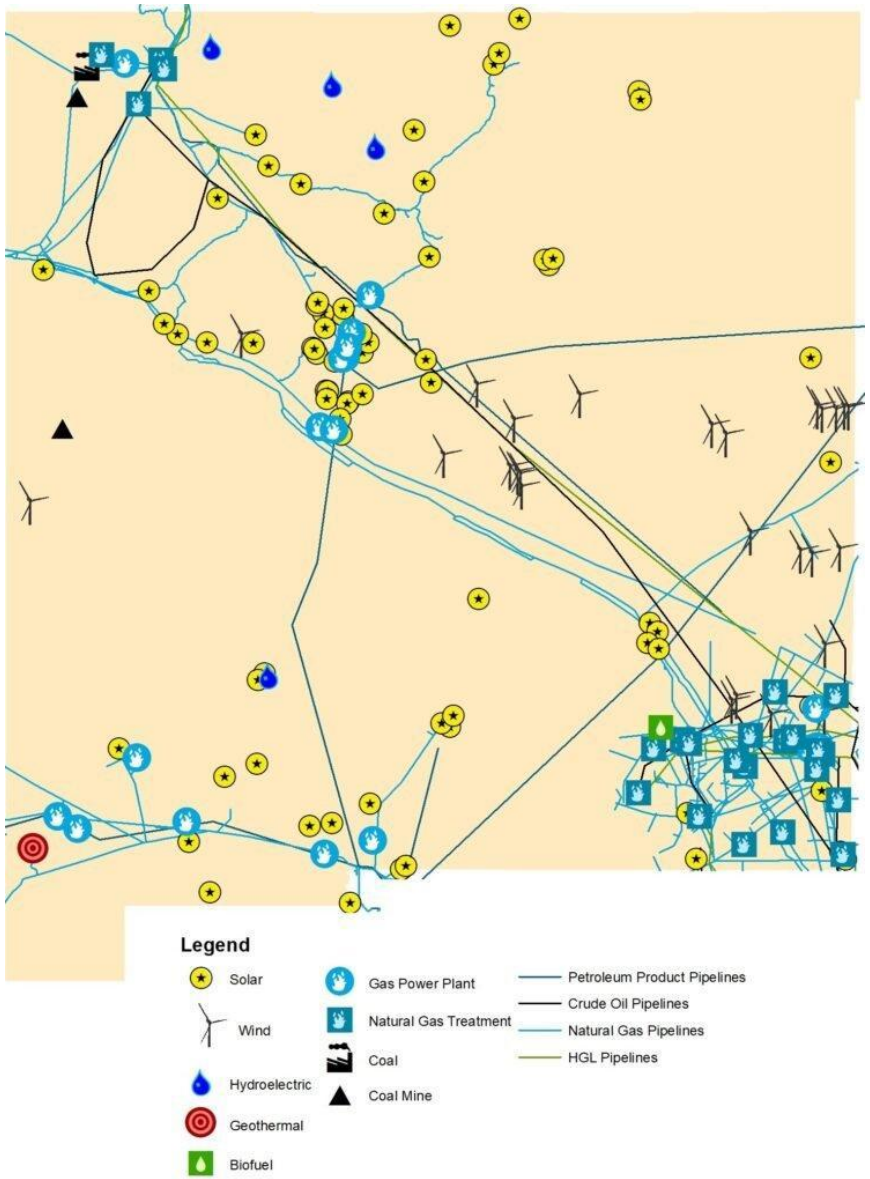
Contact: Sidney Hill
Public Information Officer, EMNRD
sidney.hill@emnrd.nm.gov

May 12, 2025

EMNRD leading Comprehensive Energy Transition Strategy for NM

Supporting the State Energy Transition Strategy roadmap effort:

- Lead contract with EMNRD – Phase I
- Data strategy development
- Partnership with EFI for policy



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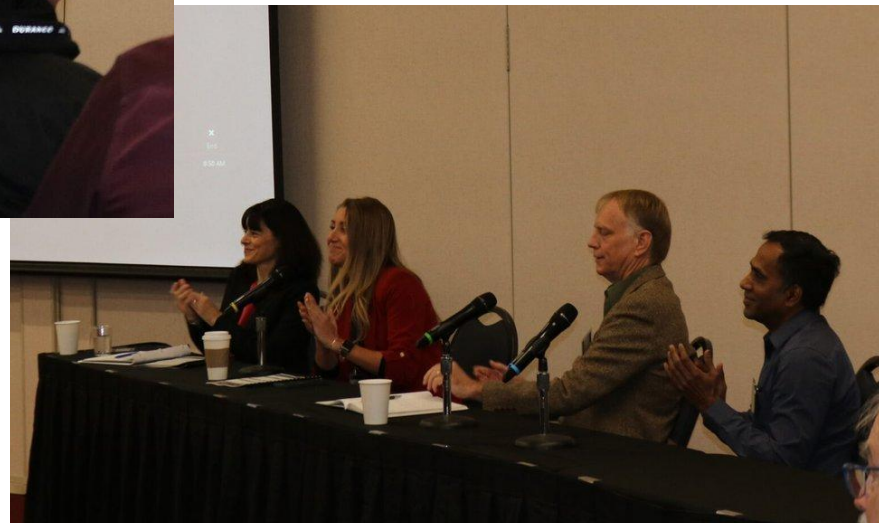
Driving the Conversation on Energy

New Mexico Energy Initiatives

Objectives:

- **To develop RD&D energy projects**
- Increase collaboration and PPPs:
  Universities, State, Industries, IOUs, NGOs…
- Support education and workforce development

