OHIO POWER SITING BOARD

IN THE MATTER OF THE APPLICATION OF THE OHIO STATE UNIVERSITY FOR A CERTIFICATE OF ENVIRONMENTAL COMPATIBILITY AND PUBLIC NEED FOR A COMBINED HEAT AND POWER MAJOR UNIT FACILITY IN FRANKLIN COUNTY, OHIO ON THE CAMPUS OF THE OHIO STATE UNIVERSITY	)))))))))	**CASE NO. 19-1641-EL-BGN**

POST-HEARING BRIEF OF INTERVENOR SIERRA CLUB

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The Ohio State University ("OSU") is seeking to build a Combined Heat and Power ("CHP") major utility facility that will lock in significant air pollution and carbon dioxide and methane emissions for the next twenty-five years, despite OSU's own recognition that more efficient, less environmentally damaging alternatives exist. The proposed facility does not represent the "minimum adverse environmental impact" as compared to currently available, economically reasonable, and technologically feasible alternatives for both heat and electric generation. Nor has OSU adequately and accurately accounted for the nature of the environmental impacts that will result from operating the proposed facility. The facility will not serve the public convenience and necessity and the Board should, accordingly, reject OSU's Application.

I. In Order to Obtain a Certificate for Construction, Proposed Facilities Must Represent the Minimum Adverse Environmental Impact as Compared to Feasible Alternatives

Ohio Rev. Code §4906.10(A)(3) requires the Board, *before* issuing a certificate for construction, find on the basis of evidence in the record before it that the proposed facility represents the "minimum adverse environmental impact, considering the state of available technology and the nature and economics of the available alternatives." The Board must, under the plain text of the statute, "consider[] the state of available technology" as part of its determination that a proposed facility meets this requirement. The Ohio Supreme Court has held an identical statutory requirement for the approval of hazardous waste facilities requires an applicant to "produce evidence of alternative technologies in order to prove that its facility represents the minimum adverse environmental impact," and requires the relevant board to

"evaluate the nature and economics of alternative technologies to determine whether a more advanced, more environmentally protective technology can and should be utilized."[1]

OSU thus has the burden under Ohio law to show that its proposed CHP facility has the minimum adverse environmental impacts as compared to feasible alternatives. Specifically, in determining whether OSU has met this standard, the Board should assess how the "fuel selection and the basic design of [the] proposed facility" compare to alternatives.[2] As the Administrative Law Judge in this proceeding has already recognized in granting Sierra Club's motion to compel production of evidence, OSU must present, and the Board must determine, whether "any feasible combination of energy efficiency measures and generation resources based upon renewable resources could serve as an alternative to the proposed…facility as a base load generation resource."[3]

For the reasons that follow, OSU has not met its burden under section 4906.10(A)(3). "[A] more advanced, more environmentally protective technology" is available to serve OSU's heating needs and "should be utilized" in lieu of the proposed gas-fired facility that will cause significant carbon dioxide, nitrogen oxide, and particulate emissions: a heated hot water system that uses heat exchangers and geothermal wells to obtain and store thermal energy.[4] OSU has produced no evidence that it has compared the proposed facility to this alternative or that this alternative is unfeasible or uneconomical to construct. To the contrary, evidence presented by Sierra Club and introduced by OSU itself show *less* environmentally destructive alternatives for

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[1] *State of W. Va. v. Ohio Hazardous Waste Facility Approval Bd.*, 28 Ohio St.3d 83, 84 (1986) (quoting Ohio Rev. Code §3734.05(C)(6)(c), now §3734.05(D)(2)(c)).
[2] *See* Order re: Motion in Limine, *In Re Am. Mun. Power-Ohio, Inc*., No. 06-1358-EL-BGN, Entry (December 4, 2007), at p. 5.
[3] *In Re Am. Mun. Power-Ohio, Inc*., No. 06-1358-EL-BGN, Entry (Mar. 3, 2008).
[4] *See State of W. Va. v. Ohio Hazardous Waste Facility Approval Bd.*, 28 Ohio St.3d 83, 84 (1986).

both heat and electricity generation exist and are currently in use at similar universities. Ohio State Energy Partners ("OSEP"), the contractor responsible for the design and construction of the proposed facility, has endorsed these technologies as more economical and efficient but OSU has failed to explain why it nevertheless seeks to build a facility it admits is less advanced and less environmentally protective. OSU has, accordingly, failed to meet its burden under Ohio law to obtain a certificate for construction.

II. OSU Could Meet its Heating Energy Needs with a Combination of Currently Available Technologies: a Heated Hot Water System and Renewable Generation Resources

OSU currently utilizes a network of steam distribution pipes to heat much of its campus.[5] The proposed CHP facility is premised on OSU's continued use of a steam heating system. But as Sierra Club's expert Dr. Ranajit (Ron) Sahu, other universities, and OSU's own contractor OSEP have all concluded, heated hot water systems in conjunction with the use of heat exchangers and geothermal generation are preferable to steam. District heating systems like OSU's do not need to rely on steam heat generated by gas, oil, or coal-burning facilities. Instead, as large-scale projects at numerous other universities have demonstrated, heated hot water systems provide a more efficient, less environmentally destructive, and ultimately cost-saving alternative to steam. As both Dr. Sahu's expert testimony and OSEP's own Feasibility Study[6] describe, in a heated hot water system half or more of the total thermal load is met through the use of excess waste; the remaining *net* heating needs can be met through geothermal

[5] *See* Application to the Ohio Power Siting Board for a Certificate of Environmental Compatibility and Public Need, Case No. 19-1641-EL-BGN (November 4, 2019) at pp. 1-2 (proposed facility will provide steam for main campus steam network east of the Olentangy River).

[6] Exhibit 4 to Direct Testimony of Serdar Tufekci (OSU Exhibit A).

