I-WEST

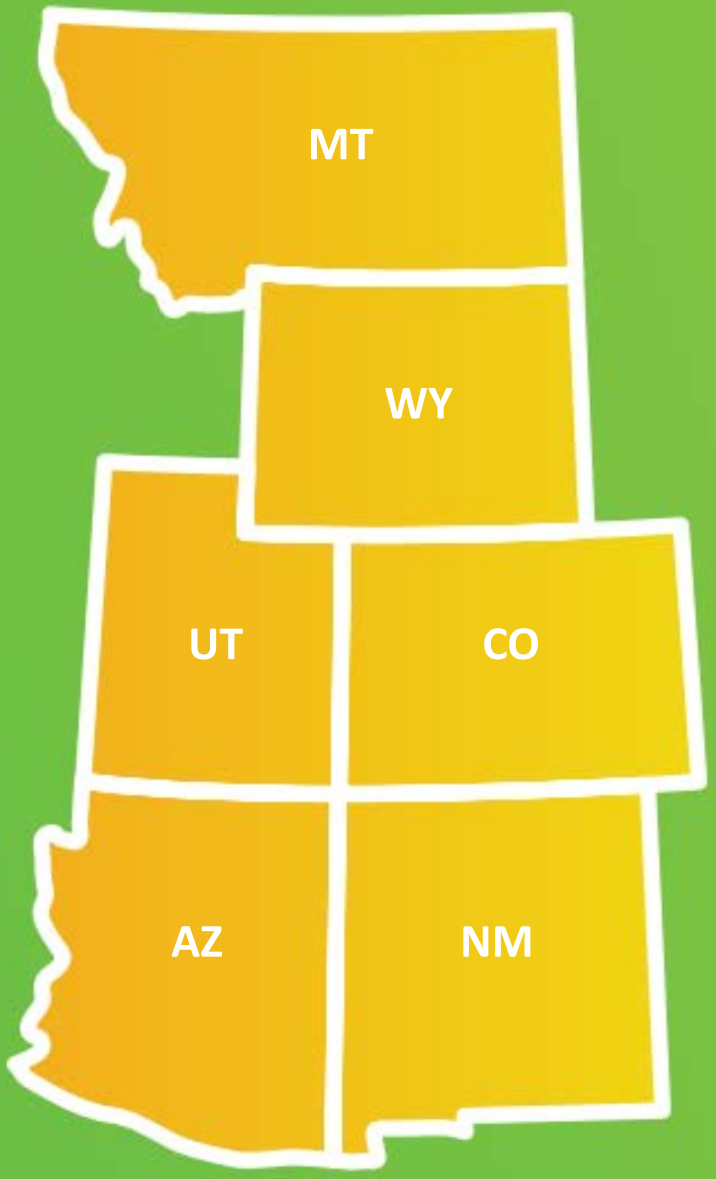
Fireside Chat

This session is being recorded.

LA-UR-23-21749

Today's Conversation

- Where we started: I-WEST overview
- Where we are now: Phase-I report
- Key findings and recommendations
- Next steps for I-WEST



1

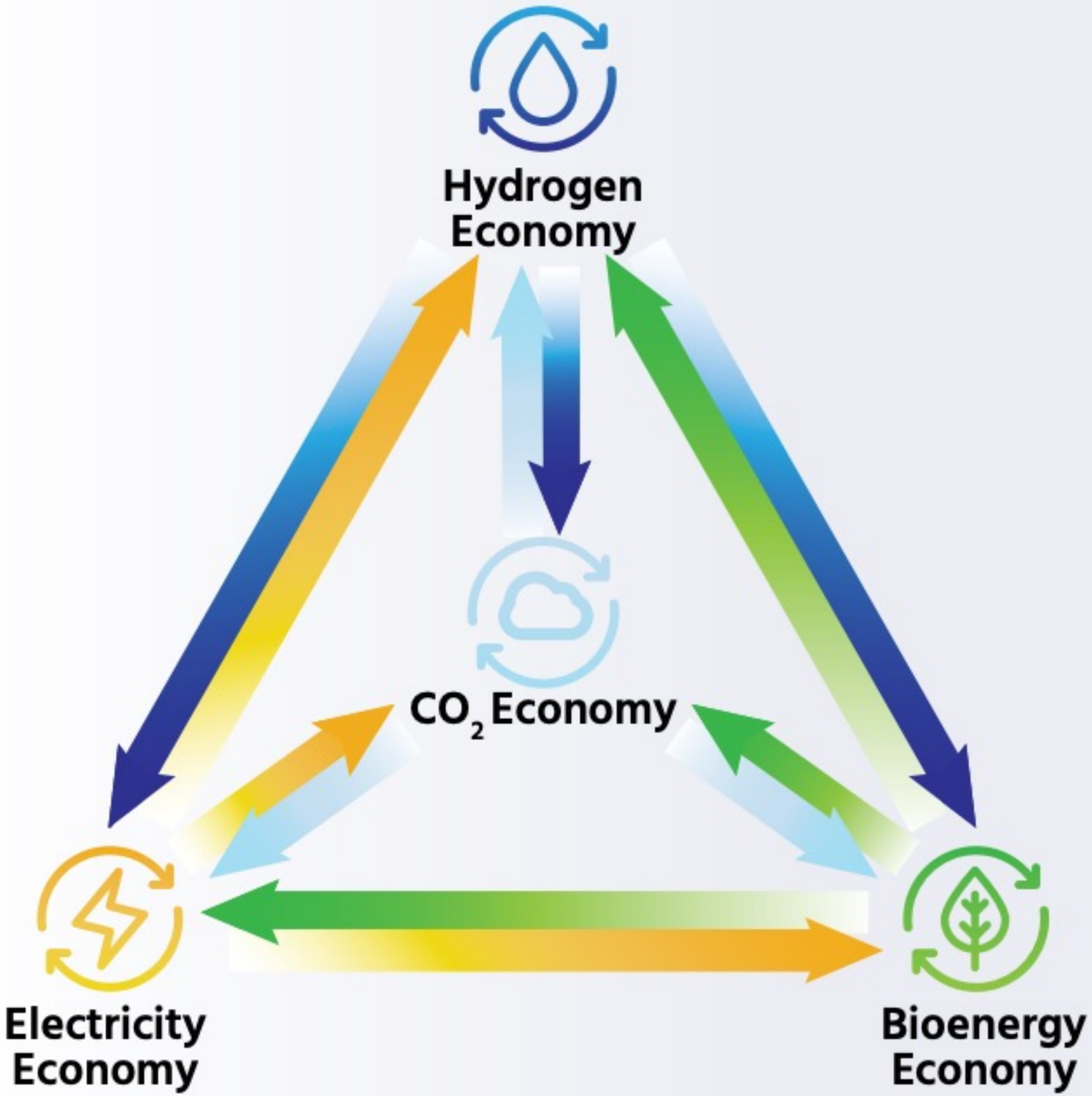
Develop a regional roadmap to carbon neutrality

Why these states?