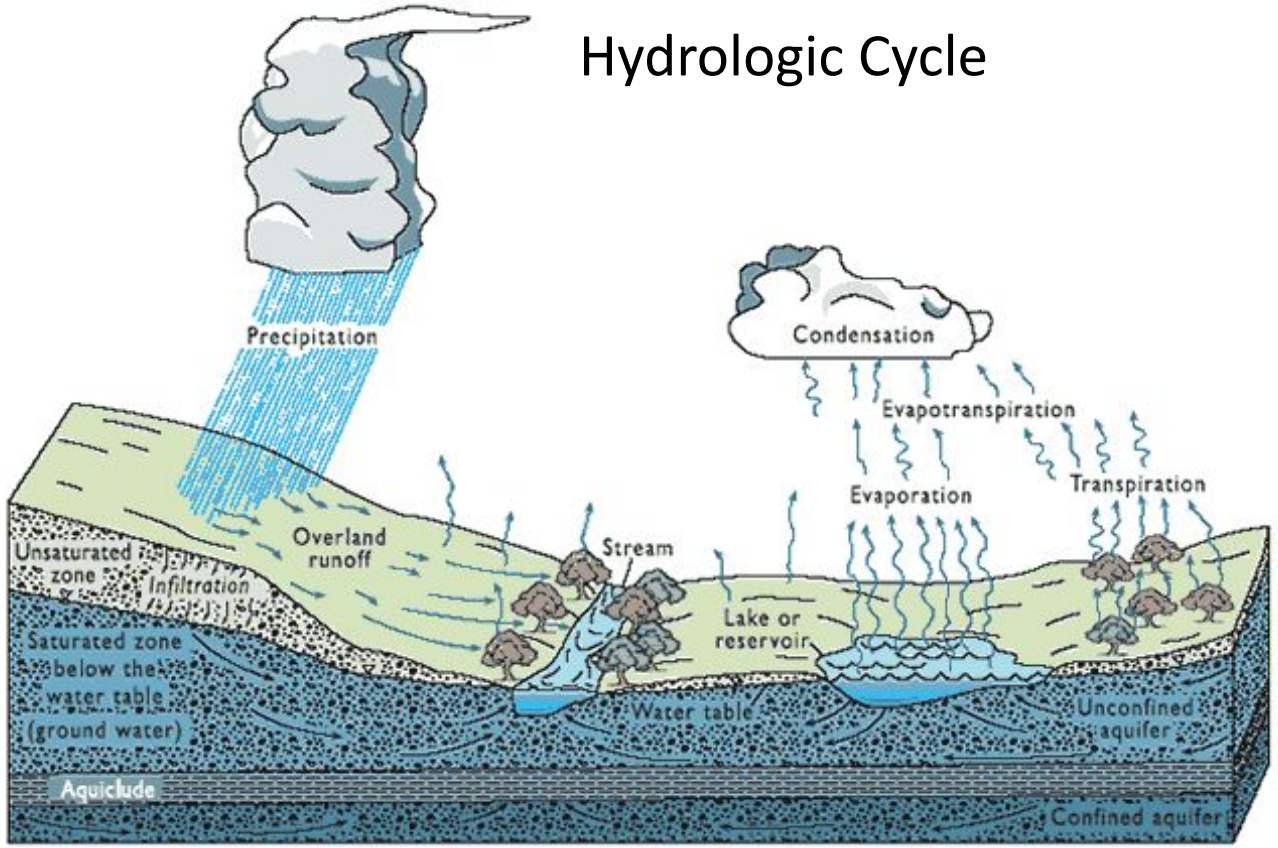


Inaugural Meeting in 2024 with 100 attendees

Charter/MOU for governance and to attract industry funding

Special Focus - Water

Hydrologic Cycle



Shari Kelly and Peggy Johnson, NM Bureau of Geology

Water shortage and security is a global AND local challenge

- New Mexico is an arid state, **1.1 million** people are affected by the long periods of drought and inconsistent precipitation.
- **87%** of public water supply comes from ground water in NM.
- The remaining water (13%) comes from rivers

Rapidly depleting aquifers requires exploration of new sustainable water resources…

