FINAL
ENVIRONMENTAL ASSESSMENT

In Support of:
Missoula City-County Health Department
Air Quality Permit Application
The University of Montana
Combined Heat and Power Project
Missoula, Montana

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ACRONYMS

AQP	Montana Air Quality Permit
ARM	Administrative Rules of Montana
ASUM	Associated Students of the University of Montana
BACT	Best Available Control Technology
CAP	University of Montana's Climate Action Plan
CFR	Code of Federal Regulations
CGT	Combustion gas turbine
CH_4	Methane
CHP	Combined Heat and Power
CO	Carbon monoxide
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalents
CTA	Cushing Terrell Architects
DB	Duct burner
dBA	A-weighted decibels (decibels corrected for human impact)
DEQ	Montana Department of Environmental Quality
DOE	United States Department of Energy
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	US Environmental Protection Agency
FD	Forced draft (fan)
GHG	Greenhouse gas
GWP	Global Warming Potential
H_2O	Water
HAP	Hazardous Air Pollutant
HRSG	Heat recovery steam generator (a type of boiler)
km	kilometers
lb/hr	pounds per hour
lb/MMBtu	pounds per million British thermal units
MAAQS	Montana Ambient Air Quality Standards
MACT	Maximum Achievable Control Technology
MAQP	Montana Air Quality Permit
MCA	Montana Code Annotated
MCCHD	Missoula City-County Health Department
MDEQ	Montana Department of Environmental Quality
MEPA	Montana Environmental Policy Act
$\mu g/m^3$	micrograms per cubic meter of ambient air
MMBtu/hr	Million British thermal units per hour
MT	Metric tons
MT/yr	Metric tons per year

MW	Megawatts
N_2O	Nitrous oxide
NA	Not applicable
NAAQS	National Ambient Air Quality Standards
NAD83	North American Datum 1983
NG	Natural Gas
NO_2	Nitrogen dioxide
NO_x	Oxides of nitrogen
NSR	New Source Review
NWE	NorthWestern Energy
NWPP	Electrical grid subregion in which NorthWestern Energy operates
OPRA	Company that builds turbines
OPRA16	OPRA turbine model proposed for this project
Pb	Lead
PM	Particulate matter
PM_{10}	Particulate matter less than 10 microns
$PM_{2.5}$	Particulate matter less than 2.5 microns
PSD	Prevention of Significant Deterioration
psi	Pounds per square inch
psig	Pounds per square inch gauge
scf	Standard cubic feet
SHPO	State Historic Preservation Office
SO_2	Sulfur dioxide
STARS	Sustainability Tracking, Assessment & Rating System
STG	Steam turbine generator
TAP, CHP TAP	Technical Assistance Partnerships (with regard to Combined Heat and Power generation)
TPY, tpy	tons per year
UM	University of Montana
US	United States
US DOE	United States Department of Energy
USC	United States Code
UTM	Universal Transverse Mercator
VOC	Volatile organic compound

EXECUTIVE SUMMARY

The University of Montana (UM) has completed a Final Environmental Assessment (EA) that analyzes potential impacts of the proposed Combined Heat and Power (CHP) Project. The overall findings of this assessment are summarized as follows:

- The proposed CHP Project is a minor source of air emissions under air quality permitting regulations and is subject to operating requirements and air emissions limitations in an Air Quality Permit issued by the Missoula City-County Health Department. These limitations assure that the project complies with ambient air quality standards and other requirements which are set to protect public health and the surrounding environment.

- The proposed location for the CHP Project is immediately adjacent to the existing UM heating plant facility that includes existing natural gas-fired boilers and is within a developed area on the UM Missoula Campus.

- Based on evaluation of alternatives to provide energy to the UM Missoula Campus into the future, the CHP Project best meets the objectives to provide reliable and cost-effective electricity and steam energy to campus facilities.

- Overall, the CHP Project will reduce the carbon intensity of the steam heat and electricity used on the UM Campus. This project contributes to efforts to lower the greenhouse gas (GHG) footprint of the campus in alignment with UM sustainability goals and Missoula Climate Plan goals and strategies.

Table ES-1 below lists the potentially impacted resources evaluated in this Final EA, the report section where the associated impacts analysis can be found, and the level of impact indicated by each analysis.

Table ES-1: Summary of Impacts on the Human Environment

Final EA Section	Resource	Impact Level				
		Major	Moderate	Minor	None	Unknown
4.0	Air Quality		X			
5.0	Climate			X		
6.1	Aquatic and Terrestrial Life and Habitats			X		
6.2	Water Quality, Quantity, and Distribution			X		
6.3	Geology and Soil Quality, Stability, and Moisture			X		
6.4	Vegetation Cover, Quantity, and Quality			X		

Final EA Section	Resource	Impact Level				
		Major	Moderate	Minor	None	Unknown
6.5	Aesthetics			X		
6.6	Unique Endangered, Fragile or Limited Environmental Resource				X	
6.7	Demands on Environmental Resource of Water, Air or Energy			X		
6.8	Historical or Archeological Sites			X		
6.9	Cumulative and Secondary Impacts (Physical and Biological Effects)			X		
7.1	Social Structures and Mores				X	
7.2	Cultural Uniqueness and Diversity				X	
7.3	Local and State Tax Base			X		
7.4	Agricultural or Industrial Production			X		
7.5	Human Health			X		
7.6	Access to and Quality of Recreational and Wilderness Activities				X	
7.7	Quantity and Distribution of Employment			X		
7.8	Distribution of Population				X	
7.9	Demands for Government Services			X		
7.10	Industrial and Commercial Activity			X		
7.11	Locally Adopted Environmental Plans and Goals			X		

Final EA Section	Resource	Impact Level				
		Major	Moderate	Minor	None	Unknown
7.12	Cumulative and Secondary Impacts (Social and Economic Effects)			X		

Approval

Based on the analyses completed for this Final EA and described in the subsequent sections, UM finds that the proposed action does not constitute "a major action of state government significantly affecting the quality of the human environment." UM further finds that this Final EA satisfies the Montana Environmental Policy Act (MEPA) requirement to "use a systematic, interdisciplinary approach that will ensure the integrated use of the natural and social sciences and the environmental design arts in planning and in decision-making that may have an impact on the human environment."

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8-3-21
Date

1.0 DESCRIPTION OF EA PROCESS AND SUMMARY

1.1 Montana Environmental Policy Act (MEPA) Background

The University of Montana (UM) has prepared this Final Environmental Assessment (EA) for the proposed UM Combined Heat and Power (CHP) Project to address environmental review requirements in the Montana Environmental Policy Act (MEPA), Montana Code Annotated (MCA) 75-1-101, *et seq*. The UM CHP Project proposes the installation of two OPRA16 dual fuel-fired combustion turbine generators, a Tulsa Combustion heat recovery steam generator (HRSG) boiler equipped with dual fuel-fired duct burner, and an Airclean Energy steam turbine generator. The primary fuel to be used during normal operations is natural gas, and diesel fuel would only be used as a backup fuel under natural gas curtailment conditions. The proposed electrical generators would produce up to 5 megawatts (MW) of power and the HRSG would generate up to 70,000 pounds per hour (lb/hr) of steam for use on the UM Campus.

Construction of this project requires the issuance of an Air Quality Permit (AQP) by the Missoula City-County Health Department (MCCHD), which has been delegated authority to issue such a permit from the Montana Department of Environmental Quality (DEQ). The UM CHP Project would also be subject to MEPA if DEQ was issuing the AQP. Since the permit will be issued by a delegated county agency without MEPA authority, UM has taken responsibility for implementing the MEPA requirements. This EA is based on the MEPA regulations in the Administrative Rules of Montana (ARM) Section 17, Chapter 4, Subchapter 6.

This Final EA focuses on the location of the proposed CHP plant and the immediate vicinity of the UM campus and analyzes potential impacts to the surrounding area. These limited boundaries were deemed appropriate given the relatively small size of the proposed plant, its "replacement role" for existing campus heating boilers, and its location in a previously developed area currently in use for a campus heating plant and parking.

1.2 Public Involvement

A Draft EA for the CHP Project was issued for public review and comment in accordance with MEPA regulations at ARM 17.4.610, Public Review of Environmental Assessments. The Draft EA was posted on the UM CHP Project website (Combined Heat & Power - Facilities Services - University Of Montana [umt.edu]) on May 13, 2021, and was subject to a 30-day comment period. A public notice of the issuance of the Draft EA was placed in the *Missoulian* Legal Notices in Section B on May 13, 2021, to provide further notice of the availability of the document for review.

This Final EA has been prepared and issued in the same timeframe as the issuance of an Air Quality Permit for the CHP Project by MCCHD. Public comments on the Draft EA were collected by UM and were then reviewed and addressed in order to complete the MEPA process for the CHP Project. Two sets of comments on the Draft EA were received from the public; the comments and UM's responses are presented in Appendix D.

1.3 Conclusion

UM has completed a Final EA for the proposed CHP Project. Our overall findings can be summarized as follows:

- The proposed UM CHP Project is a minor source of air emissions under air quality permitting regulations and will be subject to an air quality permit issued by MCCHD that establishes enforceable operating requirements and emissions limitations. These limitations assure that the project complies with ambient air quality standards and regulations which are set to protect public health and the surrounding environment.

- The proposed location for the CHP Project is immediately adjacent to an existing UM heating plant facility that includes existing natural gas-fired boilers and is within a developed area on the UM Missoula Campus.

- Based on an evaluation of alternatives to provide energy to the UM Missoula Campus into the future, the CHP Project best meets the objectives to provide reliable and cost-effective electricity and steam heat to campus facilities.

- Overall, the CHP Project will reduce the carbon intensity of the steam heat and electricity used on the UM Campus. This project contributes to efforts to lower the greenhouse gas (GHG) footprint of the campus in alignment with UM sustainability goals and Missoula Climate Plan goals and strategies.

Based on the analyses completed for this EA and described in the subsequent sections, no significant adverse impacts to the natural or human environments were identified and an EA provides an appropriate level of analysis for implementing MEPA for this project. An Environmental Impact Statement (EIS) would be prepared if the proposed action was found to be “a major action of state government significantly affecting the quality of the human environment.” See ARM 17.4.607, General Requirements of the Environmental Review Process, and ARM 17.4.608, Determining the Significance of Impacts, for further details regarding these actions.

2.0 BENEFITS AND PURPOSE OF THE PROJECT

Montana's environmental assessment regulations direct that an EA include a description of the benefits and purpose of the proposed action. This section fulfills that purpose. If a cost/benefit analysis is prepared before completion of the EA, the EA must contain the cost/benefit analysis or a reference to it (ARM 17.4.609). Section 2.3 below outlines several studies that include a cost/benefit analysis for the CHP project.

Combined heat and power (CHP) is an efficient approach for generating power and useful thermal energy (heating) from a single fuel source at the point of use. Instead of purchasing electricity from the local utility and using fuel in an onsite boiler to produce needed thermal energy, a facility can use CHP to provide both services onsite in one energy-efficient step. By recovering the heat normally wasted in power generation and avoiding transmission and distribution losses in delivering electricity from the power plant to the user, CHP reduces overall energy use, lowers emissions, and, depending on local conditions, provides operating savings and increased reliability to the end user (U.S. Department of Energy Northwest Combined Heat and Power Technical Assistance Partnerships [CHP TAP], 2016).

UM has established a website describing the development of the UM CHP project as part of the University's overall Energy Plan, located at the following web address: http://www.umt.edu/facilities/energy-plan/combined-heat-and-power.php. Questions regarding the CHP project are answered on a Frequently Asked Questions webpage at https://www.umt.edu/facilities/energy-plan/faqs.php. Further information about UM's Sustainability Programs on Energy can be found at the following web address: https://www.umt.edu/sustainability/Campus/energy/default.php.

2.1 Purpose of the Project

The primary goals of the UM CHP project are to reduce operating costs at the heating plant and to provide an on-site power generation plant that would increase reliability and lower costs of electric power for the campus (University of Montana, 2019) while reducing UM's carbon footprint. Twin OPRA16 gas combustion turbines were chosen due to the flexibility with which the two turbines can operate as well as the design flexibility of the turbines for accepting lower carbon fuels that may become available in the future. For example, if biogas, hydrogen, or other low-carbon fuel becomes reasonably available in the future, the OPRA turbines can be cheaply and easily retrofitted to burn those fuels.

The CHP system is designed to capture as much energy from the combustion of fuel as possible. In addition to generating electricity, hot exhaust gases from the combustion turbines will be used to generate steam in the heat recovery steam generator (HRSG). If there is little or no heating demand, the excess steam will be routed through a Howden steam turbine, which is able to extract electricity both via backpressure (steam-driven) and condensation mechanisms. This combination of heat and power production results in lower air pollutant and GHG emissions than combined emissions from traditional heating and power generating equipment.

Additionally, the CHP project fulfills the following strategic goals at UM:

- Cost-effectiveness,
- Replacement of aging natural gas-fired and dual fuel-fired boilers on the campus,
- Redundancy in the heating plant,
- Allowance for a more diverse energy supply at UM in the future, and
- Reduction of GHG and other pollutant emissions.

2.2 Benefits of the Project

2.2.1 GHG Reduction

The proposed project fulfills the purpose of reducing GHG emissions from the UM heating plant. According to the UM GHG Emissions Summary available on the UM CHP website: https://www.umt.edu/facilities/energy-plan/combined-heat-and-power.php, on-campus production of steam for heating buildings and purchased power from NorthWestern Energy (NWE) generate approximately 40,000 metric tons of carbon dioxide equivalents (CO_2e) per year. Steam for heating UM campus buildings is now provided by burning natural gas, with ultra-low sulfur diesel as a backup fuel. Natural gas and ultra-low sulfur diesel combustion produce GHG emissions including carbon dioxide (CO_2), nitrous oxide (N_2O) and methane (CH_4). Existing Boilers 1 and 2 will be maintained for backup function. The proposed CHP plant will burn more natural gas per pound of steam produced than the existing boilers; however, the electrical power generated by the CHP plant will significantly offset the amount of electrical power UM must purchase from NWE. As a result, UM has estimated that the proposed CHP plant would provide a carbon offset of approximately 11,880 metric tons (MT) of CO_2e annually.

2.2.2 Fuel Supply Diversity

One benefit of the proposed CHP project would be to potentially diversify the UM heating plant fuel supply as lower carbon fuels become available, as discussed above.

The heating plant currently burns natural gas as its primary fuel and will continue to do so after installation of the CHP system. Both of the existing boilers and the CHP equipment are or will be equipped to burn ultra-low sulfur diesel fuel in the case of a natural gas interruption. After addition of the CHP system, the diesel fuel emergency strategy must remain available for campus safety and security reasons.

2.2.3 Equipment Redundancy

The existing natural gas boilers at the UM heating plant were constructed in 1962 through 1968 and, although they are currently well maintained and operational, UM will need to upgrade or replace the boilers over time to maintain the primary steam heating supply for the campus. Boiler controls and other auxiliary systems for the existing boilers are quickly becoming obsolete. The proposed CHP system is part of the overall UM equipment updating schedule and provides important redundancy in steam production equipment at the plant.

2.3 Feasibility Study and Cost/Benefit Analysis

A Feasibility Study and Cost/Benefit Analysis was conducted by the United States Department of Energy Northwest Combined Heat and Power (CHP) Technical Assistance Partnerships (TAP) in 2016 and found use of a recuperated gas turbine with a heat recovery steam generator to serve UM campus steam and electricity demand to be cost-effective and have other benefits as noted in the report (US DOE NW CHP TAP, 2016). A second study was completed in 2016 by Cushing Terrell Architects (formerly CTA) for a CHP natural gas combustion turbine plant at the Missoula campus (CTA, 2016). The Cushing Terrell study evaluated three different combustion turbines, each with and without sale of electricity back to the grid. The turbines considered were:

- Twin OPRA16 (1.8 MW nominal capacity, each) gas turbines
- Solar Centaur 50 (4.6 MW nominal capacity) gas turbine
- Solar Mercury 50 (4.6 MW nominal capacity) gas turbine

The twin OPRA16 turbine CHP plant was found to have the best simple payback. The other advantage of the OPRA system is that only one turbine needs to be taken down at a time for maintenance, which allows 50% of the steam and electrical generation capacity to continue. The OPRA turbine system also includes a steam turbine generator that increases the efficiency of the system.

The OPRA system has multiple fuel options, including ultra-low sulfur diesel. Fuel changes in the OPRA system are relatively simple and straightforward: a fuel change essentially requires changing to the appropriate combustion cans, which are external to the internal moving components. Different fuel can options include hydrogen, biogas, and diesel, among others.