- Shared geographical, environmental, and demographic attributes
- Characterized by fossil fuel-based economies and share challenges related to climate
- Major producers and exporters of fossil-based energy and highly vulnerable to social and economic disruptions as a result of energy transition
- Positioned to emerge as leaders in new energy economies

Explore symbiotic economies

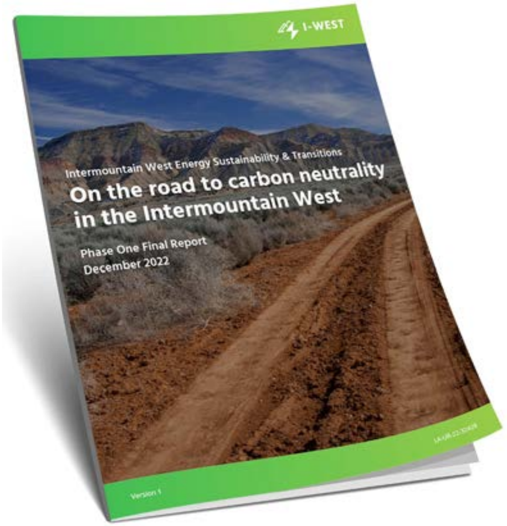
- Achieving carbon neutrality will require multiple pathways
- Pathways must reduce greenhouse gas emissions *and* be sustainable
- Symbiotic energy economies can be exploited to decarbonize critical energy sectors and create supply-and-demand scenarios for new energy industries



3 Build regional coalitions

- Successful energy transition strategies depend on effective planning and implementation at the local level
- A place-based approach engages regional stakeholders to assess societal readiness in tandem with technology readiness
- Explicitly considering policy, revenue and jobs, workforce, equity, and EESJ is key
- Regional coalitions are critical to roadmap implementation and technology deployment

Phase-I Outcome:
A framework for regional energy transition planning



Fireside chat topics

- Place-based approach
- Workforce case studies
- Building a regional bioeconomy
- Low-carbon electricity generation
- Building a regional hydrogen economy
- Carbon capture, utilization and storage

Enter your questions and comments in the chat and we will respond via email.

I-WEST Team

Segment 1
Place-based Approach

Moderated by

Alicia Corbell, San Juan College

In conversation with

Rajesh Pawar, Los Alamos National Laboratory
Renia Ehrenfeucht, University of New Mexico
Alan Krupnick, Resources for the Future
Janie Chermak, University of New Mexico
Robert Page, Arizona State University

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Key findings

Tenets of a place-based approach

- Knowledge of the geographical context of a region
- Well-defined interactions and channels between stakeholders
- Input and buy-in from a broad range of stakeholders and sovereign nations
- Balance diverse motivations for energy transition

Policies to enable energy transition

- Effective energy transition plans are ideally supported by policies
- Cross-state planning is essential for developing an integrated energy grid
- Integrated energy strategies can increase access to federal and state funds
- Regional coalitions can forge avenues for providing input on state and federal policy

Key findings

Economics and workforce impacts

- Economic impacts of energy transition are highly variable between counties
- Energy projects have far-reaching economic impacts and require tools for holistic evaluation and planning
- Current workforce skills are well positioned to transition, but workers are not always able to relocate for new jobs
- Regional colleges and universities are key to workforce (re)training

Energy, environmental, and social justice

- Equitable energy transition is an opportunity for innovation in governance
- Enduring partnerships with sovereign nations and regional communities are key to collaborative energy transition strategies
- Disadvantaged communities must have a voice in evaluating risks and benefits

Workforce Case Study
Powder River Basin

Presented by
Selena Gerace, University of Wyoming

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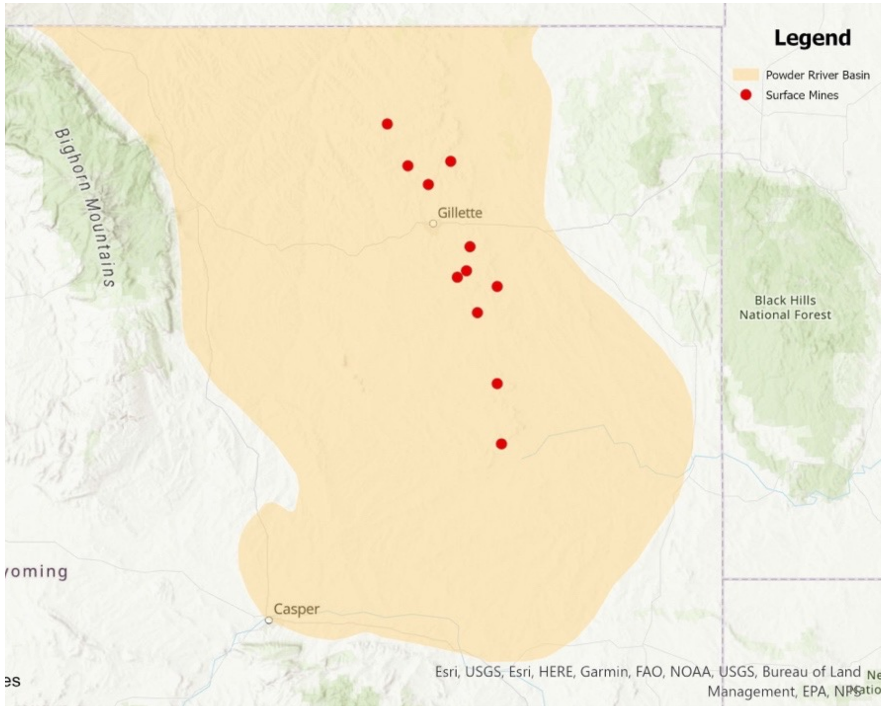
Case Study Findings

An evaluation of workforce training requirements and opportunities to develop critical mineral industries

- Opportunities for Developing Critical Mineral Industries in the PRB
- Workforce Requirements and Potential New Skills Needed
- Workforce Training and Educational Options and Potential Future Programs

Opportunities for Critical Mineral Industries in the PRB



Generous coal reserves

- Estimated 1.15 trillion short tons remaining (USGS)
- Estimated 25 billion short tons economically recoverable

Top coal producing region

- 11 operating coal mines in Campbell County
- Produced 230 million short tones of coal in 2021

Infrastructure in place

- Roads, railroads, transmission lines, mines, supply chains developed

Trained workforce

- Coal mining, power plants, oil and gas extraction, all supporting industries

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Workforce Requirements

Exploration

- Field geologies
- Geochemists
- Geophysics
- Mineralogists

Mining

- **Mostly the same skills**
    - Shovel/Loader Operators
    - Truck Drivers
    - Drillers
    - Dozer/Grader Operators
    - Heavy Equipment Mechanic
    - Electricians
    - Mine Superintendent
    - Etc.
- **May need more quantity of these skillsets**
    - Especially mining engineers

Processing

1. **Development of Processing procedures**
    - Chemical engineers
    - Chemists
    - Geochemists
    - Metallurgy engineers
2. **Operations of processing procedures**
    - Trained operators
    - Laboratory technicians
    - Maintenance personnel
    - Specialties including:
        - *Metallurgist*
        - *Safety engineers*
        - *Mechanists*
        - *Electricians*