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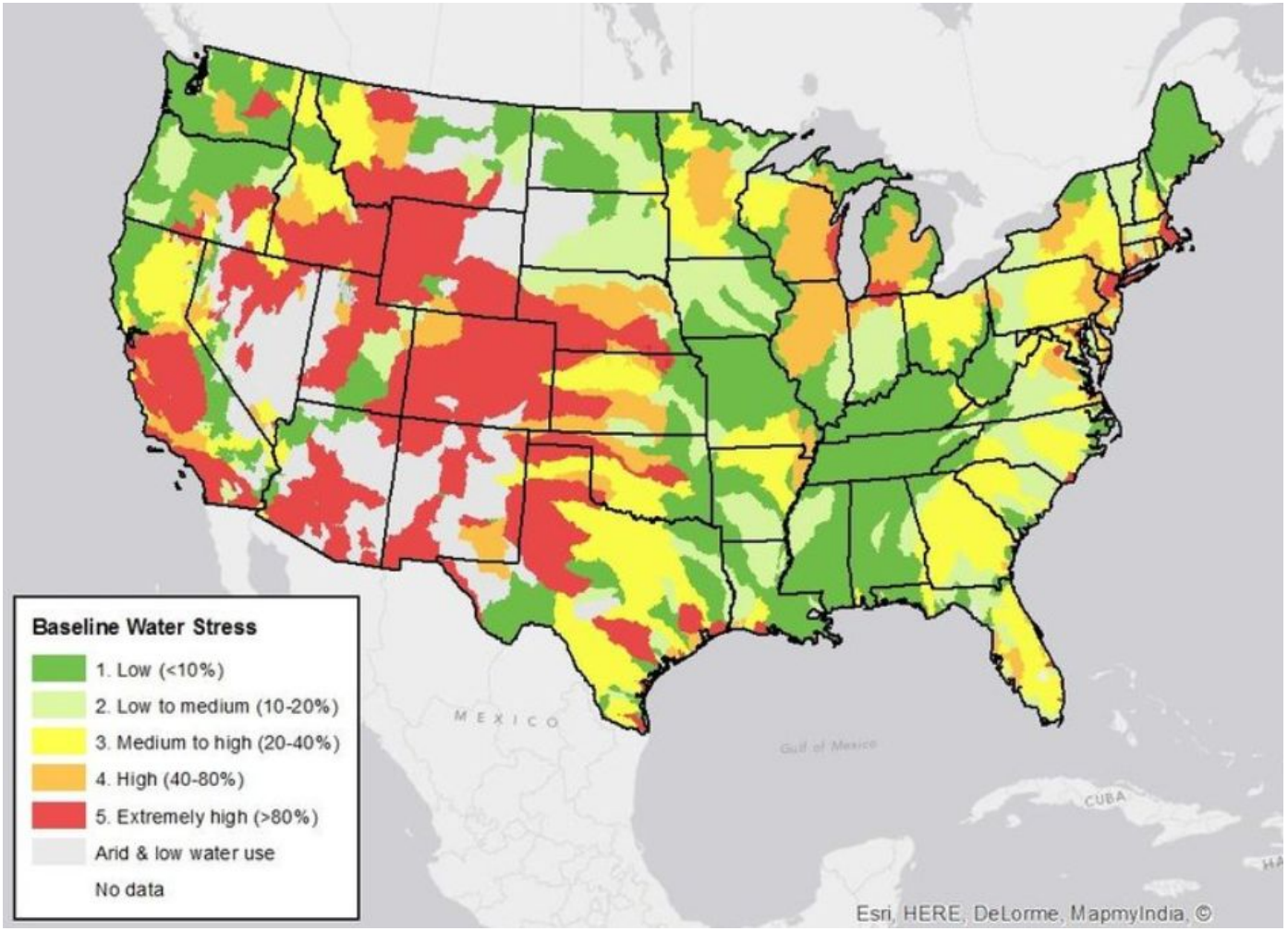
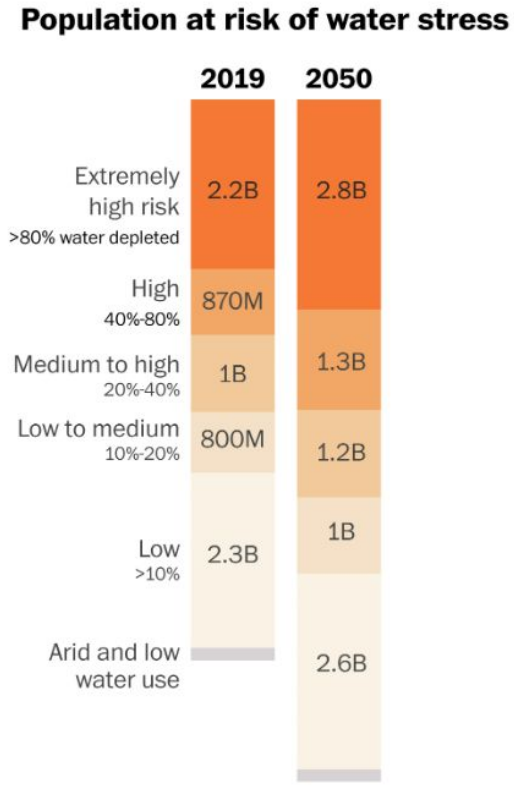
Water Stress Map of the United States



Water Stress Map of the United States Source: USGS.



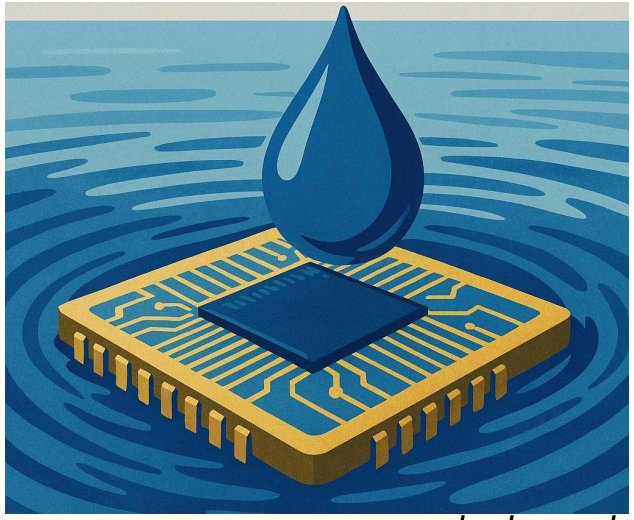
"Over one quarter of the world's population face extremely high water stress".

- World Resources Institute (WRI).

Does New Mexico have enough water?

Not for everything we want to do…

- Farming is already limited by available water, this is difficult to address because of very large volumes needed
- New Industries need more water
  - Chip fabrication
  - Data farms (cooling)
  - Grid-scale batteries (cooling, pump hydro)
  - Hydrogen needs 4-8 gallons of water per kg of hydrogen