An updated feasibility study for a UM CHP Project in 2020 looked more closely at the advantages of CHP and potential cost savings using more current data. The technology and its advantages are discussed in more detail in the report by Power Engineers (Power Engineers, 2020). The US DOE CHP TAP report, the Cushing Terrell report, and the Power Engineers CHP Feasibility Study are available on the UM CHP website: https://www.umt.edu/facilities/energy-plan/combined-heat-and-power.php.

3.0 DESCRIPTION OF PROJECT AND ALTERNATIVES

The following sections provide project background, outline the proposed fuel supply, describe the proposed CHP plant in more detail and discuss alternatives, including the "no action" alternative.

3.1 Project Background

The existing UM heating plant consists of three natural gas-fired steam boilers that produce saturated steam for the campus. Two of the boilers (B-1 and B-3) are rated at 70,000 lb/hr while B-2 is rated at 30,000 lb/hr. Currently B-2 operates closer to 25,000 lb/hr after a variable frequency drive retrofit to its forced draft (FD) fan reduced its capacity a few years ago. Boiler B-3 is currently configured to burn either natural gas or diesel to provide heating capability when natural gas is curtailed. B-2 is connected to the existing 150-foot chimney to vent combustion gases; B-1 and B-3 are vented to hoods located at the roof level of the boiler plant building. Also located in the lower level of the heating plant is a steam turbine generator (STG) rated at 440 kW and 30,000 lb/hr of steam. While steam is produced at 180 pounds per square inch gauge (psig), only 30 psig is required to satisfy the campus steam demand. The STG provides this pressure reduction while also generating electric power (CTA, 2016).

Figure 3-1 shows a photograph of the current heating plant building. The new CHP equipment will be placed east of the building in an adjacent parking area. Figure 3-2 shows an architect's rendering of the proposed new building that would house the CHP plant. A drawing showing the layout of the proposed CHP equipment is available on the UM CHP website: https://www.umt.edu/facilities/energy-plan/combined-heat-and-power.php.

Figure 3-1: UM Current Heating Plant Building

Figure 3-2: Architect's Rendering of New CHP Building

3.2 Proposed Fuel Supply

The combustion turbines will require an increased natural gas supply from NorthWestern Energy with a pressure of 200 pounds per square inch (psi). Currently, the heating plant is serviced by a 75 psi natural gas supply line. Two electric compressors will be installed to increase the natural gas supply pressure for the turbines as part of the CHP project. Some other gas supply equipment will be altered to provide adequate service to the project and existing boilers.

3.3 Process Description

3.3.1 Combined Heat and Power Equipment

The proposed CHP project includes two natural gas-fired combustion turbines (CGT) coupled with an HRSG. Figure 3-3 shows a simplified process flow diagram (e.g., one CGT trapezoid is shown in the diagram, but the proposal includes two CGTs) for the proposed CGT, HRSG, and steam turbine system that includes fuel, steam, and electricity flows.

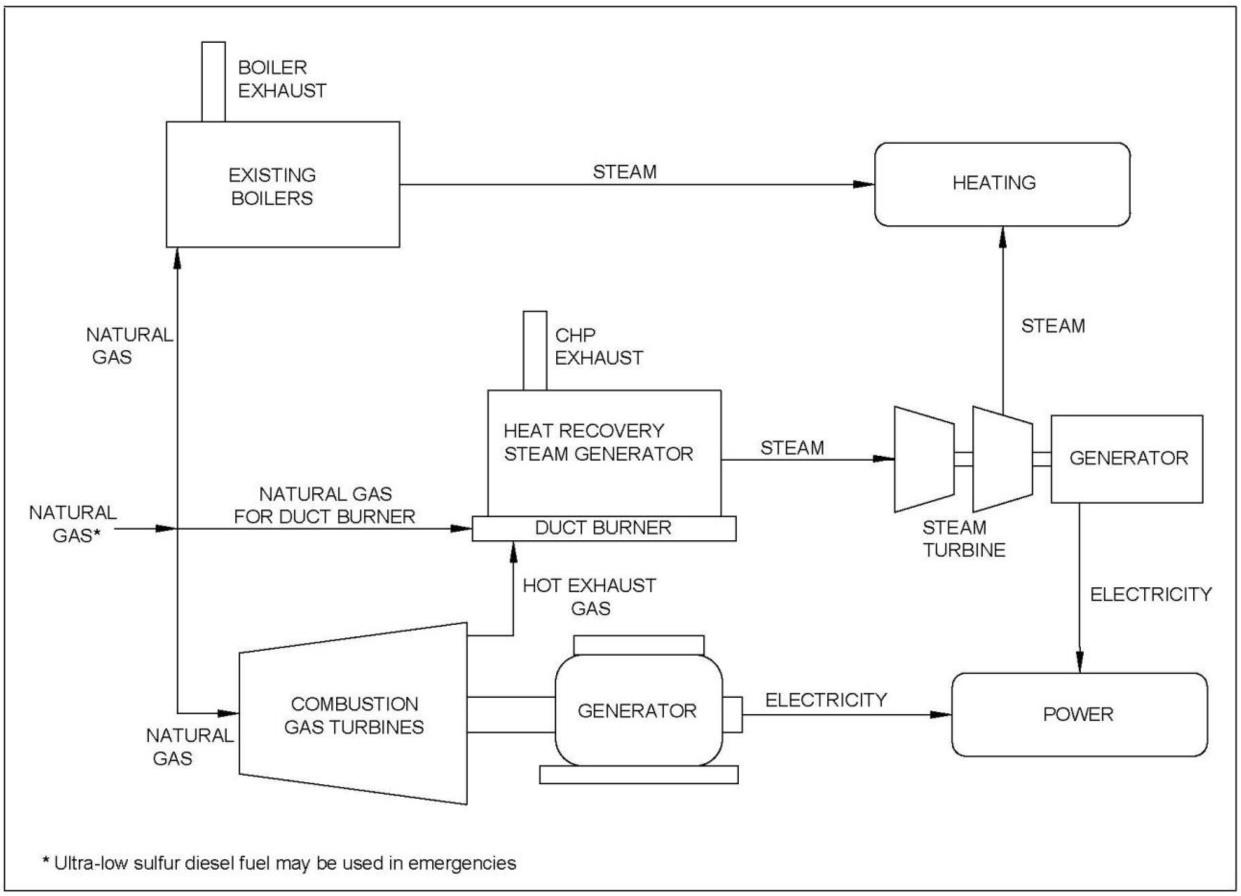

Figure 3-3: Simplified Process Flow Diagram of the Proposed UM CHP Combustion Gas Turbine with Heat Recovery Steam Generator and Steam Turbine System

CHP is an energy-efficient technology that generates electricity and captures the heat that would otherwise be wasted to provide useful thermal energy—such as steam or hot water—that can then be used for space heating, cooling, domestic hot water and industrial processes. CHP can be located at an individual facility or building or be a district energy or utility resource. CHP is typically located at facilities where there is a need for both electricity and thermal energy.

Nearly two-thirds of the energy used by conventional electricity generation is wasted in the form of heat discharged to the atmosphere. Additional energy is wasted during the distribution of electricity to end users. By capturing and using heat that would otherwise be wasted and by avoiding distribution losses, CHP can achieve efficiencies of over 80 percent, compared to 50 percent for typical technologies (i.e., conventional electricity generation and an on-site boiler) (EPA, 2021).

The following paragraphs describe the individual processes that will comprise the UM CHP Project.

1. Gas Turbine System

Gas turbine systems operate on the Brayton thermodynamic cycle, a constant pressure open cycle heat engine. The Brayton cycle consists of a compressor, a combustion chamber, and an expansion turbine. The compressor heats and compresses the inlet air which is then further heated by the addition of fuel in the combustion chamber. The hot air and combustion gas mixture drives the expansion turbine producing enough energy to provide shaft-power to the generator and to drive the compressor as well. The power produced by an expansion turbine and consumed by a compressor is proportional to the absolute temperature of the gas passing through the device. Consequently, it is advantageous to operate the expansion turbine at the highest practical temperature consistent with economic materials and internal blade cooling technology, and to operate the compressor with inlet air flow at as low a temperature as possible.

There are several variations of the Brayton cycle in use today. Fuel consumption may be decreased by preheating the compressed air with heat from the turbine exhaust using a recuperator or regenerator. The compressor work may also be reduced and net power increased by using intercooling or precooling techniques. In a combined cycle, the exhaust may be used to raise steam in a boiler and to generate additional power.

Gas turbine exhaust is quite hot, up to 800 to 900°F for smaller industrial turbines, and up to 1,100°F for some new, large central station utility machines and aeroderivative turbines. Such high exhaust temperatures permit direct use of the exhaust for applications such as combustion air preheating, drying, or other applications requiring a hot air stream. Such direct use of the exhaust is called “closely coupled CHP.” More commonly, the exhaust heat is recovered with the addition of a heat recovery steam generator (HRSG), which produces steam or hot water. A portion or all of the steam generated by the HRSG may be used to generate additional electricity through a steam turbine in a combined cycle configuration. A gas turbine system is considered to be a CHP configuration if the waste heat (i.e., thermal energy) generated by the turbine is applied in an end-use. For example, a simple-cycle gas turbine using the exhaust in a direct heating process is a CHP system (EPA, 2017). The UM CHP proposed design uses two combustion turbines in parallel, providing more flexibility in operations and meeting campus needs for energy.

2. Generator

As shown in Figure 3-3, the energy from the gas turbine drives an electrical generator. The spinning turbine is connected to the rod in a generator that turns a large magnet surrounded by coils of copper wire. The generator magnet causes electrons to move and creates electricity for delivery to the UM campus or to the electrical grid. The UM CHP proposed design uses two combustion turbines coupled with generators to produce electricity.

3. Heat Recovery Steam Generator

An HRSG is an energy recovery steam generator that recovers heat from a hot gas stream, such as a combustion turbine or other waste gas stream. It produces steam that can be used in a process (cogeneration). HRSGs generally consist of four major components: economizer, evaporator, superheater and water preheater. The different components are put together to meet the operating requirements of the unit. Some HRSGs include supplemental, or duct, firing. These additional burners provide additional energy to the HRSG, which then produces more steam (Wikipedia, 2021). The UM CHP project design utilizes an auxiliary burner to produce additional steam to meet campus demands.

4. Condensing Steam Generator

In a condensing steam turbine, the maximum amount of energy is extracted from the steam in the system. These turbines receive steam from a boiler and exhaust it to a condenser. The exhausted steam is at a pressure well below atmospheric, and is in a partially condensed state, typically of a quality near 90%. The condensing steam turbine then drives an additional small generator to produce electricity.

The proposed CHP plant will combust pipeline quality natural gas to produce steam and electricity for use by the UM campus. Natural gas burns more cleanly with lower emissions than other carbon fuels. In addition, the combustion turbine and auxiliary duct burner will be designed to emit lower nitrogen oxide emissions than conventional equipment, meeting Best Available Control Technology requirements in the air quality permitting process. By capturing and utilizing waste heat in the CHP process, the efficiency of the process is enhanced, which lessens GHG emissions from the proposed project.

A new building will be constructed adjacent to the existing UM heating plant. Drawings showing the new CHP building in relation to the current facility are available on the UM CHP website: https://www.umt.edu/facilities/energy-plan/combined-heat-and-power.php.

3.3.2 Role of Existing Boilers

Existing heating plant Boilers B-1 and B-2 will continue to be used in a backup role to the CHP Plant. Boiler B-3 will be decommissioned and left in place in the heating plant building.

3.4 Legal Description of Site

The proposed CHP plant would be located adjacent to the existing heating plant, located at 840 Connell Avenue on UM's Missoula Campus in Missoula, Montana. The legal description of the plant site is N½ of NE¼ of Section 27, Township 13N, Range 19W, M.P.M., in Missoula County, Montana. The approximate Universal Transverse Mercator (UTM) coordinates are Zone 12, North American Datum of 1983 (NAD83), Easting 273 kilometers (km), and Northing 5,194 km, and the approximate geographical coordinates are 113.98° West Longitude and 46.86° North Latitude. The site elevation is approximately 3,014 feet. The plant lies within the same 156-acre parcel as the majority of the Missoula campus buildings.

3.5 Alternatives

UM developed a list of alternatives in the 2010 Climate Action Plan (UM, 2010) and again during the 2019 Campus Climate Conversation (UM, 2019), considered their effectiveness in pursuing UM's carbon reduction goals and, through further feasibility work, determined that use of CHP as an energy supply for the campus is an effective approach.

The "no action" alternative to development of a CHP plant to supply campus energy is to continue using the existing natural gas-fired boilers and purchasing electricity from NWE. This approach will require upgrades to many of heating plant's systems since many are old, prone to breakage and are now obsolete as spare parts are no longer manufactured.

4.0 EVALUATION OF AIR QUALITY IMPACTS

The CHP Project requires a pre-construction air quality permit from MCCHD. A permit application was submitted to the local air quality agency on April 8, 2021; the application was declared complete on June 28, 2021. MCCHD issued a Preliminary Determination to issue an Air Quality Permit on July 2 and made a Final Determination on the permit on July 19. The Air Quality Permit was considered final on August 3, 2021.

This section of the EA uses the analyses and information developed for the air permit application and discusses potential air quality impacts of the proposal. For more detail and to understand the regulatory implications of the information, the reader is invited to consult the Air Quality Permit, which is posted on the MCCHD website for an additional 30 days until September 2, 2021:

https://www.missoulacounty.us/government/health/health-department/home-environment/air-quality/industry

4.1 Missoula Air Quality Issues

Missoula air quality is evaluated against the Montana and National Ambient Air Quality Standards (MAAQS and NAAQS), which are set by state and federal regulatory agencies to protect public health and the environment with a margin of safety. The local air quality program administered by MCCHD has established regulations to specifically improve and protect ambient air quality in the Missoula airshed. The following sections discuss these requirements and others, how Missoula compares against the air quality standards, and how the CHP Project would potentially impact local air quality.

4.1.1 Nonattainment Area Status

Ambient air quality monitoring in Missoula in recent years has shown the area to be in attainment with MAAQS and NAAQS, or unclassifiable in accordance with 42 USC 7407 (d)(1)(A)(ii) and (iii) for all listed pollutants. This means that the air quality in Missoula has sufficiently low amounts of the most common air pollutants that the air quality meets both state and national air quality standards for these pollutants.

For many years, Missoula was classified as a “moderate nonattainment area” for particulate matter equal to or less than 10 microns in diameter (PM_{10}), primarily due to road dust and smoke from wood-burning stoves. This meant that the amount of PM_{10} in Missoula air exceeded the PM_{10} air quality standards. Because of the efforts of MCCHD to reduce road dust and wood smoke, Missoula was redesignated as a maintenance area and as “attainment” for PM_{10} on June 24, 2019. Additionally, Missoula was previously a carbon monoxide (CO) nonattainment area but was declared in “attainment” with the air quality standards for CO on September 17, 2007.

The Missoula airshed is considered “unclassifiable/attainment” for particulate matter less than or equal to 2.5 microns in diameter ($PM_{2.5}$). The amount of $PM_{2.5}$ in Missoula air is continuously monitored by DEQ and is the basis for the health rating of the air quality. Air quality alerts are generally caused by wildfire smoke or wood smoke accumulating in the Missoula geographical “bowl.” Air monitoring data for $PM_{2.5}$ in Missoula air can be followed by clicking on the Missoula map location or the Missoula link (farther down the page) at this website:

https://svc.mt.gov/deq/todaysair/AirDataMap.aspx

4.2 Criteria Air Pollutant Emissions and Impacts

This section assesses impacts to ambient air quality that could result from the project. Significant adverse effects to ambient air quality could occur if air emissions result in ground-level pollutant concentrations that exceed national and/or state standards or if the UM CHP plant operates in a manner that does not comply with air quality permit limits and conditions.

4.2.1 CHP Plant Emissions

Construction activity air emissions would consist primarily of fugitive particulate emissions resulting from surface grading and vehicular traffic. Temporary localized emissions of gaseous combustion pollutants would also result from construction-related traffic and miscellaneous activities. All construction-related air emissions would be intermittent, of limited duration, and of low quantities with respect to air emissions that normally occur in the area. Ongoing direct, indirect, and cumulative adverse impacts on background pollutant concentrations resulting from construction-related activities would be negligible.

Full operation of the UM CHP plant requires connection to a natural gas pipeline for the plant’s primary fuel, and connection to ultra-low sulfur diesel fuel storage for backup in the event natural gas is unavailable. Vehicle emissions are expected to be unchanged as compared to operation of the existing plant. Ongoing direct, indirect, and cumulative adverse impacts on background pollutant concentrations resulting from operation-related activities would be negligible.