Potential New Skills

Depends greatly on how the technology changes and potential disruptive technologies

- Use of **autonomous vehicles, diesel/electric hybrids, electric vehicles, and drones**
- **Robotics** (could be widely adopted in mining, sampling, and loading/unloading processes)
- **Automation** (advances could disrupt industry)
- **Biologically enabled solutions** (e.g., microbes used for separation and processing of REE/CM)

Current Training and Educational Options Available

Universities

- **R&D** level work on extraction
- **Downstream** final purification
- **Bachelor's, Master's, and Doctorate** levels
  - Chemical engineers
  - Metallurgy engineers
  - Mining engineers
  - Geologists

Community Colleges

- **Daily operations**
- **Lab technicians** and operators
- **Mining**
- **Upstream** parts of processing
- **Associates degrees** and technical training
  - Diesel Technology
  - Electrical Apprenticeship
  - Industrial Electricity
  - Industrial Technology
  - Welding
  - Engineering
  - Mine Safety and Health Administration
  - Mining Technology
  - Mine Management Certificate

Potential Future Programs

Potential Future Programs at Gillette College

- **Operator Program**
  - Dozers
  - Excavators
  - Blades
  - Forklifts
  - Skid steers

Partnerships between Universities, Colleges, and Community Makerspaces

- **Makerspace 'Badge Programs'**
  - Training modules
  - Combination of virtual and hands-on
  - Badges operate like a certificate
  - Convenient and adaptable way to offer specialty trainings
  - Badges could include:
    - Foundational information REEs/CMs
    - Career opportunities in the field
    - General information about energy and infrastructure

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Workforce Case Study

Four Corners

Presented by

Alicia Corbell, San Juan College

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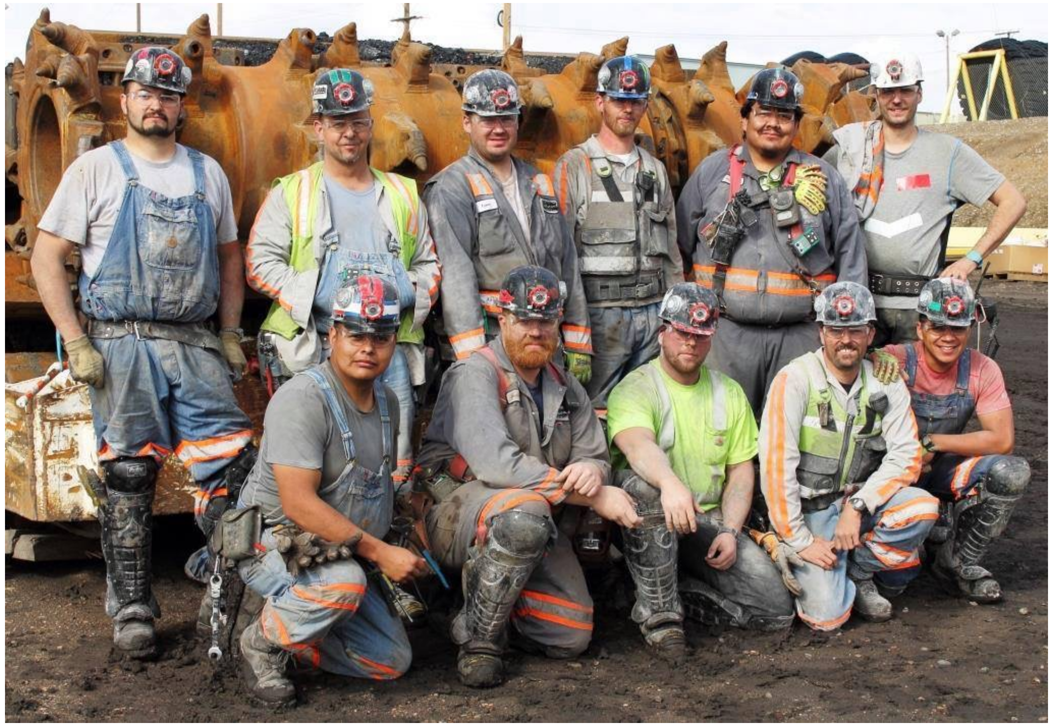
Generations of Workforce

San Juan Generating Station/San Juan Mine

- Operational in 1970’s
- Predominantly Navajo workforce
- 1,800 employees at peak
- Shuttered in June 2022



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Workforce Overview

San Juan Generating Station/San Juan Mine

Average Employee Salary	$86,000 Per Year
Average Employee Age	47 Years Old
Average Years of Service	14 Years
Percentage of Tribal Employees	40%
Percentage with Healthcare from Employment	96%

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Generations of Workforce

Four Corners Power Plant/Navajo Mine

- Established in 1960’s
- Navajo Preference
- 2,000 Employees at peak
- Slated to close in 2031

Workforce Overview

Four Corners Power Plant/Navajo Mine

Average Employee Salary	$86,650 Per Year
Average Employee Age	49 Years Old
Average Years of Service	11 Years
Percentage of Tribal Employees	80%

Economic Losses to San Juan County, NM

Lost Wages	$56.6 Million per Year
Lost Benefits	$20 Million per Year
Direct Job Losses	1,600
Indirect Job Losses	5,000 Residents
San Juan County	$3.8 Million Per Year

Loss of Student Funding

Central Consolidated*	Loss of $1.5 Million
Farmington Municipal	Loss of $1.7 Million
Aztec Schools	Loss of $165,000
Bloomfield Schools **	Loss of $77,000

*Central Consolidated serves a 91% Native American student population. 72% of students are financially disadvantaged.
**100% of Bloomfield Schools students are financially disadvantaged.

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Economic Impacts – 6 County Region

Annual Loss in Earnings	$117,212,94.00
Total Jobs Lost	1,586
Loss of NM Taxes	$20.8 Million Annually
Loss of Local Taxes	$24 Million