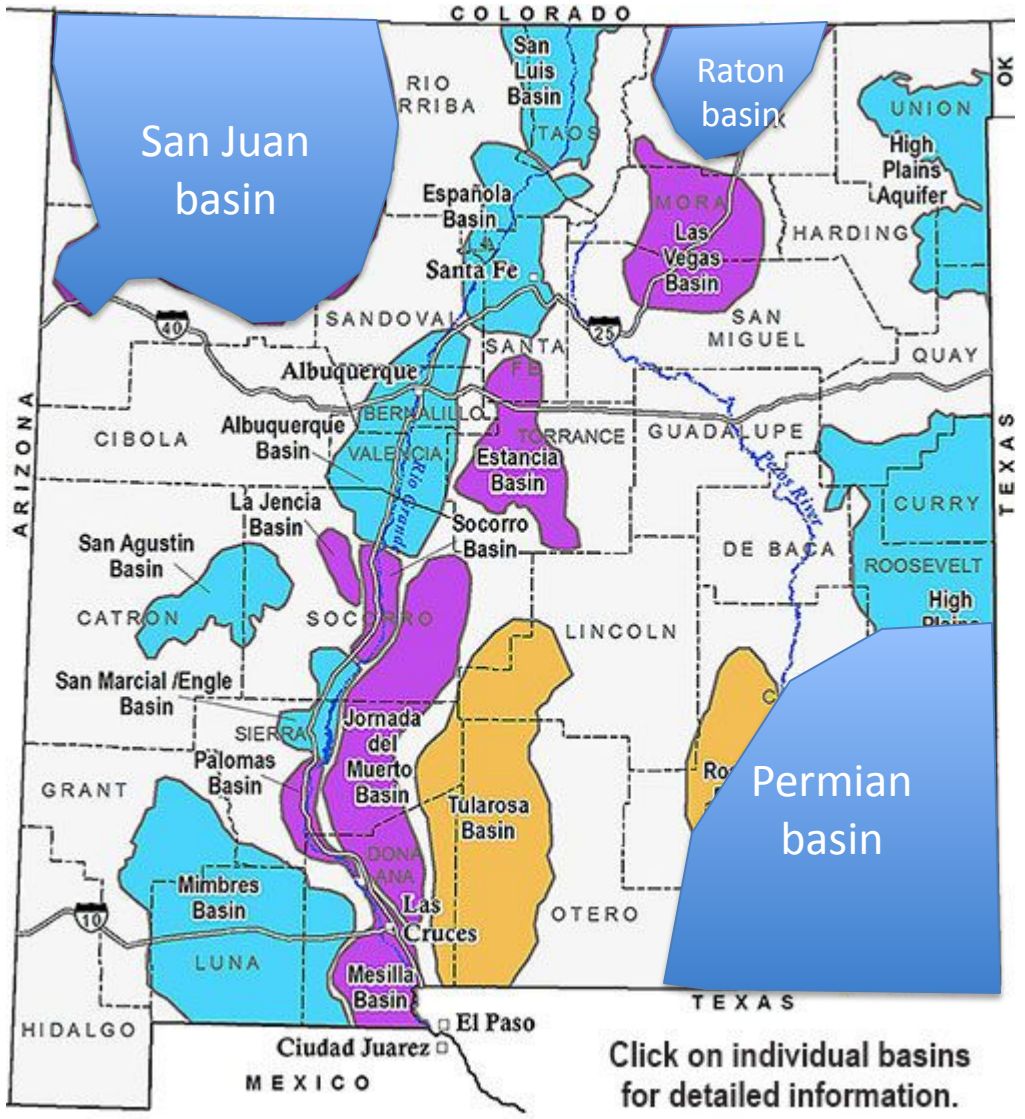


hydrogeek

So How Do We Come Up With "New" Water?

In New Mexico the answer is going to be:

- New groundwater sources…
  - Resources are already strained
- Improve "recycling" from non-traditional water sources
  1. Produced Water from oil and gas
  2. Reuse of wastewater



New Mexico Bureau of Geology and Mineral Resources Brackish water assessment

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Produced Water in New Mexico

2,748 MM bbl*

Produced water reported for New Mexico in 2025

128,641 mg/L*

Mean TDS in 46 Permian Basin produced-water samples

NM WaterSTAR

Interactive produced-water quantity and quality mapping portal

Produced water is a big issue

- In 2025, over **113 billion** gallons of produced water was generated in NM, over **310 million** gallons per day, equal to **TWICE the total daily municipal water consumption** in NM;
- **90%** of produced water is currently reinjected underground for use or disposal (the cost can exceed **$0.11/gallon**);
- Cost of water management can make profitable operations uneconomic for small producers.

Produced water desalination is challenging

- **High salinity** (as high as 201,474 mg/L), volatiles, **organics** (as high as 248.1 mg/L), etc.;
- Most commercial desalination processes focus on **brackish water** (<10,000 mg/L) **and sea water** (35,000 mg/L).

Source: * NMOCD.