(ground-based) heat generation and storage.[7] Such a system produces none or only minimal amounts of the air pollutants—most significantly, nitrogen oxide, particulate matter, and greenhouse gas emissions—produced by gas-fired generation.[8] In other words, there exists an "available technology," which other similarly situated institutions have found economical and feasible, that OSU could have chosen to meet its heating needs with a smaller adverse environmental impact.[9]

A heated hot water system enables the use of non-polluting, carbon-neutral thermal generation technologies instead of gas or other fossil-fuel on-site combustion. Because hot water carries lower energy than steam, it can be produced through less energy-intensive means and avoids inefficiencies associated with the heat losses and operational and management costs intrinsic to steam systems.[10] The OSU campus, like most district heating systems, has both heating and cooling load throughout the year; in such systems a significant proportion of the total heating needs can be met through heat exchanges that capture what would otherwise be wasted heat from its chillers.[11] In a heated hot water system, this excess heat is used to heat water to 130 or 140 degrees Fahrenheit (significantly less than the temperature of steam), and that water is circulated to provide in-building ambient heating.[12] Where the heating load exceeds the simultaneous cooling load such that additional energy is required, the system uses geothermal

[7] Direct Testimony of Dr. Ranajit (Ron) Sahu, Sierra Club Exhibit F (henceforth "Sahu Testimony") at 21:10-15.
[8] Sahu Testimony at 35:15-24.
[9] *See* Ohio Rev. Code §4906.10(A)(3).
[10] Sahu Testimony at 31:9-11 & fn. 47; *see* Cross Examination of Dr. Ranajit Sahu in Proceedings Before the Ohio Power Siting Board in Case No. 19-1641-EL-BGN July 14, 2020, Volume I (henceforth "Sahu Cross-Exam") at 314:3-12 (describing inefficiencies associated with transferring heat from CHP-generated steam to hot water system).
[11] Sahu Testimony at 7:9-16.
[12] *See* Redirect Testimony of Dr. Ranajit (Ron) Sahu in Proceedings Before the Ohio Power Siting Board in Case No. 19-1641-EL-BGN July 14, 2020, Volume I (henceforth "Sahu Redirect") at 349:3-350:8.

sources.[13] This geothermal energy can be drawn from or stored within wells as shallow as 35 feet, relying on the fact that the earth maintains a constant temperature below 5 to 10 feet belowground regardless of the local geology.[14] These wells can be constructed without restricting surface use.[15]

The Feasibility Study for the proposed facility conducted by OSEP[16] on OSU's behalf recognizes that replacing OSU's current steam system with a heated hot water system is preferable on nearly every metric and will be done at some point in the future.[17] According to OSU's witness Serdar Tufekci, heated hot water is preferable to steam with respect to its ability to facilitate heat recovery and generation efficiency, and can (unlike steam) be used in conjunction with heat storage, and is the "clear choice" for new construction.[18] Table 3 of Appendix N of OSEP's Feasibility Study[19] for the proposed facility, reproduced below, summarizes the advantages of a heated hot water system:

[13] *Id*. at 350:6-8.
[14] Sahu Redirect at 335:18-336:15; Sahu Cross-Exam at 357:20-23 (describing varying depths of geothermal wells used for heating systems).
[15] Sahu Cross-Exam at 357:8-17.
[16] OSEP "is a joint venture between ENGIE North America and Axium Infrastructure [that has been] was awarded [a contract] to manage the energy infrastructure of the utility system of Ohio State Columbus Campus." Cross-Examination of Serdar Tufekci in Proceedings Before the Ohio Power Siting Board in Case No. 19-1641-EL-BGN July 14, 2020, Volume I (henceforth "Tufekci Cross-Exam") at 13:11-16.
[17] Sahu Testimony at 29:13-19 and Feasibility Study (Exhibit 4 to Direct Testimony of Serdar Tufekci), Appendix N. As Dr. Sahu acknowledged, heated hot water systems cannot fulfill some of the non-heating functions of steam, such as sterilization; however sterilization and other similar needs could be met through localized boilers. *See* Tufekci Cross-Exam at 54:19-22.
[18] Tufekci Cross-Exam at 48:13-17, 60:23-61:19.
[19] Exhibit 4 to Testimony of Serdar Tufekci, OSU Exhibit A.

Table 3: Comparison of Steam and HHW

Pros and Cons	Steam	Hot Water
Usage		
Air and space heating	Yes	Yes
Low temperature process loads (domestic hot water, humidification)	Yes	Yes
High temperature process loads (sterilization)	Yes	No (needs stand-alone system)
Energy		
Generation efficiency (HHW: boilers and heat pumps, steam: boilers only)	Poor to Average (70-80%)	Good (85%) to Excellent (400%)
Distribution heat losses	High (30%-50% for old systems)	Low (5-10%)
Combined heat and power potential	Yes	Yes
Heat recovery potential	No	Yes
Energy storage potential (thermal, electric)	No	Yes
Operation & Maintenance		
Operation & maintenance cost	High (up to $12/ft for old systems)	Low (as low as $1/ft)
Hazard potential (due to high temperatures and pressures)	High	Low
Difficulty of hiring qualified personnel	High	Low
Sustainability		
Water usage	High	Low
Deep decarbonization potential	Unlikely	Favorable

Recognizing the clear advantages of hot water systems, other universities with similar heating needs have chosen to retire steam generation in favor of heated hot water and report significant benefits as a result. At least seven colleges or universities have converted to heated hot water systems for use in conjunction with heat exchangers and geothermal storage and recovery to address a significant portion or all of the campus's heating needs: Stanford University; University of British Columbia; University of California, Davis; Brown University;

Ball State University; University of Rochester; and Carleton College.[20] Notably, Stanford University constructed its combined heating and cooling ("CHC") system to *replace* a cogeneration plant like the facility OSU proposes to construct and anticipates the CHC system will reduce greenhouse gas emissions by 68% and save hundreds of millions of dollars over the next thirty years.[21] The example of Ball State University is also particularly instructive, both because it shares similar climactic conditions with OSU (as it is located approximately 150 miles due west of the Columbus campus) and because Ball State was able to meet all of its heating needs through a combination of heat exchangers and geothermal wells with an energy system that began operation in 2012, thus providing proof of concept.[22]

In sum, the evidence—both Dr. Sahu's testimony describing the planning and implementation of heated hot water systems at other universities and the Feasibility Study OSU itself submitted in support of its Application—demonstrates that a technological alternative that is currently used and useful is available to provide heating in lieu of steam generation. This alternative avoids the most significant environmental impacts of the proposed facility that OSU has identified (namely, the emission of air pollutants including carbon dioxide, methane, particulate matter, and nitrogen oxides) and, according to studies performed by other universities, "present[s] long-term costs similar" to the "best gas-based option" that incorporates heat recovery.[23]

[20] Sahu Testimony at 24:11-15.
[21] Sahu Testimony at 26:3-11.
[22] Sahu Testimony at 24:22-25, 25:2-6.
[23] Sahu Testimony at 35:7-11 (quoting from Stagner, J.C., "Stanford University's 'fourth-generation' district energy system," in *District Energy* (2016), attached as Exhibit RS-J).