2017 Economic Impact Study – Economic Modeling Specialists Inc.

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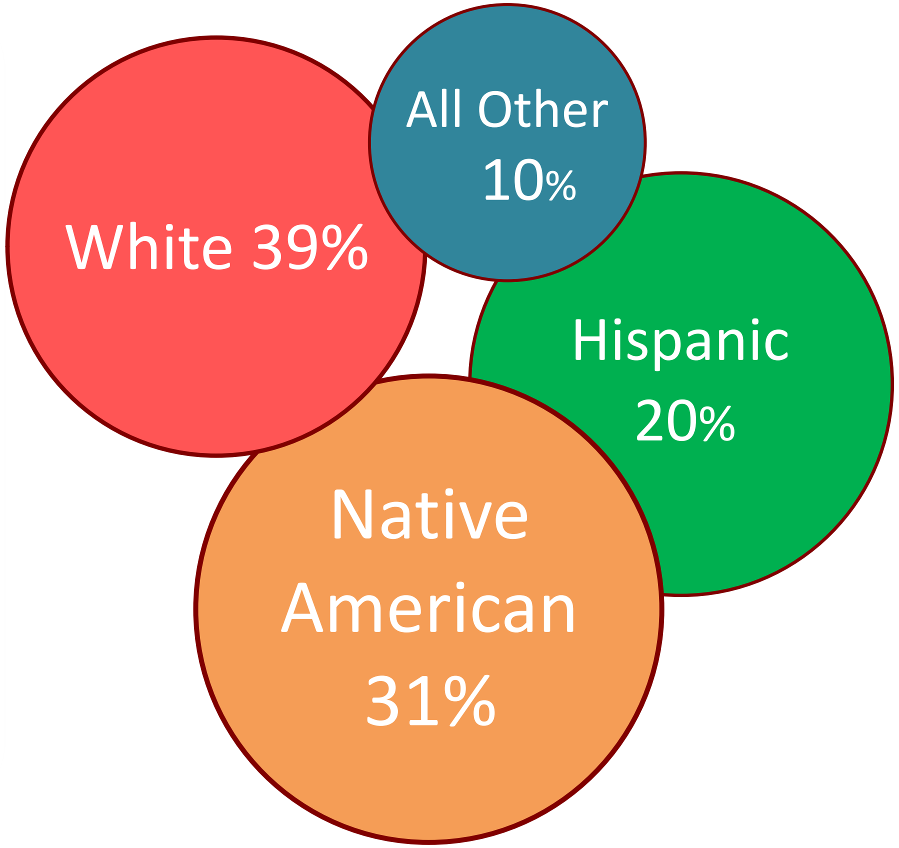
San Juan College Student Demographics



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POWER Grant

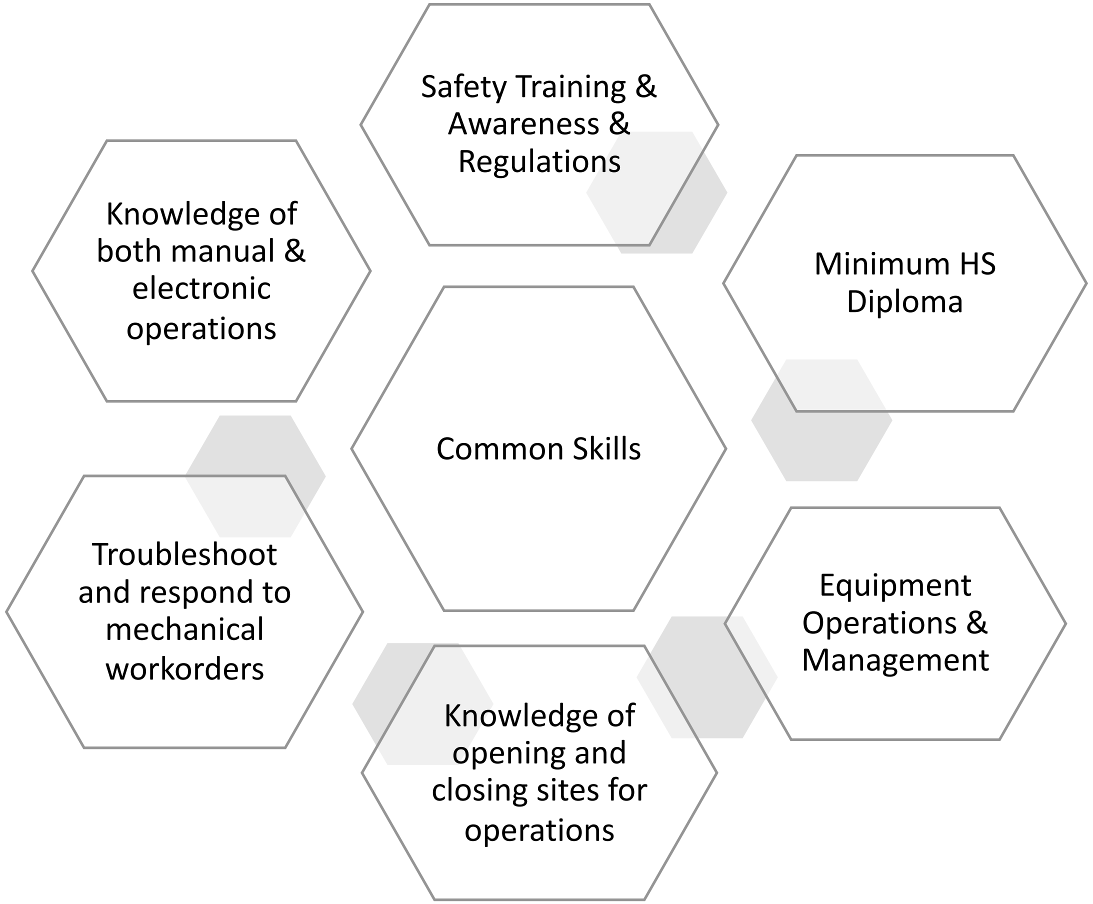
2015 Award of $1.4 million

Certificate programs:

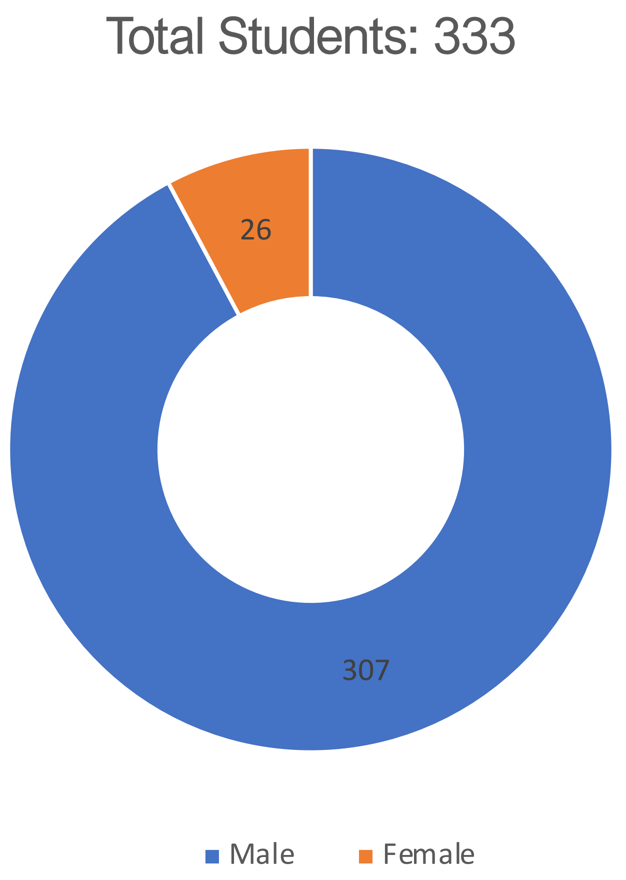
Commercial Driver’s License (CDL)
Instrumentation Controls & Electrical