**Hightower, Permian Basin Produced Water Quality Drivers, Produced Water Society Permian Basin Summit, 2023.

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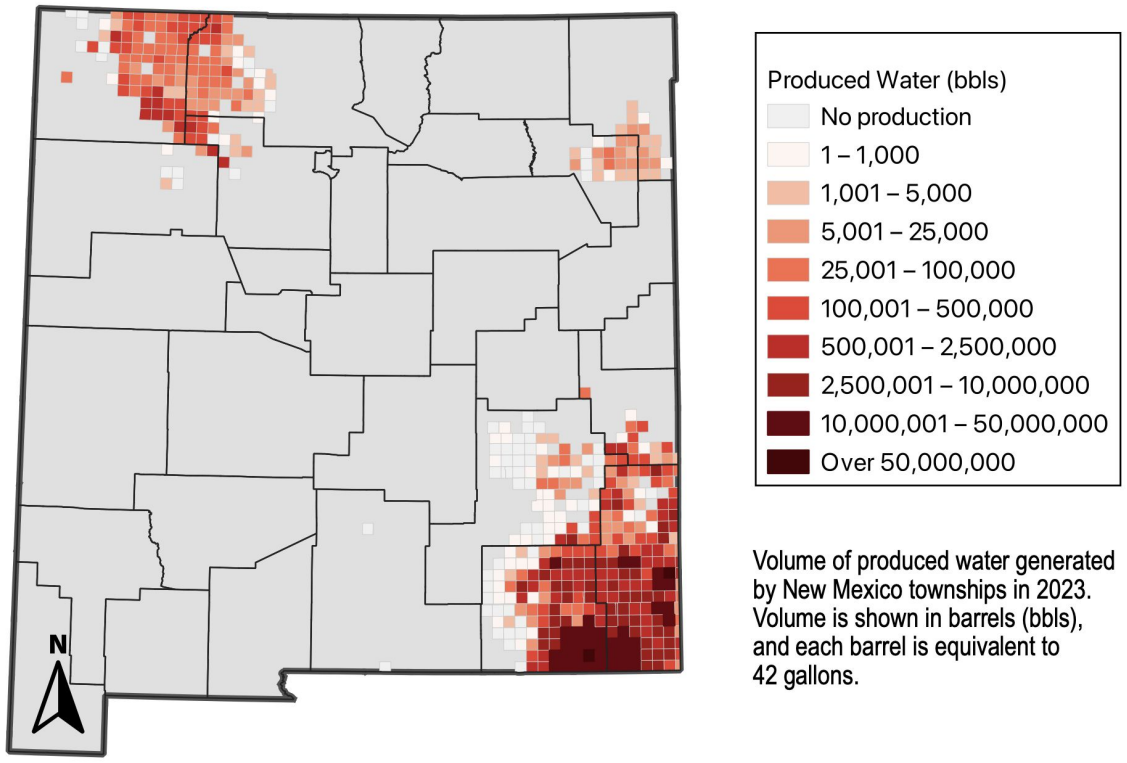
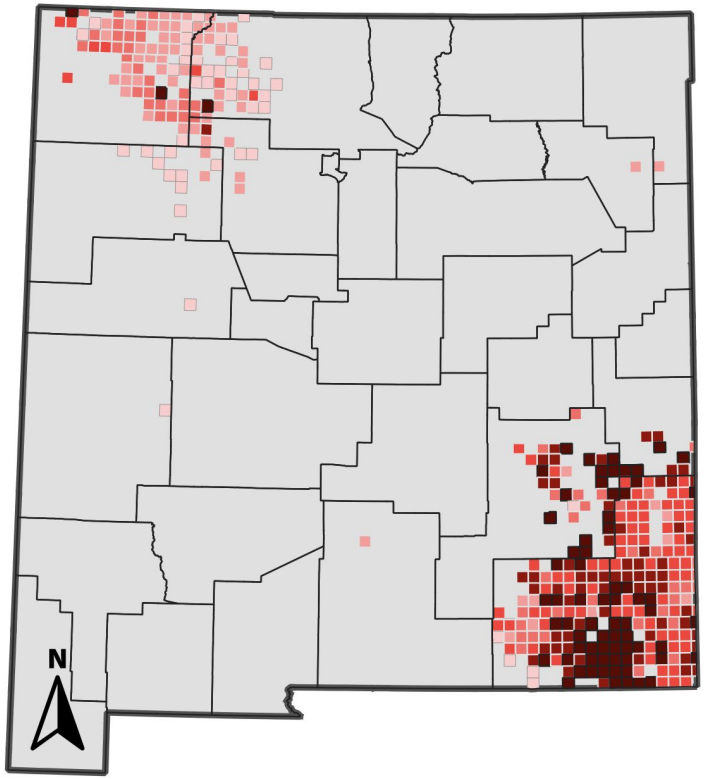
Produced Water Distribution in New Mexico



Produced Water (bbls)
- No production
- 1 – 1,000
- 1,001 – 5,000
- 5,001 – 25,000
- 25,001 – 100,000
- 100,001 – 500,000
- 500,001 – 2,500,000
- 2,500,001 – 10,000,000
- 10,000,001 – 50,000,000
- Over 50,000,000

Volume of produced water generated by New Mexico townships in 2023. Volume is shown in barrels (bbls), and each barrel is equivalent to 42 gallons.



TDS (ppm)
- 1 - 10,000
- 10,000 - 25,000
- 25,000 - 50,000
- 50,000 - 100,000
- 100,000 - 150,000
- >150,000

Average quality of produced water generated by New Mexico townships based on total dissolved solids (TDS, in parts per million, ppm).

Figure 2. (Left) Volume of produced water generated by New Mexico townships in 2023; (Right) Average quality of produced water generated based on total dissolved solids (TDS, in parts per million, ppm).

Source: Cather/PRRC

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Produced Water Purification

Challenges and Opportunities:

- New Mexico is the **second-largest** oil-producing state and among top natural-gas producers.
- Produced water can be up to **6 times saltier than seawater**, can also carry:
  - TDS often reaching 200,000 mg/L,
  - hydrocarbons such as oil and grease (2-565 mg/L),
  - suspended solids (1.2-1,000 mg/L),
  - dissolved organic compounds up to 1,500 mg/L,
  - and metals or major ions including Ba, Fe, Ca, Mg, and Li across basin-specific concentration ranges.
- Reuse discussions: **disposal-only** >>>>> **fit-for-purpose treatment, oilfield recycling, and potential closed loop new industrial water supplies**.

Current Produced Water Management

In New Mexico:

59.9%

Deep-well disposal / SWD

40.1%

Enhanced oil recovery injection/Pressure maintenance injection

0%

Beneficial reuse outside oil and gas

PRRC Research Goal: develop **affordable, portable and scalable robust membrane**-based desalination technologies to convert produced water as a sustainable water resource.