III. OSU Failed to Investigate Alternatives to the Outdated Proposed CHP Technology for Either Its Heating or Electrical Needs

OSU commissioned a feasibility study for a gas-fired cogeneration facility in 2009, and has remained committed to this increasingly antiquated technology notwithstanding the intervening decade of technological advancements.[24] OSU and its contractor, OSEP, have failed to produce any evidence OSU conducted even minimal investigations into the use of generation technologies with less adverse environmental impacts for either heating or electricity prior to applying for construction of a CHP facility. Relying solely on "general[] know[ledge]" of the economics, reliability, and thermal capacities of renewable resources—resources who have undergone significant development and whose costs have dropped dramatically during that period—OSU declined to perform any formal study of any non-emitting generation alternatives in the ten years between this study and its Application submission.[25] Even more egregiously, despite OSEP's own conclusion that heated hot water is more efficient, more forward-looking, and more consistent with reducing carbon dioxide emissions than the steam system on which the proposed facility relies, OSU inexplicably failed to perform even minimal research into the use of heated hot water as an alternative to the construction of the proposed CHP facility. OSU cannot meet its burden to show that the proposed facility represents the "minimum adverse environmental impacts" when it has submitted no evidence that this environmentally preferable alternative that has been constructed at other major universities and medical centers is economically or practically infeasible here.[26]

[24] *See* Cross-Examination of Scott Potter in Proceedings Before the Ohio Power Siting Board in Case No. 19-1641-EL-BGN July 14, 2020, Volume I (henceforth "Potter Cross-Exam") at 189:14-25 (OSU has "been considering the construction of a CHP facility since at least 2009").
[25] Potter Cross-Exam at 190:14-22.
[26] *See* Ohio Rev. Code §4906.10(A)(3).

A. OSU did not conduct any analysis into the feasibility and cost associated with district-wide conversion to heated hot water, the use of heat exchangers on a district-wide basis, or expanding its current geothermal systems.

Pursuant to the terms of their contract, OSU requested and OSEP performed an updated (2018)[27] Feasibility Study for a CHP facility. That Study identified heated hot water as preferable to its legacy steam system and recognized the benefits other campuses obtained through such a conversion. At the evidentiary hearing before this Board, OSEP's CEO and OSU's witness conceded that Dr. Sahu is correct that heated hot water "is a technology to implement going forward."[28] However, in preparing the instant Application and selecting gas-fired co-generation as the means of meeting its heating needs, neither OSU nor OSEP conducted any further investigation to determine the costs associated with conversion to heated hot water or the installation of geothermal wells or system-wide heat exchangers at OSU's campus in the immediate-to-short-term, instead treating the construction of the CHP as an "assumption" after which conversion to heated hot water may be implemented.[29]

The record is bereft of any documentation to support OSEP's assumption that gas-fired steam generation is preferable and a precondition for the use of heated hot water at some indefinite point in the future. Neither OSU nor OSEP produced a formal assessment of the costs and benefits associated with converting its legacy steam system to heated hot water prior to committing to the construction of the CHP facility.[30] OSU left other components of a hot water-based thermal generation system similarly unexplored. OSEP failed to conduct a study as to the

[27] *See* Tufekci Cross-Exam at 137:1-2 (Feasibility Study presented in 2018; most work on the Study completed in 2017).
[28] Tufekci Cross-Exam at 60:16-18.
[29] *See* Tufekci Cross-Exam at 65:3-17.
[30] Tufekci Cross-Exam at 65:7-17; Potter Cross-Exam at 195:8-12.

feasibility of geothermal energy as a campus-wide solution to OSU's heating needs.[31] OSEP did not assess the feasibility of the use of heat recovery chillers, or heat exchangers, as a means of meeting OSU's heating needs.[32] OSU did not investigate the cost of the steam-to-heated hot water conversion projects at other universities that have completed or initiated such projects, and OSU's witness was able to provide only a vague estimate of the cost of a campus-wide replacement of the underlying pipes, an estimate that contradicted the estimate provided as part of the Feasibility Study.[33] OSU staff did not even reach out to individuals associated with the conversion of steam to heated hot water thermal systems at other universities to discuss these projects, despite having previously communicated with those individuals through "peer channels."[34]

To the extent OSU peremptorily concluded that heated hot water and associated technologies were infeasible or cost-prohibited, it did so without any understanding of its actual heating needs and thus the amount of energy geothermal systems would actually have to provide. OSU has not conducted the analysis necessary to identify what the *net* heating needs of its Columbus campus are. To determine the *net* heating needs of the OSU campus—that is, the total thermal energy required at a given time above what can be met through the use of heat exchangers—the operator of a district heating system must conduct an hour-by-hour analysis of heating *and cooling* needs.[35] OSU did not conduct this analysis at a system-wide level.[36]

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[31] Tufekci Cross-Exam at 81:11-13.
[32] Tufekci Cross-Exam at 82:2-5.
[33] *See* Tufekci Cross-Exam at 77:20-78:11; 74:2-77:9 (OSU Witness questioned the accuracy of cost estimates produced as part of the Feasibility Study as too law but could not identify the assumptions that went into those estimates or produce an alternative estimate other than "a few hundred million").
[34] Potter Cross-Exam at 191:10-20.
[35] Sahu Testimony at 7:8-25.