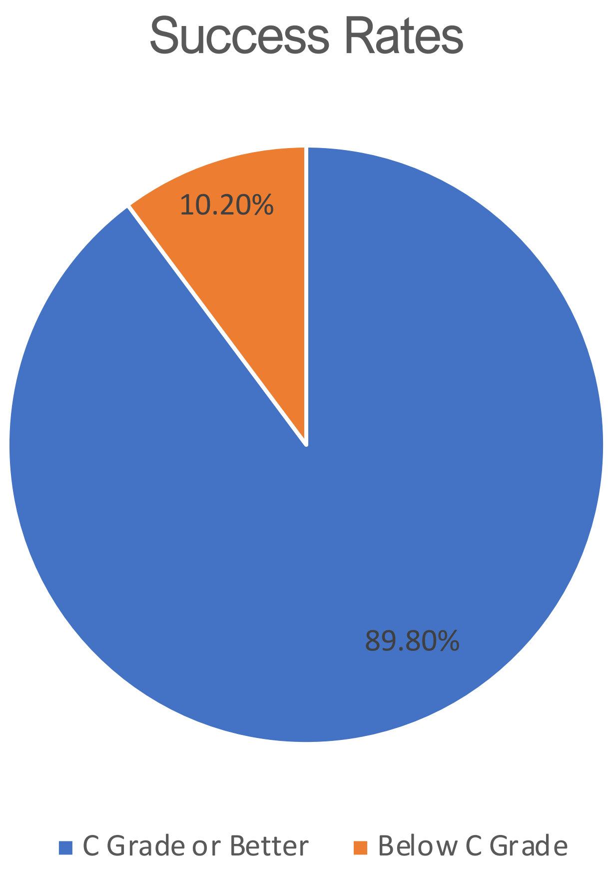
Cyber Security (CompTIA)

Transferrable Skills

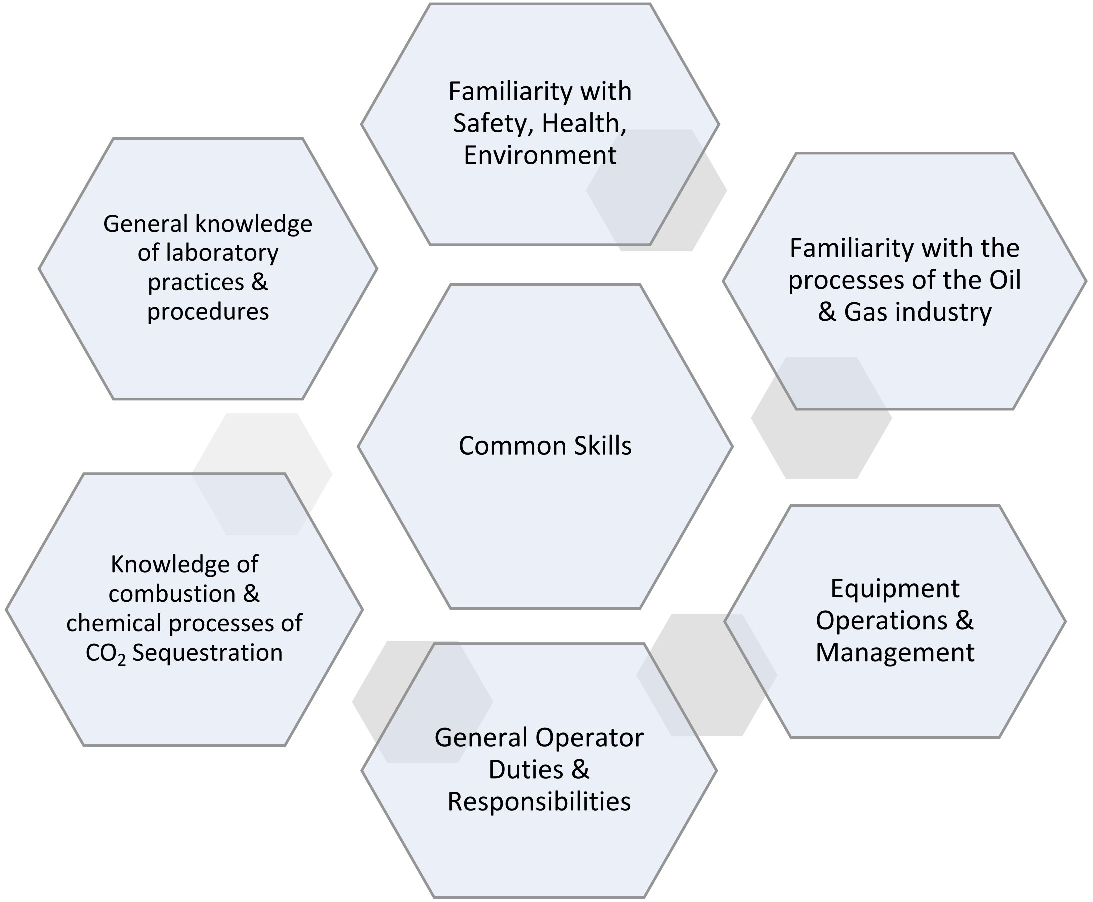


Instrumentation Controls & Electrical Technology Certificate Program Participants





Evolutionary Skills



Forward Movement

Memorandum of Understanding

New Mexico based BayoTech

Training provider of choice

Congressional Appropriation

Clean Hydrogen Technician Advanced Certificate Program

Co-Chair Education Committee

Center for Hydrogen Safety

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Segment 2
Bioenergy Economy

Moderated by

Sheila Van Cuyk, Los Alamos National Laboratory

In conversation with

Babs Marrone, Los Alamos National Laboratory
Renia Ehrenfeucht, University of New Mexico
Janie Chermak, University of New Mexico
Bob Page, Arizona State University