Sources: NMOCD
https://wwwapps.emnrd.nm.gov/ocd/ocdpermitting/Reporting/Production/ExpandedProductionInjectionSummaryReport

PRRC Produced Water Research Program

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Hollow Fiber Membrane Research: **Affordable, portable and scalable** desalination technologies

Hollow fiber membranes

Organics removal

- Ultrafiltration
- Microfiltration
- Membrane adsorption
- **Hybrid process**

Desalination

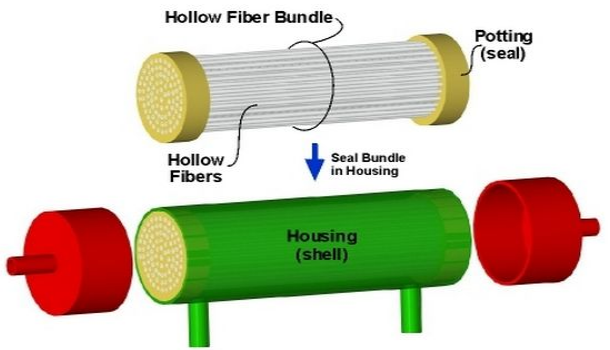
- Nanofiltration
- Reverse/Forward osmosis
- Membrane distillation
- **Hybrid process**

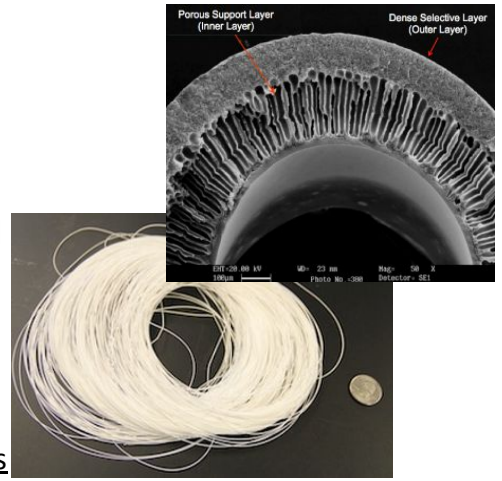
Compared to flat sheet membrane:

✔**higher productivity per unit volume** (high packing density and large surface area)
- For a 0.04 m^3 membrane device:
- HF membrane: 575 m^2 (90 mm in diameter);
- Spiral wound flat-sheet membrane: 30 m^2;
- Tubular configuration: 5 m^2.

✔**self-supporting**

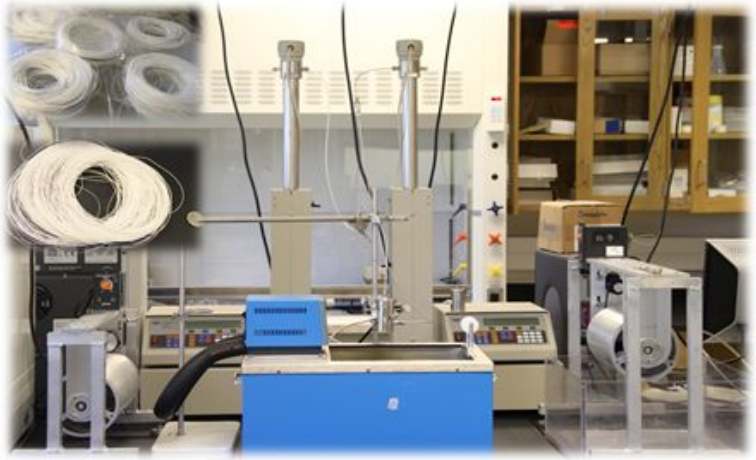
✔**small footprint, easily scalable**





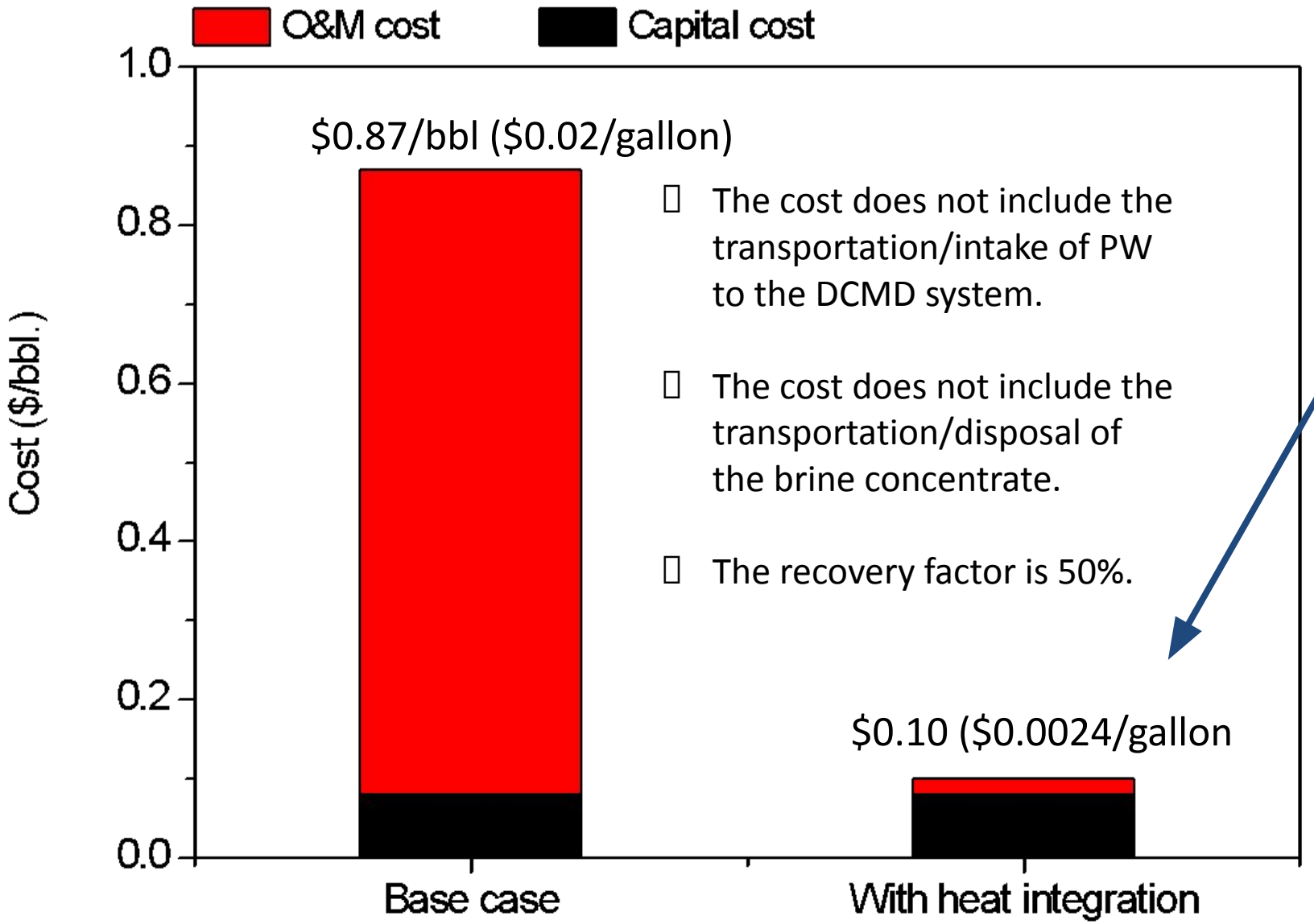
Hollow fiber membrane module*
* https://www.permselect.com/membranes

