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Data Center Ordinance Guide

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HOW TO USE THIS GUIDE

This guide is intended to provide information based on our current understanding of data centers. Information and approaches may evolve, and we will aim to update this document when warranted. Some data center issues are better regulated by state or federal governments and regional energy markets. While some of those issues may be acknowledged, the purpose of this guide is to provide and explain zoning language pertaining to a principal data center use.

We strongly recommend that the ordinance language presented in this document be integrated fully under a Conditional Use scenario. After an introduction to the issues, the remainder of this guide will highlight specific Conditional Use zoning ordinance recommendations. The format identifies each issue with an explanation followed by suggested zoning language in bold text. As always, each municipality should review the recommendations and thoughtfully consider how they may best be applied in a specific community or district.

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Disclaimer

The information provided in the Data Center Ordinance Guide (the "Guide") is for educational and general informational purposes and does not comprise and is not intended as legal advice. All information contained in the Guide is provided in good faith, however the authors make no representation or warranty of any kind, express or implied, regarding the accuracy or completeness of any information contained in the Guide. It is recommended that you consult with a solicitor or other qualified professional before making any decisions based on information provided in the Guide.

INTRODUCTION

Like the electric grid and roadway networks that form the more traditional parts of our critical infrastructure, data centers are becoming a component of modern-day infrastructure that drives our increasingly digitally-oriented lives and economy. Until recently, data centers were often accessory to the corporate office or research and development buildings they supported, and larger data centers were concentrated in certain parts of the country such as northern Virginia and the Pacific Northwest. The advent of artificial intelligence and its exponential growth is driving unprecedented investment from the tech industry in data center development to win a global AI race. Some states, Pennsylvania included, are interested in the potential economic impact of this investment and are considering the incentivizing of data center development. At the same time, local municipalities are beginning to understand the potential environmental and community impacts of this use and recognize a need to provide regulations specific to large data centers.

These facilities require substantial and continuous electrical power, fiber connectivity, specialized cooling systems, and often significant land area. As this use was not contemplated in many existing zoning and land development regulations, municipalities should proactively evaluate and establish clear standards to address siting, design, environmental performance, power generation and grid interconnection, and compatibility with surrounding land uses. The **purpose of this data center ordinance guide** is to define large-scale data centers as a unique land use and to provide a regulatory framework that protects public health, safety, and welfare while offering predictability for property owners, residents, and developers. This ordinance guide provides information about the key topics related to data center development and recommendations for performance standards that can help ensure that any data centers provide the most community benefit with the least impact. Ultimately, this guide and the adoption of a data center ordinance are not an indication of advocacy or opposition, but an establishment of prudent safeguards to help municipalities navigate any interest that may come their way.

WHAT IS A DATA CENTER?

Data centers are buildings that often resemble warehouses or when designed well, office buildings, that serve as a physical hub for the flow of digital information. They house network infrastructure such as computers and/or telecommunications and related equipment (e.g., rows of servers, routers, switches, firewalls, and storage systems) where information (commonly referred to as "the cloud") is stored, processed, and/or distributed, and where data flows continuously through fiber optic cables. They range greatly in size; some are as small as 5,000 square feet, while some are as large as a few million square feet. A data center may include more than one principal building, in which case it may be described as a "data center campus."

TYPES OF DATA CENTERS

In the 1990s and 2000s, **corporate** or **enterprise data centers** were commonly developed to store and process a single entity's data and were sometimes located on the same site as a company's office building. Data centers being developed as a principal use are more common now and are defined based on their business model. These include:

- **Retail data centers** lease space and equipment in the data center to multiple companies or to a single company with turnkey data center service. The data center operator provides day-to-day operational services.
- **Wholesale data centers** also lease space in a data center building to multiple companies, or more commonly a single company, but provides only the space within the data center and power. The lessee provides, operates and maintains the computing infrastructure it needs.
- **Hyperscale data centers** are large facilities built by a single company to meet their specific needs. They are primarily used for cloud storage, artificial intelligence, subscription-based software, and other processes that require massive computing capacity. They are designed to be scalable (up or down) to meet changing demand and workloads.