Had OSU done a comparison of "the simultaneous delivery of heating and cooling from [a] cogeneration plant," both the Stanford and Ball State analyses suggest OSU would have found significant overlap, establishing that a heat recovery-based heating and cooling system could have significantly reduced OSU's need for heat generation—or even geothermal storage.[37] Stanford's study concluded that even in the Midwest, this overlap amounted to more than half of a campus's annual heating needs.[38] As Dr. Sahu testified, there is nothing about OSU's campus or climate to suggest a similar study at OSU would produce different results.

Moreover, the benefits of the proposed CHP facility to OSU's current steam heating system are overstated. OSU already operates a steam-generating facility used primarily for heating—and will continue to maintain this facility even if the proposed facility is constructed. OSU witness Mr. Tufekci testified that OSU will continue to generate approximately 15% of its annual steam needs at the McCracken facility.[39] As Mr. Tufekci and OSEP acknowledge, the *total* retirement of McCracken is contingent on precisely the type of conversion to and construction of a heated hot water and geothermal system identified by Dr. Sahu and seven other universities as preferable to CHP heat generation.[40] Even after the construction of the proposed facility, OSU will maintain five of the six boilers at McCracken as operational and permitted, maintenance which OSU's witness characterized as requiring "minimal cost."[41] The proposed

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[36] Tufekci Cross-Exam at 84:5-10. OSU declined to perform such an analysis, according to Mr. Tufekci, because the use of heat exchangers is inconsistent with the current campus steam system. *Id*.
[37] *See* Sahu Testimony at 25:1-6; 28:21-29:11.
[38] Sahu Testimony at 30:3-8.
[39] Tufekci Cross-Exam at 38:2-5.
[40] Sahu Testimony at 36:8-11; *see* Tufekci Cross-Exam at 36:14-23 ("In order to retire McCracken…some alternative heating sources must be identified and installed.")
[41] Tufekci Cross-Exam at 124:24-125:3, 126:2-4, 12-13.

CHP facility thus creates redundant steam generation; OSU is, in the words of its own witness, purchasing a third car when it can only drive one.[42]

In short, OSU failed to offer *any* justification for its decision to invest hundreds of millions of dollars in a steam-generating facility notwithstanding its own acknowledgement that a "4th Generation"[43] heated hot water system is preferable and, moreover, has not conducted the analysis necessary to assess the relative costs (both immediate and lifecycle) and capacities of building a CHP facility versus converting to a CHC system. Relying solely on the fact that OSU currently relies on a steam system, OSU rejected conversion out of hand—and now seeks to buy a horse farm (a steam generating facility) for its horse-drawn buggy when electric cars (CHC systems) are already available and increasingly in use.[44]

B. OSU failed to investigate renewable alternatives as a means of generating electricity in lieu of the proposed facility

At the hearing before the Board, OSU's witness stated that the primary purpose of the proposed facility will be to serve campus heating needs.[45] These needs, as described above and as evidenced by Dr. Sahu's testimony and projects at Ball State and Stanford Universities, can likely be met through conversion to a heated hot water system, with thermal generation provided through heat exchangers and supplemented by geothermal wells; OSU has introduced no evidence to the contrary. OSU has similarly failed to adduce evidence as to why its electrical needs cannot be met through the construction of generation resources without the particulate,

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[42] Tufekci Cross-Exam at 126:8-13.
[43] Sahu Testimony at 31:3-8 (quoting from Appendix N of the Feasibility Study, Exhibit 4 to OSU Exhibit A). As both Dr. Sahu and OSEP's Feasibility Study explain, steam heating (including the use of steam produced through cogeneration) is considered a "1st Generation" technology dating back to 1900, as contrasted with the use of "Low Temperature Hot Water" (water circulating at temperatures between 120 and 140 degrees Fahrenheit), which is considered "4th Generation" district heating technology.
[44] Sahu Testimony at 34:16-22.
[45] Tufekci Cross-Exam at 92:23-93:1.

nitrogen oxide, and greenhouse gas emissions associated with gas-fired steam turbines. Although OSU cites cost and reliability as grounds for rejecting solar or wind electrical generation as an alternative to the proposed CHP facility, it has not produced evidence to substantiate either ground, relying on implausibly high estimates of "all-in" solar prices and overstating the benefits of the proposed CHP facility to justify its more environmentally damaging choice.

As OSU's witness Mr. Tufekci acknowledged, there is no technical barrier to OSU obtaining the entirety of its electrical needs from *off*-campus renewable generation.[46] But OSU did not issue an RFP or otherwise investigate the cost of off-site solar or wind power purchase agreement ("PPA"), instead relying on inflated figures without attribution or explanation provided by OSEP for a hypothetical solar procurement contract. As part of its Feasibility Study for the proposed CHP facility, OSEP did produce a figure purporting to show the cost of off-site solar as an alternative.[47] The stated "all-in" cost, however, includes a number of unsubstantiated "costs." Although OSU's witness stated some of these costs are "publicly available," he could not provide a description of or basis for each of these charges or testify as to whether OSU paid similar costs as part of its PPA with Blue Creek Wind Farm.[48] Nor did OSU solicit any bids for a PPA to determine the likely cost of such off-site procurement.[49] The resulting total—$64/MWh—is nearly double the average bid ($35.67/MWh) for a solar power purchase

[46] Tufekci Cross-Exam at 90:19-25.
[47] The Concession Agreement between OSU and OSEP provided OSU with the option of requesting a feasibility study for a *CHP* facility specifically. *See* Tufekci Cross-Exam at 16:1-12.
[48] Tufekci Cross-Exam at 97:21-23, 98:23-25, 99:12-13 (stating that "some" of the costs were based on publicly published information by AEP), 99:14-20.
[49] Tufekci Cross-Exam at 98:14-24.

agreement received by an Indiana utility from 26 solar generation facilities.[50] This superficial and unsupported estimate thus provides no basis for rejecting renewable electrical generation as a matter of cost. OSU also did not consider constructing its own *on*-site renewable generation resources to meet the electricity needs the proposed facility is intended to fulfill.[51]

