A. FACILITY PLANNING DOCUMENTATION:
CDHE approved Facility Program Plan .......... Yes .......... X .......... No .......... N/A .......... Date Approved .......... 7/2019

B: PROJECT SUMMARY/STATUS:
Colorado Mesa University (CMU) requests capital construction funds and spending authority to expand the campus-wide geo-exchange system, on our main campus in in Grand Junction Colorado, to provide sufficient drill and loop field capacity to allow 100% of existing campus buildings to be connected into the geo exchange resource.

CMU’s existing geo exchange system is the largest of its kind in Colorado and across the Intermountain West. The current system provides sufficient drill field and loop field capacity to serve 16 campus buildings, both academic and auxiliary facilities, for a total connected load of 1.2 million square feet. The current system saves CMU $1.5 M ¹ in annual operating costs and reduces our Carbon footprint by nearly 9k metric tons² annually.

¹ Savings are based on paying a blended rate of $0.11/kWh for electricity, 1.2M square feet of connected load, and savings of 12kWh/sf/yr. for buildings served by geo exchange (22 kWh/sf/yr.), versus those served with traditional HVAC systems (10kWh/sf/yr.)
² Savings are based on blended production between coal and natural gas fired power plants in Colorado, with coal fired facilities producing 2.26 pounds of CO₂ per kWh of electricity produced and natural gas facilities producing 0.97 pounds of CO₂ per kWh
The current request would allow CMU to expand drill and loop field capacities to serve an additional 20 campus buildings, 716,191 square feet of additional connected load, and would save CMU an additional ±$1M in annual operating costs while reducing our Carbon footprint by an additional 5k metric tons annually.

**Executive Summary: CCHE Capital Construction Scoring Criteria**

- **Health and Safety**: Criterion #1 is not applicable; this project doesn’t propose a new building or significant remodel, and instead proposes improvements to utility infrastructure to lower annual operating costs and reduce our Carbon footprint.
- **Reduction of Deferred Maintenance**: The improvements proposed in this project will not reduce campus deferred maintenance needs in buildings that will be connected to the system in the future.
- **Other Fund Sources**: CMU can contribute 56% of the total cost of the project in cash. None of these funds will be coming from student fees, and will instead come from university reserves and/or fundraising.
- **Space Needs Analysis**: The project under consideration expands the campus-wide geo-exchange system on university grounds. While this project will not alleviate space needs, it will alleviate energy needs that impact all courses and programs. This project will allow CMU to save the university, and therefore the students, money while utilizing green technologies to reduce CMU’s impact on the environment and allow those resources to be invested into more direct programs and services supporting student success.
- **Achieves Master Plan Goals**: This Energy Independence project is integral to achieving all four statewide policy goals as well as institutional planning goals.
- **Governing Board Priority**: This project is CMU’s third priority.

In addition, our request has been highlighted by and supports Governor Jared Polis’ “Heat Beneath our Feet initiative, by leveraging the use of “...geothermal energy technologies for both electricity generation and heating and cooling systems in western states...”

**C. SUMMARY OF PROJECT FUNDING REQUEST (CC_CR-C form):**

<table>
<thead>
<tr>
<th>Funding Source</th>
<th>Total Project Cost</th>
<th>Total Prior Appropriation</th>
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**D. PROJECT DESCRIPTION/SCOPE OF WORK/JUSTIFICATION:**

History of Appropriated Projects funded with controlled maintenance, capital renewal, capital construction, emergency CM repairs, cash, or operational funds completed within the last fifteen (15) years or ongoing projects that can be associated with either this CC/CR building or infrastructure request.

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<th>Project No.</th>
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3 https://westgov.org/initiatives/overview/the-heat-beneath-our-feet
CMU has completed many geo-exchange projects as part of larger projects, all with university reserves.