These data center types' square footage and power usage can vary. This guide is designed to address the largest of data centers - those over 100,000 square feet. We suggest that data centers under 100,000 square feet in size could be allowed as an industrial or accessory use; however, municipalities should still ensure that zoning regulations for them are comprehensive. For reference, the large-scale data centers that have been proposed in our region between 2022 and the present have ranged from one to six million square feet with a proposed energy demand ranging between 50 megawatts to 1 gigawatt.

Ordinance Definitions:

DATA CENTER: A facility primarily used for housing and operating computer systems and associated equipment, including servers, data storage and processing systems, and accessory infrastructure such as cooling systems, power generators, electrical substations, and network hardware.

DATA CENTER CAMPUS: A data center campus includes all of the structures and real estate owned, controlled, leased or otherwise occupied primarily for the use and purpose as Data Center(s), including: (i) Data Center(s); (ii) Data Center Accessory Uses; and (iii) all other systems, equipment, piping, conduit and other ancillary equipment, structures, and other appurtenances that are incidental to and/or needed for the construction, support, operation, repair, maintenance, and/or protection of the Data Center(s) and/or the data center campus.

SENSITIVE RECEPTOR: Buildings used for residences (including institutional uses with a residential component), schools, daycare centers, preschools, hospitals, community centers, and similar institutional uses.

POTENTIAL BENEFITS

Economic Impact

The economic benefits to local municipalities can vary based on the scale of data center development along with the existing conditions or uses preceding the data center. Known examples vary greatly. Data centers can also have spin-off economic impacts where adjacent or nearby uses are incentivized to locate or invest in sites that may be able to use the additional data facilities, such as a biotech campus.

Municipalities with local real estate taxes stand to gain more from data center developments than those with earned income taxes. Business privilege taxes or fees can also boost a municipality's revenue related to data centers. Additionally, municipalities can gain significant revenue from application review and permit fees related to data centers; however, reviews may require gaining additional technical expertise, and municipalities should review their fee schedule to ensure that revenue will cover expenses.

Jobs

Data centers generate fewer permanent jobs by square footage compared to other industrial and research & development uses, though some of the jobs created are high-paying permanent ones for which traditional college degrees may not be required. Data centers also generate security and maintenance related jobs. Jobs generated by data centers in the construction industry are more significant but they only exist during the construction period.

Low Traffic

Compared with other uses, data centers generate relatively little traffic given the smaller number of employees and low delivery needs. Construction-related traffic, however, can last longer than that for other land developments given that some large-scale data centers are built in phases to get individual buildings up and running as quickly as possible. Construction could be a 24-hour operation, generating traffic at all hours of the day and night, depending on what the municipal code allows.

CONDITIONAL USE

Most Pennsylvania models suggest a Conditional Use (CU) approach to allow for detailed consideration by the elected government body with the ultimate power to approve or deny during a public hearing. We also recommend the Conditional Use approach. Conditional uses are intended to permit uses that are appropriate within a zoning district, subject to specific standards and conditions, to ensure compatibility with surrounding land uses and the protection of the public health, safety, and welfare. However, it's important to remember that Conditional Uses are still by-right uses in Pennsylvania, but subject to the standards within the CU ordinance. Failing to meet those standards as a CU allows the municipality to deny approval. All of the following ordinance language is intended to be applied within a Conditional Use section for data centers.

It is also recommended to require concurrent Conditional Use and Preliminary Land Development Applications. This will ensure that all pertinent material to the land development proposal is submitted and available to the elected officials as they consider the Conditional Use application.

ACCESSORY USES FOR DATA CENTERS

Accessory uses for a data center may be substantial in number, scale, and potential for generating nuisances. Equipment associated with data centers, or their potential accessory structures, may include: mechanical equipment; backup power generation facilities ranging from power plants to generator banks and batteries; water towers;

water and/or sewage treatment facilities and pump stations; above and below ground utility lines including water, power, and high-speed internet; environmental controls (air conditioning or cooling towers to prevent equipment from overheating, fire suppression, etc.); and security features like fencing and gatehouses.

Some data center developers are proposing to build on-site power generation as their primary source of energy (called "co-location"). Such power generation facilities are best considered and regulated as a second principal use. Municipalities may need to review their code to assure that multiple principal uses are allowed on one parcel or allow for an exception associated with a data center use.

