THE OHIO STATE UNIVERSITY

Frequently Asked Questions

University Energy Use, Climate Action Plan and Combined Heat & Power Facility

Summary: Ohio State seeks to reduce university carbon emissions in the most cost-effective manner through a variety of actions, including the establishment of a combined heat and power facility at the Columbus campus.

How does Ohio State currently use energy?

Ohio State uses energy in two primary ways at its Columbus campus. First, electricity is used to power campus lighting and cooling and all manner of electronic appliances that plug into building outlets — ranging from the computers on our desks to the ultracold freezers in our labs and hospital system. Second, natural gas is burned in boilers to produce hot water and steam to provide heating to campus buildings. Steam is also used for sterilization, research purposes, HVAC humidity control, and in the kitchens ("process steam").

Currently, the overwhelming majority of the university's electricity load is purchased from the competitive retail electric service provider market. Various portions of this electricity purchase are bid at different points in time to ensure the university keeps its purchased electricity costs down. In addition, Ohio State has executed a long-term power purchase agreement with Blue Creek Wind Farm to serve a portion of the electricity demand of the Columbus campus. In Fiscal Year 2019, the Blue Creek Wind Farm electricity accounted for 14% of the university's total purchased electricity, with the remaining 86% coming via the market, municipal providers, and rural cooperative utility providers.

In regard to heating, nearly all of the university's Columbus campus hot water and steam is currently generated on campus through the McCracken Power Plant and related building boiler systems. McCracken, located in the academic core of campus, has operated for over 100 years. In 2007, the university converted McCracken from a coal-fueled facility to natural gas. In addition, geothermal exchange provides heating and cooling to some Columbus campus buildings, particularly a few south campus residential hall towers and the Nationwide & Ohio Farm Bureau 4-H Center.

The Columbus campus electricity peak demand is 110 MW in the summer, and the heating peak demand is 153 MW (thermal) in the winter.

What is the carbon emissions impact of Ohio State's energy use?

These two activities — purchased electricity and providing heat through on-campus use of natural gas fuel — accounted for nearly three-quarters of the university's FY19 greenhouse gas emissions (as reported as carbon dioxide equivalents, or CO_2e). The majority of the rest of the emissions came from campus commuting by employees and students and university-related air travel.

Specifically, the university's purchased electricity resulted in 264,718 metric tonnes of CO_2e in FY19, as well as 13,877 metric tonnes of CO_2e due to related electricity transmission and distribution loss, for a total of 44.9% of total university emissions. Natural gas use for the purpose of heating resulted in 171,654 CO_2e in FY19, or 27.7% of total university emissions. The remaining 27.4% is mostly due to the campus commuting and university-related air travel.

FY20 figures are not yet finalized. However, due to the COVID-19 pandemic response, which significantly reduced Columbus campus operations, the FY20 figures will likely be an anomaly.

How will the proposed combined heat and power facility affect energy use and carbon emissions?
The proposed combined heat and power facility is one component of an updated energy system for Ohio State that will serve existing academic, research and medical care space and will allow for new building expansion within the planned West Campus Innovation District. The university's existing natural gas-fueled heating facility, the century-old McCracken Power Plant, cannot efficiently meet the university's increasing heating demand.

Rather than build another inefficient facility, the university has proposed the combined heat and power facility to utilize newer technology that will generate electricity and heating for campus buildings. The fundamental advantage of a combined heat and power facility is that it produces both electricity and heat (steam and/or heating hot water) at the same time, in one combined process. Natural gas is used in combustion turbines which produce electricity, and the exhaust energy (the waste heat) is used to make steam which can both generate more electricity through a steam turbine, or provide heat to the campus through the steam and heating hot water distribution network. Unfortunately, as further discussed below, meeting heating and process steam demand with renewable energy sources is not currently feasible — that is a global challenge not isolated to Ohio State. Regardless, as the regional electricity grid continues to rely upon coal much more than renewable energy generation, the combined heat and power facility's change in fuel source from grid energy to natural gas and its ability to capture waste heat energy to produce steam will reduce the existing carbon emissions from the university's buildings by over 30% in the first full year of the combined heat and power facility's operation.

