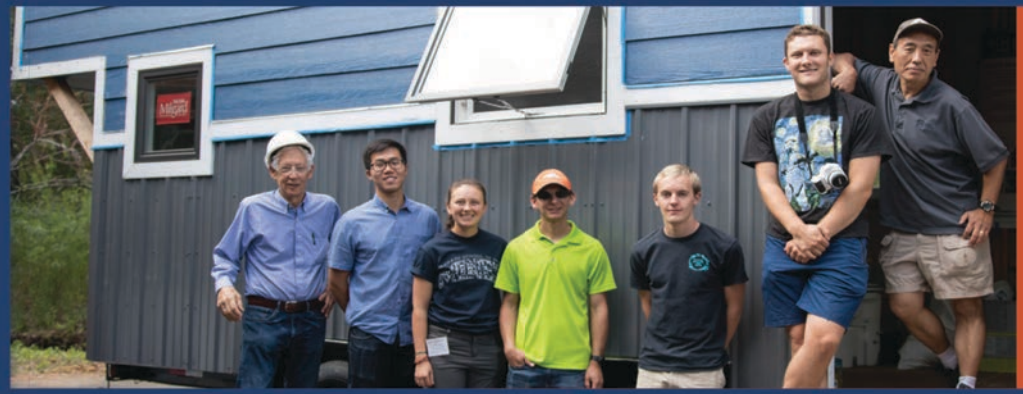
ENERGY &SUSTAINABILTY

REPORT | 2019



COLORADOSCHOOLOFMINES
EARTH • ENERGY • ENVIRONMENT

THE MAKING OF A SUSTAINABLE CAMPUS

Colorado School of Mines' mission of educating and inspiring students from all backgrounds and advancing knowledge and innovations is united with our commitment to integrate sustainability into our culture, academics and operations. At Mines, students have opportunities to take courses that relate environmental issues to society, culture, engineering, and applied sciences. Mines faculty are engaged in a broad spectrum of sustainability-related research projects, ranging from water purification research to the advancement of photovoltaic technologies. Our operations teams are modernizing the way we build and maintain campus facilities, emphasizing efficiency and cost-savings, in addition to conservation.

In this inaugural edition of the Mines sustainability report you can read about our efforts to reduce our environmental impact through energy and water conservation, waste reduction and green transportation. This report highlights current sustainability-related outreach, learning and research. Additional achievements from the past year include:

- The formation of the student Green Team, with over 125 participants and growing;
- Renewal of a campus Sustainability Committee made up of representatives from academia, operations, and student governments;
- A photovoltaic site assessment for solar arrays;
- Hosting *"Zero Waste"* events which identified measures to reduce packaging, utilized compostable utensils and dishes and provided easy to use recycling and composting containers. These measures diverted a significant amount of landfill waste.

Thank you for your interest and to find out more about sustainability at Mines, please see our website at *mines.edu/sustainability*.

COVER PHOTOS: (clockwise from top left): The National Renewable Energy Laboratory [NREL] hydrogen car exhibit on Earth Day; Engineering students at Mines learn how to design and build a more sustainable world; students touring the National Wind Technology Center learn about a new palm tree inspired wind turbine; Students built a carbon cube for Earth Day; Students built an energy-efficient tiny home; Starzer Center is one of many green buildings on campus; Students biking to class.

PRINTED ON POST-CONSUMER RECYCLED PAPER

DESIGN &CONSTRUCTION

What is LEED?

LEED (Leadership in Energy and Environmental Design) Certification is a globally recognized symbol of sustainability achievement. Available for virtually all building project types, from new construction to interior fit-outs and operation and maintenance, LEED provides a framework that project teams can apply to create healthy, highly efficient, and cost-saving green buildings.