Ordinance Definition:

DATA CENTER ACCESSORY USE: Ancillary uses or structures secondary and incidental to a Data Center Use. Accessory uses secondary and incidental to a data center are allowed, including but not limited to:

a. **Back-Up Energy Generation. The use shall not include energy generation systems used or intended to be used to supply power to the data center during normal operations.**
b. **Administrative**
c. **Security**
d. **Fiber optic lines**
e. **Utility lines**
f. **Electrical substations**
g. **Domestic and non-contact cooling water and wastewater treatment facilities**
h. **Water towers**
i. **Pump stations**
j. **Heating, ventilation, air conditioning, and cooling towers**

SITE ELEMENTS THAT ATTRACT DATA CENTERS

There are several necessary infrastructure components to make a site feasible for data center development. However, in the push to expand computing capacity, data centers may be built in locations with less-than-optimal infrastructure access. For example, if a data center cannot obtain the power or interconnection it needs from the grid, it could attempt to develop its own dedicated power supply. The primary infrastructure considerations are listed below. Municipalities should identify locations within their boundaries that meet these criteria and ensure regulations are in place that: 1) clearly specify in which zoning district(s) data centers are a permitted use, or 2) put regulations

in place specific to data center development if the parcels or tracts are in an appropriate location for a data center, i.e., an industrial district.

- **Power:** Data centers need access to high-voltage transmission lines to obtain the massive amount of power needed for their operations. The closer a data center is to a transmission line, the less expensive it will be to power their facility, though up to 2 miles away could be feasible.
- **Natural gas pipelines:** If electric transmission lines are not accessible or adequate power is not available, some data centers may opt to co-locate and build a behind-the-meter power generation facility: most frequently a natural gas turbine. Developers of these systems will look to be located near a high-capacity natural gas pipeline to power their generation plant. In these cases, interconnection with the grid may still be desirable or even necessary for back-up power, but the grid supplier may not be willing to interconnect and meet the potential energy demand if it will not be the primary source of power.
- **Fiber optic:** Digital information to and from a data center flows through underground fiber optic cables. Thinking of the fiber optic network like the road network, data centers need access to the "interstate highway" level fiber optic lines, not the "collector road" fiber optic lines.
- **Water:** Some data centers rely on water to cool the thousands of processors within the building, potentially requiring millions of gallons of water per day depending on the cooling system used and the outside temperature. It is less common for data centers to draw water directly from surface or ground water; rather, most water-cooled data centers prefer to connect to a public water system.
- **Land:** Data centers are often built as part of sprawling campuses, sometimes including their own energy generation facility, requiring large tracts of land for the facility itself and for buffering adjacent uses.
- **Access:** Although data centers generate relatively little traffic when operational, the construction phase can generate truck traffic, so access to an arterial roadway is optimal.

ZONING DISTRICTS

In Southeast Pennsylvania, data centers are most appropriate in heavy industrial settings, which are typically located away from residential or other sensitive uses and may have existing power infrastructure. Depending on the scale of the data center and the distance from sensitive uses such as residences, schools, medical facilities, public places, and other institutional uses, light industrial districts could also be appropriate.

Municipalities should also consider adequacy of the transportation network to facilitate construction activity when selecting appropriate zoning districts and locations in the municipality for data centers.

Ordinance Language

1. **Data centers are allowed by conditional use in the HI heavy industrial zoning districts.**
2. **Data centers shall take access from an arterial or collector road and shall have secondary access suitable for emergency response purposes.**

SCALE/AESTHETICS

Municipalities should regulate the aesthetics of large-scale data centers to ensure these expansive, highly utilitarian facilities are compatible with the surrounding communities to the greatest extent possible. Because data centers often consist of large, windowless buildings, extensive mechanical equipment, perimeter security fencing and security offices, and substantial lighting, regulations specific to large-scale data centers can address design standards such as building massing, façade articulation, exterior materials, color palettes, landscaping buffers, equipment screening, and lighting controls. These requirements are intended to reduce visual impacts and soften the appearance of large building footprints.