In addition, the combined heat and power facility will provide additional environmental and financial benefits to Ohio State through its related construction of a new district heating and cooling network. This network will provide efficient and reliable heating and cooling energy to the existing and future buildings on the west side of the Olentangy River. District heating and cooling network systems are inherently more energy efficient and lower cost to operate compared to in-building heating and cooling solutions.

The combined heat and power facility will necessitate the university increasing its purchase of natural gas while simultaneously allowing a reduction in current purchased electricity. On balance, then, the combined heat and power facility will result in annual total purchased energy cost savings for Ohio State and a reduction in greenhouse gas emissions.

The plan to build the combined heat and power facility is driven by considerations of costs, reliability, and emissions reductions. Specifically, as identified in the university's Climate Action Plan, Ohio State aims to address 55% of its existing greenhouse gas emissions by 2030 and achieve overall carbon neutrality by 2050. The combined heat and power facility is the best way that Ohio State can achieve the most amount of emission reductions in the shortest amount of time at a cost that is affordable.

Could Ohio State convert to 100% renewable energy?
Switching to 100% renewable energy is not possible currently or for the foreseeable future, particularly in meeting heating and process steam demand, because renewable technologies are not yet technically or economically feasible to address the university's range of current and pending energy needs.

Renewable energy is an important part of Ohio State's path to carbon neutrality. The university is fully committed to increasing the amount of renewable energy sources within the university's energy mix portfolio to continue to reduce greenhouse gas emissions. Renewable energy will be folded into Ohio State's energy fuel load in a financially responsible manner, as outlined in the university's updated Climate Action Plan.

That includes continuing the existing amount of renewable energy currently delivered to campus via power purchase agreement, as well as increasing the percentage of renewable energy within the

university's remaining purchased electricity and adding new solar energy generation capacity on-site at the Columbus campus.

Renewable energy technologies produce energy by converting solar, wind or geothermal energy, or other such freely available resources, into electricity, heat, or mechanical energy. While the fuel stock for electricity generated from renewable energy is "free," the total delivered cost to a buyer like Ohio State is still above standard electricity purchase rates by 15 to 20% and will be much higher than the rate at which the combined heat and power facility will operate. In addition, it is not technically or economically feasible for renewable energy sources to address Ohio State's heating needs given the university's current system. While the university is currently using heating hot water and heat recovery chillers in many different buildings on campus, and will expand this in the future, these chillers do not replace the need for additional thermal generation. The main heating infrastructure on campus is a steam network. Converting to a heat pump or electric boiler system which could run on renewable electricity would require a massive infrastructure overhaul on the Columbus campus and sharply increase the annual net cost of energy purchased to operate such a system. In addition, even if the university undertook an extraordinary capital expense to convert to a hot water heating system from its existing steam system, the university would still have a need to generate considerable amounts of steam for hospital, lab and dining service uses across the campus.

Ohio State currently operates a large geothermal exchange well field (primarily under the South Oval) for heating and cooling purposes and is working with Ohio State Energy Partners to expand the benefits of that renewable energy source to some additional buildings. In addition, the Climate Action Plan recommends identifying new geothermal locations to further leverage that source. However, for reference, the 411 geothermal wells underneath the South Oval and Hale Green primarily serve five buildings on campus and provide less than 1% of Ohio State's current energy demand. With nearly 500 buildings on campus, Ohio State does not have the available space to make geothermal a cornerstone of its energy use planning. Instead, geothermal will more likely be utilized on a limited basis when the campus geology allows for such development for building projects.

Why is Ohio State building a new facility that is powered by natural gas instead of waiting to invest in 100% renewable energy?

If Ohio State chose to not build the combined heat and power facility now, then it would continue to burn natural gas through a different new facility using traditional technology just for heating and process steam, and meet most of its electricity needs through grid purchases while waiting until a future date when the cost of delivered renewable electricity is affordable for institutional buyers. It is uncertain when that date will come. During the interim, then, the university would forgo the cumulative greenhouse gas emission reductions, and cumulative cost savings in reduced annual energy purchases, that the combined heat and power facility will deliver. The result would be a lose-lose proposition in terms of both the environment and the university's budget.

