

ENERGY

Colorado School of Mines Research



COLORADO SCHOOL OF
MINES

ENERGY

CHALLENGES DON'T WAIT.

NEITHER DOES
COLORADO SCHOOL
OF MINES.

Energy is a defining opportunity of our time, driving global markets and enabling prosperity, accelerating technological innovation and demanding reliable, affordable and sustainable power at unprecedented scale. And with that demand, our energy systems become more complex. The future of energy will require a flexible mix of resources working together, from conventional fuels to emerging technologies, to support demand while strengthening resilience and security. Meeting this moment takes bold research, trusted expertise and close collaboration.

The future of energy starts at Colorado School of Mines—the world's premier energy university.

At Mines, we stand at the center of the energy conversation. We integrate education, research and industry partnerships to spur innovation and prepare adaptable, forward-thinking talent to lead what's next in the domestic and international energy workforce. Recognized by the prestigious Carnegie Classification as an R1 institution—among the top five percent in the U.S.—we pair 150 years of applied science and engineering excellence with a relentless focus on real-world impact.

Our expertise spans the full energy ecosystem, from subsurface resources and advanced energy technologies to infrastructure modernizations and generation and storage solutions. We work closely with organizations like the U.S. Geological Survey and National Laboratory of the Rockies to accelerate breakthroughs. We are objective and trusted thought leaders who can deliver actionable insights to shape effective, evidence-based energy policy. Here, faculty and students bring technical depth and systems-level insight to the world's toughest energy challenges. Our cutting-edge solutions strengthen economies, secure supply chains and power a more resilient energy future.



Explore how Mines is leading energy innovation at mines.edu/energy-research.

Chemical engineering graduate student Vardhan Senthil assembles a turbine in the Advanced Propulsion and Diagnostics Laboratory at Mines.

LEADERS

POWERING THE FUTURE

At Mines, we leverage our deep expertise in subsurface science, advanced materials and energy systems to lead what's next in energy. Our students and faculty work hand-in-hand with industry and government partners to accelerate real-world innovation that reshapes how we meet global demand, strengthens resiliency and leads to a more prosperous energy future.



MINES ENERGY ALLIANCE

The Mines Energy Alliance provides opportunities for companies to establish strategic relationships with Mines, uniting a dynamic network of researchers, educators, industry and government affiliates and philanthropic donors to collaboratively drive progress in the energy sector.

——> Learn how you can connect with and leverage the Mines Energy Alliance at **energy.mines.edu/alliance**.



FUTURE ENERGY SCHOLARS

The Future Energy Scholars at Mines is an academic pathway that equips students with the skills, experience and connections to become tomorrow's energy leaders. Through hands-on research, internships and industry connections, Mines is shaping the workforce that will power the energy future.

——> Learn more about the Future Energy Scholars at **futureenergyscholars.mines.edu**.



ADVANCED ENERGY SYSTEMS (AES) GRADUATE PROGRAM

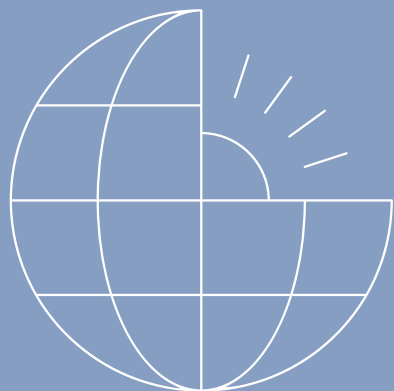
With a focus on emerging energy technologies, the Mines and National Laboratory of the Rockies (NLR) Advanced Energy Systems graduate engineering program is designed to prepare future energy professionals and research leaders to tackle the complex challenges of a dynamic energy world. This prestigious and highly interdisciplinary program provides a rich landscape where students benefit from the insights, expertise and facilities across both Mines and NLR.

——> Learn more about the program at **energysystems.mines.edu/program**.



KEY PARTNERSHIPS

- U.S. Geological Survey
- National Laboratory of the Rockies



THE ENERGY FUTURE IS

MORE THAN A ONE-SIZE- FITS-ALL SOLUTION



The need to deliver affordable, abundant and secure energy with practical, scalable solutions has never been greater. Mines researchers are answering that call, advancing technologies and solutions to power the next generation of energy systems. Drawing on the institution's expertise in subsurface science, advanced materials and systems integration, their work focuses on areas such as tapping into geothermal resources, recycling and reusing nuclear fuel and how to make future power-generation technologies fuel-agnostic. Mines researchers are pushing energy innovation toward greater flexibility and efficiency while helping industry and government partners reduce risk, lower costs and accelerate deployment.