<table>
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<tr>
<th>Description</th>
<th>$8.8M</th>
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Description - This request will provide four additional drill fields, 309k lineal feet of drill field capacity, 2,000 lineal feet of new central loop piping to connect existing and proposed fields into one contiguous system available to serve all buildings on CMU’s main campus, and all associated appurtenances (vaults, pumps, valves, sensors, direct digital controls, etc.). The new loop field will connect to existing loop fields and existing boilers and cooling towers spread across campus. Continuing the push towards connecting all new facilities and significant remodels into the geo exchange system will provide a cleaner, more energy efficient means of heating, cooling, and producing domestic hot water now and for many decades into the future. The improvements proposed in this request will also improve the performance and safety of the existing system, which is at capacity, by providing sufficient excess capacity to prevent existing boilers and coolers towers from running extended periods of time during the coldest and warmest parts of the year. It’s not unusual during the hottest three or four weeks of summer for temperatures in the central loop to get high enough for heat pumps in older facilities (Escalante Hall and Wubben/Science) to shut down. Though the system is designed to supplement drill fields with existing cooling towers to lower loop field temperatures during the hottest part of the summer, and to employ boilers to heat the loop up when necessary, during the coldest weeks of winter, having to do so greatly diminishes energy savings over the long term.

Other difficulties CMU has experienced with increasing loop field temperatures over time have shown up in existing building systems that do not have functional refrigeration head pressure safety switches; if the condenser water temperature gets too high, there is a risk that the refrigerant charge will release from the equipment to the nearby environment, which is bad for occupants and bad for the environment.

CMU may choose to request additional state funding to convert existing buildings from traditional heating and cooling systems to more efficient heat pump systems in the future, or may elect the performance contracting route which would allow all buildings to be connected with debt being paid back via future energy savings. Regardless of which route is chosen, a phased approach to avoid shutting down large parts of campus at the same time.

E. PROGRAM INFORMATION:
Geo-exchange systems are a proven technology that has been used to heat and cool hospitals, manufacturing facilities, commercial office buildings, large hotels, casinos, and resorts for many years. CMU’s system is different from most geo exchange systems in use today where one building is connected to one drill field. CMU’s system connects many different buildings to many different drill fields, cooling towers, and boilers, which allows heat energy to be shared from room to room within a building, from floor to floor, from building to building, from building to ground, or from a building to a heat sink such as the university’s 800k gallon swimming pool or irrigation water that CMU’s uses to keep our campus green. The expanded geo-exchange system proposed in this year’s request will increase CMU’s loop field capacity and will allow CMU to continue it’s practice of connecting all new buildings and significant remodels into the campus wide system.

With the rising cost of energy, an ever-expanding campus, and the university’s commitment to reducing greenhouse gasses, energy consumption has been a frequently discussed topic when considering
continued expansion. Colorado Mesa University has previously requested funding to solve critical infrastructure issues associated with electrical and geo-exchange capacity, none of which received state funding. This current request replace the 2009 solar request and the 2013 tri-generation submittals.

Colorado Mesa University’s primary power supply is provided by Xcel Energy at the north end of the campus on Orchard Avenue. This service provides 13.2 kV power across two separate electrical loops that function to provide redundancy in the way power is delivered across campus. One, or more buildings (so long as each building is located within the same reach of the loop), can be taken offline while power is provided to all other buildings on the loop. Providing looped pathways for high voltage power delivery across campus helps to more evenly distribute loads as well. The two existing loops and the main power supply from Xcel Energy provide around 6 mW of power, which was sufficient to allow development within the current boundaries of the university campus (Orchard Avenue on the north, 12th Street on the east, North Avenue on the south, Cannell Avenue on the west).

As CMU has expanded past Cannell Avenue, the need for additional power supply and reducing current electrical demand has become a growing concern. The one line diagram in Figure 1.2 identifies the two main campus loops and provides information on the size of transformers and anticipated loads on both the east and west loops. CMU’s current power delivery system meets all requirements for reliable, cost-effective power delivery. Unfortunately, CMU’s one and only power supply from Xcel Energy is not large enough to allow the continued development anticipated on the campus master plan. In the absence of an expanded geo/PV project, CMU will soon need to incur a cost of over $1,000,000 to add one additional main electrical feeds to campus.
Expanding the geo-exchange system on the main campus will help delay the point at which an additional power supply from Xcel Energy is needed. Expanding CMU’s geo exchange system to serve existing facilities will reduce demand for electricity on campus by 12kWh/sf/year, for each building connected, which will provide additional capacity during peak periods when the existing electrical system will struggle to keep up with demand.