Global climate emissions must be cut in half by 2030, according to the International Panel on Climate Change, to avoid the negative climate impacts that would occur regardless of what actions are taken after that date. The combined heat and power facility represents Ohio State's best opportunity to drive down significant emissions in a timely manner while meeting the different campus energy needs. Greenhouse gas emissions are additive, so reducing emissions today is more valuable than reducing emissions sometime in the future through a more perfect solution.

Finally, it will be possible to transition the facility to cleaner fuel sources when those are more technically and financially viable. Renewable natural gas, which includes a variety of production methods from recovering landfill gas emissions to using different biogas options, is technically available today but currently economically prohibitive. While these options do have separate environmental impacts to consider, the university could explore those with lower total emission profiles to move away from traditional natural gas as a fuel source. Further, Ohio State intends to lead research, in partnership with Ohio State Energy Partners, to find new solutions to address global heating needs with renewable energy. This includes developing new innovations in generating

hydrogen fuel derived from renewable energy. In this manner, the combined heat and power facility could serve as a showcase "living lab" to demonstrate viable alternative heating fuel solutions to help solve the global challenge of sustainable heating options.

Does the City of Columbus' renewable energy goal, and aggregation plan, benefit Ohio State?
Mayor Andrew Ginther's goal to achieve 100% renewable energy for residents, and some small businesses, within the City of Columbus through community aggregation is laudable and will help the City achieve Paris Accord-level climate commitments.

However, the action will have no bearing upon Ohio State, just as Ohio State's actions will have no bearing upon the City's efforts in this regard.

For clarification, the City's aggregation plan would only pertain to electricity use for residential customers and businesses utilizing less than 700,000 kWh annually. It does not pertain to heating that is provided via natural gas fuel to those residential or small business customers. The City's plan also does not include large electricity buyers, such as Ohio State, which utilizes approximately 600 million kWh annually at its Columbus campus.

Under aggregation, if approved by Columbus voters, the City of Columbus will be able to negotiate power purchase agreements, or equivalent renewable energy credits, to supply the amount of electricity that is used by City of Columbus residents and applicable small businesses. While this will benefit the region's greenhouse gas emission footprint, the electricity will not come to or be available for use on Ohio State's campus.

In order for Ohio State to increase the amount of renewable energy within its purchased electricity use profile, and claim the related emission reductions, it would need to pursue its own actions separate from the City of Columbus, which might include developing direct power purchase agreements with renewable energy generation companies, negotiating with utilities to purchase energy fuel mixes with higher renewable content, or purchasing renewable energy directly from the competitive retail electricity suppliers market. The university regularly seeks these options and others when bidding energy purchases. In fact, one recent beneficial development resulting from this work is that all electricity Ohio State now purchases for non-Columbus campus use is offset on a one-to-one basis with Renewable Energy Credits.

Regardless, how the City of Columbus addresses electricity aggregation will not benefit Ohio State's energy use or the amount of renewable energy available to Ohio State for purchase.

How do the proposed combined heat and power facility's emissions reductions account for emissions within the natural gas supply chain and the potency of methane?
The proposed combined heat and power facility's emissions reductions were calculated with the same global warming potential (GWP) values that are used to calculate the university's total emission footprint. Ohio State, like many other public and private institutions that develop greenhouse gas emission footprints, utilize GWP values derived from the periodic IPCC Assessment Reports. GWP values give different weight to different emission types relative to carbon dioxide, in order to develop one common reporting metric: carbon dioxide equivalents, or CO_2e. The GWP values are updated as needed between the IPCC Assessment Reports as scientific understanding of different emission types grow or the methods involved for generating the emission types change (for the better or worse, from a climate impact standpoint). So for example, the GWP value assigned to methane was 21 times that of carbon dioxide under the IPCC Second Assessment Report, 25 times in the Fourth Assessment Report, and 28 times in the Fifth Assessment Report. These values help Ohio State, and other emission reporting entities, better assess the full emissions impact of various fuel uses through a common set of weighted figures. In this regard, the heightened potency of methane is accounted for within the university's existing emissions footprint, as well as the anticipated emissions footprint after the combined heat and power facility is operational.

Similarly, the GWP values do account for emissions that escape through the natural gas supply chain, to an extent. Currently, GWP values account for emissions during transmission (via pipeline) but do not account for emissions at the point of extraction (through flaring or other activities).