Read about the solutions researchers are pursuing at **mines.edu/advanced-energy-technologies**.

Professor and Ben L. Fryrear Presidential Chair Jenifer Shafer works with graduate student Klemmer Nicodemus in one of the nuclear engineering labs on campus.

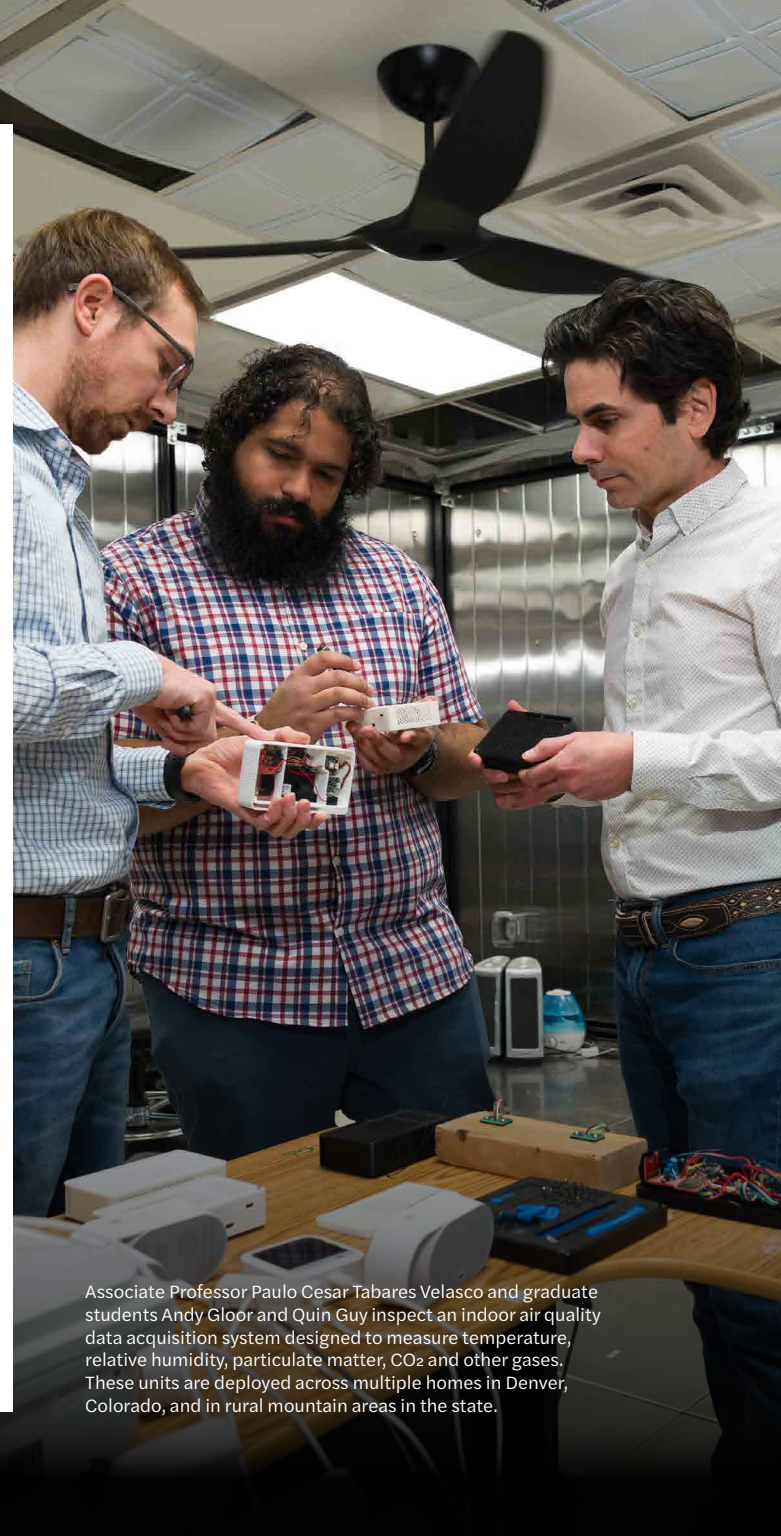
POWER UNDER PRESSURE

When the power goes out—whether from deep freezes, high winds or wildfire threats—it reveals just how much modern life depends on an energy system under strain. Across the United States, rising electricity demand is pushing aging infrastructure beyond what it was designed to handle. The consequences go beyond inconvenience, exposing gaps in reliability, resilience and who recovers first when systems fail.