All fuel combustion results in the formation of water vapor from oxidation of hydrogen in the fuel. Similar to the existing natural gas boilers, the CHP equipment is expected to produce a visible white steam plume during operation, which would dissipate in the atmosphere. The water vapor plume would be more noticeable during low outdoor temperatures. The volume of water vapor in the plume would not be enough to noticeably impact local weather conditions, such as fog. The CHP plant will have a condenser/cooling unit which may, at times, also emit visible water vapor when the plant is operating.

The combustion turbines and the HRSG duct burner would be the only sources of air emissions associated with the project. The turbines and HRSG burners would have the potential to emit the following regulated pollutants when combusting natural gas (or any other carbon-based fuel): oxides of nitrogen (NO_X), CO, volatile organic compounds (VOC), particulate matter (PM), PM_{10}, $PM_{2.5}$, sulfur dioxide (SO_2), lead (Pb), and CO_2.

In addition to using pipeline quality natural gas to limit air emissions, the CHP plant will utilize Dry Low-NO_X burner technology as the best available control technology for the proposed gas combustion turbines in the UM CHP system. The HRSG duct burner will utilize an Ultra-Low-NO_X burner to further control NO_X emissions from the facility before the exhaust reaches the atmosphere.

Table 4-1 presents estimated potential annual emissions of criteria pollutants from the proposed CHP equipment while burning natural gas. Other existing campus combustion sources are also included. These values represent potential emissions from maximum operating conditions year-round, which are not anticipated. Actual emissions of the pollutants are anticipated to be 50 to 85% of these quantities. More detail on emissions of air pollutants from the proposed project and other campus sources is available in the Air Quality Permit application for the project and in the final Air Quality Permit.

Table 4-1: Facility Annual Maximum Potential to Emit Summary

	Pollutants						
Source	**NO_X (tpy)**	**CO (tpy)**	**VOC (tpy)**	**PM_{10} (tpy)**	**$PM_{2.5}$ (tpy)**	**SO_2 (tpy)**	**$CO_2e^{(1)}$ (MT/yr)**
Proposed Sources							
Combustion Gas Turbines – NG(2)	13.1	12.9	4.22	1.55	1.55	0.80	24,939
HRSG Duct Burner – NG(2)	20.4	19.9	1.96	2.71	2.71	0.21	38,619
Black Start Engine for CGT - Diesel	1.45	1.45	0.14	0.017	0.017	0.003	261
Existing Sources to be Retained							
Boiler B1 - Natural Gas(2)	18.8	31.6	2.07	2.86	2.86	0.23	40,767
Boiler B2 - Natural Gas(2)	16.1	13.5	0.89	1.23	1.23	0.10	17,472
Small Stationary Sources	8.07	6.74	0.45	0.61	0.61	0.07	8,690
Emergency Generators	5.14	1.53	0.40	0.34	0.34	0.32	177
Total: CGTs, DB, B1, and B2 firing natural gas full-time plus small and emergency sources	83.1	87.6	10.1	9.3	9.3	1.73	130,925

(1) GHG from the CGT, DB, B1 and B2 were estimated based on natural gas fuel for 8,760 hours. Units are metric tons per year (MT/yr) of CO_2 equivalent (CO_2e).
(2) Fired on natural gas all year.

4.2.2 Air Quality Impacts

Estimated air quality impacts were determined for the area immediately surrounding the project site. Air dispersion models were used to perform the analyses. These models use hourly meteorological data, terrain elevation data, and emission source data to calculate ground-level pollutant concentrations that would result from the project's worst-case emissions at a set of defined locations. For this project, appropriate local and regional meteorological data were used in the model to analyze potential ambient impacts from the existing and proposed emissions sources. NAAQS and MAAQS are used to compare predicted impacts and are provided in Table 4-2.

Table 4-2: Ambient Air Quality Standards

Pollutant	Averaging Period	Applicable Standard	Regulatory Limit [a]	Regulatory Compliance Value Used
PM_{10}	24-hour	NAAQS	150 $\mu g/m^3$ [b]	Maximum 6th highest[c]
	24-hour	MAAQS	150$\mu g/m^3$ [d]	Maximum 2nd highest[e]
	Annual	MAAQS	50 $\mu g/m^3$ [f]	Maximum 1st highest[e]
$PM_{2.5}$	24-hour	NAAQS	35 $\mu g/m^3$ [g]	Mean of maximum 8th highest[h]
	Annual	NAAQS	12 $\mu g/m^3$ [i]	Mean of maximum 1st highest[j]
Carbon Monoxide (CO)	1-hour	NAAQS	35 ppm[d] (40,000 $\mu g/m^3$)	Maximum 2nd highest[e]
	1-hour	MAAQS	23 ppm[d] (26,286 $\mu g/m^3$)	Maximum 2nd highest[e]
	8-hour	NAAQS and MAAQS	9 ppm[d] (10,000 $\mu g/m^3$)	Maximum 2nd highest[e]
Sulfur Dioxide (SO_2)	1-hour	NAAQS	75 ppb[k] (196 $\mu g/m^3$)	Mean of maximum 4th highest[l]
	1-hour	MAAQS	0.5 ppm[m] (1,300 $\mu g/m^3$)	Case-specific
	3-hour	NAAQS	0.5 ppm[d] (1,300 $\mu g/m^3$)	Maximum 2nd highest[e]
	24-hour	MAAQS	0.10 ppm[d] (260 $\mu g/m^3$)	Maximum 2nd highest[e]
	Annual	MAAQS	0.02 ppm[f] (52 $\mu g/m^3$)	Maximum 1st highest[e]
Nitrogen Dioxide (NO_2)	1-hour	NAAQS	100 ppb[n] (188 $\mu g/m^3$)	Mean of maximum 8th highest[o]
	1-hour	MAAQS	0.30 ppm[d] (564 $\mu g/m^3$)	Maximum 2nd highest[e]
	Annual	NAAQS	53 ppb[f] (100 $\mu g/m^3$)	Maximum 1st highest[e]
	Annual	MAAQS	0.05 ppm[f] (94 $\mu g/m^3$)	Maximum 1st highest[e]
Lead (Pb)	3-month	NAAQS	0.15 $\mu g/m^3$ [p]	Case-specific
	90-day	MAAQS	1.5 $\mu g/m^3$ [q]	Case-specific
Ozone (O_3)	1-hour	MAAQS	0.10 ppm[d]	Not typically modeled
	8-hour	NAAQS	0.070 ppm[r]	Not typically modeled

a. Units are micrograms per cubic meter ($\mu g/m^3$), parts per million (ppm) or parts per billion (ppb).
b. Not to be exceeded more than once per year on average over three years.
c. Concentration at any modeled receptor when using five years of meteorological data.
d. Not to be exceeded more than once per year.
e. Concentration at any modeled receptor for each year of modeled meteorological data.
f. Not to be exceeded in any modeled calendar year.
g. Three-year mean of the upper 98th percentile of the annual distribution of 24-hour concentrations.
h. Five-year mean of the 8th highest modeled 24-hour concentrations at the modeled receptor for each year of meteorological data modeled.
i. Three-year mean of annual concentration.
j. Five-year mean of annual averages at the modeled receptor.
k. Three-year mean of the upper 99th percentile of the annual distribution of maximum daily 1-hour concentrations.
l. Five-year mean of the 4th highest daily 1-hour maximum modeled concentrations for each year of meteorological data modeled.
m. Not to be exceeded more than 18 times in one calendar year.
n. Three-year mean of the upper 98th percentile of the annual distribution of maximum daily 1-hour concentrations.
o. Five-year mean of the 8th highest daily 1-hour maximum modeled concentrations for each year of meteorological data modeled. For the significant impact analysis, the five-year mean of maximum modeled 1-hour impacts for each year is used.
p. Three-month rolling average, evaluated over three years.
q. Ninety-day average, not to be exceeded.
r. Annual 4th highest daily maximum 8-hour concentration, averaged over three years.

Modeling results and discussions of the analyses of project impacts relative to each of the above NAAQS and MAAQS are provided in the following paragraphs.

National Ambient Air Quality Standards Analysis

Table 4-3 compares modeled peak concentrations of NO_2, SO_2, PM_{10} and $PM_{2.5}$ with the appropriate NAAQS. As shown, the project would comply with all ambient air quality standards to assure protection of public health and the environment. As is the standard with permitting a new facility, maximum potential to emit emissions were used in the modeling analysis. In reality, the UM CHP plant and existing heating plant will actually operate at some combined steam and electricity production well below the permitted maximum operation. The resulting ambient impacts from those "actual" emissions would therefore be less than the conservative modeling predictions provided in Table 4-3.

Table 4-3: National Ambient Air Quality Standards Impact Analysis Results, Natural Gas

Pollutant	Avg. Period	Modeled Conc. (μg/m^3)	Background Conc. (μg/m^3)	Total Conc. (μg/m^3)	NAAQS (μg/m^3)	% of NAAQS
$PM_{2.5}$	24-hour	9.10[a]	23	32.1	35	91%
	Annual	1.47[b]	7.2	8.67	12	72%
PM_{10}	24-hour	12.2[c]	57	69.2	150	46%
NO_2	1-hour	143[a]	19.1	162	188	86%
	Hot Spot	144[a]	19.1	163	188	87%
	Annual	9.32[d]	1.8	11.1	100	11%
SO_2	1-hour	9.88[e]	13.1	23.0	196	12%

a. Maximum of five-year means of 8th highest modeled concentrations for each year modeled.
b. Five-year mean of annual concentration.
c. Maximum of 6th highest modeled concentrations for a five-year period.
d. Maximum annual impact of five years modeled.
e. Maximum of five-year means of 8th highest modeled concentrations for each year modeled.

Note that the modeled concentrations shown in the table above include additional background concentrations representative of current ambient air quality. Background concentrations for the NAAQS/MAAQS modeling demonstrations were provided in MDEQ guidance documents as explained in the CHP Plant Air Quality Permit Application.

NAAQS modeling was also performed to evaluate the NO_2 1-hour modeled impacts from the proposed and existing equipment operating on ultra-low sulfur diesel. As shown in Table 4-4, the modeled impact when burning ultra-low sulfur diesel is higher than when burning natural gas but is still in compliance with the NAAQS.

Table 4-4: Ambient Air Quality Standards Impact Analysis Results for NO_2, Ultra-Low Sulfur Diesel Fuel

Sources Operating	NO_2 Modeled Conc. (µg/m^3)	NO_2 Background Conc. (µg/m^3)	NO_2 Total Conc. (µg/m^3)	NO_2 NAAQS (µg/m^3)	% of NAAQS
CGTs, DB, B1 and B2	163[a]	19.1	182	188	97%

a. Maximum of five-year means of 8th highest modeled concentrations for each year modeled.

Montana Ambient Air Quality Standards Analysis

The MAAQS included in Table 4-2 have slightly different values and compliance formats than the corresponding NAAQS. For example, the MAAQS compliance value for 24-hour PM_{10} is the high-2nd-high value modeled for each year of meteorological data, whereas the NAAQS compliance value for 24-hour PM_{10} is the high-6th-high value modeled with five years of meteorological data. Both modeled PM_{10} values are well below both standards.

The NO_2 annual MAAQS is 94 µg/m^3 whereas the NO_2 annual NAAQS is 100 µg/m^3. Both are determined by the maximum annual average modeled - the NO_2 annual impacts for this project are only 11% of the MAAQS. The NO_2 1-hour MAAQS is 564 µg/m^3 based on the high-2nd-high modeled value. The 1-hour NAAQS is far more stringent than the MAAQS; compliance with the NAAQS also indicates compliance with the MAAQS.

4.3 Hazardous Air Pollutant (HAP) Emissions and Regulations

The air quality permit application includes HAP estimates calculated using emission factors from AP-42 for the natural gas and diesel combustion sources. Only factors for organic compounds and metals specifically identified as HAPs as defined by Section 112(b) of the Clean Air Act are included in the inventory. The total HAP emissions potential for the UM heating plant is 2.49 tons/year, which means the plant falls into the minor source category and will be subject to the Environmental Protection Agency (EPA) minor source regulations. The UM facility is only subject to Maximum Achievable Control Technology (MACT) standards that apply to equipment at a minor HAP source (also referred to as an "area source," as opposed to a "major source").

4.4 Air Quality Impacts - Summary

Impacts to air quality from the CHP project are projected to be moderate for $PM_{2.5}$ and NO_2, and minor for the remaining criteria air pollutants and HAPs. While air dispersion modeling using potential emissions for the air permit application shows impacts approaching ambient air quality standards for $PM_{2.5}$ and NO_2 from the project and existing boilers, actual emissions will be much less and impacts proportionately less. Further, limits on air emissions from the CHP project are included in the Air Quality Permit issued by MCCHD, assuring the potential for impacts on air quality in the local area is managed carefully.

5.0 EVALUATION OF CLIMATE IMPACTS

This section of the EA analyzes the potential impacts of the CHP project on climate change. For this analysis, the potential GHG emissions from the project are determined and reviewed against applicable GHG regulations. An accounting of projected actual GHG emissions from the UM heating plant before and after the project is provided and campus emissions are discussed in relation to UM goals to help mitigate climate change.

This section utilizes the analyses and information developed for the air permit application, the 2019 Climate Action Plan Summary – Campus Climate Conversation report (University of Montana, 2019), other data generated as part of the CHP project design, and conversations with UM personnel knowledgeable about efforts to mitigate potential impacts on climate from campus activities.

The 2019 summary was based on a Climate Conversation event that took place on Thursday, April 4, 2019. Students, faculty, staff, and administrators discussed the status and goals of GHG emissions from the UM campus. The CHP project was included as "Strategy #2" in the discussion and received some positive support. Recommendations from the discussion were the following (emphasis added):

- Continue to seriously explore the viability of a combined heat and power facility and **share the anticipated financial and emissions savings with campus**.

- Couple the project, if possible, with onsite solar generation ["Strategy #3"] and a Zero Net Growth policy ["Strategy #4"] where feasible.

The event participants were told that a CHP project could provide up to 85% of the annual electrical consumption for the campus and would reduce UM's electrical carbon footprint by one-third. Participants also emphasized that the campus heating plant should explore more non-fossil-fuel options.

A review of the potentially applicable regulatory requirements for GHG emissions from the project is given in the following sections.

5.1 CHP GHG Emissions

GHG emissions were calculated for the proposed CHP project, including the CGT and HRSG duct burner, using maximum potential operating conditions (see Table 5-1). A full accounting of campus sources is included in the GHG inventory found in the air quality permit application (available from MCCHD). Emission factors for CO_2 and other GHGs were taken from EPA's GHG reporting requirements in 40 CFR Part 98, Tables C-1 and C-2. GHG emission rates were calculated in both U.S. and metric units to determine applicability of various regulatory programs.

Note that Table 5-1 lists the full potential to emit GHG emissions from the CGT and HRSG combustion equipment. Air permit applications require the disclosure of the maximum emissions from combustion equipment based on full-time operation for all 8,760 hours in a year. In reality, the equipment will not operate at full capacity for the entire duration of a year.

Table 5-1: GHG Emissions Potential to Emit from the CHP Equipment

Calculated Emissions		CGT		HRSG			Total
Pollutant	Emission Factor[a] (lb/MMBtu)	Emission Rate (lb/hr)	Emission Rate (tpy)	Emission Rate (lb/hr)	Emission Rate (tpy)	GWP[c]	CO_2e Emission Rate (MT/yr)[b]
CO_2	117.0	6,270	27,463	9,709	42,526	1	63,492
CH_4	2.20E-03	1.18E-01	0.518	1.83E-01	0.801	25	29.9
N_2O	2.20E-04	1.18E-02	0.0518	1.83E-02	0.0801	298	35.7
						Total CO_2e:	63,558

(a) Title 40 CFR 98 Tables C-1 and C-2 to Subpart C
(b) Metric tons per year (MT/yr)
(c) Global Warming Potential (GWP); 40 CFR 98, Subpart A, Table A-1

5.1.1 GHG Tailoring Rule

In general, the GHG Tailoring Rule applies to New Source Review/Prevention of Significant Deterioration (NSR/PSD) at major stationary sources that emit greater than 75,000 tons CO_2e per year or that modify their facility with a resulting emissions increase greater than 75,000 tons CO_2e per year according to 40 CFR 52.21(b)(49)(iv).

The proposed CHP project will not be an NSR/PSD major stationary source. In addition, even if it was a major stationary source, the projected GHG emissions from the new CHP facility are less than the GHG Tailoring Rule thresholds. Therefore, the GHG Tailoring Rule, which has permitting implications, will not apply to the facility.