All that said, reducing carbon dioxide emissions rightfully remains the primary focus of Ohio State, as these are the most harmful emissions to the climate due to their very high prevalence — now, in fact, exceeding levels never experienced in human history.

Could Ohio State increase renewable energy production at regional campuses, given space restrictions at the Columbus campus?
While increasing renewable energy production at Ohio State's regional campuses is technically feasible, it has been difficult to identify opportunities with positive net present value. Recently, the Marion campus added a rooftop solar array with grant assistance from the Sustainability Institute, but that has, unfortunately, been an exception to the norm. The university will continue to explore renewable options for the regional campuses, but the use of that generated electricity would almost certainly stay at the local campus. It would not be directed to the regional grid or to the Columbus campus because the electricity generated at the regional campuses likely would not exceed or even meet the electricity needs at each of those campuses. Further, unless the university became a utility company or competitive retail electric service provider, Ohio State would be legally barred from transporting electricity from a regional campus to its Columbus campus.

How will the proposed combined heat and power facility affect air quality?
Air quality modeling research, conducted by the third party air quality engineering firm TRC, concluded that the combined heat and power facility will have a negligible impact on the existing air quality of Franklin County and will not affect the County's attainment status for any pollutant. Similarly, the modeling research found that the facility will have a negligible impact on sensitive locations in the vicinity of the project, including Ohio State's Wexner Medical Center.

The Ohio EPA granted the facility an air quality permit following the agency's review of the project for applicable air quality requirements, meeting the agency's definition of de minimis impact.

The facility will include state-of-the-art pollution control equipment to significantly avoid emissions of carbon monoxide, nitrogen oxide, volatile organic compounds, and organic hazardous air pollutants. These items include dry low nitrogen oxide burners within the combustion turbines, an oxidation catalyst bed and selective catalytic reduction system within the heat recovery steam generator (HRSG) stacks, and high efficiency water mist drift eliminators and impingement baffles for the facility's cooling towers.

How does Ohio State compare to other higher education institutions in the use of renewable energy?
According to U.S. EPA green energy use rankings, Ohio State currently uses the 14th most amount of "green energy" in the nation for higher education institutions, as of July 27, 2020. Within the Big Ten, Ohio State trails only the University of Maryland and Northwestern University in this regard. If the renewable energy actions identified within Ohio State's Climate Action Plan were in place today, our university might rank fifth overall on the U.S. EPA list and first in the Big Ten.

Sustainability efforts across universities are critical for helping to drive local climate actions. Within the State of Ohio and relative to many of its peers, Ohio State is unique in terms of its size and scope of activities. For example, consider the following comparisons to several other in-state institutions:

University of Cincinnati: As part of its own Climate Action Plan, the University of Cincinnati has executed a 15-year solar power purchase agreement to provide the university with 100% renewable electricity during that time frame. This is a laudable action. Upon preliminary review of their agreement, it appears the total amount of electricity purchased is slightly less than half of Ohio State's existing wind energy power purchase agreement. For additional reference, the University of

Cincinnati operates a combined heat and power facility, for which it has won numerous awards from U.S. EPA and others for energy efficiency and avoided greenhouse gas emissions.

University of Toledo: Through its Scott Park Campus development, the University of Toledo has installed an eight-acre solar field that generates 1.2 MW of energy for campus operations, as well as two small wind turbines. Again, this action is commendable, as it provides over a quarter of the electricity need at that campus. Ohio State's Climate Action Plan, though, recommends the installation of nearly nine times that amount of solar energy generation capacity on the Columbus campus.

Cleveland State University: As part of its most recent three-year purchased electricity bid, Cleveland State was able to include Renewable Energy Credits for 58% of its total electricity purchase. The amount of green energy Cleveland State can now take credit for is equivalent to about one-third of Ohio State's wind energy purchase/use. The structure of Cleveland State's purchase looks similar to what Ohio State has recently successfully negotiated for all non-Columbus campus purchased electricity.

All of these efforts are worthwhile and meaningful within the context of each institution's setting and level of electricity use. However, there are no other in-state higher education institutions that are able to achieve the scale of renewable energy impact that Ohio State has and continues to strive toward, and relatively few within the entire country that have exceeded our accomplishments to date.