Ordinance Language

1. **Principal building facades shall require a horizontal offset of at least ten feet at intervals of no more than 150 linear feet (measured horizontally) of principal building facade.**
2. **No more than 80 percent of a principal building facade may consist of one building material.**
3. **No more than 80 percent of a principal building facade may consist of one color, texture, or pattern.**
4. **Principal building facades shall require fenestration, step-back(s), cantilever(s), projection(s), or architectural elements extending horizontally across at least 60 percent of the facade.**
5. **Each principal building shall include an articulated main entrance. This entrance shall be differentiated from the rest of the building with a change in building material, pattern, texture, color, or architectural accent. It shall also either project or be recessed from the adjoining building plane.**

6. **Elevations/renderings of all principal building facades visible from off-site shall be submitted with the conditional use application.**

   Fencing: shall not include barbed or razor wire and shall be subject to municipal fence standards.

DIMENSIONAL STANDARDS

The following dimensional recommendations are not definitive in their applicability. Some variation may be appropriate based on district requirements for other industrial uses. Municipalities should identify potential tracts in their districts that could be proposed for large-scale data centers and assess the impact the below standards would have on the feasibility of data center development. If sites are not near residential areas or sensitive receptors, municipalities can consider reducing setbacks so as not to bring legal challenges on the basis of exclusion.

Some ordinances also require a minimum distance from residential uses or other sensitive receptors with 1,000 feet being a more commonly selected distance. This figure could be considered arbitrary if the design of the data center was effective at mitigating potential impacts. The recommended language and the conditional use process should allow for the opportunity to reduce that distance if other performance standards, such as noise, can be demonstrated to be less than otherwise required.

Lot Size

Establishing a one-size-fits-all minimum lot size could prevent smaller data centers from being established. Setbacks and other dimensional standards will better determine the feasibility of lots within a district but the ordinance language uses a five acre minimum threshold which may only work for a two-story data center at the minimum size of 100,000 square feet. A maximum lot size is not included in the ordinance language but may be considered in more rural municipalities that want to protect against losing potential agricultural land, or in municipalities with limited industrial land that would not want to see that district monopolized by a data center use.

Height

Data centers may range in height from 30 feet to 150 feet or more, with each story being roughly double the height of a typical office building due to space for airflow and cooling equipment. Rooftop accessory structures like parapet walls, rooftop equipment, and stairwells can add up to 20 feet of additional height, particularly for air cooled data centers and those that use evaporative cooling. Freestanding accessory structures such as water towers and power generation facilities can be higher still. Municipalities should consider the underlying district's height standards for consistency, but if there is a lower maximum height, they may want to allow for up to 60 feet for a data center. The ability to build more than one floor could provide more energy and cooling efficiency.

Setbacks

Data centers may have profound impacts on their neighbors. When regulating data centers, municipalities often create extensive setbacks from residential uses as well as sensitive receptors, including institutional uses. Some require greater setbacks in the data center development for taller structures such as water towers.

Impervious Coverage and Building Coverage

Data center buildings and impervious areas can affect vast swathes of land. This has great impacts on site disturbance, stormwater runoff, woodlands, farmlands, and habitat. The below standards could be modified to remain consistent with other industrial uses within the proposed district permitted for data centers.

Ordinance Language

1. **Minimum Lot Size: Data centers over 100,000 square feet in gross floor area shall have a minimum lot area of 5 acres.**
2. **Maximum Height: Data centers and freestanding accessory uses may not exceed 60 feet in height. For data center principal buildings, the maximum height shall be inclusive of rooftop appurtenances and rooftop accessory uses.**
3. **Minimum Setbacks: Data center principal buildings, accessory uses, and truck idling areas shall have a minimum setback from all property lines of 250 feet, with the exceptions of utility lines, fiber optic lines, and security stations.**
4. **Data centers shall be a minimum of 1,000 feet from residential uses, residential districts, and/or other sensitive receptors. This distance may be reduced to a range of 500 – 999 feet if the applicant can successfully demonstrate how it will exceed other environmental performance standards including noise levels that do not exceed ambient noise for that area, visual screening and/or aesthetic improvements that mask the data center use, and do not contribute to any thermal air changes that would affect the closest sensitive receptors.**
5. **Roof-mounted equipment shall be set back from the parapet at least as far as the equipment's height above the roof surface.**
6. **Maximum Building Coverage: 40% (or consistent with eligible zoning district)**
7. **Maximum Impervious Coverage: 50% (or consistent with eligible zoning district)**