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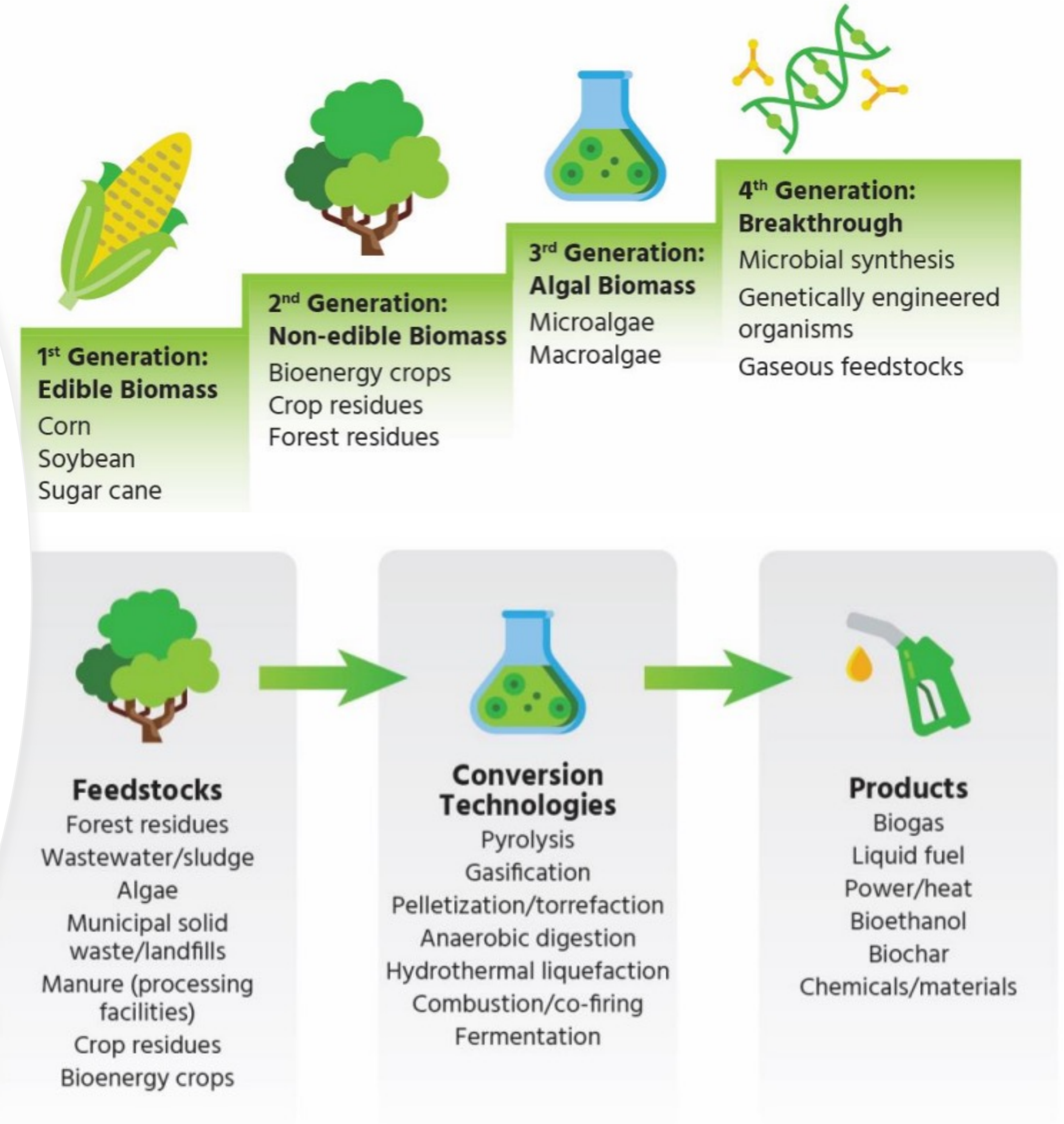
Key findings

Regional relevance

- Abundant sunshine, wind, and solar potential present opportunities for a bioeconomy
- Though currently a small sector, numerous projects are emerging
- A bioenergy economy would intersect with numerous other economic sectors to create supply and demand

Opportunities and challenges

- Opportunities exist to utilize 2nd and 3rd generation feedstocks
- Water scarcity challenges must be addressed to reduce water needs for bioenergy production
- A distributed model of small-scale technologies that engages local communities could help accelerate growth
- Workforce opportunities are emerging, and local academic institutions are critical to increase readiness



Segment 3
Low-carbon Electricity

Moderated by

Adam Mate, Los Alamos National Laboratory

In conversation with

Mary Ewers, Los Alamos National Laboratory
Bob Page, Arizona State University
Janie Chermak, University of New Mexico
Alan Krupnick, Resources for the Future

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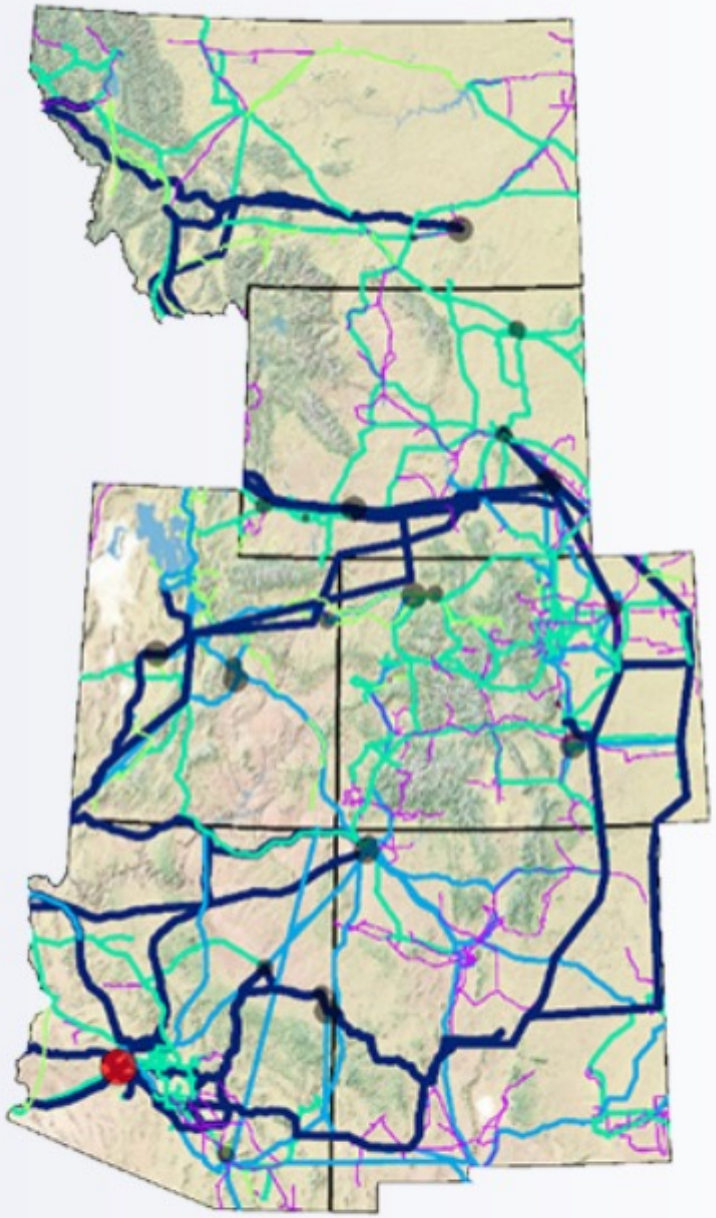
Key findings

Regional relevance

- Fossil-based power plants are the largest sources of electricity in the region, making the electricity sector a critical component of decarbonization
- Transitioning to low-carbon pathways for electricity could reduce regional emissions by roughly 80 percent
- As an energy exporter to other western states, the region is faced with rising demands for low-carbon electricity

Opportunities and challenges

- Modeling suggests the region is well positioned to pursue a variety of pathways to low-carbon electricity
- Adding new energy generation will necessitate increased transmission capacity, storage, and reserves
- Introducing renewables has created a backlog of requests for interconnection with regional transmission and distribution grids
- A regional workforce that understands energy production and inter-state energy transmission will be critical



Segment 4
Hydrogen Economy

Moderated by

Babs Marrone, Los Alamos National Laboratory

In conversation with

Raj Singh, Los Alamos National Laboratory
Renia Ehrenfeucht, University of New Mexico
Prashant Sharan, Los Alamos National Laboratory
Alan Krupnick, Resources for the Future
Michael Heidlage, Los Alamos National Laboratory