To explain its failure to adequately compare the costs and benefits of renewable and gas-fired steam electrical generation, OSU has taken the position that renewables cannot meet its stated reliability and resiliency needs and are thus categorically infeasible. But the proposed CHP facility shares many of the insufficiencies OSU attributes to wind or solar generation.[52] First, as OSU admits, the proposed facility will not meet the NFPA 110 level 1 requirements to serve as the backup electricity source for OSU's medical facilities.[53] If the proposed facility is approved, OSU will continue to rely on diesel emergency backup generators for its "critical facilities," which make up close to one third of the nameplate capacity of the proposed facility.[54] The facility as designed and described in the Application also lacks "black start capability"; if the proposed facility were to go down at the same time as the grid due to, *e.g.*, extreme weather

[50] Sahu Testimony at 22:18-20, 23:5-6. As Dr. Sahu testified, the number of sunny days in Ohio and other Midwestern states is comparable and Ohio and Indiana have similar solar resources; and there is no reason why the cost of solar would differ between Ohio and Indiana. Sahu Cross-Exam at 244:3-8; Sahu Redirect at 337:4-12.

[51] Tufekci Cross-Exam at 88:15-19.

[52] Solar and wind generation can also be used in conjunction with currently available electricity storage resources to address the intermittent nature of solar generation. *See* Sahu Testimony at 23:10-11.

[53] Sahu Testimony at 8:5-7 (citing Feasibility Study Table 1).

[54] Tufekci Cross-Exam 30:8-13; 30:21-31:3. Notably, Stanford—which unlike OSU *did* conduct a formal comparison of gas-generated steam heat and heated hot water systems—concluded that the use of CHP turbines for heat generation will make that system *less* reliable than a heating system that uses heated hot water (and exchangers and geothermal wells), which do not have moving parts and corresponding risk of breakdown. *See* Sahu Testimony at 27:12-16 (citing Stagner, J.C., "Stanford University's "fourth-generation" district energy system," in *District Energy* (2016), available at https://sustainable.stanford.edu/sites/default/files/IDEA_Stagner_Stanford_fourth_Gen_DistrictEnergy.pdf and attached as Exhibit RS-J to Sierra Club Exhibit F.)

conditions in Columbus, the proposed facility would be incapable of restoring power to campus until the grid itself came back online.[55] Electricity from the proposed facility will be routed through existing substations, so the CHP will still be subject to vulnerabilities associated with transmission from facility to the substation and up to point of use.[56] Finally, the proposed facility suffers from a vulnerability that neither the grid nor renewable generation resources share: The proposed facility relies on a single gas pipeline as its fuel source; a disruption to that pipeline will prevent the proposed facility from operating.[57]

Just as OSU did not conduct an analysis of its combined heating *and cooling* loads to determine whether it could meet some or all of its heating needs through heat exchangers, OSU did not adequately assess or evaluate the scope of its actual reliability needs. OSU has not conducted any studies of the reliability of grid electricity to establish the comparative advantage of on-campus steam turbine generation.[58] The sole study introduced into evidence regarding the use of CHP facilities for their islanding capabilities on which OSU did rely was completed seven years ago, did not consider alternative facilities as a means of providing similar capabilities, and described facilities' responses during a single weather event (Super Storm Sandy).[59]

OSU's rejection of alternative electrical generation technologies that do not create the adverse environmental impacts associated with the proposed CHP facility rests on the overstatement of both solar costs and CHP capacities. OSU has not met its burden to show that

[55] Tufekci Cross-Exam 31:9-32:1.
[56] Tufekci Cross-Exam 34:11-35:1; Sahu Redirect at 347:11-22.
[57] Tufekci Cross-Exam 33:25-34:6.
[58] Tufekci Cross-Exam at 19:10-13 (OSEP did not investigate "rate of disruption of electricity supply from the PJM grid to the OSU campus over a historical period).
[59] Tufekci Cross-Exam at 180:25-181: 22. Notably, each of the CHP facilities described in the report had a nameplate capacity of 57 MW or less, or about half the nameplate capacity of the proposed facility. *Id.* at 181:23-182:2.

no alternative technology exists which can provide the electrical generation benefits *actually provided* by the proposed facility with less adverse environmental impact.

C. The Staff Report's conclusion that the facility represents the minimum adverse environmental impact similarly lacks any comparative basis.

The Staff Report's conclusion that the project "represents the minimum adverse environmental impact" suffers from the same absence of comparative evidence or analysis as OSU's Application.[60] OPSB Staff limited their review to OSU's Application itself, and thus did not consider the "nature and economics" of a system-wide conversion to heated hot water or solar or wind electrical generation as alternative "available technologies."[61] At the hearing, when asked to what the Staff was comparing the proposed facility when concluding it "minimize[d]" the adverse environmental impact, the Staff witness primarily responsible for assessing environmental impacts of the proposed facility conceded that his analysis was limited to cogeneration and "the technology that [OSU] would install."[62] The Staff did not consider, or compare the proposed facility to, any other technology to assess whether it in fact "minimized adverse environmental impacts."[63] Accordingly, the Board should not adopt the Staff Report's conclusion with respect to Rev. Code §4906.10(A)(3).