ENERGY SOURCES

Large-scale data centers are among the most energy-intensive land uses, with individual facilities often demanding 50 to 100 megawatts of electricity or more—comparable to the consumption of a small city. Unlike most commercial or industrial uses, data centers operate continuously, requiring uninterrupted power for servers and cooling systems. Their round-the-clock load can necessitate new substations, high-voltage interconnections with transmission infrastructure, and other highly costly improvements, potentially including new transmission lines. Utility companies are required by state and federal law to provide service to applicants, but the amount of time it will take to provide service can vary greatly, and in the case of large load users like data centers, the wait for energy service can be years.

Additionally, power redundancy is a critical component of data center power systems to ensure continuous operation of the data center. Power redundancy systems can include natural gas or diesel powered generators, battery systems, as well as grid interconnection in the case of those data centers with co-located power generation systems.

Due to grid constraints, new data center developments should be designed and operated to meet the highest achievable standards of energy efficiency. The U.S. Green Building Council's LEED BD+C: Data Centers rating system provides an accepted framework of best practices tailored specifically to the unique energy demands of data center facilities. Municipalities may incentivize or require adherence to these standards as part of the conditional use process, to help reduce overall electricity consumption, improve operational performance, and lessen strain on local infrastructure while supporting broader sustainability goals.

Even with strong energy efficiency measures, the spike in power demand from data centers poses a threat to local climate action goals. However, there could be one silver lining in terms of opportunity. Data centers could play a meaningful role in transitioning to cleaner energy sources by driving demand for new renewable energy sources. Municipalities can encourage renewable integration or sourcing a certain percentage of power from renewable generation sources, as well as using battery storage instead of some, or all, back-up generators. Renewable energy can also be required to achieve a land use-related bonus, such as additional height or square footage. Of course, any standards must be related to an achievable threshold based on what energy markets are capable of providing.

On most parcels in the region, on-site solar will not be a feasible option for powering a new data center due to size constraints (a solar field to produce 50 MW of power would require approximately 400 acres of land including setbacks, access roads, etc.). That said, municipalities should still encourage data centers to utilize on-site solar energy and battery storage to the extent possible and help reduce their peak load requirements , meet their reliability and redundancy needs, and minimize on-site emissions. To further mitigate their energy impacts, data center developers can also invest in off-site solar

+ battery storage development projects- which is typically the quickest type of energy generation system to build.

Direct investment in renewable energy projects and physical or virtual power purchase agreements should be encouraged over acquiring renewable energy credits to offset grid-purchased power due to their stronger environmental benefits. Municipalities can encourage data center developers to invest in local solar projects, including rooftop solar in the community..

Many data centers track and report their renewable energy consumption. Municipalities can incentivize or require public reporting to ensure accountability.

Ordinance Language

1. **Projects shall be designed and constructed to meet the current USGBC LEED BD+C: Data Centers rating system, or equivalent design standard, as approved by the municipal engineer.**
2. **The applicant for a data center shall provide an Energy Usage Plan with the Conditional Use application. The Energy Usage Plan shall provide or identify, at a minimum :**
    a. **Annual electricity demand**
    b. **Energy supply sources that will be utilized**
    c. **Energy storage capacity (if applicable)**
    d. **Proposed sources of back-up power**
    e. **Documentation of efforts to maximize use of renewable and/or clean energy for all electrical and cooling needs, including those to: Reduce the need for new electric generation by incorporating the best available energy efficiency into the design of data center servers, cooling units, and the building structure.**
        i. **Cover 50-80% of all unused roof space with solar arrays to offset a portion of the demand on the electric grid and reduce onsite emissions.**
        ii. **Explore battery storage as a backup energy source for 50-100% of total onsite back-up energy needs to reduce or eliminate the pollution associated with diesel backup generators.**
        iii. **Support off-site renewable energy generation through a power purchase agreement or other arrangement that will result in new renewable energy generation within the PJM region .**
        iv. **Monitor and report energy efficiency and emissions data to the municipality on a regular basis.**

f. If interconnecting to the energy grid, documentation of the energy utility interconnection approval process with answers to the following:
    i. Documentation that an application for the project has been filed with the electric utility provider, and the required fee has been paid.
    ii. Documentation that a transmission security agreement has been received by the applicant.
    iii. Documentation that the transmission security agreement has been signed by all necessary parties.
    iv. The date that the electric utility provider provided for the proposed energization of the data center.
g. The Energy Usage Plan will be prepared and certified by a professional engineer. The plan shall be subject to review and comment by the municipality. The municipality shall have the right to require supplemental or amended plans based upon comments by the municipality prior to any zoning approval.