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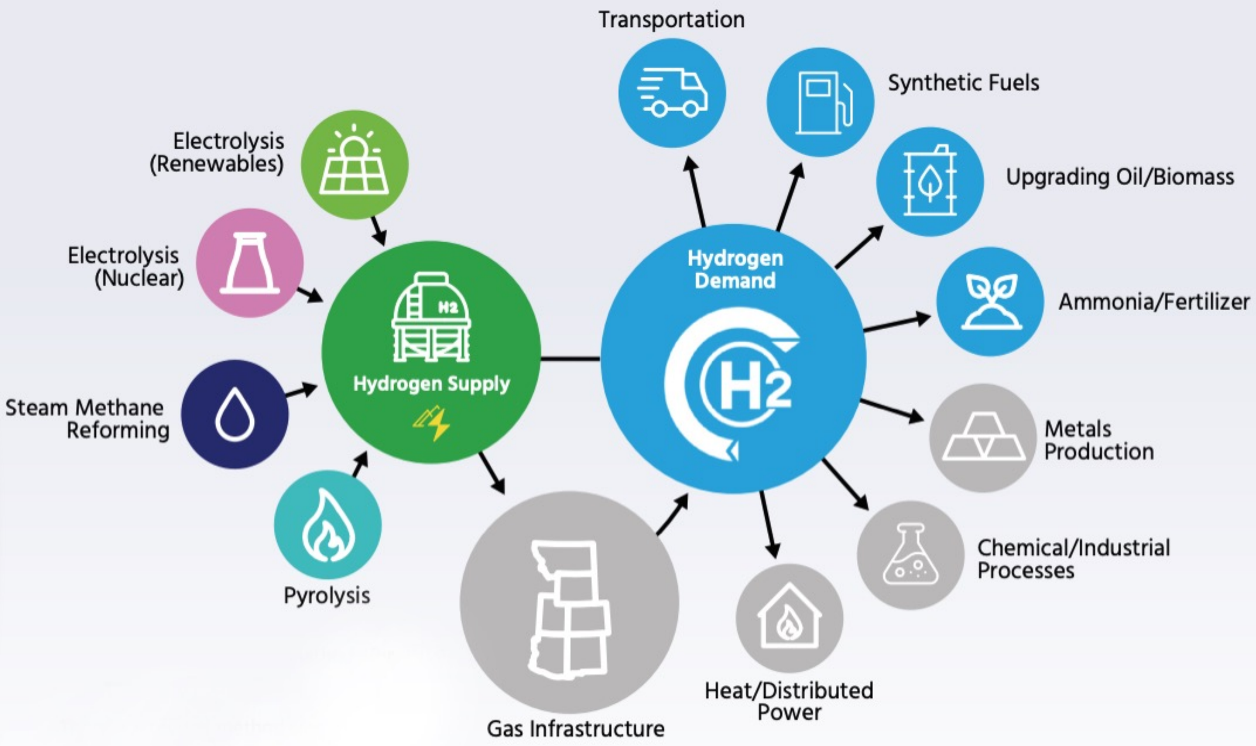
Key findings

Regional relevance

- Abundant natural resources, including natural gas, make the region ideal for large-scale hydrogen production
- Existing infrastructure and workforce could be utilized, which would reduce time and cost to scale up production
- The transportation sector represents an opportunity to create a demand for hydrogen and reduce emissions

Opportunities and challenges

- Enabling technologies that allow for use of non-potable water are needed for sustainable hydrogen production
- A better understanding of climate impacts on regional water availability is needed
- Opportunities to transition government-owned fleets could help accelerate technology deployment
- An assessment of infrastructure needs for hydrogen production, storage, and transportation is needed
- Regional concerns about environmental impacts must be addressed with lifecycle analyses



Segment 5

CO_2 Capture, Utilization, and Storage

Moderated by

Scott Quillinan, University of Wyoming

In conversation with

Derek Vikara, National Energy Technology Laboratory
Jim Gattiker, Los Alamos National Laboratory
Alan Krupnick, Resources for the Future
Bob Page, Arizona State University

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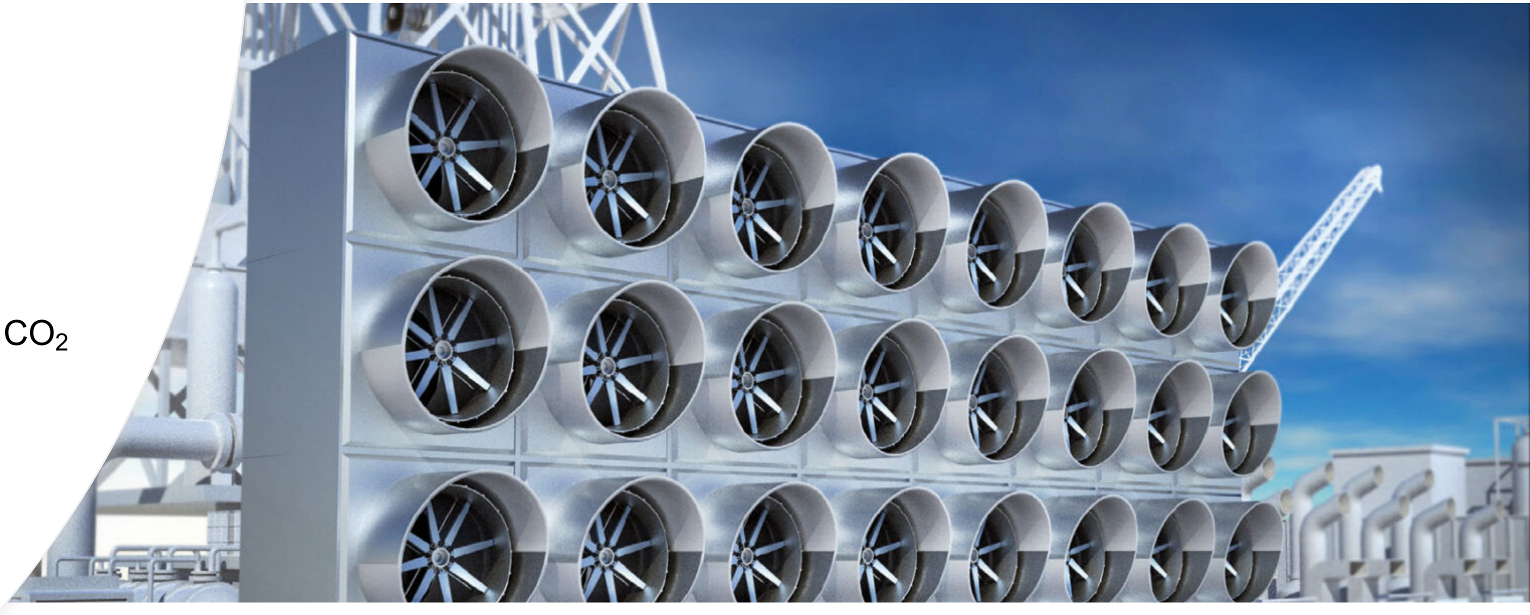
Key findings

Point source management

- Point sources account for 65 percent of regional CO_2 emissions
- Point source capture can significantly reduce CO_2 emissions in the term with readily available technology
- Opportunity exists to utilize produced water for point source capture, with enabling water treatment technology
- 45Q tax credits are key to sustainable point source capture technology adoption