3 million+ gross square feet of buildings on campus

142 buildings on campus

STARZER WELCOME CENTER

8 LEED CERTIFIED BUILDINGS

2 LEED GOLD
- Brown Hall
- Starzer Welcome Center

5 LEED SILVER
- Maple Hall
- Marquez Hall
- Elm Hall
- Student Wellness Center
- Marv Kay Stadium

1 LEED CERTIFIED
- Korell Athletic Center

ELM RESIDENCE HALL

BUILDINGS PURSUING LEED CERTIFICATION

1 LEED PLATINUM
- Jackson Street Residence Hall
  [Only LEED Platinum in City of Golden]

4 LEED GOLD
- CoorsTek Building
- Arthur Lakes Library
- Spruce Hall
- Office/Parking Garage

1 LEED SILVER
- Shops II Building

ENERGY &EMISSIONS

ENERGY & WATER SAVINGS

Campus energy use is increasing but decreasing when adjusted for campus growth.

11% **Decrease in ENERGY** use intensity since 2017
[EUI is the energy consumed divided by the gross square footage]

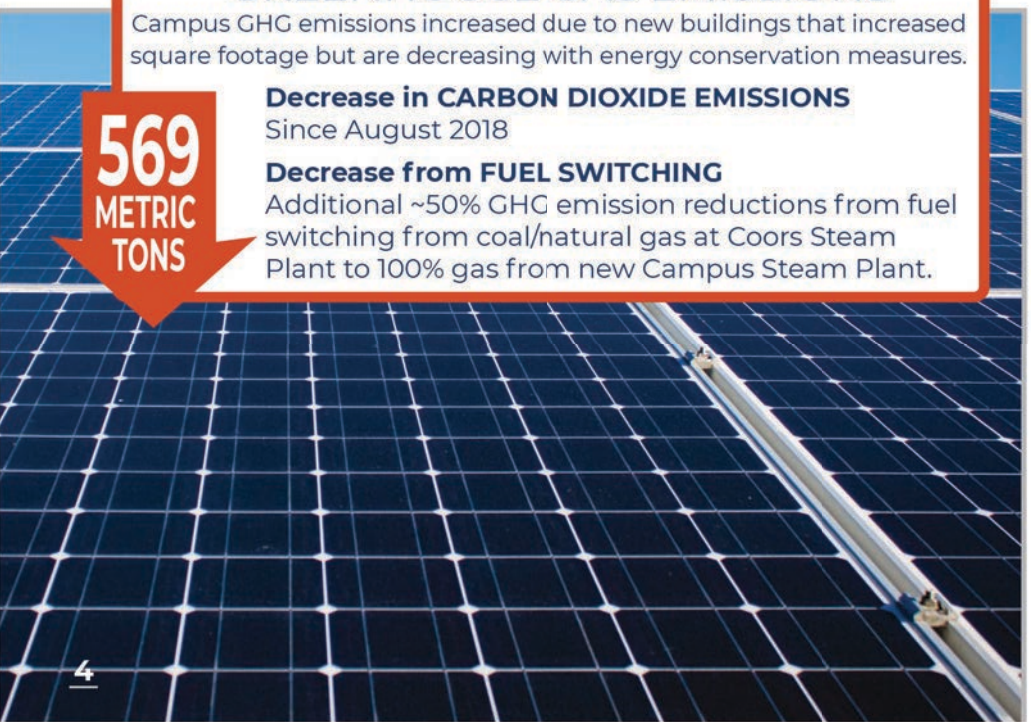
25% **Increase in STEAM GENERATION** efficiency since 2017

GREENHOUSE GAS EMISSIONS

Campus GHG emissions increased due to new buildings that increased square footage but are decreasing with energy conservation measures.

569 METRIC TONS **Decrease in CARBON DIOXIDE EMISSIONS** Since August 2018

Decrease from FUEL SWITCHING
Additional ~50% GHC emission reductions from fuel switching from coal/natural gas at Coors Steam Plant to 100% gas from new Campus Steam Plant.



CoorsTek BUILDING

The CoorsTek building saves energy by using daylighting in the atrium. Energy-efficient windows reflect heating and cooling back into the space.

SOLAR ARRAYS | NEW CONSTRUCTION

Parking Garage / Office Building

| A solar array is planned for the new parking garage on Maple Street. The solar array will offset power for interior lighting and further reduce our GHG emissions.

Residential Hall

| Rooftop solar panels will offset 10% of the electrical use for the new residence hall on Jackson Street. An high energy-efficient heating and cooling system will provide a 40% reduction in energy usage compared to a traditional heating and cooling system that uses more energy to operate.