IV. OSU Has Proposed a Facility with Significant Adverse Environmental Impacts and has Failed to Account for the Full Extent of those Impacts

As set forth in OSU's Application and Title V Permit, the proposed facility qualifies as a major stationary source of nitrogen oxides, particulate matter with diameter of less than 2.5

[60] *See* Staff Report of Investigation (Staff Exhibit A) at p. 22.
[61] Cross-Examination of Robert Holderbaum in Proceedings Before the Ohio Power Siting Board in Case No. 19-1641-EL-BGN July 15, 2020, Volume II (henceforth "Holderbaum Cross-Exam") at 374:19-375:15; *cf.* Ohio Rev. Code §4906.10(A)(3).
[62] Cross-Examination of Andrew Conway in Proceedings Before the Ohio Power Siting Board in Case No. 19-1641-EL-BGN July 15, 2020, Volume II (henceforth "Conway Cross-Exam") at 381:3-10, 389:5-11.
[63] Conway Cross-Exam at 389:5-11, 390:2-6.

microns, and greenhouse gases. These emissions will have immediate, adverse effects on the health of individuals in the immediate vicinity of the proposed facility (including patients and staff at the Wexner Medical Center) and contribute to global atmospheric carbon dioxide and methane levels and concomitant climate effects. Besides the reported emissions, OSU has failed to fully investigate or document the precise scope of these effects, performing modeling to assess particulate and nitrogen oxide concentrations that relied on faulty meteorological and background assumptions (and conducting such modeling only *after* Sierra Club intervened and raised concerns about the impact of the anticipated emission and ignoring entirely the impacts of natural gas extractions). Although OSU claims that the facility will result in reduced greenhouse emissions as compared to its current reliance on steam generation at McCracken and electricity from the PJM grid, these claims rest on faulty assumptions about the current generation mix on the PJM grid and are not enforceable under OSU's Title V permits, which allow for the continued operation of McCracken. The proposed facility thus presents significantly greater adverse environmental impacts than the above-described alternatives, and the full extent of these impacts are not documented in OSU's Application and supporting materials.

A. OSU claims that the proposed facility will reduce the campus carbon footprint, but its claims lack evidentiary support.

As OSU acknowledges, existing trends in the levels of atmospheric carbon dioxide and other greenhouse gas emissions "threaten[s] our current living conditions."[64] Increased emissions contribute to droughts, fires, and algal blooms—to name only a few of the accelerating effects of current atmospheric carbon dioxide levels and concomitant warming—both in Ohio

[64] Path to Carbon Neutrality Ohio State Climate Action Plan (Sierra Club Exhibit C and attached as Exhibit RS-C to Sahu Testimony, Sierra Club Exhibit F) at p. 6.

and worldwide.[65] The proposed facility is projected by OSU to emit more than 300,000 tons per year of greenhouse gases,[66] and has the potential and a Title V permit to emit up to 464,278 tons of greenhouse gases per year.[67] Despite this, OSU touts the proposed facility as the centerpiece of its carbon emissions reduction plans. OSU currently purchases its electricity from AEP, which draws from the PJM electric grid, and uses McCracken, a gas-burning facility, to generate steam for its heating needs.[68] OSU claims the proposed facility will reduce emissions by replacing electricity generated on the PJM grid and realizing efficiencies associated with cogeneration by the proposed CHP facility rather than the McCracken facility.[69] But these claims fall apart under scrutiny.

In calculating the anticipated decrease in carbon dioxide emissions attributable to the proposed facility due to the switch from grid- to CHP-generated electricity, OSU relied on a "grid carbon footprint" for the PJM electricity grid of 1510 lb/MWh.[70] This figure dates from 2016.[71] Contemporaneous data characterizing the PJM generation mix show the PJM carbon footprint has changed considerably since then. As OSU acknowledges, carbon emission savings

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[65] *Id*.

[66] OSU's witness testified that, in combination with McCracken, the proposed facility is anticipated to emit 314,570 tons per year of greenhouse gas equivalents; the witness could not state and could not point to any place in the Application or associated materials that describes what portion of those emissions would come from the proposed facility. Tufekci Cross-Exam at 142:8-143:9.

[67] Tufekci Cross-Exam at 140:22-142:4 (OSU witness Mr. Tufekci testified that the permit assumes 100% operation and that maintenance requirements and that the maximal operation is typically estimated at 95% but that the only limit on plant operations that would cause a reduction in greenhouse emissions below the permitted amount was "campus demand.")

[68] Tufekci Cross-Exam at 127:23-25; 124:17-18.

[69] Tufekci Cross-Exam at 120:14-18.

[70] Sahu Testimony at 19:20 (citing "Summary" Tab of Carbon Footprint worksheet, produced at OSU 003930 and attached as Exhibit RS-P to Sierra Club Exhibit F.)

[71] Tufekci Cross-Exam at 127:6-7. The number also reflects only the Ohio PJM grid, although OSU's witness admitted that OSU's electricity is not drawn exclusively from Ohio generation facilities. *Id*. at 127:20-22.

associated with electricity generation at the proposed facility are all attributable to the switch from coal-fired generation within the grid mix to natural gas at the proposed facility.[72] But in the first three months of 2020, coal units accounted for only 18% of generation; nuclear plants (which has *no* carbon dioxide emissions at generation) accounted for 34.5%.[73] OSU does not explain how the substitution of generation that is less carbon-intensive than 18% of the current PJM generation mix but *more* carbon-intensive than 34.5% of that mix (and roughly equivalent to natural gas generation[74] on the grid, which makes up the largest portion of PJM generation) can reduce the carbon emissions associated with electricity generation for its campus.[75] OSU's attribution of carbon savings to the substitution of natural gas-fired generation for the PJM grid mix appears to be a mathematical impossibility.

On cross-examination with regard to these facts, OSU witness Mr. Tufekci instead emphasized the carbon savings associated with the efficiencies attributed to cogeneration.[76] Nothing in the Application or Permit, however, *requires* OSU to realize these efficiencies and reduced emissions. Although OSU has stated that it intends to reduce its reliance on McCracken for heat generation (thereby reducing emissions associated with McCracken's operation), it has no plans to retire five of the six boilers at the facility before 2035.[77] Moreover, as discussed *supra*, OSU and OSEP failed to consider the use of heat exchangers and geothermal energy

[72] Tufekci Cross-Exam at 131:7-18.
[73] Sahu Testimony at 19:27-20:1 (citing Monitoring Analytics, LLC, *State of the Market Report for PJM* (May 14, 2020), p. 21, *available at* https://www.monitoringanalytics.com/reports/PJM_State_of_the_Market/2020/2020q1-som-pjm.pdf and excerpted at Exhibit RS-F to Sierra Club Exhibit F.)
[74] *See* Tufekci Cross-Exam at 130:9-16.
[75] Moreover, as OSU acknowledges, the carbon footprint of the grid is anticipated to decline over time. Tufekci Cross-Exam at 121:18-19.
[76] *See, e.g.* Tufekci Cross-Exam at 130:24-131:2.
[77] Tufekci Cross-Exam at 36:1-13 (McCracken anticipated to provide 15% of campus heating needs but only one of five boilers will be retired prior to 2035).

generation as part of a heated hot water system, which could facilitate McCracken's *total* retirement and which other universities have reported will enable carbon emission reductions equal to or greater than OSU anticipates the proposed facility will realize.[78]

B. The proposed facility will also emit significant quantities of criteria pollutants, the effects on ambient concentrations of which OSU has not adequately or accurately modeled.