CMU currently owns and operates one of the largest community-type geo-exchange systems in higher education. Geo-exchange technology uses the Earth’s renewable energy to heat and cool buildings (HVAC) as well as provides domestic hot water for showers, sinks, and cooking equipment. According to the U.S. Environmental Protection Agency (EPA), geo-exchange is “The most energy-efficient, environmentally clean, and cost-effective space conditioning systems available today”\(^4\).

\(^4\) See https://www.epa.gov/rhc/geothermal-heating-and-cooling-technologies.
CMU’s current geo-exchange system is comprised of eight existing loop fields with one new field currently under design and consideration. These loop fields contain more than 434,000 linear feet of 2” diameter high-density polyethylene pipe (HDPE) and are connected via 5,000 linear feet of 18-inch diameter HDPE known as the “Central Loop”. The loop fields consist of 4,427 boreholes approximately 400-600 feet deep or 213,300 linear feet of total loop field. Attached to this system includes approximately one thousand heat pumps, five cooling towers for supplemental cooling, two boilers plants for supplemental heating, and six central loop pumps (50 horsepower each - 3 north & 3 south) that move condenser fluid around the central loop.

The campus-wide geo-exchange system provides extremely efficient heating, cooling, and domestic hot water generation. The central loop provides up to 89% of the energy needed to heat and cool the connected buildings (1,213,572 sf). There are currently a total of 16 connected buildings across the campus. These buildings include Dominguez Hall (56k sf), North Avenue Residence Hall -Lucero (110k sf), University Center (104k sf), Wubben/Science (111k sf), Houston Hall (80k sf), Bunting Residence Hall (72k sf), Garfield Residence Hall A&B (93k sf), The Maverick Center (220k sf), The Maverick Pavilion (33k sf), Escalante (76k sf), Tomlinson Library (95k sf), Wingate Residence Hall (43k sf), Confluence Hall (68k sf), Aspen Apartments (46k sf), and St. Mary’s Medical Education Center (25k sf). All new construction and significant remodels are anticipated to be on the central loop. The exhibit in Figure 1.3 provides a graphic representation of CMU’s Global Management System (GMS), current geo-exchange central loop, associated bore fields, supplemental cooling/heating equipment, and loop field piping.

Figure 1.3
The continued use of geo-exchange technology at CMU represents a significant investment in green technologies that have proven to be cost effective. A traditional HVAC system consumes as much as 22 kWh/sf/yr while a geo-exchange system consumes about 10 kWh/s.f./yr. This saves the university as much as $1.5M/year. Conservative estimates show our carbon footprint has been reduced by 9,000 metric tons/yr with the use of geo-exchange technology.

Health and Safety
Criterion #1 is not applicable. The Energy Independence project is not intended to replace, but rather to supplement what CMU is doing today to heat and cool campus facilities. This project supports energy conservation including green, clean, cost and consumption. The Energy Independence project is not necessitated by the age of existing infrastructure. Therefore, this request would qualify as a “new building” where health and safety issues do not apply and will not be applied to DHE’s denominator.

Reduction of Deferred Maintenance
This project is not intended to reduce deferred maintenance on campus and will instead allow CMU to continue connecting all new buildings and significant remodels into the campus wide geo exchange system over time.

Other Fund Sources
CMU is able to contribute 56% of the total cost of the Energy Independence project. None of these funds will be coming from student fees and will instead come from university reserves and fundraising for this purpose.

Space Needs Analysis
The project under consideration expands the campus-wide geo-exchange system on university grounds. While this project will not alleviate space needs, it will alleviate energy needs that impact all courses and programs. This project will allow CMU to save the university, and therefore the students, money while utilizing green technologies to reduce CMU’s impact on the environment and allow those resources to be invested into more direct programs and services supporting student success. In short, CMU’s Energy Independence project will benefit all students and the whole campus.