5.1.2 Mandatory GHG Reporting

This regulation requires annual reporting of GHG emissions to EPA by direct GHG emitters, including natural gas-fired heating facilities. The GHG Reporting Rule applies to sources that emit greater than 25,000 MT/yr of CO_2e emissions. The applicability of the rule is based on actual emissions and not on a source’s potential emissions.

The emission inventory included in Section 3.0 of the Air Quality Permit application shows the potential to emit of the UM facility is greater than 25,000 MT/yr of CO_2e from fossil fuel combustion. Based on the emission factors used, the UM heating plant would exceed the reporting threshold by burning more than 460,000 standard cubic feet (scf) of natural gas in a year. UM will monitor actual annual fuel use consistent with the methodologies of the rule to determine if GHG reporting is required.

5.2 Campus GHG Emissions

As part of their Sustainability Program, UM regularly calculates and tracks campus-wide annual GHG emissions. This allows measurement of success in reducing emissions and helps mark progress over time. UM's GHG Emissions Summary spreadsheet is available on the UM CHP website: https://www.umt.edu/facilities/energy-plan/combined-heat-and-power.php. The spreadsheet documents quantities of fuels and other energy sources utilized and calculates metric tons of CO_2e produced each year for various direct and indirect emissions sources. These methods were utilized to account for potential changes in campus GHG emissions following implementation of the CHP project. By tracking overall emissions and analyzing them against available metrics, progress on UM's sustainability goals can be realized.

5.2.1 GHG Accounting

Determining the change in GHG emissions after the installation of the proposed CHP project must account for both the change in emissions generated onsite at the UM campus and the change in electricity purchased from NWE. UM reviewed guidance documents from EPA and the World Resources Institute in order to be consistent with current GHG accounting protocols.

The GHG Protocol website and EPA Center for Corporate Climate Leadership classify GHG emissions as Scope 1, Scope 2, or Scope 3. Scope 1 emissions are direct GHG emissions that occur from sources that are controlled or owned by an organization, such as emissions associated with fuel combustion in boilers, turbines, and vehicles. Scope 2 GHG emissions are indirect GHG emissions associated with the purchase of electricity, steam, heating or cooling. Scope 3 emissions include emissions both upstream and downstream of an organization's activities. This EA evaluates the change in Scope 1 and Scope 2 GHG emissions with the implementation of the proposed CHP project.

The boundary for this analysis is the UM heating plant. The energy and GHG emission inputs and outputs from the heating plant are the subject of this analysis.

Scope 1 Emissions

Scope 1 GHG emissions from the project result from the combustion of natural gas and, in the case of natural gas curtailment, the combustion of diesel fuel. For the purpose of this analysis, only the combustion of natural gas was considered since curtailment and diesel fuel combustion on campus are rare and only occur under unusual and/or emergency conditions.

As described above, UM currently operates three natural gas-fired boilers. Calendar year 2018 was used to calculate baseline GHG emissions from the three boilers prior to implementation of the CHP project. Projected annual operating hours for the CHP turbine and HRSG were used to calculate post-project GHG emissions.

Scope 2 Emissions

Scope 2 GHG emissions were determined based on the use of the most appropriate emission factor to apply to the amount of power purchased from the local utility. NWE is the local utility provider, providing both electricity and natural gas. The amount of electricity purchased from NWE is expected to decrease from 36,080 megawatt-hours (MWh) per year to approximately 5,462 MWh per year with the implementation of the CHP project, which is an 85% reduction in purchased electricity.

The amount of GHG emissions from the production and distribution of electricity from NWE to the UM campus was estimated using the EPA Emissions Hub emission factor for non-baseload power from NWPP, which is the eGRID Subregion of which NWE is a part (EPA, 2021). Guidance from EPA states that annual non-baseload output emission factors should be used to estimate GHG emission reductions from projects that cut electricity use. Further, UM requested that the Washington State University Energy Program (WSUEP) provide an analysis of GHG Accounting for the CHP Project (see spreadsheet in Appendix A for more detail). The WSUEP analysis is provided in Appendix B; that analysis supported the use of EPA Emissions Hub GHG emission factors from electricity supplied to the campus.

Table 5-2 shows the actual heat input to the existing heating plant boilers and purchased electricity from NWE for calendar year 2018, and the projected annual heat input to the CHP system and supplemental electricity expected to be purchased from NWE. Table 5-2 also shows the expected reduction in GHG emissions as a result of the installation of the CHP project. Note that the projected GHG emissions from the CHP system are lower than the GHG potential to emit for the reasons discussed above related to Table 5-1.

Table 5-2: GHG Emissions Accounting, Pre- and Post-CHP Implementation

GHG Source	Actual Heat Input MMBtu/yr	GHG Emissions: Combustion (Scope 1) Mt/year CO_2e(4)	NWE Power Purchased MWh	GHG Emissions: Power Purchase (Scope 2) Mt/year CO_2e(5)	UM Power Produced MWh	GHG Emissions: Total Mt/year CO_2e
Pre-CHP Implementation: Existing Heating Plant, Base Year: 2018						
Boiler #1	197,494	10,490				10,490
Boiler #2	47,527	2,524				2,524
Boiler #3	6,744	358				358
Power Purchase – NWE (1)			36,080	26,643		26,643
Total Base Year	**251,765**	**13,372**	**36,080**	**26,643**		**40,015**
Post-CHP Implementation: CHP Project On-Line(2)						
Combustion Gas Turbine	431,900	22,940			24,422	22,940
Steam Turbine					7,087	
HRSG Duct Burner	21,890	1,163				1,163
Boiler #1(3)	0					
Boiler #2(3)	0					
Power Purchase – NWE (1)			5,462	4,033		4,033
Total CHP On-Line	**453,790**	**24,103**	**5,462**	**4,033**	**31,509**	**28,136**
Savings in GHG Emissions						**30%**

(1) NWE Power Purchase includes transmission losses estimated at 5.1 % of load – per EPA eGRID 2019 Grid Gross Loss for Western US https://www.epa.gov/egrid/egrid-questions-and-answers#egrid5aa
(2) Projected annual operating levels.
(3) CHP plant is capable of 70,000 lb/hr of steam production with duct burner. During the base year of 2018, there were no hours in the year that exceeded 70,000 lb/hr, so there would appear to be no need to engage either of the existing heating plant boilers. Max usage was 63,240 lb/hr.
(4) GHG Emissions Factors from 40 CFR 98, Subpart C: Table C-1 & C-2, GWP from Subpart A: Table A-1.
(5) Apply 2019 eGRID GHG Emissions Factor for NWPP Region, Non-Baseload per recommendation of US DOE Northwest Combined Heat and Power Technical Assistance Partnership (NW CHP TAP): 0.73843 Metric tons CO_2e/MWh.

The greater amount of GHG emissions from the UM heating plant CHP project is offset by a greater reduction in the amount of GHG emissions generated by the production and delivery of electricity from NWE since the CHP project will generate steam for the campus while also producing a greater amount of electricity. The system is designed to maximize the recovery of useful energy from the combustion turbine generator, the HRSG, and the steam generator. For example, when steam is not needed to heat the campus, more electricity can be generated by the two electrical generators that are integral to the system. When campus steam demand is high, electricity will still be generated by the CHP system, although a relatively smaller amount of electricity will still need to be purchased from NWE, as shown in the table above.

5.2.2 STARS Program

UM participates in the Sustainability Tracking, Assessment & Rating System (STARS) program (Association for the Advancement of Sustainability in Higher Education, 2019). Operations credits under OP1, Emissions Inventory and Disclosure, are addressed in the air permit application. Operations credits under OP2, GHG Emissions, are discussed in this section of the Environmental Assessment for the CHP project.

As discussed above, the boundary established for this analysis is the heating plant, and the analysis addresses both energy inputs to and energy outputs from that boundary. One way to normalize the information among different campuses is to determine the amount of GHG emissions per square foot of campus served by the heating plant. This is also helpful for determining the relative impact of implementation of the CHP project compared to the existing heating plant boiler system.

Table 5-3 shows the GHG emissions pre- and post-project implementation normalized to square footage of the UM campus served. The data in this table is based on 2018 actual emissions and projected annual emissions post-CHP implementation.

Table 5-3: GHG Emissions Accounting Normalized to Square Footage of Campus Served by the Central Heating Plant, Pre- and Post-CHP Implementation

	Square Footage of Campus Served	GHG Emissions: Total kg/year CO2e	GHG Emissions per Square Foot: kg GHG/sq. ft.
2018 Actual	3,269,529	40,016,000	12.2
Under the Proposed CHP Project	3,499,740	28,136,000	8.0
		Benchmark reduction:	4.2
		Percent reduction in GHG emissions per square foot of campus served by the heating plant, post-CHP implementation:	34%

The GHG emissions per square foot of campus served by the heating plant will be reduced by approximately 34% upon implementation of the CHP project. The proposed project allows for an increase in the square footage of campus served, as well as generating less in GHG emissions. This is a good example of the insight gained from normalizing GHG emissions data to the amount of campus building space served by the heating plant.

5.2.3 GHG Impacts

As discussed above, the CHP project provides an opportunity to reduce the UM campus GHG footprint, positions the heating plant to use alternate fuels in the future, and puts UM in more control of their energy future. While UM's current GHG footprint of approximately 40,000 metric tons per year of CO_2e is extremely modest when compared to US 2019 GHG emissions of about 6.6 billion metric tons per year of CO_2e (EPA, 2021) and global total emissions approaching 51 billion tons annually, UM wishes to be proactive in reducing emissions and mitigating negative impacts on climate.

In summary, the proposed CHP project will improve the GHG footprint of the UM campus and is in keeping with the stated goals of the 2019 Campus Climate Conversation (University of Montana, 2019).

6.0 SUMMARY OF POTENTIAL PHYSICAL AND BIOLOGICAL EFFECTS

In addition to air quality impacts, the EA regulations require evaluation of the potential physical and biological effects of the project related to these additional features:

a. Terrestrial and Aquatic Life and Habitats;
b. Water Quality, Quantity, and Distribution;
c. Geology and Soil Quality, Stability, and Moisture;
d. Vegetation Cover, Quantity, and Quality;
e. Aesthetics;
f. Unique Endangered, Fragile or Limited Environmental Resources;
g. Demands on Environmental Resources of Water, Air, and Energy;
h. Historical and Archaeological Sites; and
i. Cumulative and Secondary Impacts.

6.1 Terrestrial and Aquatic Life and Habitats

Impacts from construction and operation of the proposed CHP plant on terrestrial and aquatic life and habitats would be minor because of the relatively small portion of land that would be disturbed and the minor impact to the surrounding area from the air emissions when considering area air dispersion characteristics. The proposed CHP plant would be located next to the existing heating plant building on UM's Missoula Campus. This location is adjacent to Mount Sentinel, which is habitat to a variety of terrestrial animals. Terrestrials such as bears, deer, and rodents use the general area near the facility. The area surrounding the facility would not be fenced to limit access to the site. The amount of human activity in the area is expected to discourage most animals from approaching the facility. A specific discussion of threatened and endangered species is included in Section 6.6 of this EA.

Little or no impact on aquatic life and habitats would occur from the proposed plant because UM is not proposing to directly discharge effluent to the surface water or ground water in the area. The air emissions from the proposed CHP plant would have a very minor effect on any nearby water body. Approximately four million gallons of process water per year would be required for operation of the CHP plant; this estimated demand is approximately 2% of average campus water consumption annually. The water would be supplied by the City of Missoula Water utility.

Installing connections of sewer and water pipelines to the site would result in minimal impact on terrestrial and aquatic life and habitats because the construction would result in minimal disturbance to water and land and the disturbance would be temporary in areas not already disturbed.

6.2 Water Quality, Quantity and Distribution

The nearest surface water body is the Clark Fork River, which is approximately 900 feet northeast of the proposed plant. The existing UM stormwater management plan would be updated to include new infrastructure and its effects on stormwater in order to minimize impacts to the Clark Fork River.

Facility wastewater would not be directly discharged to surface water. Blowdown from the condensing/evaporative cooling unit associated with the CHP plant and other process wastewater would be discharged to the Missoula Wastewater Treatment System. The City of Missoula currently treats 6 to 9 million gallons per day of wastewater. The wastewater treatment plant has a maximum capacity of 12 million gallons per day. The additional wastewater from the proposed CHP plant would represent a minimal portion of the average daily throughput for the City of Missoula.

Process water would be obtained from the City of Missoula Water utility, the primary water provider in the Missoula area. Based on the estimated water consumption discussed above, the proposed plant would have minimal impact on the water supply for Missoula.

6.3 Geology and Soil Quality, Stability and Moisture

Impacts to geology and soil quality, stability and moisture from the facility are estimated to be minor. Approximately 0.5 acre at the site would be disturbed for the construction of the proposed CHP plant facility. The project site is located within the same 156-acre parcel as the majority of the Missoula campus buildings.

Soils in the area are characterized as unconsolidated gravels and cobbles of glacial origin. The static water level from an adjacent pumping well was 59 feet below the ground surface (Montana Groundwater Information Center, 2021). There are no known unique geologic or physical features at the site.

The subsurface soils are considered adequate to support the foundations for the proposed plant. The soil stability in the immediate vicinity would likely be impacted by construction activities. The facility would not be discharging any material to the soil.

Installing connections to sewer, water, and natural gas pipelines for the CHP site would result in minimal impact on geology and soil quality, stability and moisture because the construction would result in minor disturbance to water and land.

6.4 Vegetation Cover, Quantity and Quality

The proposed CHP plant would be located in the parking area adjacent to the existing heating plant building. The construction and operation of the proposed CHP plant would result in minimal impact to urban vegetation cover, quantity, and quality.

6.5 Aesthetics

The proposed CHP plant would be built adjacent to the existing heating plant building and to the north of Aber Residence Hall. The proposed location is surrounded by UM campus buildings to the north, south, and west. The Mount Sentinel trailhead is approximately 400 feet to the east and is a popular recreation area for hikers. The facility would be visible to users of the Mount Sentinel trail and from vehicles along Campus Drive.

The footprint of the plant would be approximately 0.5 acre. Emissions from the CHP plant would be emitted to the atmosphere through a new single 50-foot stack. An architectural rendering of the proposed CHP building is shown in Figure 3-2.

The proposed CHP plant would result in noise for the area immediately surrounding the heating plant. The primary sources of additional noise would be from the turbines, cooling fans, natural gas compressors and the stack. The CHP plant would be designed to meet the requirements of the Noise Control chapter of the Missoula Municipal Code (Missoula Municipal Code, 2010). The maximum noise levels allowed by the Missoula Municipal Code for residential and commercial areas are provided in Table 6-1 below.

Table 6-1: Maximum Noise Levels Allowed by the Missoula Municipal Code Noise Ordinance

Location	**Time**		
	7:00 a.m. to 7:00 p.m.	**7:00 p.m. to 10:00 p.m.**	**10:00 p.m. to 7:00 a.m.**
Residential	60 dBA	55 dBA	50 dBA
Commercial	65 dBA	60 dBA	55 dBA

The area would experience increased vehicle use during construction of the CHP plant, but this would be temporary. The number of vehicle trips in the area in the longer term would not increase substantially over existing traffic and would not result in adverse impacts.

The proposed CHP plant would not generate any adverse odors into the surrounding neighborhoods. Air emissions from the plant are characterized in the Air Quality Permit application for the CHP Plant and are discussed further in Section 4.0 of this EA.

6.6 Unique, Endangered, Fragile or Limited Environmental Resources

In Missoula County, seven species have been identified as federally endangered, threatened, or proposed candidate species. These seven species and their designation information are summarized in Table 6-2 (Montana Fish, Wildlife and Parks, 2021).

Table 6-2: Endangered, Threatened, Proposed and Candidate Species in Missoula County

Scientific Name	Common Name	Status
Ursus arctos horribilis	Grizzly Bear	Listed Threatened
Howellia aquatilis	Water Howellia	Listed Threatened
Lynx canadensis	Canada Lynx	Listed Threatened, Designated Critical Habitat
Salvelinus confluentus	Bull Trout	Listed Threatened, Designated Critical Habitat
Coccyzus americanus	Yellow-Billed Cuckoo (western pop.)	Listed Threatened
Calidris canutus rufa	Red Knot	Listed Threatened
Pinus albicaulis	Whitebark Pine	Proposed

Because the CHP plant would be located in a developed, paved area, there is minimal chance of impacting endangered species or species of concern at the proposed plant location. Further, through the air quality analysis conducted in support of the air quality permit application, impacts on the surrounding environment meet applicable ambient air quality standards set to protect public health and the environment.