UTILITY COSTS

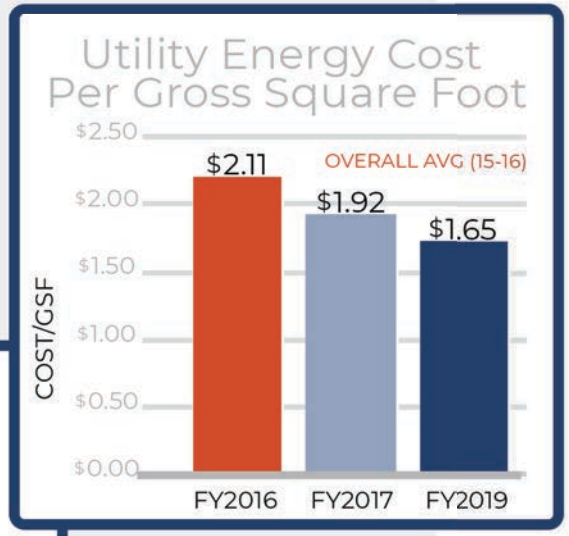
Utility ISOC Program Savings

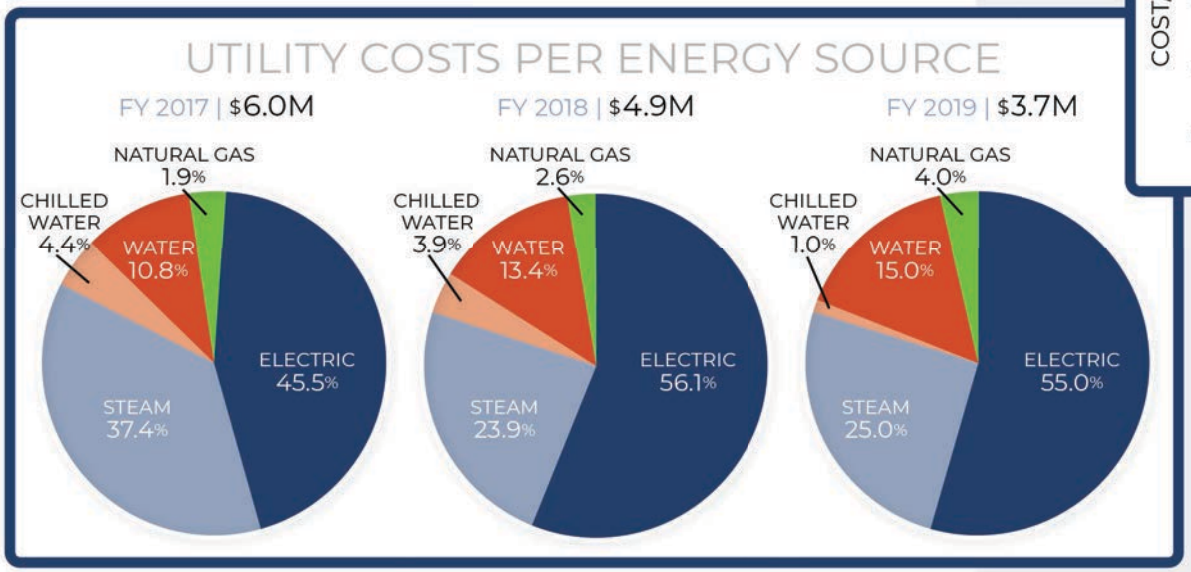
The Interruptible Service Option Credit (ISOC) reduces electrical rates for Xcel Energy's customers that switch to backup generators for power during peak demand.

Cost for Generators: $ 5.7 M
Annual Savings: $ 809K
Year Built: 2018 | PAYBACK: 7 YEARS

CAMPUS DIESEL GENERATORS

ENERGY Costs are Decreasing and SQUARE FOOTAGE IS INCREASING.





INVESTMENTS IN OUR FUTURE

Most government buildings last 60 to 100 years or more. Energy Savings Performance Contracts are an alternative financing mechanism for government buildings that use savings generated by the project to fund infrastructure improvement programs in cost effective energy conservation measures.