Leveraging the use of geothermal technologies to heat and cool buildings will impact the top 10 occupations with the highest projected openings at the relevant education level in the most recent Bureau of Labor Statistics projections. This project will affect students pursuing associates degrees in the following occupations:

1. Heavy and tractor-trailer truck drivers
2. Nursing assistants
3. Bookkeeping, accounting, and auditing clerks
4. Teaching assistants, except postsecondary
5. Medical assistants
6. Hairdressers, hairstylists, and cosmetologists
7. Automotive service technicians and mechanics
8. Licensed practical and licensed vocational nurses
9. Computer user support specialists
10. Preschool teachers, except special education
It will affect students pursuing bachelor’s degrees in the following occupations:

1. General and operations managers
2. Registered nurses
3. Software developers and software quality assurance analysts and testers
4. Project management specialists and business operations specialists, all other
5. Accountants and auditors
6. Elementary school teachers, except special education
7. Management analysts
8. Market research analysts and marketing specialists
9. Personal service managers, all other; entertainment and recreation managers except gambling; and managers, all other
10. Secondary school teachers, except special and career/technical education

Achieves Goals
This Energy Independence project is integral to achieving statewide policy goals as well as institutional planning goals.

This Energy Independence project supports Governor Polis’s The Heat Beneath our Feet Initiative and Colorado’s Higher Education Master Plan. Specifically, Goal 2, Erase Equity Gaps. In Fall 2020, nearly 60% of CMU’s students received PELL and/or reported that they were first generation.

This Energy Independence project supports Goal 4 as well; Invest in Affordability and Innovation, by helping CMU develop resources that will allow public institutions of higher education to meet projected enrollment demands while promoting affordability, accessibility, and efficiency. Heating and cooling campus facilities at reduced costs when compared to traditional HVAC systems, positively impacts CMU’s ability to offer other high demand programs and services to meet CO needs. Our geo exchange system can also serve as a pilot project for other universities and the general public who are interested in leveraging innovative technologies to foster resource sustainability and environmental stewardship.

Moreover, this project fits in with general statewide goals of conservation, repurposing, and renewal and ties into the Governor’s commitment to electrifying building systems, Governor’s Executive Order on Greening of State Government (D 2019 016), and SB22-118, Encourage Geothermal Energy Use, which in effect encourages community-based geo exchange systems. Said directives require Institutions to

- Analyze how requested projects conform with the State's High Performance Certification Program (HPCP)
  - This project meets three goals of sustainable development. These goals include affordable and clean energy, responsible consumption and production, and climate action. Regulating temperatures in the central loop increases the efficiency of the heat pumps throughout campus and allows CMU to continue to add new buildings to the central loop. Adding solar collectors will allow CMU to produce additional, affordable, reliable, and clean energy that is needed to meet the current and future power demands of our campus.
- Analyze on-site renewable energy generation or renewable clean energy purchases,
  - This project supports the use of on-site renewable technologies.
• Encourage the creation of community geothermal gardens
  o Identifies geothermal equipment as a type of pollution control and renewable energy
generation devise
• Provide documentation that the Institutions explored options for the electrification of building
systems, and such review shall include a full life cycle cost analysis of the impact of electrification.
  o Our proposed Energy Efficiency project directly addresses electrification of our buildings by
    allowing CMU to continue replacing traditional heating equipment that uses natural gas to
    heat air or water to warm a building, with geo exchange heat pumps which rely on electricity
to both heat and cool buildings.
• Provide documentation or plans showing that at least 20% of parking spaces will be pre-wired for
  charging, and that at least 5% will have Electronic Vehicle (EV) chargers installed, and
  o This capital request does not include any pre-wiring or EV Charges as we are not addressing
    parking lots in our requests. Any future requests on our current parking lots would include
    this requirement

The Energy Independence project also contributes to CMU’s Institutional Facilities Master Plan.\(^5\) When
CMU created its last Facilities Master Plan, it was noted that any significant addition of facilities beyond
what existed would require additional power infrastructure. This has indeed occurred and this Energy
Independence project can serve as a partial solution to CMU’s power needs.