6.7 Demands on Environmental Resources of Water, Air and Energy

Natural gas would come from NWE through an existing pipeline to the UM campus. Ultra-low sulfur diesel to be used as backup in the event of a natural gas curtailment would be sourced from local suppliers and stored in an existing 20,000 gallon tank located on the site. The CHP project will add an additional smaller diesel storage tank incorporated into the base of the standby generator. The amount of natural gas consumed by the CHP facility at normal operation is estimated to be 450 million standard cubic feet per year. This can be compared to a total natural gas consumption for Montana of 81 billion standard cubic feet per year (Energy Information Administration, 2019).

For these reasons, the impacts on energy resources would be minor.

The CHP plant would require up to four million gallons of process water per year to operate the plant and produce the steam needed to supply the campus. Process water would be provided by the City of Missoula Water utility. As a result of the new CHP plant, there would be an increase in water usage for the heating plant.

Wastewater from the plant would be sent to the City of Missoula wastewater treatment plant. The existing natural gas boilers would experience decreased utilization as a result of the project, and the quantities of wastewater generated by the overall plant would be similar to current quantities produced. The project would not result in a significant increase in wastewater generated.

The proposed CHP plant would meet local, state, and national ambient air quality standards designed to protect human health and the environment. Several ambient air quality scenarios were modeled, including “worst case” conditions for NO_X, CO, VOC, PM, PM_{10}, $PM_{2.5}$, and SO_2 as described in Section 4.2. Compliance with ambient air quality standards was shown during these conditions. Based on modeling results, the proposed CHP plant, combined with the modified existing heating plant, would not have a significantly adverse effect on air quality.

6.8 Historical and Archaeological Sites

The CHP plant would be located on the campus of the University of Montana in the existing parking lot adjacent to the heating plant building. The heating plant building is within the University of Montana Historical District. This property has been part of the University of Montana since it was founded in 1893.

The National Register of Historic Places currently includes three places recognized as historically significant in the project area:

1. University Apartments,
2. University Area Historic District,
3. University of Montana Historic District.

Given these designations, UM personnel consulted with local historic preservation specialists and the State Historic Preservation Office (SHPO) to determine how to preserve and/or mitigate any impacts to historic values. A letter documenting this consultation and its results is provided in Appendix C; it stipulates the following actions by the university:

- Using the same red and brown brick pattern that is used on the original structure on the brick wainscot of the addition.
- Dividing the windows of the addition in a similar layout to those that are on the original structure. In the large Tudor style windows on the original structure, the mullions are of different thicknesses that break up the different panes of glass. Using a similar pattern on the addition would help to reference the original structure.
- Using pre-cast concrete of the same color or as close as can be matched to the terra cotta finishes on the original structure on the sill for the wainscot and windows.

Based on UM’s agreement to the above stipulations, SHPO concurred the project will have no adverse effect on the historic district.

6.9 Cumulative and Secondary Impacts

Current and foreseeable projects in the Missoula area would include industrial activities, agriculture, road construction, and fires (wildfire and prescribed burning) and would have a cumulative effect on air quality. The potential for emissions from the construction and operation of the proposed CHP plant to combine with emissions from a nearby source to create a short-term ambient air quality or visibility exceedance is low. Using dispersion modeling and agency guidelines, coupled with the "worst case" potential air emissions for the proposed CHP plant, shows that the national and Montana ambient air quality standards would be protected.

The facility would be located near existing utilities. Connecting to the existing utilities necessary to operate the plant (electric, sewer, water) would result in minimal disturbance and minor cumulative and secondary impacts. An existing natural gas pipeline will be upgraded to support the increased demand from the CHP plant.

As described in Section 6.7, the facility would have a minimal impact on water resources (supply and wastewater treatment). No cumulative or secondary impacts to water resources are expected as a result of this project.

7.0 SUMMARY OF POTENTIAL SOCIAL AND ECONOMIC EFFECTS

The following sections summarize the social and economic effects of the proposed project on the human environment.

a. Social Structures and Mores;
b. Cultural Uniqueness and Diversity;
c. Local and State Tax Base and Tax Revenue;
d. Agricultural or Industrial Production;
e. Human Health;
f. Access to and Quality of Recreational and Wilderness Activities;
g. Quantity and Distribution of Employment;
h. Distribution of Population;
i. Demands for Government Services;
j. Industrial and Commercial Activity;
k. Locally Adopted Environmental Plans and Goals; and
l. Cumulative and Secondary Impacts

7.1 Social Structures and Mores

The addition of the proposed CHP plant to UM's boiler facility would not cause a disruption to any native or traditional lifestyles or communities (social structures or mores) in the immediate area. The proposed land use for the facility is consistent with the current land use which is the operation and support of the UM campus. The areas adjacent to the CHP plant would continue to be used by the university and general population of Missoula.

7.2 Cultural Uniqueness and Diversity

Cultural uniqueness and diversity of the area near the facility would not change because the immediate area is currently used for steam generation and parking. These uses would continue during and after construction. The surrounding area would remain unchanged as a result of the project, including the historic heating plant building and the existing brick stack.

7.3 Local and State Tax Base and Tax Revenue

Because UM is a state higher education institution, it does not pay local or state taxes. The proposed plant would result in construction jobs to build the plant (see Section 7.7), but no permanent increase in employment. Increased temporary employment from the project would yield a minimal increase to the state and local tax base and overall tax revenue.

7.4 Agricultural or Industrial Production

Since the facility would impact only a relatively small amount of currently developed land, impacts to any agricultural and industrial production in the area from operation of the facility would be negligible. The air quality analyses demonstrate the CHP facility will comply with the NAAQS and MAAQS which protect public health and public welfare with an adequate margin of safety, thereby assuring impacts to the surrounding area are minimal.

7.5 Human Health

The UM CHP plant proposes to use the best available control technology, or BACT, for air pollution control and, given the dispersion of the emissions, overall impacts to human health would be minor. Taking into account dispersion characteristics such as wind speed, wind direction, atmospheric stability, stack height, and stack temperature, the modeled impacts demonstrate that the facility would yield impacts below the NAAQS and MAAQS. The air quality permit for the facility would incorporate federally enforceable conditions to ensure the facility will be operated in compliance with all of the applicable air quality rules and standards. The potential for impacts to human health or the environment through pathways other than air would be minimal.

7.6 Access to and Quality of Recreational and Wilderness Activities

Recreational and wilderness activities in the area primarily encompass the UM Campus, Mount Sentinel, Clark Fork River corridor, and two wilderness areas. The wilderness areas are the Rattlesnake National Recreation Area and Wilderness approximately four miles north of the UM campus and the Selway-Bitterroot Wilderness Area approximately 16.5 miles southwest of the UM campus.

The construction of the CHP plant would not adversely affect access to or quality of any currently available recreational or wilderness activities. Air quality impacts for the UM heating plant have been analyzed and are below the NAAQS and MAAQS which are protective of human health. The highest air quality impacts are adjacent to the UM CHP plant and quickly diminish with distance from the source. There is negligible potential for the heating plant to have a measurable impact on recreational or wilderness activities.

7.7 Quantity of Distribution of Employment

The CHP plant is being proposed as an addition to the UM heating plant for the reasons discussed in Section 2. UM does not anticipate the need for any additional heating plant staff following the completion of the CHP project.

The construction phase of the CHP plant would employ local trades as much as practicable for the anticipated 30-40 workers needed for construction. This level of employment will have minimal effect on a community of Missoula’s size.

7.8 Distribution of Population

UM anticipates that no additional employees will be required to operate the UM heating plant following completion of the CHP project.

7.9 Demands on Government Services

UM demands on government services would generally remain at current levels. As discussed above, the project would not significantly impact existing local services.

7.10 Industrial and Commercial Activity

The construction of the CHP plant would slightly increase the industrial and commercial activity in the vicinity of the UM heating plant. This activity would be similar to the numerous buildings that have been erected on the campus. Ongoing plant operations would require routine truck deliveries of various materials and supplies to the facility.

7.11 Locally Adopted Environmental Plans and Goals

On May 18, 2020, at a joint meeting of the Missoula City Council and Missoula Board of County Commissioners, the Climate Ready Missoula Plan was adopted by the Board of County Commissioners as an issue plan of the Missoula County Growth Policy and by the City Council as an issue plan of the *Our Missoula*: City Growth Policy 2035 (Climate Ready Missoula Plan, 2020). Among the Plan's Goals + Strategies are those for Energy, including to "develop local energy savings programs to reduce energy cost burden and exposure to energy price volatility." The UM CHP Project can fall in line with this strategy by placing UM in control of both their local steam produced for heating, and the majority of the electricity used on the campus.

In addition to Missoula's local planning, the University of Montana 2010 Climate Action Plan (CAP) (University of Montana, 2010) outlined strategies developed by UM's Sustainability Coordinator and the Associated Students of the University of Montana (ASUM) Sustainability Coordinator with input from a Technical Working Group. The stated goal of the 2010 CAP was to achieve carbon neutrality by 2020 with an interim GHG emission reduction of 15% below 2007 levels by 2015.

The UM CAP was updated in 2019 through a campus climate conversation that was summarized in a report (University of Montana, 2019). This report acknowledges that the campus would not reach carbon neutrality by 2020. However, the report describes five carbon emission reduction strategies, one of which was to install a combined heat and power facility on campus in combination with a strategy of Zero Net Growth and/or large-scale solar where feasible. In this regard, the installation of the proposed CHP project is in line with the UM campus community's stated carbon reduction goals.

The 2010 CAP and 2019 CAP update documents are available online at http://www.umt.edu/greeningum/documents/CAPFinal.pdf.

7.12 Cumulative and Secondary Impacts

Major cumulative and secondary impacts from this project are linked to the UM CAP goal of carbon neutrality. UM anticipates approximately 11,880 metric tons CO_2e of reductions from the operation of a CHP plant.

A secondary beneficial impact of the CHP plant would be to move the campus toward controlling its own energy supply and what fuels that energy. For example, possible use of bio-fuels or hydrogen as they become available could be an important demonstration project for the state and region.

8.0 REFERENCES

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APPENDIX A – GHG ACCOUNTING FOR CHP PROJECT

Greenhouse Gas Accounting for CHP Project
UM Heating Plant Before and After CHP Project on-line
Actual to Projected Emissions Comparison, Firing Natural Gas

EPA Emissions Hub for Non-Baseload NWPP GHG EF: 0.73843 MTCO2e/MWh

GHG Source	Base Year: 2018	Actual Natural Gas Heat Input MMBtu/year	GHG Scope 1 Emissions: Combustion Mt/year CO_2e[4]	NWE Power Purchased MWh	GHG Scope 2 Emissions: Power Purchase Mt/year CO_2e[5]	UM Power Produced MWh	GHG Emissions: Total Mt/year CO_2e
Boiler #1		197,494	10,490				
Boiler #2		47,527	2,524				
Boiler #3		6,744	358				
Power Purchase - NWE [1]				36,080	26,643		
Total Base Year		251,765	13,372	36,080	26,643		**40,015**

CHP Project On-Line[2]							
Combustion Gas Turbine		431,900	22,940			24,422	
Steam Turbine						7,087	
HRSG Duct Burner		21,890	1,163				
Boiler #1[3]		0					
Boiler #2[3]		0					
Power Purchase - NWE [1]				5,462	4,033		
Total CHP On-Line		453,790	24,103	5,462	4,033	31,509	**28,136**
						Total Projected GHG Emissions Reduction:	**11,879**
						Savings in GHG Emissions	**30%**

[1] NWE Power Purchase' includes transmission losses estimated at 5.1 % of load - per EPA eGRID 2019 Grid Gross Loss for western US. Link here

[2] Projected annual operating levels

[3] CHP plant is capable of 70,000 lbs/hr of steam production with duct burner. During the base year of 2018, there were no hours in the year that exceeded 70,000 lbs/hr, so there wouldappear to be no need to engage either of the existing heating plant boilers. Maximum steam usage was 63,240 lb/hr.

[4] GHG Emissions Factors from 40 CFR 98, Subpart C: Table C-1 & C-2, GWP from Subpart A: Table A-1

[5]Apply 2019 eGRID GHG Emissions Factor for NWPP Region, Non-Baseload per recommendation of US DOE Northwest Combined Heat and Power Technical Assistance Partnership (NW CHP TAP)

Scope 1 Emission Factor:

40 CFR Appendix Table C-1 to Subpart C			GWP	Emission Factors	
Natural Gas Default CO2 Emission Factor	53.06	kgCO2/MMBtu	1	53.0600	kgCO2e/MMBtu
Natural Gas Default CH4 Emission Factor	0.001	kg CH4/MMBtu	25	0.0250	kgCO2e/MMBtu
Natural Gas Default N2O Emission Factor	0.0001	kg N2O/MMBtu	298	0.0298	kgCO2e/MMBtu
		Total:		53.1148	kgCO2e/MMBtu
				0.0531	MTCO2e/MMBtu

Scope 2 Emission Factor:
Non-Baseload EF from EPA eGRID NWPP Region:

	lb/MWh	MT/MWh	GWP	Emission Factors	
CO2	1,617.500	0.73368566	1	0.73368566	MTCO2e/MWh
CH4	0.156	0.00007076	25	0.00176901	MTCO2e/MWh
N2O	0.022	0.00000998	298	0.00297375	MTCO2e/MWh
			Total:	0.73842842	MTCO2e/MWh
	1 metric ton =	2,204.62	lbs		

STARS Program Calculations, OP2	Square Footage of Campus Served	GHG Emissions: Total Mt/year CO2e	GHG Emissions: kg/year CO2e	GHG Emissions per Square Foot
2018 Actual	3,269,529	40,016	40,016,000	12.2
Under the Proposed CHP Project	3,499,740	28,136	28,136,000	8.0
			Benchmark Reduction:	4.2
			Percentage Reduction:	34%

APPENDIX B – WSUEP GHG ANALYSIS

CHP Third Party Review of GHG Emissions Analysis

University of Montana
Missoula, Montana

Recuperated Gas Turbine

with Heat Recovery Steam Generation

Northwest CHP TAP

May, 2021

Introduction

The US DOE Northwest Combined Heat and Power Technical Assistance Partnership (NW CHP TAP) at Washington State University Energy Program's (WSUEP) has been asked to provide third party review of the GHG emission analysis performed for the proposed gas turbine CHP project at the University of Montana by Bison Engineering, Inc. Onsite fuel uses and utility electricity purchases of the baseline and the proposed CHP alternative are summarized in **Table 1**.

Bison Engineering used a total CO2 (not CO2e) electricity emission factor from the electric utility Northwestern Energy (NWE), weighted for owned and purchased generation. With the minor correction of using CO2e, the NW CHP TAP assesses Bison Engineering's choice of the electricity emission factors to be valid. However, after reviewing the electricity utility NorthWestern Energy's generation resources, we recommend using eGrid non-baseload emission factors instead of the utility's emission factor for total generation. Emission factors estimated for the Dave Gates Generating Station, which provides regulating capacity for NWE, are similar to eGrid non-baseload factors. NWE also purchases significant capacity on the market to meet variable retail load. It is our judgment that eGrid non-baseload factors will best represent the NWE's own regulating capacity and its market resources which are the resources that will be primarily offset by the proposed CHP plant.

Selection of electricity emission factors has a large impact on CO2 emissions estimation results and so must be carefully considered. Generally, eGrid emission factors are preferred over utility or state-level emission factors, as will be discussed below, but organizations sometimes choose to use utility-level emission factors if required by a funder or specified by policy. If utility level emission factors are used, marginal emissions (load following or regulating) are preferred over baseload emission factors or emission factors for the utility's total generation mix. As part of this analysis, The NW CHP TAP team performed three comparison analyses using eGrid non-baseload electricity emission factors and emission factors calculated from the heat rates of two generation stations Northwestern Energy uses for marginal generation.

For natural gas use, Bison Engineering used emission factors for combustion of natural gas from 40 CFR 90, rather than using emission factors specific to technology types. The impact of this difference on GHG emissions is minor. Selecting fossil fuel emission factors by technology primarily impacts results for NOx emissions. For a GHG emission analysis, NW CHP TAP supports this selection. For reference, natural gas emission factors by technology type used as defaults in the U.S. EPA's GHG calculator for both GHG and criteria pollutants are summarized in Table 3.

Emission factors for natural gas and electricity recommended by NW CHP TAP are summarized in **Table 2**.