Laboratory and Bench Scale



Large scale apparatus for hollow fiber membrane fabrication.

Techno-Economic Analysis of PRRC Systems



- The cost does not include the transportation/intake of PW to the DCMD system.
- The cost does not include the transportation/disposal of the brine concentrate.
- The recovery factor is 50%.

Energy is the most expensive component!

If free energy such as geothermal or renewables are used the cost can decrease dramatically

Cost is per barrel
(1 barrel = 42 gallons)

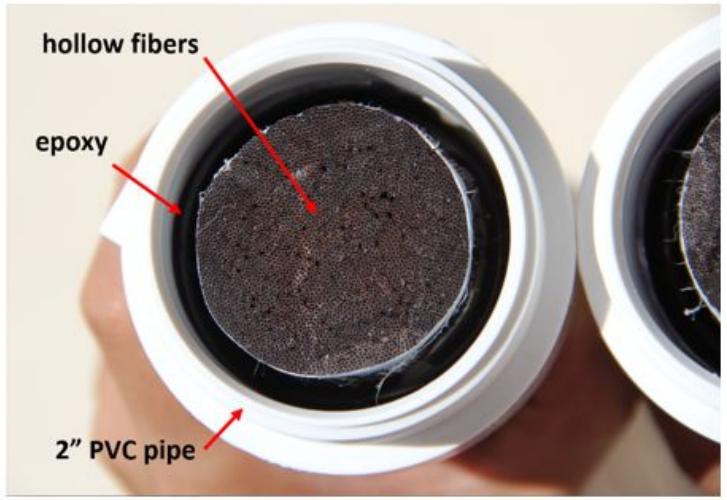
This makes the price very reasonable

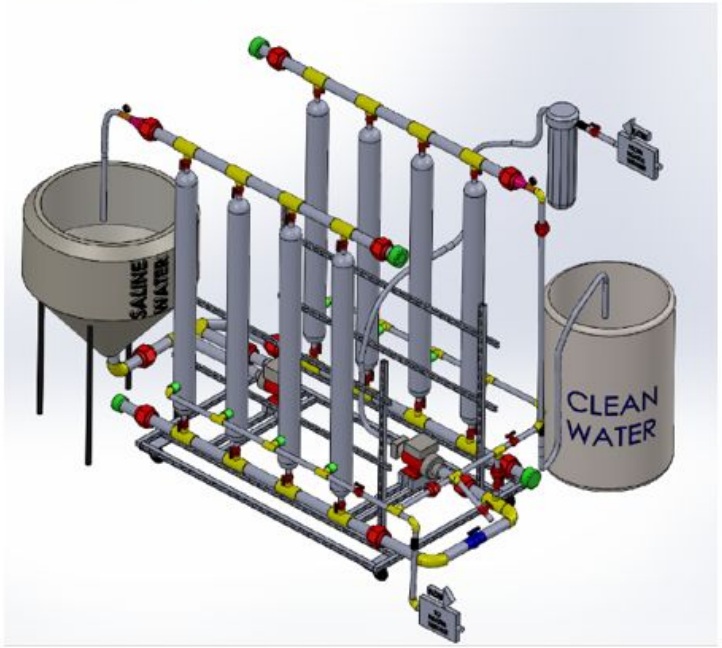
Water Filtration – Hollow Fiber Membranes