This project supports CMU’s Institutional Strategic Plan goals. This Energy Independence project
directly supports CMU’s 2020 goals as follows:
• CMU will continue to serve as a leader in community based geo-exchange systems (Goal #2).
• Will result in reduced costs as this technology will lower demand on the local energy delivery system
  and reduce CMU’s reliance on traditional energy supplies helping CMU become more competitive
  in the business of higher education (Goal #3).
• This project allows CMU to use a new technology to lower CMU’s carbon footprint which will
  positively impact student enrollment and satisfaction; providing learning opportunities for students;
  and, simultaneously help meet an important statewide goal (Goal #3).
• This project will “continue to strengthen financial and organizational structures that support the
  University’s strategic goals” (objective 3c of CMU Goal #3) by providing an energy source that is less
  expensive than traditional energy sources

Finally, this Energy Independence project contributes to CMU’s five-year needs list (attached with these
documents).

*Governing Board Priority*
This project is CMU’s third priority.

**F. CONSEQUENCES IF NOT FUNDED:**
The state could choose to not fund this project. Failure to fund this request will result in a missed
opportunity for the state to materially reduce energy consumption, positively impacting carbon
footprint and energy costs; and it may result in added emergency replacement costs. If the existing
components of the traditional HVAC systems are not proactively replaced, the university runs the risk

\(^5\) Mesa State College, *Facilities Master Plan.*
of system failures and may be compelled to request emergency funding if the systems fail before planned replacement. This will result in expensive repairs and additional costs associated with rental equipment to keep buildings operating when critical HVAC components fail. Most recently, the university had to request emergency funds to repair one of the chillers in the Performing Arts building. In order to make these repairs, an expensive rental will have to be brought in and replacement parts will have to be expedited to keep the building properly conditioned so programs can continue without interruption.

G. LIFE CYCLE COST (LCC)/COMPARATIVE ANALYSIS:
CMU has examined several alternative methods to reduce the amount of electricity consumed on campus. The current alternatives and green technologies that have submitted include Tri-generation, Demand Side Management, additional electric feed from Xcel Energy, and do nothing.

Tri-generation
In 2013, Colorado Mesa University (CMU) requested approval from the Colorado Department of Higher Education to move forward with plans to construct and operate a Tri-generation, combined cooling, heating and power facility (CCHP) on our main campus in Grand Junction, Colorado. CMU had identified several sites for the proposed CCHP project. The site chosen for the new facility was to be near the periphery of the future campus, as identified in the most recent version of the campus master plan. This juncture along 7th Street was unique in the fact that Xcel Energy has an existing 5” diameter high-pressure steel gas line under 7th Street. The gas line had the potential to deliver gas in appropriate volumes as well as at or very near the pressure needed for the proposed CCHP plant.

The previous program plan described a 10,000 square foot masonry building that would have housed a gas turbine and generator. The masonry structure would have been built above a 12’ deep concrete foundation where the gas turbine and new generator would be placed. The main floor of the building was to allow room for equipment storage, a control room, and offices. The gas turbine and generator would have been placed below ground to decrease noise levels and to provide a water-tight concrete enclosure that would contain any fluid leaks. Heat recovery systems and absorption chillers systems would have worked in concert with heat exchangers between the campus-wide geo-exchange system and the CCHP system to regulate temperatures in the central loop. This system would have helped regulate temperatures in the central loop. Overall, this would have increased the efficiency of heat pumps and would have allowed CMU to continue to add new buildings without having to drill additional fields. However, as the economics of green energy sources have changed, CMU has returned to focus on geothermal and photovoltaic systems for the future.

Demand Side Management/ Response Program
CMU currently has (1) main campus meter that measures the primary power supply that is provided by Xcel Energy. In 2010, CMU contracted with EnerNOC and Trane to provide demand limiting response support. During periods of peak demand, such as hot summer days, Xcel’s system may require more power than is normally available. The demand limiting response program helped reduce the amount of electricity that is purchased or generated, which helps Xcel meet electric system requirements at critical times. In return for participating, CMU received a monthly bill credit for the load that we were able to shed.
In 2015, Xcel proposed that CMU move from EnerNOC into their new program known as the Interruptible Service Option Credit (ISOC). If the demand-limiting program could connect with CMU’s Global Management System, we would receive a much higher bill credit for a 300 kW of load shedding ability (~ $22K for one hour or $40K for ten-minute intervals). CMU contracted with Trane to update their load shedding ability, which evolved into a sub-metering project where each building on campus was individually metered.