Cost: $ 3.0 M | PAYBACK: 9.1 YEARS [2019]
Guaranteed Annual Savings: $ 307K
Utility Rebates: $ 167K
GHG Emissions Savings: 2,600 Tons*
***Equivalent to 2,204 Vehicles or 11,220 Trees for 1 Year**

ENERGY SAVINGS PERFORMANCE CONTRACT PHASE 1 | 2009-2010

- Upgraded campus lighting in most buildings
- New water irrigation system and controls
- Domestic water retrofits
- Energy recovery reduces steam usage in Hill Hall, Coolbaugh, and Alderson

McKinstry
For The Life Of Your Building

20% WATER Reduction Since 2009

STATE MANDATED GOAL WAS 10%

ENERGY EFFICIENT LIGHTING IN BROWN HALL

STUDENT REC CENTER AT NIGHT

PowerED Campaign | Energy and Water Savings

- Ongoing commissioning and operational improvements
- Reporting and analysis of utility data and savings
- Occupant engagement campaign, including Shut the Sash, Green Team, Sustainability Committee, Buildings Dashboard, Energy and Water Savings Competitions, New Student Orientation Integration, Mines branded website, posters, stickers, and other engagement measures.

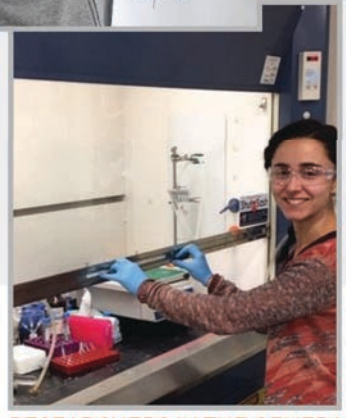
Cost: $ 4.8 M | PAYBACK: 10.8 YEARS [2028]
Guaranteed Annual Savings: $ 446K
Utility Rebates: $ 94K
GHG Emissions Savings: 4,401 Tons*
***Equivalent to 3,426 Vehicles or 18,992 Trees for 1 Year**

ENERGY SAVINGS PERFORMANCE CONTRACT PHASE 2 | 2018-2020

- New chiller, heat exchanger, controls, and distribution system [Berthoud Hall]
- Energy-efficient lighting upgrades to 22 buildings
- People Power Planet behavior change campaign
- 3-year contract

People.Power.Planet
MY CAMPUS IS HELPING TO SAVE THE EARTH!

STUDENTS SIGN UP FOR PowerED CAMPAIGN



RESEARCHERS IN THE GENERAL RESEARCH LAB AND HILL HALL COMMIT TO '*SHUT THE SASH*' TO SAVE ENERGY

THE POWERED CAMPAIGN IS AUDITING HILL HALL, WHICH CONTAINS NUMEROUS RESEARCH LABS, TO REDUCE ENERGY CONSUMPTION THROUGH ENERGY EFFICIENCY MEASURES AND OCCUPANT BEHAVIOR CHANGE.

INVESTMENTS IN OUR FUTURE

New Chiller [Cooling] Plant | 2018

- A new chiller plant was installed in the Green Center
- Increased reliability
- More efficienct equipment
- Connects 3 buildings on a loop system (Green Center, Hill Hall, Coolbaugh Hall)

Cost: $ 8.0 M
Annual Savings: $ 145K
Green Center Built: 1971
Chiller Plant Installed In Basement: 2019

GREEN CENTER

GREEN CENTER [CHILLER] PLANT

New Heating [Steam] Plant | 2017

- Mines now produces its own steam and is no longer reliant on Coors
- Increased reliability due to failing steam lines from Coors
- Reduced steam losses of 20% during transmission

Cost: $ 13.5 M
Annual Savings: $ 745,000
Heat Plant Built: 1948
Campus Steam Plant Renovated: 2017

HEATING [STEAM] PLANT

RECYCLE &WASTE DIVERSION

Waste Diversion

In FY19, our waste diversion rate was 42%, which means 42% of our waste was recycled and diverted from landfill. The rate does not include e-waste, lab recycling, and other hard-to-recycle items such as tires, paint, and batteries.

Twelve of the 44 water bottle refill stations have data collection devices. Based on data collected from these 12 stations, Mines avoided the use of 171,490 plastic bottles.