Direct air capture

- Regional climate, open space, and access to renewable energy sources are ideal for DAC
- Scale-up and deployment are in early stages but progressing rapidly
- Long-term DAC will be central to developing a supply of CO_2 to support other symbiotic economies
- Infrastructure and siting needs must be evaluated in collaboration with regional stakeholders



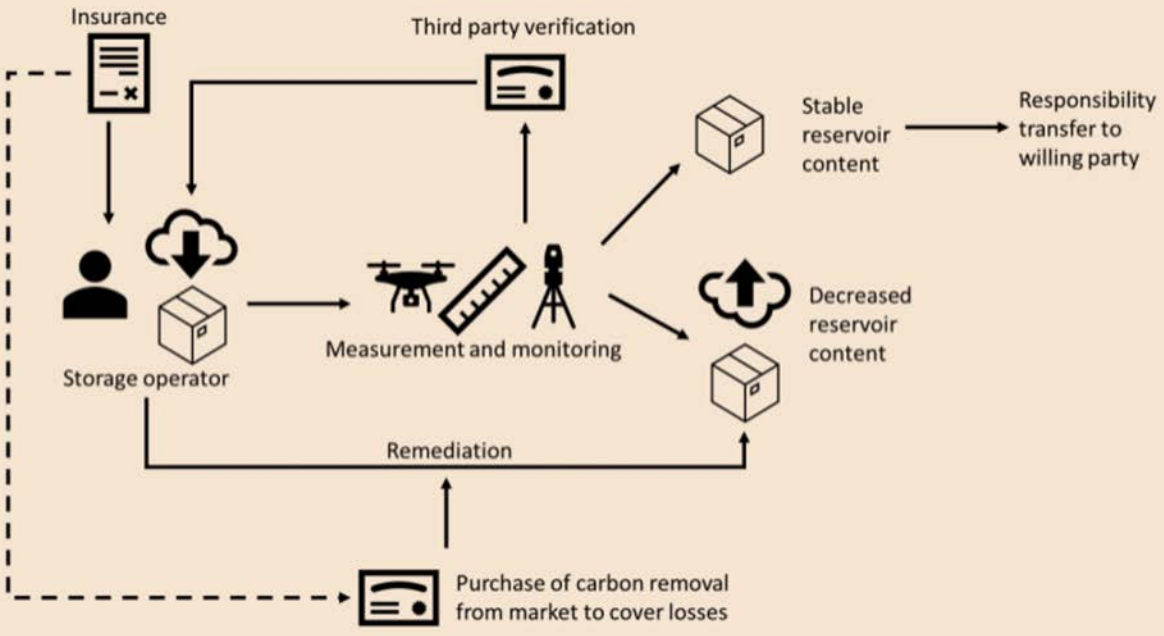
Key findings

CO_2 storage and utilization

- Regional geologic formations have capacity to store roughly 6,000 years' worth of current emissions
- Point source capture and direct air capture technologies will create a supply of CO_2 that necessitates permanent, safe underground storage
- Tax credit incentives such as 45Q represent billions of dollars in savings for regional companies
- Stakeholder engagement is key to assessing pipeline infrastructure and addressing concerns over safety and environmental impact

Certification

- As the scale of carbon sequestration continues to grow, certification will be critical to ensuring safe, reliable, permanent CO_2 storage
- Numerous certification schemes currently exist and there is opportunity to establish an international accreditation system



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Next Steps

Presented by

Scott Quillinan
University of Wyoming

Proposed Phase-II Framework

Place-based approach

- Economics
- Policy
- Workforce
- Energy, environmental, and social justice

Symbiotic economies

- Carbon capture, utilization, and storage
- Hydrogen
- Bioenergy

Energy sector strategies

- Electricity
- Transportation
- Industry (heavy emitters)

Technology feasibility studies

- Technoeconomic analyses
- Lifecycle analyses

Climate modeling

- Climate impacts on water availability

New scope and approaches

Expand regional partnerships

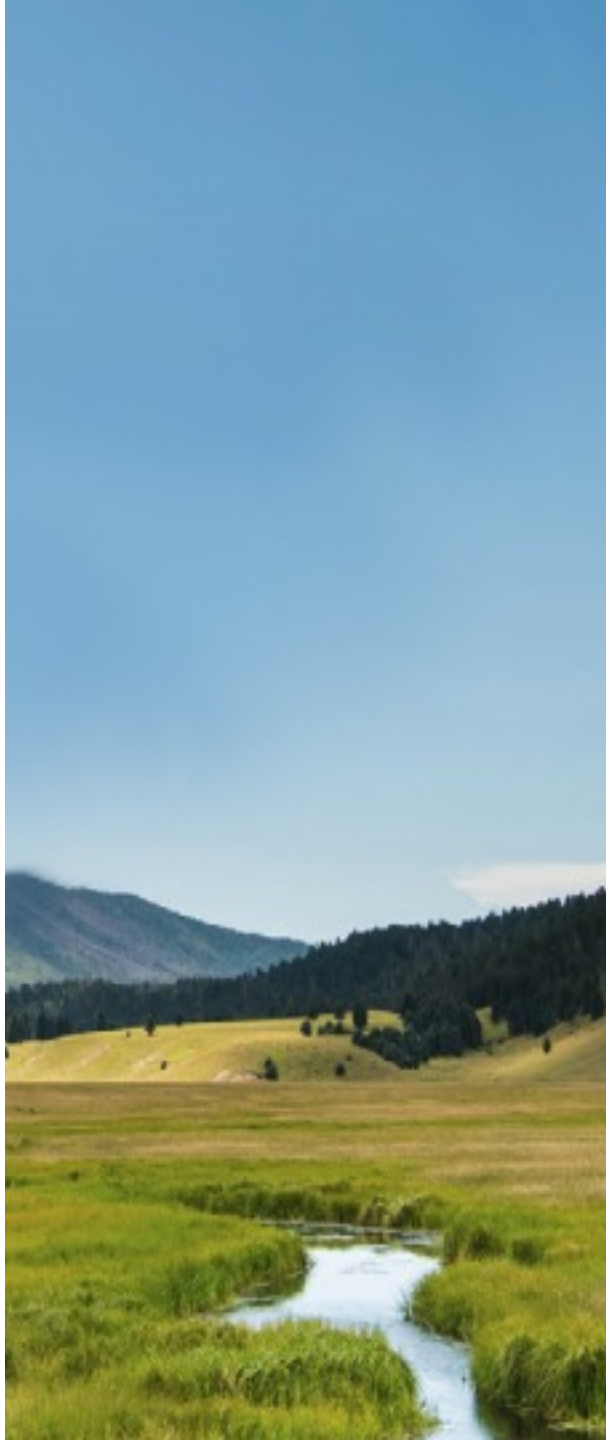
- Increase engagement with sovereign nations
- Add new regional college and university partners
- Leverage new national lab capabilities

Add technology pathways

- Solar
- Wind
- Geothermal
- Hydropower
- Nuclear

Conduct case studies

- Shift focus from assessment to application
- Sub-region analyses to assist communities with energy planning
- Higher degree of integration with policy, economics, and EESJ studies



Thank you for joining!

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