CMU currently has (30) whole-building meters, (14) sub-circuits for zones and shared geothermal equipment, using a combination of integrated smart meters and pulse outputs. This data is being analyzed and reported in order to assist in understanding the campus’ energy baselines, identify future improvements, improve normalized carbon footprint emission, and ultimately decrease utility spend. Site-specific energy demands, optimization strategies, and associated financial savings have been identified with Trane Intelligent Energy Services. This project was funded internally and is now complete.

*Additional electric feed from Xcel Energy*

Another option that was considered included extending an additional electrical feed to the main campus from across 7th street. This may still be an option in the future, though it is far from the best option as it does not reduce CMU’s dependence on traditional energy sources and will therefore increase carbon footprint and costs. In fact, without continued implementation of geo-fields and/or Solar, another electric feed will be required in the future as CMU continues to grow.

**H. ASSUMPTIONS FOR CALCULATIONS:**

Costs for the Energy Independence project are provided by the campus Energy Manager in coordination with CMU’s energy engineering and sustainability consultants.

Colorado Mesa University is requesting state capital funds (CCFE) and spending authority to fund the expansions of geo-exchange and solar PV systems. The total project budget includes the following:

- $1,169,940 for professional fees including A.E. design fees, construction management fees, code review and code inspection, site surveys, investigations, and reports.
- $6,610,060 for construction of infrastructure service/utilities.
- $784,000 for equipment and furnishings.
- $29,028 for art in public places.
- $15,582 for required project contingencies.

**I. SUSTAINABILITY:**

This program plan meets three goals of sustainable development. These goals include affordable and clean energy, responsible consumption and production, and climate action. Regulating temperatures in the central loop increases the efficiency of the heat pumps throughout campus and allows CMU to continue to add new buildings to the central loop.

**J. GOVERNOR’S INITIATIVE**

CC/CR projects shall review the Governor’s Executive Order on Greening of State Government (D 2019 016). The directives require Institutions to
• Analyze how requested projects conform with the State's High Performance Certification Program (HPCP)
  o As state above, this program plan meets three goals of sustainable development. These goals include affordable and clean energy, responsible consumption and production, and climate action. Regulating temperatures in the central loop increases the efficiency of the heat pumps throughout campus and allows CMU to continue to add new buildings to the central loop. Adding solar collectors will allow CMU to produce additional, affordable, reliable, and clean energy that is needed to meet the current and future power demands of our campus.
  o While this project is obviously mainly a sustainability project, this project will also seek to achieve Green Globes Certification due to expected long-term savings of Green Globes over LEED. Both certifications meet the requirements outlined in the state’s HPCP.
• Analyze on-site renewable energy generation or renewable clean energy purchases,
  o CMU’s Energy Efficiency program plan is all about the on-site renewable options. In terms of renewable clean energy purchases, CMU would continue to review these options as they arise but outside of the capital request process.
• Provide documentation or plans showing that at least 20% of parking spaces will be pre-wired for charging, and that at least 5% will have Electronic Vehicle (EV) chargers installed, and
  o This capital request does not include any pre-wiring or EV Charges as we are not addressing parking lots in our requests. Any future requests on our current parking lots would include this requirement
• Provide documentation that the Institutions explored options for the electrification of building systems, and such review shall include a full life cycle cost analysis of the impact of electrification.
  o Our proposed Energy Efficiency project directly addresses electrification of our buildings by reducing the reliance on natural gas through expanded capacity and connection of our geo-exchange system. If the proposed project were to be fully funded and implemented, we would essentially have zero natural gas use on the campus for heating or cooling.

K. OPERATING BUDGET IMPACT:
The estimated operating budget for this new Energy Independence project includes the costs of highly skilled and technical support staff required to know how to operate and maintain geo-exchange associated technologies. These operating costs will be offset by long-term energy savings. The university is prepared and has planned to accommodate this budget requirement and it will not affect state operating requests.

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