Zero Waste Events

In 2019, we setup zero waste stations for E-Days. Nearly 90% of the event waste was diverted recovering nearly 1,377 pounds of material through recycling and composting.

Hard-to-Recycle

We recycle hard-to-recycle items such as bike tires and tubes, used oil, and paint.

Green Move Out/Move In

Used furniture, small appliances, cardboard, and other items are recycled when students move in and out.

Lab Recycling

We recycle lab waste such as nitrile gloves, plastic pipette boxes and trays, block styrofoam, and gel packs.

Electronic Waste | E-Waste

We recycled 15.2 tons of e-waste in 2018. E-Waste is hazardous waste and must be recycled through responsible hazardous waste disposal companies. Examples of e-waste include computers, televisions, and printers.

Mines Student In A Research Lab

Campus Water Bottle Refill Station

Researcher Recycles Nitrile Gloves

Zero Waste Station At E-Days

Mines Student Displays Bike Tubes For Recycling

Mines Students Helping At Move-In

Campus E-Waste Collection Area

SURPLUS PROPERTY

We partnered with University of Colorado Boulder to sell working surplus property through a state auction warehouse. Proceeds from the sale of surplus property, defray disposal costs, fund sustainabilty projects and campus research.

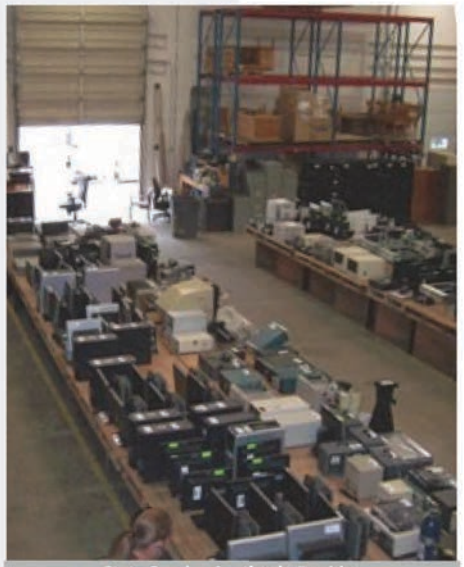
Lab Equipment
Working lab equipment is resold to other schools and research labs at auction.

Computers & Electronics
We send working computers, monitors, printers, copiers, and more to state auction for resale to the public.

Vehicles
Some old vehicles were sold at state auction this year.

Scrap Metal
We recycled more than 65 tons of scrap metal in 2018. Scrap metal comes from surplus such as old metal filing cabinets to small appliances and old mining equipment.


Old Microscope Sold At State Auction


State Surplus Auction in Boulder


Old Surplus Mining Equipment


Old Surplus Mines Vehicle

ACADEMICS &RESEARCH

Among the numerous sustainability related courses offered at Mines are environmental and humanitarian engineering, advanced energy systems, renewable energy systems design, sustainable building design and green chemistry.

Several professors are integrating the PowerED buildings database that tracks energy, water, and emissions for campus buildings into their curricula. The Sustainability Office and Facilities Management Department are supporting energy and water conservation research on campus through funding and project review.

MINES RECEIVED A $4 MILLION NATIONAL SCIENCE FOUNDATION GRANT TO TACKLE THE PUBLIC HEALTH AND ENVIRONMENTAL CHALLENGES POSED BY ARTISANAL AND SMALL-SCALE GOLD MINING IN COLUMBIA.

CECS TRADE FAIR TIED FOR 3RD PLACE: MAPLE HALL RETROFIT

NINE SENIOR DESIGN TEAMS PARTICIPATED IN A CAMPUS ENERGY SIMULATION PROJECT TO OPTIMIZE CAMPUS ENERGY USE BY DEVELOPING OPENSTUDIO BUILDING ENERGY SIMULATION MODELS FOR CAMPUS BUILDINGS.

ON EARTH DAY 2019, STUDENTS BUILT A CARBON CUBE TO EDUCATE THE CAMPUS ABOUT CARBON EMISSIONS GENERATED FROM ELECTRICITY USE IN CAMPUS BUILDINGS. THE CUBE REPRESENTS 1/3 OF A TON OF CARBON.