In addition to significant carbon emissions, the proposed facility will be a major source of nitrogen oxide and particulate matter emissions; both pollutants present significant health risks to Columbus residents who live, work, or obtain medical services in close proximity to the proposed facility. The proposed facility's Title V permit allows it to emit up to 40.32 tons per year of particulate matter with a diameter of less than 2.5 microns ("PM2.5").[79] Any increase in exposure to PM2.5 increases health risks.[80] Even if total ambient levels of PM2.5 remain below the NAAQS, more particulate matter will cause more adverse cardiovascular events; no study has found a level below which PM2.5 does not have adverse effects on human health.[81] The

[78] *See* Feasibility Study (Exhibit 4 to OSU Exhibit A), Appendix N; Tufekci Cross-Exam at 57:20-59:11 (four universities reported planned or realized reductions in carbon emissions of 22 to 50 percent; projections were of similar nature to those reported by OSU with respect to construction of the CHP facility).

[79] Tufekci Cross-Exam at 143:10-24. This number is *net* the reduction in emissions associated with the retirement of Boiler #5 at McCracken. *Id*. at 143:25-144:2.

[80] Sahu Testimony at 9:28-29 (citing California Air Resources Board's summary of $PM_{2.5}$ health impacts, *available at* https://ww2.arb.ca.gov/resources/inhalable-particulate-matter-and-health#:~:text=For%20PM2.,symptoms%2C%20and%20restricted%20activity%20days; U.S. EPA fact sheet, "Health and Environmental Effects of Particulate Matter (PM), at https://www.epa.gov/pm-pollution/health-and-environmental-effects-particulate-matter-pm). As Dr. Sahu notes in his testimony, a recent study concluded that even a 1 $\mu g/m^3$ increase in $PM_{2.5}$ increases the death rate from COVID-19 by 8%. *See* Sahu Testimony at 9 fn. 16 (quoting Wu et al., "Exposure to air pollution and COVID-19 mortality in the United States: a nationwide cross-sectional study," *available at* https://projects.iq.harvard.edu/covid-pm/home).

[81] Sahu Testimony at 10 fn. 17 (citing 70 Fed. Reg. 65,983, 65,988 (Nov. 1, 2005) ("emissions reductions resulting in reduced concentrations below the level of the standards may continue to provide additional health benefits to the local population."); 71 Fed. Reg. 2620, 2635 (Jan. 17, 2006) (U.S. EPA unable to find evidence supporting the selection of a threshold level of

proposed facility would also be permitted to emit up to 39 tons per year of nitrogen oxides—another criteria pollutant under the Clean Air Act and a precursor to ozone.[82]

Although OSU has performed some modeling to estimate the effects of these emissions on ambient concentrations, this modeling suffers from three significant defects and thus the full scope of these increased emissions are unknown.[83] First, the model uses meteorological data from a weather station several miles from the proposed CHP facility at a location. This location lacks distinctive attributes of the site of the proposed facility which are likely to affect the flow of air and pollutants: The proposed location is adjacent to the Olentangy River, within a dense campus with numerous buildings of varying heights. [84] A model that relies on meteorological data from a site that lacks these distinctive attributes affecting the flow of air and pollutants is

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$PM_{2.5}$ under which the death and disease associated with $PM_{2.5}$ would not occur at the population level); Letter from Gina McCarthy, EPA, to Hon. Fred Upton, U.S. House of Representatives (Feb. 3, 2012), *available at* https://www.nrdc.org/sites/default/files/epa-letter-upton-pm-benefits-20120203.pdf).

[82] Tufekci Cross-Exam at 143:21-24; Sahu Testimony at 9:14-18. As Dr. Sahu noted, the MERP utilized by TRC to measure the effect of increased nitrogen oxide and particulate matter emissions on ozone levels around the proposed facility simply relies on proportions rather than taking into account the complicated chemistry associated with ozone production and is therefore not a "reliable estimate." Sahu Redirect at 341:22-342:11. Franklin County, where the proposed facility will be located, was listed as "nonattainment" for ozone by the U.S. EPA as recently as 2018 and is currently only in "marginal" attainment. *See* EPA Green Book, available at https://www3.epa.gov/airquality/greenbook/anayo_oh.html.

[83] Notably, OSU did not initially conduct the Prevention of Significant Deterioration ("PSD") analysis of how anticipated emissions would increase the concentration of criteria pollutants in ambient air near the proposed facility. Instead, OSU relied on an exemption issued pursuant to Ohio Admin. Code 3745-31-13(D)(1), which authorizes the Director of the Ohio EPA to grant, at his or her discretion, an exception from PSD requirements to major stationary sources that are or "would occur at" a "non-profit educational institution." *See* Application at p. 61. After the Sierra Club intervened and raised concerns about the effects of emissions, particularly particulate matter emissions, in close proximity to medical facilities (including the Wexner Medical Center), OSU performed modeling of the effect of these emissions on ambient concentrations, which it produced on July 6, 2020. *See* Tufekci Cross-Exam 151:16-152:12; Sierra Club Exhibit E (July 6 Model).