Table 1. Energy Analysis Results for Baseline and Proposed CHP Project

Energy Source & Technology	Energy Uses	
	Baseline	CHP Alternative
Purchased Electricity*	34,240,341 kWh/year	5,182,995 kWh/year
Natural Gas, Existing Boilers	251,765 MMBtu/year	-
Natural Gas, Combustion Turbine	-	431,900 MMBtu/year
Natural Gas, Duct Burner	-	21,890 MMBtu/year

* Not including transmission and distribution losses. T&D losses are estimated at 5.1% per USEPA (2019) for the Western Interconnect

Table 2. Recommended Emission Factors

	Natural Gas (40 CFR 98) (kg/MMBtu)	**Electricity, eGrid Non-Baseload NWPP (EPA 2019)** (metric tonnes/MWh)
CO2e	53.11	0.7368
CO2	53.06	0.7337
CH4	1.00E-03	7.08E-05
N2O	1.00E-04	4.54E-06

Table 3. Technology-Specific Natural Gas Emission Factors*

	Natural Gas-Fired Existing Boiler (kg/MMBtu)	Natural Gas-Fired Combustion Gas Turbine (kg/MMBtu)	Natural Gas Duct Burner (kg/MMBtu)
CO2e	53.08	53.08	53.08
CO2	53.03	53.03	53.03
CH4	9.98E-04	1.00E-03	9.98E-04
N2O	9.07E-05	1.00E-04	9.07E-05
CH4	4.54E-02	7.00E-02	3.63E-02
N2O	2.64E-04	2.65E-04	2.64E-04

* Defaults from USEPA's GHG calculator

NorthWestern Energy Generation Resources

Northwestern Energy's generation includes hydro, wind, natural gas, coal, and solar generation resources.[1,2] NWE also purchases significant electricity on the market. Northwest Energy's two natural gas generating stations that provide regulating capacity are the 150 MW Dave Gates Generating Station

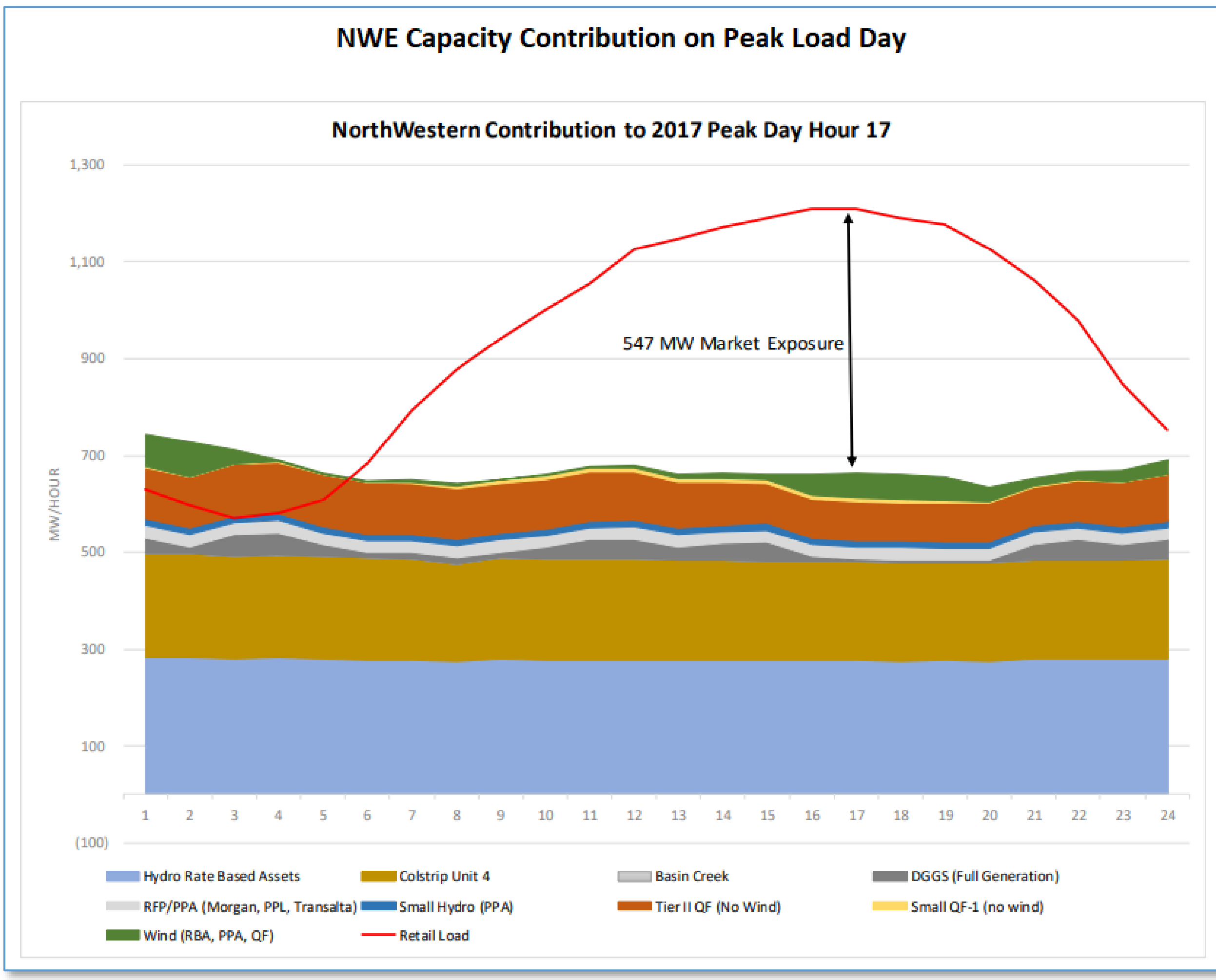
[1]Northwestern Energy, 2019 Electricity Supply Resource Procurement Plan, Docket No. N2018.11.78, August 2019, https://www.northwesternenergy.com/docs/default-source/documents/defaultsupply/plan19/ch-2019-vol-1-final.pdf

[2]Northwestern Energy, 2020 Supplement to the 2019 Electricity Supply Resource Procurement Plan, December 2020, https://www.northwesternenergy.com/docs/default-source/documents/defaultsupply/2020_supplement_to_2019_procurement_plan.pdf

and the 50 MW Basin Creek Station. NWE also uses Colstrip Unit 4 and their hydropower plants to meet moment-to-moment changes in generation.

Capacity contributions on their peak day in 2017 are shown in Figure 1, which shows their 547 MW of market exposure (purchases required) on this day. Also, notice how operation of the Dave Gates Generation Station varies through the day in response to wind generation and retail load. Basin Creek did not contribute capacity on this day.

Figure 1. NorthWestern Energy's capacity contribution on peak load day in 2017



Source: 2019 Electricity Supply Resource Procurement Plan, Docket No. N2018.11.78, August 2019
https://www.northwesternenergy.com/docs/default-source/documents/defaultsupply/plan19/ch-2019-vol-1-final.pdf

NWE Natural Gas Regulating Capacity

Dave Gates Generating Station (DGGS) has three 50 MW plants, with a total of six dual fuel Pratt & Whitney FT8-30 Swiftpac combustion turbines. The facility provides regulation capability to the electrical grid, adjusting its power output every 10 seconds, balancing out variable retail load and the variable output from the wind turbines in the area.[3] DGGS provides regulation service resource, as well as contingency reserves, load following services, and peaking capacity at times of peak demand.[4]

Basin Creek is a 52 MW peaking facility with nine 5.7 MW reciprocating engines that can be dispatched individually. In 2013, NorthWestern noted it uses three units for non-spinning reserve requirements, leaving about 35 MW of capacity (six units) to be used to serve the peak and energy needs of retail customers. NorthWestern dispatches the Basin Creek units on an hour-by-hour basis when the variable cost to generate there is lower than the market price for energy; it is typically dispatched in the hours when loads and prices are highest.[5]

Heat Rates of NWE Natural Gas Resources

CO2 electricity emission factors can be calculated for a generating plant from its heat rate. An economic dispatch study conducted by E3, provided heat rate curves that were developed from DGGS from hourly data on operation, as shown in Figure 2. This is compared to heat rate curve for Basin Creek in Figure 3, from the same study.

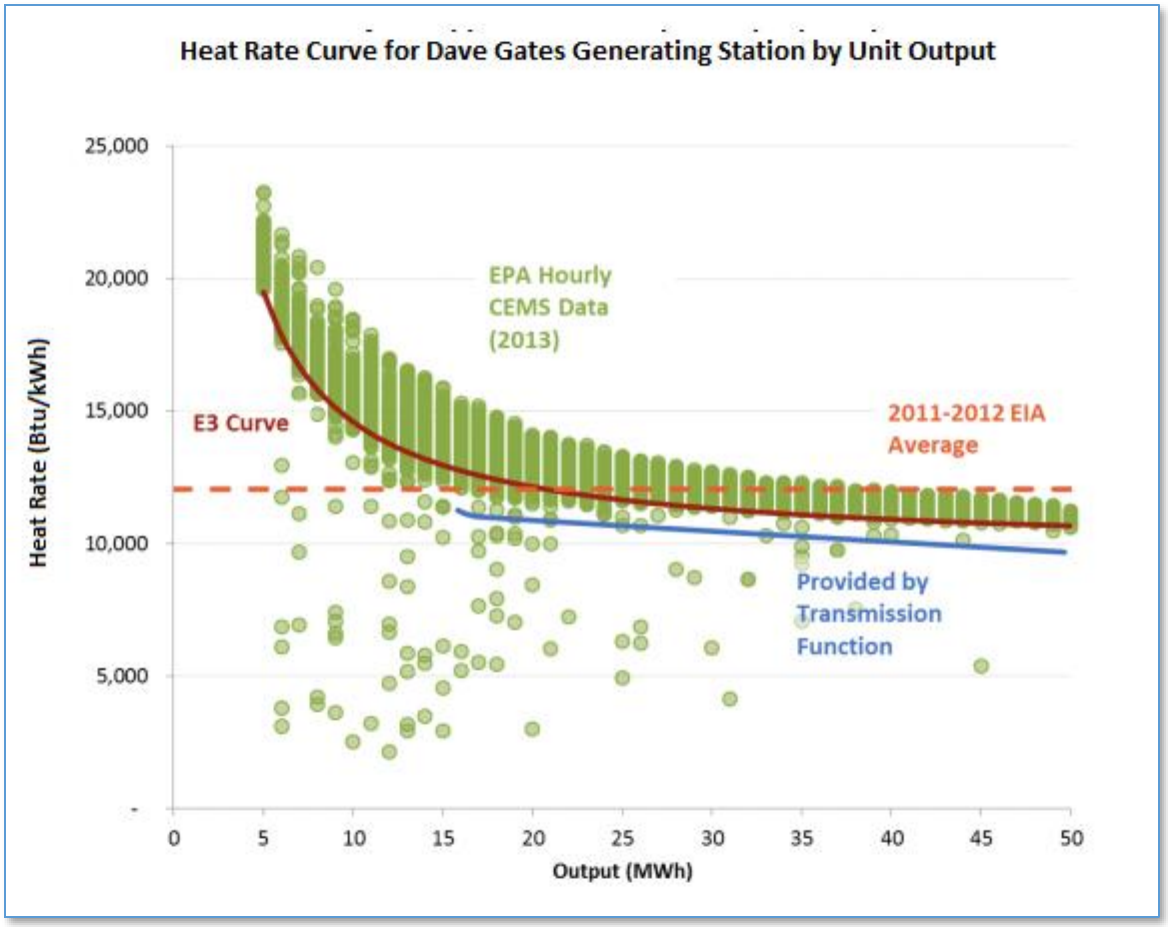
Due to frequent part load operation, the average heat rate of DGGS was on average 12,800 Btu/kWh. The analysis used a heat rate for Basin Creek of 9,071 Btu/kWh, indicating the multiple individual units operate at higher loads.

[3] Corval Group, David Gates Generating Station at Mill Creek, https://www.corvalgroup.com/markets/power-energy/northwestern-energy/

[4] Northwestern Energy, 2015 Electricity Supply Resource Procurement Plan, https://www.northwesternenergy.com/docs/default-source/documents/defaultsupply/plan15/volume1/chapter12resultsandconclusions

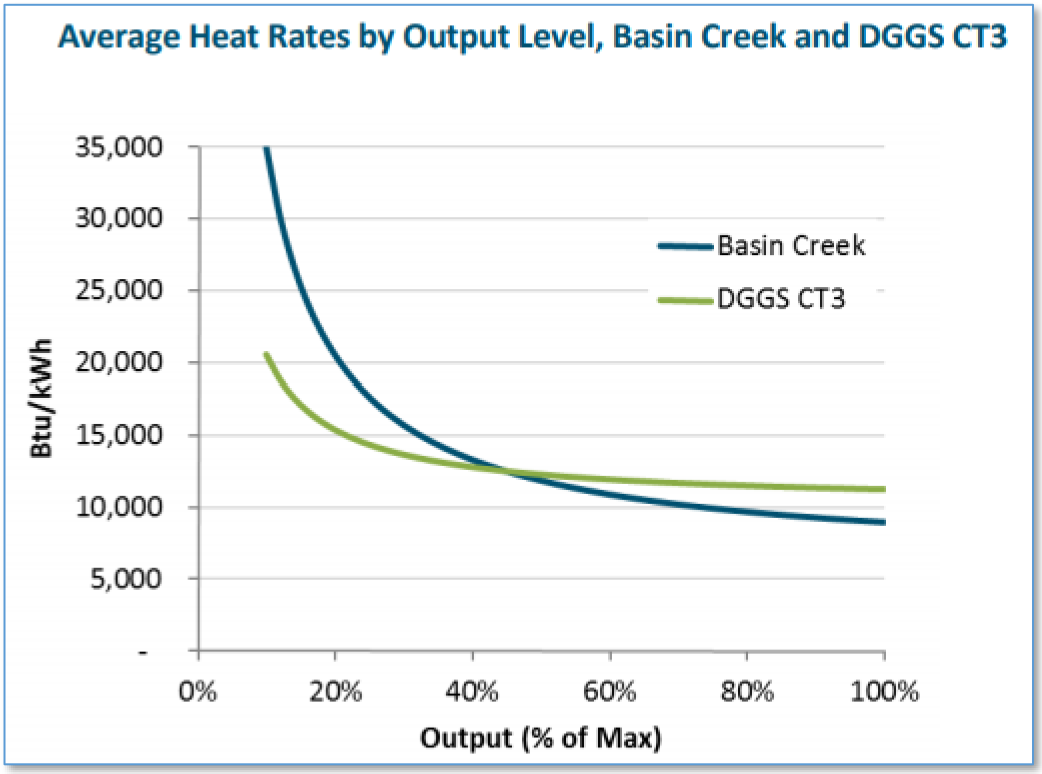
[5] Northwestern Energy, 2013 Electricity Supply Resource Procurement Plan, https://www.northwesternenergy.com/docs/default-source/documents/defaultsupply/plan13/2013-Elec-Plan-Vol-1-Chap-2-Current-Portfolio

Figure 2. Heat rate curve vs Unit Output for Dave Gates Generation Station



Source: Basin Creek Dispatch Study, Analyzing the Benefits of a Co-Optimized, Dispatch Procedure, March 3, 2016
https://www.northwesternenergy.com/docs/default-source/documents/defaultsupply/plan15/volume2/basincreekdispatchstudy

Figure 3. Heat rate curve vs Percent Output for Dave Gates Generation Station and Basic Creek Station



Source: Basin Creek Dispatch Study, Analyzing the Benefits of a Co-Optimized, Dispatch Procedure, March 3, 2016 https://www.northwesternenergy.com/docs/default-source/documents/defaultsupply/plan15/volume2/basincreekdispatchstudy

Greenhouse Gas Emission Analysis Assumptions

Assumptions used in Bison Engineering's analysis and our comparison analyses are summarized in **Table 4** and electricity emission factors are summarized in **Tables 5**. The analyses include the direct emissions associated with fuel combustion at the site and at the utility power plant. They also include emissions associated with electricity transmission and distribution (T&D) losses to the site. They do not include pre-combustion emissions associated with extraction, processing, and delivery of fuel either to the site or to the electric utility.

Table 4. GHG Emissions Analysis Assumptions

Electricity Emissions Factor Sources: See **Table 5**	
Natural Gas Emissions Factor Sources: 40 CFR 98 Subpart C, **Table 6**	
EPA eGrid Subregion	NWPP
Emissions Time Horizon	100 year (Kyoto)
Pre-combustion Electricity Emissions	Not Included
Transmission and Distribution Losses	5.1% (eGrid Western Interconnect, 2019)
Off-Site GHG Emissions of Natural Gas	Not Included
GWP per unit mass relative to CO2	
Carbon Dioxide (CO2)	1
Methane (CH4)	25
Nitrous Oxide (N2O)	298
Emissions of Typical U.S. Passenger Car	4.73 cars per metric tonne CO2e
Emissions of Typical U.S. Home	24.83 homes per metric tonne CO2e

Emission Factors Used in Analysis

Electricity emission factors are summarized in **Table 5.** Natural gas emission factors are summarized in **Table 6.**

We chose to use natural gas emission from 40 CFR 98, rather than technology specific emission factors. The difference in results is negligible and we are more concerned with selecting appropriate electricity factors, which have significant differences.