3. A proposed Data Center whose Energy Usage Plan shows power demand of over 50 megawatts (MW) and that proposes to connect to the power grid shall be required to procure a minimum of 10% of its power from renewable generation sources generated withing the PJM region, which include solar, wind, hydroelectric power, geothermal, and waste heat from data center cooling processes. Electricity supply shall be procured through a power purchase agreement or similar mechanism as opposed to purchasing renewable energy credits (RECs) only.

POWER LINES AND CO-LOCATION OF ENERGY GENERATION SYSTEMS

Although connecting to the grid is most advantageous for data centers, infrastructure upgrades needed for interconnection could add years to a project's construction timeline. If the required grid infrastructure upgrades will take too long, some data centers may opt to install their own dedicated power generation plant, called "co-location". The Commonwealth of Pennsylvania is also incentivizing this approach, as demand for power generation has already outstripped supply. For developments that choose to install their own natural gas generation system, locating near a natural gas transmission pipeline is a key factor in site selection.

A power generation facility co-located on the same tract as a proposed data center has the potential to be far more impactful to nearby uses than the data center itself; however,

the impacts of a power generating facility depend on the type of facility (nuclear vs. natural gas turbine, vs solar, etc.), each requiring their own distinct set of regulations. For these reasons we recommend municipal codes consider power generation facilities as a separate principal use instead of an accessory use to the data center.

Although power generating systems are subject to state and federal regulations, municipalities can regulate location on a site, in which districts they are permitted, setbacks from property lines and sensitive uses, and special reporting such as air quality monitoring. It should be noted that natural gas combined cycle and single cycle turbines can degrade air quality, not just in the immediate vicinity but within miles of the facility, even when they adhere to their air quality permit limitations. Setbacks from sensitive uses should be significant and strictly adhered to.

Some municipal codes may restrict parcels to a single principal use: as such, municipalities should assess whether their current codes: 1) adequately regulate power generation facilities, 2) permit these facilities in the same districts where data centers are permitted, and 3) allow multiple principal uses on such sites.

Additionally, some data centers may require a dedicated electrical substation, so municipal ordinances for power generation should also include standards for substations. This guide considers electrical substations as an accessory use to data centers.

Ordinance Language

Definition:

Energy Generation System- Any energy generation system designed or used to supply power directly to a Data Center during normal operations, including solar, wind, fossil fuel, fuel cells, or nuclear energy generating systems.

1. **Any energy generation system designed or used to supply power directly to a Data Center during normal operations, including solar, wind, fossil fuel, fuel cells, or nuclear energy generating systems, shall not be considered part of the Data Center use but shall be subject to existing municipal or utility regulations. Such systems shall be considered a separate principal use and shall be approved according to all applicable state and federal regulations along with municipal zoning regulations applicable to such use. The applicant shall select, design, and locate the energy generation systems to limit noise, emissions, and visual impacts to adjacent and nearby uses as much as possible. Data center principal buildings shall be located between energy generation systems and residential districts or any other sensitive receptors .**

2. **Electric Utility Substations on the same property as the Data Center they serve shall be located on the side or rear of a Data Center principal building so they are screened from public view and shall not be located in a required front yard. On-site substations do not require a buffer or screening between the Data Center Principal Building and the substation.**
3. **Data Center electric utility substations visible from an arterial roadway shall include a combination of year-round opaque landscaping and screening walls to minimize visual impact.**
4. **Burying power lines serving the property is strongly encouraged. On-site power lines of 34.5 kV and below shall be buried.**
5. **Proposed substations on a parcel that abuts a zoning district boundary other than industrial, and/or a boundary with a property with a sensitive receptor shall be set back a minimum of 800 feet from the property line. If abutting both another industrial-zoned parcel and use, substations shall meet the requirements for accessory uses in the underlying zoning district.**

BACKUP POWER

Data centers commonly use backup generators to ensure uninterrupted power during grid outages. These backup generators are most often diesel powered. Diesel powered generators are tested regularly and run during power outages: this can be noisy and generate emissions such as NOx, a greenhouse gas and air pollutant that can cause health issues with prolonged exposure. Data centers that use diesel generators will likely need to acquire an air quality permit from PA DEP. Natural gas-powered generators are also available but relatively uncommon, though they might be advantageous if a data center is located near a natural gas pipeline.