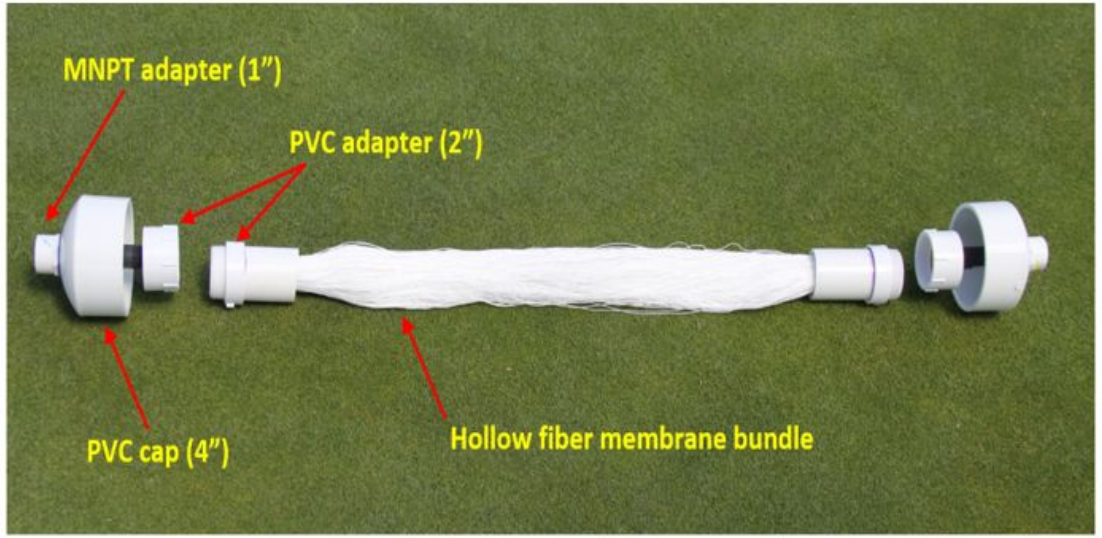
30 years of produced water research with dozens of funded projects

- Polymeric hollow fiber membranes have been fabricated at PRRC for produced water treatment. The removal efficiency for organics salt removal is greater than 95% in a single pass, under a relatively low pressure (less than 30 psi).
- Working with PESCO to manufacture and distribute systems for domestic and industrial uses
  - **PESCO has licensed our technology and is preparing to mass produce units**
- Committed to building six 500 gpd systems for rural Native American communities
  - Partnership with Navajo Technical University
- Have projects to extract critical minerals from produced water
  - Successfully isolating and extracting Lithium from Permian basin water

Early prototype circa 2016







Commercial Prototype (PESCO) in Field Tests

5000 gallons per day

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N^4WPP Brackish water Desal

Navajo Tech-NMT-Navajo Nation Water Purification Project – Working to Desalinate brackish water wells on the Navajo Nation

500 gallons per day

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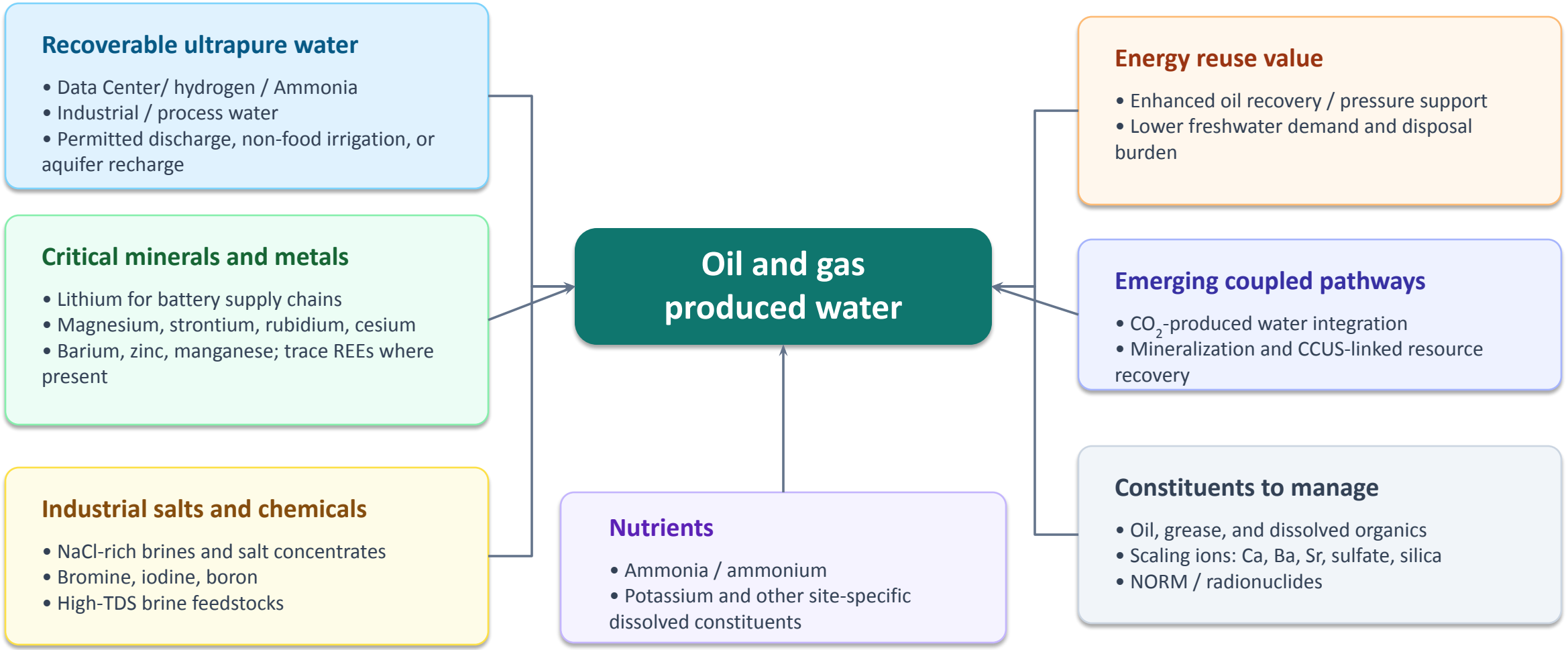
Available Resources in Produced Water



Sources: Scanlon et al., *Science of the Total Environment*, 2020; Gerardo and Song, *Environmental Science: Water Research & Technology*, 2025; Yelatontsev et al., *Desalination*, 2026; Biswas et al., *ACS Omega*, 2025; *Water Research*, 2026, 294, 125546.

Thank you

New Mexico Tech
Petroleum Recovery Research Center

Please come see us!