Table 5. Electricity Emission Factors from four sources

	NorthWestern Energy Total Generation Mix (metric tonnes/MWh)	eGrid Non-Baseload (EPA 2019) (metric tonnes/MWh)	Dave Gates Generating Station (Average Heat Rate of 12,800 Btu/kWh) (metric tonnes/MWh)	Basin Creek Reciprocating Engine Plant, 9071 Btu/kWh) (metric tonnes/MWh)
CO2e	0.5400	0.7368	0.6824	0.4819
CO2	0.5300	0.7337	0.6793 *	0.4814 *
CH4		7.08E-05	1.28E-05 **	9.06E-06 ***
N2O		4.54E-06	1.28E-06 **	8.24E-07 ***

* Calculated from heat rates

** Estimated from typical emission of combustion turbine, EPA GHG Calculator default

*** Estimated from typical emission of lean-burn reciprocating engine, EPA GHG Calculator default

Table 6. Natural Gas Emission Factors Used in All Four Analyses

	Natural Gas (40 CFR 98)	
	(lb. per MMBtu)	(kg per MMBtu)
CO2e	117.10	53.11
CO2	116.98	53.06
CH4	2.20E-03	1.00E-03
N2O	2.20E-04	1.00E-04

Electricity Emission Factors

Bison Engineering obtained their electricity emission factor from “Northwestern Energy Statistics, ESG/Sustainability Template – Section 2: Quantitative & Qualitative Information”. **Table 7** shows a screenshot of the GHG emissions data from this document. Notice the carbon dioxide equivalent (CO2e) emission factor for owned and purchased power is 0.54 metric tonnes per MWh or 1.190 lb. per kWh. The Bison analysis selected the CO2 factor of 0.53 metric tonnes per MWh, which neglects the contributions of CH4, N2O and other minor GHG gases. This is a minor correction.

For the Dave Gates Generating Station and Basin Creek Station, electricity emission factors for CO2 are calculated from their average heat rates – 12,800 Btu/kWh and 9,071 Btu/kWh, respectively -- using emission factor of 117.10 lb. CO2 per MMBtu for natural gas combustion. Emission factors for CH4 and N2O are assumed from the EPA GHG Calculator defaults for combustion turbines and lean burn reciprocating engines.

Table 7. Excerpt from NorthWestern Energy Statistics GHG Emissions

NorthWestern Energy Statistics

Ref. No.	Refer to the 'Definitions' tab for more information on each metric	Baseline 2008 Actual	2015 Actual	2016 Actual	2017 Actual
	Emissions				
5	**GHG Emissions: Carbon Dioxide (CO2) and Carbon Dioxide Equivalent (CO2e)**				
5.1	**Owned Generation** (1) (2) (3)				
5.1.1	Carbon Dioxide (CO2)				
5.1.1.1	Total Owned Generation CO2 Emissions (MT)	3,715,475	3,058,483	2,689,092	2,590,437
5.1.1.2	Total Owned Generation CO2 Emissions Intensity (MT/Net MWh)	1.08	0.46	0.50	0.47
5.1.2	Carbon Dioxide Equivalent (CO2e)				
5.1.2.1	Total Owned Generation CO2e Emissions (MT)	3,734,024	3,079,913	2,708,780	2,609,793
5.1.2.2	Total Owned Generation CO2e Emissions Intensity (MT/Net MWh)	1.09	0.47	0.51	0.47
5.2	**Purchased Power** (4)				
5.2.1	Carbon Dioxide (CO2)				
5.2.1.1	Total Purchased Generation CO2 Emissions (MT)	2,677,718	1,855,722	1,942,160	1,930,498
5.2.1.2	Total Purchased Generation CO2 Emissions Intensity (MT/Net MWh)	0.48	0.80	0.66	0.64
5.2.2	Carbon Dioxide Equivalent (CO2e)				
5.2.2.1	Total Purchased Generation CO2e Emissions (MT)	2,696,857	1,867,740	1,954,904	1,939,507
5.2.2.2	Total Purchased Generation CO2e Emissions Intensity (MT/Net MWh)	0.48	0.81	0.66	0.65
5.3	**Owned Generation + Purchased Power**				
5.3.1	Carbon Dioxide (CO2)				
5.3.1.1	Total Owned + Purchased Generation CO2 Emissions (MT)	6,393,193	4,914,204	4,631,251	4,520,935
5.3.1.2	Total Owned + Purchased Generation CO2 Emissions Intensity (MT/Net MWh)	0.71	0.55	0.56	0.53
5.3.2	Carbon Dioxide Equivalent (CO2e)				
5.3.2.1	Total Owned + Purchased Generation CO2e Emissions (MT)	6,430,881	4,947,653	4,663,684	4,549,301
5.3.2.2	Total Owned + Purchased Generation CO2e Emissions Intensity (MT/Net MWh)	0.71	0.56	0.56	0.54

Source: "Northwestern Energy Statistics, ESG/Sustainability Template – Section 2: Quantitative & Qualitative Information" available at https://www.northwesternenergy.com/docs/default-source/documents/investor/northwestern-energy-eei---esg-worksheet60daa9db59a5695faa4dff2e00d81af8.pdf

Natural Gas Emission Factors

Natural gas emission factors selected by Bison were from 40 CFR 98. The most recent revision of this data is available as "Memo: Table Final 2015 Revisions" at https://www.epa.gov/ghgreporting/subpart-c-general-stationary-fuel-combustion-sources . A direct link to the 2015 Memo download site is: https://www.regulations.gov/document/EPA-HQ-OAR-2015-0526-0083.

We verified emission factors for CO2, CH4 and N2O used in the Bison analysis agree with the most recent table in 40 CFR 98. Notice this data provides CO2, CH4 and N2O emission factors, but not factors for the criteria pollutants NOx or SOx. Values for CO2, CH4 and N2O are only slightly different than those used by default by USEPA by technology and the differences have negligible impact on GHG emissions results.

Recommendations for Selecting Electricity Emission Factors

We recommend the GHG analysis be revised to use 2019 eGrid non-baseload emission factors, unless UM prefers utility emission factors as a matter of policy. If UM chooses to use the utility emission factor, we recommend using the emission factors estimated for the Dave Gates Generating Station as representative of marginal emissions.

This recommendation is based on consideration of region and category of emission factor (marginal versus total or baseload), as well as examining NWEs marginal generation.

Region

Selection of electricity emission factors is often a matter of the policy of an organization or funder. In the absence of such a policy, however, eGrid emission factors are generally preferred over utility or state level emission factors. As explained by USEPA, "eGRID subregions represent sections of the grid that have similar resource mix and emissions characteristics, operate as an integrated entity, and support most of the demand in the subregion with power generated within the subregion." State level aggregation and utility specific emission factors generally are less representative of the true impact of a project due to generation that is imported and exported across these boundaries.

On the other hand, the NorthWestern utility emission factor does account for both owned and purchased generation, which makes region less of a concern.

Emission Factor Category

A larger concern is that the Northwestern utility emission is for *total* emissions, not non-baseload or marginal emissions. Marginal emissions are generally significantly higher than baseload or total emission factors.

There are three categories of eGrid emission factors based on heat rate of generation dispatched: (1) baseload (or total), (2) non-baseload (or marginal) and (3) fossil fuel output. In CHP analyses, fossil fuel output emission factors, if available, are selected for CHP plants that operate more than 6,500 hours per year. Non-baseload (marginal) are used for plants operating less frequently or if fossil fuel output emission factors are not available. Using baseload or total emission factors generally does not represent the true impact of plant operation because of how utility generation is dispatched as load varies.

For more background, refer to the U.S. Environmental Protection Agency "Fuel and Carbon Dioxide Emissions Savings Calculation Methodology for Combined Heat and Power Systems", which provides documentation of their calculator. This reference in available at https://www.epa.gov/chp/fuel-and-carbon-dioxide-emissions-savings-calculation-methodology-combined-heat-and-power

Comparison of Results

Reductions in carbon dioxide equivalent emissions for the two analyses are summarized in **Table 8** and shown in Figures 3 to 6. Using NWE's emission factors for the total generation mix results in an 18% reduction in GHG emissions. Emission reductions using emission factors for DGGS and eGrid's non-baseload emission factors are higher and similar at 27% and 30%, respectively. Emissions reductions using Basin Creek emission factors are lower at 13%. However, it does not appear Basin Creek is representative of the utility's marginal generation.

Table 8. Comparison of results with four sources for electricity emission factors

	NorthWestern Energy Total Generation Mix	eGrid Non-Baseload (EPA 2019) (Recommended)	David Gates Generating Station (Average Heat Rate of 12,800 Btu/kWh)	Basin Creek Reciprocating Engine Plant, (Heat Rate of 9,071 Btu/kWh)
CO2e Emissions, Baseline (metric tonnes per year)	32,795	**39,878**	37,843	30,704
CO2e Emissions, CHP Alternative (metric tonnes per year)	27,028	**28,101**	27,807	26,712
CO2e Emissions Reductions (metric tonnes per year)	5,767	**11,777**	10,036	3,992
Percent CO2e Emissions Reductions	18%	**30%**	27%	13%

* Carbon dioxide equivalent (CO2e) is a measure used to account for the global warming potential greenhouse gases – like methane (CH_4), and nitrous oxide (N_2O) – that contribute to climate change. It equals the quantity of carbon dioxide that would have the same global warming potential as the other gas. For example, the global warming potential of methane is 25 pounds CO2e per pound CO2.

Figure 3. Estimated greenhouse gas emissions before and after implementation of the CHP alternative using Northwest Energy's emission factors for total generation mix

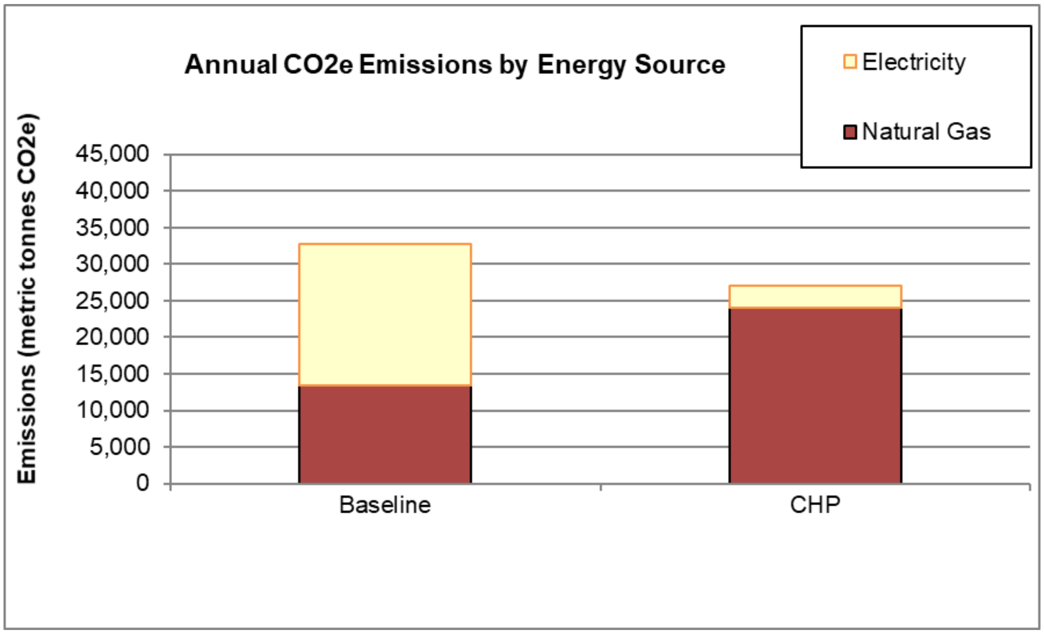


Figure 4. Estimated greenhouse gas emissions before and after implementation of the CHP alternative using eGrid non-baseload electricity emission factors, 2019

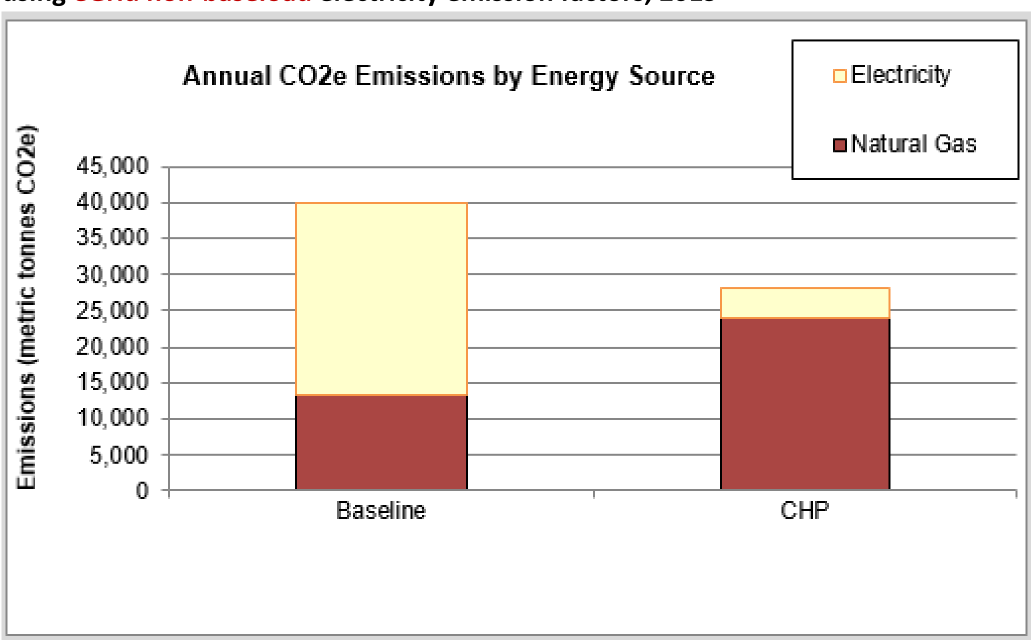


Figure 5. Estimated emissions of criteria pollutants before and after implementation of the CHP alternative using electricity emission factors estimated for the David Gates Generating Station

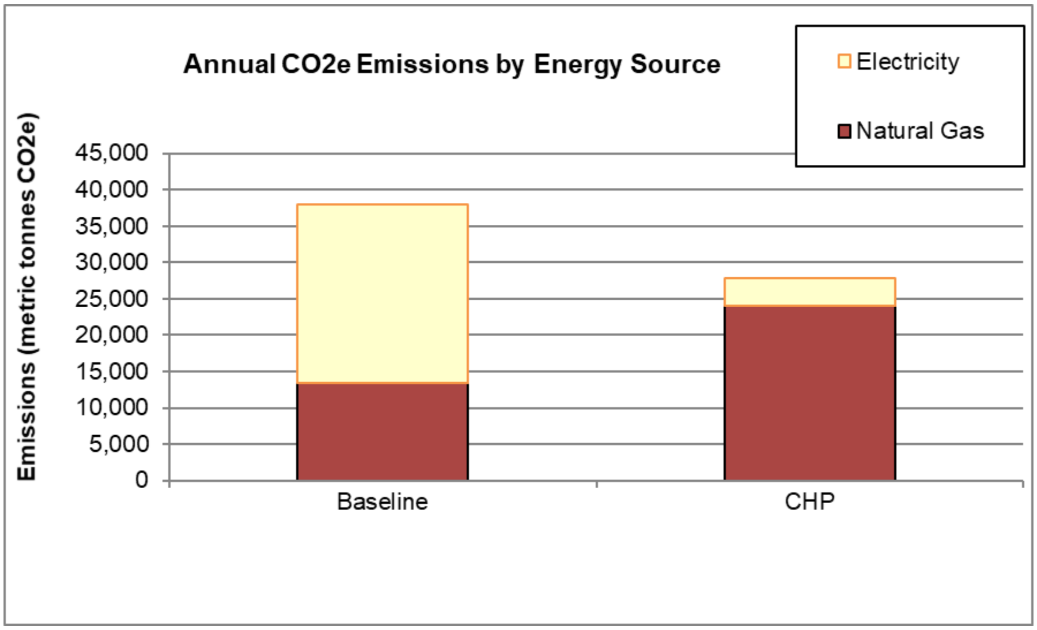
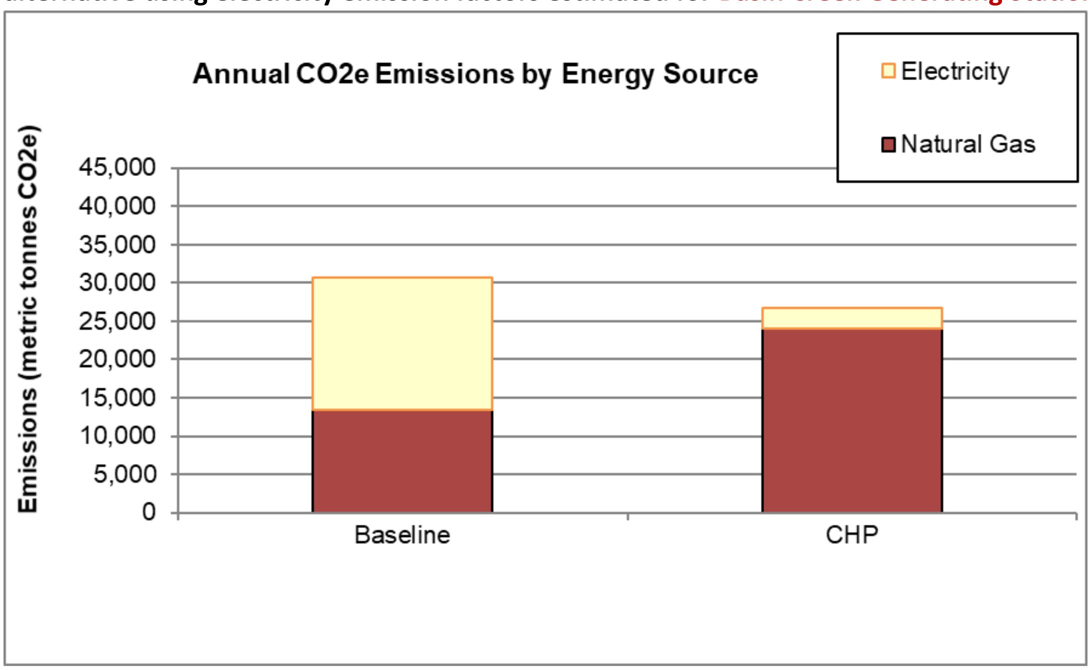