I'm feelin' green and I ♥ it!
mines.peoplepowerplanet.com

MINES HOSTS 10 SUSTAINABILITY RELATED RESEARCH CENTERS

1. Renewable Energy Materials Research Science and Engineering Center
2. Colorado Fuel Cell Center
3. Colorado Renewable Energy Research Collaboratory
4. Reinventing the Nation's Water Infrastructure
5. Advanced Energy Control and Power Systems
6. Advanced Water Technology Center
7. Center for Environmental Risk Assessment
8. Center for Solar and Electronic Materials
9. Power Systems Engineering Research Center
10. Integrated Ground Water Modeling Center

NREL
NATIONAL RENEWABLE ENERGY LABORATORY

THE NATIONAL RENEWABLE ENERGY LABORATORY [NREL] AND THE COLORADO SCHOOL OF MINES ARE PILOTING A NOVEL ADVANCED ENERGY SYSTEMS (AES) GRADUATE PROGRAM IN FALL 2019 TO ADDRESS THE NEED FOR MORE ADVANCED ENERGY SYSTEMS AND INFRASTRUCTURE.

IN JULY 2019, ERIC TOBERER, ASSOCIATE PROFESSOR OF PHYSICS AT COLORADO SCHOOL OF MINES, WON THE U.S. PRESIDENTIAL EARLY CAREER AWARD FOR SCIENTISTS AND ENGINEERS (PECASE) FOR HIS RESEARCH ON NON-TRADITIONAL THERMOELECTRIC AND PHOTOVOLTAIC MATERIALS.

MINES STUDENTS WORKING ON THE SOLAR DECATHLON AFRICA HOUSE.

MINES DESIGN FOR SOLAR DECATHLON AFRICA HOUSE

TRANSPORTATION

Green Cars & Car Share

Students and faculty receive a 20% discount on parking passes for green cars and trucks.

A campus car share program is available through zipcar. We have a Jeep Wrangler named "Javier" and a Ford Focus named "Shawshank".

RTD

Student fees pay for RTD bus and Light Rail passes for all students. Staff and faculty receive a discount on monthly RTD passes. The Golden "Green Bus" takes passengers to and from Mines from the Jeffco Court House Light Rail Station. Buses run every 15 minutes during the school year and every hour in the summer.

VEHICLES & CHARGING STATIONS ON CAMPUS

4 | Electric vehicle charging stations average ~1300 charges per year. 2 are located in the CTLM parking lot and 2 in the Ford lot.

6 | Planned EV Charging Stations

EV Charging Station In CTLM Lot


EV Charging Station Ribbon Cutting

GRANTS

| RECEIVED

Electric Vehicles

We received $25,100 in grants from the state for 4 electric vehicle charging stations.

Recycling

We received $25,000 from the state for new recycling bins for 3 buildings, recycling boxes for nitrile gloves used in labs, and recycling promotional materials.

| PROPOSED

Electric Vehicles

We submitted a grant application in May 2019 for 6 additional EV charging stations.


New Recycling Station In Coolbaugh Hall

Recycling Marketing Materials

OPERATIONAL KEY PERFORMANCE INDICATORS

569 METRIC TONS

DECREASE
OF CARBON DIOXIDE EMISSIONS
SINCE AUGUST 2018

11%

DECREASE
IN ENERGY USE INTENSITY
SINCE 2017
THE MILES PER GALLON FOR YOUR BUILDING

42%

MATERIALS RECYCLED
DIVERTED FROM LANDFILL
SINCE 2017

20%

DECREASE
IN DOMESTIC WATER USE
SINCE 2009

25%

INCREASE
IN STEAM GENERATION EFFICIENCY
SINCE 2017

$2.3

MILLION
IN ENERGY COST SAVINGS
SINCE 2017

Source | EnergyCAP is an energy management and energy accounting software program used by facilities management for tracking, managing, processing, reporting, benchmarking, and analyzing utility bills and energy and sustainability information. EnergyCAP also interfaces with the EPA's Energy Star Portfolio Manager software for energy and water conservation in commercial buildings.

MINES SUSTAINABILITY