Diesel generators are subject to regulation through federal EPA standards that are enforced at the state level. There are multiple tiers of emissions standards that apply to diesel generators, with Tier 4 being the highest. “Prime power generators,” or those used to operate the facility when disconnected from the grid (not just for emergency use) are required by the EPA to meet Tier 4 requirements. Those used for emergency generation are only required to meet Tier 2-3 requirements. Municipal codes can specify that diesel generators are only used for emergency backup power and must meet Tier 4 standards.

Some data centers may participate in demand response programs to curtail power usage at the request of the utility company/grid operator when the grid is most stressed. During these times, the utility pays the data center to switch to backup power, relieving stress on the grid. This is different than a user voluntarily switching to diesel generation to reduce their peak power usage which reduces the user’s energy bill but is not necessary for grid reliability purposes. To reduce air quality and noise concerns municipal ordinances should ensure generators are not used for “peak shaving” purposes..

Large-scale battery energy storage systems could provide back-up power as well as support data center operations during times of peak usage on the grid, which would also reduce the data centers' power costs. Relying on batteries for backup power reduces emissions and sound and is becoming more common as data centers strive to meet company-wide sustainability goals.

Ordinance Language

1. **Diesel generators shall meet Tier 4 emission standards of the U.S. Environmental Protection Agency.**
2. **Diesel generators shall undergo annual testing, and reports shall be provided to the municipality to ensure that data center equipment is performing as designed and that emissions from the data center do not exceed permitted limits.**
3. **Emergency energy generation that uses diesel, gasoline, or another fossil fuel shall be used only at the following times:**
    a. **When the primary source of energy is not available due to an emergency outage.**
    b. **During routine maintenance, or readiness testing for a short duration of time and capped at 100 hours per year.**
    c. **Routine maintenance testing of back-up fossil fuel-powered generators is restricted to the hours of 9 am through 3 pm Monday through Friday.**
4. **Use for peak shaving or supplying power to the grid is prohibited. The applicant shall design and locate emergency energy generation systems to limit noise and visual impacts as much as possible.**

WATER USAGE

Large-scale data centers can have significant impacts on local water resources based solely on the demands of their cooling systems. Typical water-based cooling systems use large volumes of water to dissipate the intense heat generated by servers and associated equipment, and individual large-scale and hyperscale data centers may consume millions of gallons of water annually to support cooling operations alone. The amount of water directly used by data centers is dependent upon several factors, including seasonal conditions and system design. In periods of water stress, such as in warm summer months when cooling needs peak, this increased water demand can compete with residential, agricultural, and ecological needs, placing added pressure on municipal water supplies and local water sources. Additionally, co-located power systems most commonly utilize natural gas turbine generators, which also require large amounts of water for power production. Coupled with a water-cooled data center, overall water needs for large-scale and hyperscale data centers can be substantial, and are best served by public

water suppliers. If public water is not available, ordinance language should be opened to private sourcing only if a detailed water feasibility study is provided to the satisfaction of the municipality.

Most modern data centers operate on closed-loop systems supplied by public water from water treatment plants, rather than withdrawing from surface and groundwater sources to meet water needs. This approach shifts demand onto public water utilities, adding pressure to expand treatment and distribution capacity, increase source water intake, or undertake additional investments to accommodate high-volume demand.

New and emerging technologies in data center cooling systems have proven to significantly reduce water consumption compared to traditional closed-loop systems. For example, immersion cooling submerges data center equipment in a conductive liquid that transfers and condenses the heat through evaporative cooling, achieving efficiencies in power and water usage. Given the rapid pace of innovation in data center design, municipal ordinances should restrict antiquated technologies that rely on surface or groundwater for evaporative cooling while providing flexibility to adopt more water efficient solutions as they become available.