Mines researchers are rethinking how energy systems are built, upgraded and protected. Their work spans everything from retrofitting homes with smarter, more flexible technologies to developing advanced models that help utilities anticipate and reduce wildfire risk. Just as critical, they work alongside communities to understand how people use energy, make decisions and navigate tradeoffs—ensuring solutions are grounded in real-world needs. By combining engineering innovation with human insight, they are helping design energy systems that can adapt, recover and serve communities more reliably in an increasingly uncertain future.



Read the story at
mines.edu/energy-infrastructure.



Associate Professor Paulo Cesar Tabares Velasco and graduate students Andy Gloor and Quin Guy inspect an indoor air quality data acquisition system designed to measure temperature, relative humidity, particulate matter, CO₂ and other gases. These units are deployed across multiple homes in Denver, Colorado, and in rural mountain areas in the state.



Graduate student Louis Miyasaki and Professor Tzahi Cath work with the electrocoagulation pilot system in the Center for a Sustainable WE²ST at Mines.

ENGINEERING THE BALANCE BETWEEN ENERGY AND WATER

Energy and water are essential for sustaining modern life, and the two resources are deeply intertwined. Demand for both continues to climb, and pressure on both systems is becoming an urgent challenge. At Mines, researchers are working to mitigate that tension with work spanning energy-efficient water treatment options, desalination technologies and nature-based solutions that reduce the burden on both systems, unlocking new water sources while lowering energy use. By rethinking how energy and water work together, Mines is helping build a future where both resources are more resilient and ready to meet rising demand.



Read the story at
mines.edu/energy-water-nexus.



MODELING AMERICA'S ENERGY FUTURE

Forecasting the future of energy in the United States means looking beyond electricity demand to a complex web of systems, from fuel supply and industrial production to the critical minerals that power modern technology. Assistant Professor Maxwell Brown is helping untangle those complexities and provide real-world solutions. Using advanced computational models, his work links power generation, global trade and resource availability to show how disruptions can ripple across industries, drive costs and shape energy security. His insights are giving policymakers and industry leaders the tools to make more informed decisions, helping build a more resilient, affordable and secure energy future—from mine to megawatt.



Read the full story at
mines.edu/energy-modeling.

TURNING ANALYSIS INTO ACTION

The Payne Institute for Public Policy at Mines is a world-class research and policy hub dedicated to turning data and analysis into real-world impact. Rooted in Mines' legacy of solving tough scientific and technical challenges, the Payne Institute combines rigorous research, expert collaborations and policy engagement to tackle the most pressing issues in energy and environmental policy.

Their work informs governments, industry and communities with actionable insights, shaping strategies that are practical, resilient and forward-looking. By connecting data, people and ideas, the Payne Institute translates complex challenges, such as energy security, supply chain transparency, critical minerals and emerging technologies, into solutions that influence decisions and shape the current and future global energy landscape.

Energy conversations the Payne Institute is currently leading:

- Geothermal energy
- Nuclear energy
- Energy and artificial intelligence
- Low-carbon energy technologies
- Supply chain transparency
- Energy security
- The future energy workforce



Learn more about the Payne Institute and engage with their researchers and thought leaders at payneinstitute.mines.edu.



This map shows nighttime lights in the United States, with electric lights shown in yellow, gas flares in red and boat lights in the ocean areas in white.
Photo by the Payne Institute's Earth Observation Group



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research.mines.edu

At Colorado School of Mines, research turns urgency into action.

As a leading public R1 university in applied science and engineering, Mines delivers the workforce, advancements and partnerships that fuel industry and strengthen society. Our researchers confront real-world challenges as trusted experts and pragmatic problem-solvers. From advanced energy technologies to quantum systems, Mines research is rooted in context, integrating technical innovation with economic, environmental, policy and social insight to create enduring solutions with impact. Explore our insights and expertise at **research.mines.edu**



View this publication digitally and explore more content
about how Mines is leading energy innovation at
mines.edu/energy-research.

Cover: Abstract background of light rays radiating through space.