Figure 6. Estimated emissions of criteria pollutants before and after implementation of the CHP alternative using electricity emission factors estimated for Basin Creek Generating Station



APPENDIX C – SHPO LETTER

Big Sky. Big Land. Big History.
Montana
Historical Society

Historic Preservation
Museum
Outreach & Interpretation
Publications
Research Center

February 2, 2021

Mr. Paul Trumbley
Associate Director of
Utilities and Engineering
University of Montana
32 Campus Drive #9360
Missoula, MT 59812-9360

Ref: UM Heating Plant Updated Drawings and Actions

Dear Mr. Trumbley,

Thank you for consulting with the Montana State Historic Preservation Office (SHPO) regarding the proposed addition to the UM Heating Plant which is a contributing building to the University of Montana Historic District (24MO471). After a review of your consultation package and through correspondence between our two offices, SHPO concurs that the proposed addition will have *no adverse effect* to the historic district given the following stipulations which you agreed upon in your February 1, 2021 email. These stipulations include:

- Using the same red and brown brick pattern that is used on the original structure on the brick wainscot of the addition.
- Dividing the windows of the addition in a similar layout to those that are on the original structure.
- Using pre-cast concrete of the same color or as close as can be matched to the terra cotta finishes on the original structure on the sill for the wainscot and windows of the addition.

Please see the attached email correspondence which indicates that the University of Montana has committed to these stipulations for the addition.

Thank you for your hard work regarding this matter. If you have any questions or concerns regarding this letter or its contents, please feel free to reach out to me. I can be reached at 406.444.7717 or at eric.newcombe@mt.gov.

Sincerely,

Eric Newcombe

Eric Newcombe, M.A.
Historic Architecture Specialist
State Historic Preservation Office
P.O. Box 201202/1301 E. Lockey Avenue
Helena, MT 59602
Eric.Newcombe@mt.gov
(406) 444-7717

File ID: UM-2021-2021020205

APPENDIX D – PUBLIC COMMENTS AND RESPONSES

University of Montana (UM) Combined Heat & Power (CHP) Project Environmental Assessment (EA) Public Comments and Responses

Public comments and responses are presented below in a format of question from the commenter followed by an answer from UM. (Note: Questions may be paraphrased.)

Q1: If UM's CHP saves the university money, shouldn't those savings be invested in other energy efficiency and conservation projects to further reduce UM's carbon footprint?

A1: UM's administration is aware of the benefits of investing in energy/carbon reductions to both increase utility savings and shrink UM's emissions footprint. However, the university's needs are broad and deep and resources are limited. UM's administration applies its overarching perspective to best determine how resources such as utility savings are allocated across campus operations. Last year, UM's administration spent over $200k to identify additional utility-saving measures and, with the support of the Kless Sustainability Fund, Campus Recreation and the University Center will both implement energy savings measures this summer.

Q2: The EA refers readers to the CHP's website's Frequently Asked Questions (FAQ) for additional information, but the FAQ has this to say about emissions reductions:

> ***We are crunching the numbers to see what the emissions footprint of CHP will be based on the most appropriate equipment for campus, how much electricity we will generate, and current emissions associated with purchased electricity from NorthWestern Energy. Please check back for those estimates.***

I would like a better analysis of how the CHP emissions will affect the air quality in my neighborhood.

A2: The referenced FAQ Statement refers to calculation of greenhouse gas (GHG) emissions from the CHP Project. It will be updated to report the results of the GHG emissions analyses in the EA, which show a reduction in net GHG emissions when replacing current UM energy sources with CHP equipment.

UM's environmental consultant, Bison Engineering, Inc., calculated air emissions from the CHP project and performed emissions modeling for the air permit application. Significant detail is available in Appendix C "Emissions Inventory," but Table 6-7 in the Air Quality Permit Application (reproduced below) best summarizes the modeled impacts. These analyses examine the worst-case scenarios to determine maximal impact. Note that NAAQS as referred to in the table means "National Ambient Air Quality Standards" which are set by EPA to protect public health with a margin of safety. For the listed pollutants, the CHP operation will not exceed these standards at the highest receptor location when modeled using conservative assumptions for emissions and dispersion. The highest modeled air impact receptors are located on the elevated terrain east of the current Heating Plant, at the base of Mount Sentinel. Neighborhoods surrounding UM are expected to see much lower impacts from operation of the CHP Project.

Table 6-7: Results for Cumulative NAAQS Impact Analysis, Natural Gas

Pollutant	Avg. Period	Modeled Conc. (µg/m^3)	Background Conc. (µg/m^3)	Total Conc. (µg/m^3)	NAAQS (µg/m^3)	% of NAAQS
$PM_{2.5}$	24-hour	9.10[a]	23	32.1	35	91%
	Annual	1.47[b]	7.2	8.67	12	72%
PM_{10}	24-hour	12.2[c]	57	69.2	150	46%
NO_2	1-hour	143[a]	19.1	162	188	86%
	Hot Spot	144[a]	19.1	163	188	87%
	Annual	9.32[d]	1.8	11.1	100	11%
SO_2	1-hour	9.88[e]	13.1	23.0	196	12%

a. Maximum of five-year means of 8th highest modeled concentrations for each year modeled.
b. Five-year mean of annual concentration.
c. Maximum of 6th highest modeled concentrations for a five-year period.
d. Maximum annual impact of five years modeled.
e. Maximum of five-year means of 8th highest modeled concentrations for each year modeled.

Note: Table 4-3 of the EA is the same as Table 6-7 in the air permit.

Q3: Page 12 of the EA says that the air quality permit states that the permit is still under review by MCCHD. The results of that independent analysis by MCCHD should be available before the public is expected to comment on the EA.

A3: The EA process is separate and distinct from the air permitting process, but each can inform the other. UM attempted to conduct them in parallel, but unavoidable delays knocked them out of lockstep. The air permit application was filed with the Missoula City-County Health Department (MCCHD) in April. At the time of filing, a public notice was placed in the *Missoulian* by MCCHD. The public had until 5/8/21 to provide comment to MCCHD on the application. MCCHD reviews any comments, gathers the information it needs for a decision on the permit, and then prepares a draft air permit and provides additional opportunity for public comment for 14 days on the draft. In summary, there are several opportunities for the public to engage MCCHD and be informed on the air permitting process.

Q4-a: EA Table 5-2 predicts a 30% reduction in UM's annual GHG emissions while Table 5-3 predicts a 34% reduction. If true, this is a valuable reduction. It was not clear what assumptions were made about the sources of electricity in the NorthWestern Energy (NWE) grid information that was used. Was NWE electricity assumed to be 40% from fossil fuel sources, and 60% from non-fossil fuel sources?

A4-a: Data on utility power generation were taken from the US Environmental Protection Agency (EPA) Emissions & Generation Resource Integrated Database (eGRID) which inventories all generators throughout a specific eGRID region with data provided by the utilities. UM's eGRID region is the North West Power Pool (NWPP). All of NWE's generation is included. This is the method recommended by the US Department of Energy for determining emissions that are offset by the implementation of new energy projects because this attempts to account for power purchases made by NWE from other regional power providers.

Q4-b: Was the future mix of NWE sources assumed to be the same as the current mix?

A4-b: This analysis did not attempt to forecast the future mix of utilities' power generation.

Q5: The Third-Party Review of the GHG Emissions Analysis by the independent consultant (NW CHP TAP) analyzed four different sets of assumptions about the carbon footprint of electricity from NWE. The resulting reductions in carbon emissions ranged from 13% to 30%. The consultant recommended the assumption that estimated the greatest reduction in carbon emissions, but I did not understand their rationale for choosing that assumption.

A5: As energy projects such as UM's CHP project come on-line, how do they affect the grid and its allocation of dispatchable power generators? DOE and EPA recommend using "non-baseload" emission factors which are representative of generators that utilities can quickly ramp up or down depending upon minute-to-minute characteristics of the power demand. These generators are the last to be put on-line and the first to be dispatched, generally because they are more expensive to operate and are less efficient. Large baseload generators are cheaper to operate but do not have the necessary nimble flexibility to closely follow such dynamic loads. Utilities therefore use more responsive technologies such as – in NWE's case – the Dave Gates Generating Station. Another so-called "peaker plant" is NWE's Basin Creek Generation Station which, for unspecified reasons, appears not to be utilized by NWE for their characteristic "Peak Day" evaluation that NWE submitted to the Public Service Commission in support of a recent rate case (see Figure 1 in NW CHP TAP's evaluation). These plants are two of the four scenarios examined. The other two scenarios were the recommended eGRID non-baseload regional factor and also the "total" emissions factor as reported by NWE in their ESG/Sustainability template which was initially used by Bison Engineering. Each of these four scenarios resulted in differing emissions factors which led to the range of GHG reductions quoted.

In their review of Bison Engineering's initial GHG evaluation, The DOE Northwest CHP Technical Assistance Partnership (NW CHP TAP) determined that the NWE total generation mix emissions factor was not appropriate because it contained baseload generation. The eGRID non-baseload regional factor was recommended for two reasons: 1) it best represents the grid effects of not needing as much "peaker" power due to UM's CHP operation; 2) the regional aspect of this choice better accounts for the need of NWE to purchase spot market power to meet its peak retail demands. NW CHP TAP then went on to gauge this recommendation by evaluating two of NWE's known peaker generators. The Dave Gates Generating Station produced an emissions factor close to that of the recommended eGRID value while the Basin Creek Generation Station produced the lowest emissions factor but it is not actively utilized by NWE and was deemed non-representative.

Q6: What are the impacts of the larger natural gas pipeline needed to bring a larger natural gas supply to campus?

A6: The source of UM's natural gas is dependent upon the particular supplier chosen by the State of Montana to serve its agencies (including UM). The current supplier is Shell Energy and most of the gas is sourced in Canada and transported to the UM campus through an existing network of NWE and other transmission pipelines. Once in Missoula, the gas is distributed to end-use customers, again through NWE pipelines. There will be a short, 100 foot or so, section of new connector pipe, but it is only necessary to supply the CHP with a slightly higher natural gas pressure (~80 psig) and it will be located on campus, near the project. The existing network of pipelines is already sufficiently sized to provide the increase in natural gas necessary for the operation of the CHP.

Q7: I'm writing to comment on the MEPA documents for the new CHP. I am a Professor of Geosciences at UM, and my teaching and research focus on the nexus of energy and water systems. I appreciate that years of planning and analysis have gone into the Draft EA and the proposal for a new CHP, and that the new CHP would have substantial environmental and emissions advantages compared to the current system. In reviewing the Draft EA, I was disappointed that only one alternative, a no action alternative, is identified, despite reference to other alternatives developed as part of the 2010 Climate Action Plan and the 2019 Campus Climate Conversation. It appears that none of those alternatives were seriously considered.

The references to potentially using hydrogen as an alternative gas source in the future are a red herring and a distraction. Hydrogen is very far from being a commercially viable source. In contrast solar and wind are well established fossil-fuel free sources of electricity (and solar as a heating and cooling source); the cost of renewables has declined dramatically; and there is ample untapped roof space on campus for solar. Meanwhile the negatives of continued investment in fossil

fuels are becoming more evident, including methane and CO2 emissions, the social cost of carbon, and implications for wildfire, air quality, air and water temperature, etc. The city of Missoula and Missoula County (as well as many members of the public) are objecting to Northwestern Energy's plans to build a new natural gas plant and have pledged to achieve 100% clean electricity this decade. The highest CO2 concentrations (419 ppm) in millions of years were just recorded. The west is facing another severe drought year. In this context it is irresponsible of UM to move forward with new investment in fossil-fuel-based energy systems without a more comprehensive consideration of alternatives that more completely weighs the costs of a natural gas system (e.g., accounting for the social costs of carbon), current economic trends surrounding renewables, technological trends regarding battery storage, federal policy, and our campus's commitment to sustainability and finding solutions for the greatest threat facing humanity, climate change. Thank you for the opportunity to comment.

A7: UM has explored and will continue to explore a variety of energy generation opportunities, even once the CHP is operational. UM does have plans to add more solar to its roofs. Besides the existing PV systems on Todd, Fitness Rec Center, Lommasson, and Eck Hall there is a public-private partnership agreement for the Mansfield Library to potentially host 260 kiloWatts of solar once the library's roof is replaced. Part of our work with McKinstry, our energy services contractor, has been to conduct a solar feasibility study to identify roofs around campus that are the best fit for solar in the future and to calculate generation potential and cost, given current equipment and roof replacement needs. As soon as that feasibility study is complete, we will share it via our UM sustainability website.

The team involved with developing the CHP project has also investigated wind projects, biomass, solar and – yes - even hydrogen. Table 7-1 below lists some of the larger alternative energy projects that UM has explored over the years. None of these large-scale renewable energy projects was feasible either for financial or legal reasons.

Unlike many of the universities around the country that have invested significantly in renewables, UM does not have the ability to competitively bid for its electrical needs due to Montana's statutes. UM's purchased electrical power must be provided by NorthWestern Energy (NWE) so, to the degree that NWE decarbonizes, UM's carbon footprint will benefit as will all customers of the utility. UM supports the efforts by the City of Missoula and Missoula County to attain 100% renewable energy by 2030 and UM is hopeful that their advocacy will produce results, but such a decision is ultimately up to NWE.

To provide a better sense for UM's energy situation, consider one of the projects from Table A7-1. CustomerFirst Renewables is a nationwide company specializing in customized approaches to attaining an organization's energy/sustainability goals. They've had high-profile successes in deregulated markets but, after spending months working with UM and trying to understand Montana's regulatory environment, their best solution was to merely have UM invest in either a west Texas wind project or a North Carolina solar project and use the profits to purchase carbon offsets for our own electrical supply. This was not a satisfying outcome. We should also note the scale necessary to power the entire UM main campus: it would take 30 MegaWatts or 96,000 solar photovoltaic panels to provide the 35 million kWh annually needed and require 60 acres of space or 18 Ovals' worth. The cost – not including energy storage – exceeded $45M. As you mention, costs of renewables are coming down and the energy outputs are increasing. UM continues to follow these trends and look for projects. The feasibility report from our consultant will provide a good roadmap to guide future efforts.

Table A7-1: Alternate Energy Projects Considered by UM Over the Past Decade

PROJECT	YEAR	SIZE	DEVELOPER	COST
Judith Highlands Community Wind	2010	500 MegaWatts	National Wind LLC and Montana Wind Resources	N/A
Biomass Gasification	2011	34,000 pounds per hour steam	McKinstry and Nexterra	$25M
Norris Hill Wind	2013	10 MegaWatts	Sagebrush Energy	$23M
TX Wind/NC Solar	2014	36 MegaWatts	CustomerFirst Renewables	$24 to $43M
UM Solar Covered Parking	2015	3 MegaWatts	Western Renewable Energy	$30M
Deer Creek Solar PPA	2018	3 MegaWatts	Cypress Creek Renewables	N/A