[84] Sahu Testimony at 14:14-26.

non-representative.[85] Second, the site of the proposed facility is in close proximity to a freeway (Highway 315) and thus is likely to have high localized levels of particulate matter due to traffic; however, the location used by OSU to determine background pollutant levels is not similarly located to a highway and thus does not reflect the true level of background particulate concentrations at the proposed site.[86] The model provided by OSU therefore understates the total amount of particulate matter pollution at the proposed site. Third, the highest concentrations of particulate matter and nitrogen oxide emissions near the facility are likely to occur when the plant is at lower loads (due to reduced exit velocities).[87] Although the consultant OSU contracted to perform analysis of projected ambient concentrations claims it modeled 12 different scenarios, including one in which the facility operates at less than 75% load, nothing in the report identifies the twelve scenarios under which this consultant produced a model.[88] It is thus unclear whether the maximum nitrogen oxide and particulate concentrations have in fact been identified.

C. Neither OSU nor the Staff Report has investigated or attempted to characterize the adverse environmental impacts associated with the proposed facility's fuel supply.

The belated analysis OSU conducted to model the likely impact of combustion at the proposed facility site on air quality contains significant gaps and rests on unreliable assumptions. Moreover, OSU neglected to conduct *any* investigation in the adverse environmental impacts

[85] *Id*.
[86] Sahu Testimony at 15:2-8; Sahu Cross-Exam at 286:20-287:1 (closest site used for background concentration at least half a mile from nearest highway, Interstate 71).
[87] Sahu Testimony at 13:6-8. Testimony provided by OSU's witness also supports the inference that the proposed facility will operate at loads below 75% regularly, increasing the incidents of higher concentrations around the facility. *See* Tufekci Cross-Exam at 95:3-96:21 (describing electrical loads of 40-80 MW as typical).
[88] Tufekci Cross-Exam at 159:11-14, 161:18-22.

associated with the extraction of natural gas for use in the proposed facility.[89] Neither OSU witness could identify the source of natural gas to be used in the proposed facility, although OSU witness Mr. Tufekci acknowledged that "incremental or marginal" gas production in the United States is expected to be derived from shale deposits and OSU witness Mr. Potter stated that Ohio is a "net exporter of gas."[90] The adverse impacts associated with natural gas extraction include large-scale emissions of fugitive methane at the point of natural gas extraction; the impact on climate change associated with these methane emissions have been found to exceed that of the hundred thousands of tons of carbon dioxide emitted at combustion.[91] OSU ignored the methane emissions, water usage, and waste management aspects of natural gas extraction in its analysis of the proposed facility, leaving a significant proportion of the adverse environmental impacts undocumented and uncharacterized.

The Staff Report similarly did not address these lifecycle emissions or environmental impacts of natural gas extraction in concluding that "the Applicant has determined the nature of the probable environmental impact for the proposed facility."[92] OPSB staff's consideration of air pollutant emissions from the proposed facility was limited to confirming that OSU had obtained the requisite permits from Ohio EPA and examining the data provided in the Application.[93]

V. The Board Should Deny OSU's Application for a Certificate of Environmental Compatibility and Public Need

[89] Tufekci Cross-Exam at 17:17-20, 144:19-145:12; *see* Potter Cross-Exam at 197:2-19 (OSU did not conduct any analysis of the environmental impacts associated with the extraction of natural gas other than what OSEP and TRC may have performed).
[90] Tufekci Cross-Exam at 144:14-18; 146:23-147:9; Potter Cross-Exam at 196:15-21, 197:2-5.
[91] Sahu Testimony 17:22-18:2.
[92] *Contrast* Staff Report at p. 20 and Conway Cross-Exam at 391:6-9.
[93] Holderbaum Cross-Exam at 373:1-5.

OSU seeks permission from this Board to construct a gas-fired cogeneration facility for a legacy steam system that OSU's own contractor, OSEP, admits is inferior in every described metric to an alternative technology that is currently available. As Dr. Sahu's testimony and OSEP's own Feasibility Study show, universities that similarly situated with respect to both medical facility needs (Stanford) and climactic conditions (Ball State) have chosen to convert from steam heating to heated hot water systems that utilize heat exchangers to capture waste heat and geothermal energy generation to meet campus heating needs without any of the air pollution impacts associated with gas-fired generation and report both carbon emission and cost savings as a result of the conversion. Despite its own findings, neither OSEP nor OSU took any steps to assess whether such a conversion was feasible or cost-effective at OSU; OSU conducted *no* studies into system-wide heated hot water use, heat exchangers, geothermal energy, or even performed a system-wide assessment of the overlap between its current heating and cooling loads. Similarly, with respect to its electricity needs, OSU did not attempt to solicit bids for off-site renewable electricity generation or investigate solar or wind generation beyond a superficial and unsupported price estimate inconsistent with recent, published solar PPA bids.

Instead of pursuing—or even researching—what OSU admits are more efficient technologies with greater capacity for decarbonization, OSU seeks to build a facility that will require redundancies with respect to all of its stated purposes. OSU plans to maintain its current steam generation facility for at least another 15 years, will be legally required to maintain diesel backup generators capable of generating 31 MW for critical infrastructure, and will lock the Columbus campus into two decades or more of fossil fuel generation even as the PJM grid's carbon footprint declines. The proposed facility may have "represent[ed] the minimum adverse environmental impact" for heat and electrical generation when it was first conceived in 2009, but

technological advancements since then have rendered it antiquated. The proposed facility will emit forty tons each of particulate matter and nitrogen oxide, both harmful to humans in their own right and precursors to ozone formation (another criteria pollutant); it will emit—in conjunction with McCracken—more than 300,000 tons per year of greenhouse gases. The environmental effects of natural gas extraction to fuel the proposed facility are totally unknown but likely to be significant, potentially doubling the total greenhouse gas emissions associated with the facility.

In contrast, a combination of heated hot water systems and solar or wind electrical generation will have none of these adverse environmental impacts. Given the existence and demonstrated feasibility of these alternatives and OSU's failure to present any evidence to support its decision to nevertheless pursue construction of a gas-fired CHP facility, OSU has failed to meet the statutory standard set forth at Ohio Rev. Code §4906.10(A)(3) and its Application should, accordingly, be rejected.

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Respectfully Submitted,

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Summary: Brief Siera Club's Posthearing Brief electronically filed by Mr. Tony G. Mendoza on behalf of Sierra Club