Municipalities can incorporate water-focused performance standards into zoning and land development ordinances to mitigate the impacts of direct water consumption by data center operations. These measures may include requiring water-use reporting and efficiency benchmarks, encouraging or mandating the use of closed loop or other water-efficient cooling technologies, and promoting water reuse or replenishment targets. .

Ordinance Language

1. **No principal use on a data center site shall use private groundwater wells or direct withdrawals from surface watercourses as its primary source of water for cooling purposes if a public water source is available.**
2. **Data centers shall be designed to include a closed-loop water circulation system to cool data center processing equipment. An applicant may propose an alternative cooling system that can be demonstrated to use less water and energy than closed-loop systems to the satisfaction of the municipal engineer.**
3. **If the proposed source is from a public system, the applicant shall submit certified documentation that the public authority has the capacity to supply the water needed.**
4. **If the data center will utilize nonpublic water sources, the applicant shall provide a water feasibility study, prepared by a qualified professional. The purpose of the water feasibility study is to determine if an adequate supply of water is present to support the proposed data center's water use and to evaluate the potential adverse effects on the quantity and quality of existing wells or nearby surface waters.**

The water feasibility study shall include, at minimum, the following information:

a. **Calculations of the projected water needs, including seasonal fluctuations.**

b. **A geologic map of the proposed project area within a radius of at least one mile from the site property boundary.**

c. **The location of all existing and proposed wells within 1,000 feet of the site property boundary with a notation of the capacity of all high-yield wells.**

d. **The location of all surface waters within 1,000 feet of the site property boundary and all known point sources of pollution.**

e. **A determination of the long-term safe yield of the water source.**

f. **A determination that the proposed water supply system poses no adverse impacts on the quantity and quality of water in nearby wells, streams, and the groundwater table**

g. **Identification of how water will be recycled, treated, or released into surrounding water bodies.**

h. **A statement of the qualifications and the signature(s) of the person(s) preparing the study.**

5. **No approvals shall be granted until all required state and regional permits have been obtained (i.e., PADEP, SRBS, DRBC).**

6. **The applicant shall provide a drought response plan to demonstrate compliance with state, water supplier, and local drought declaration requirements.**

7. **Wastewater disposal analysis:**

a. **The applicant shall submit an analysis of wastewater disposal needs to either a public sewer system or private system, indicating the quantity of wastewater generation expected. Wastewater shall include sewage and water discharged as part of the data center's HVAC system.**

b. **Any untreated wastewater generated is prohibited to be discharged to stormwater systems or surface waters.**

c. **If wastewater will be conveyed and/or treated by a public system, the applicant shall submit documentation certified by the public authority that the public authority can support the conveyance and treatment needed.**

d. **If the data center is to rely upon a private system of wastewater disposal, a wastewater feasibility study shall be required. The purpose of the study is to determine if there is an adequate ca-**

pacity to dispose of wastewater and that the disposal technique does not pose adverse impacts on surrounding water bodies. A wastewater feasibility study shall include the following information at a minimum:

i. **Calculations of the projected wastewater generation including the sources of wastewater.**
ii. **A geologic map of the area with a radius of at least one mile from the site property boundary.**
iii. **The location of all existing and proposed wells within 1,000 feet of the property boundary, with reference to the capacity of all high-yield wells.**
iv. **The location of all surface waters within 1,000 feet of the property boundary and all known point sources of pollution.**
v. **Identification of the process by which water will be recycled or released into surrounding water bodies.**
vi. **A determination that the proposed wastewater disposal system has no adverse impact on the quantity and quality of water in nearby wells, surface waters, and the groundwater table.**
vii. **A statement of the qualifications and the signature(s) of the person(s) preparing the study.**

THERMAL IMPACTS

Data centers require significant cooling systems to cool servers and other equipment; however, the heat generated can be captured and transferred to a nearby use to reduce their heating costs. Significant energy savings can be achieved by directly using waste heat for heating applications like pre-heating water or ventilated air for buildings. Specialized equipment can also provide for the efficient recovery and reuse of heat from data center equipment for space heating. To make this possible, a recipient for the heat should be located nearby or adjacent to the data center (optimally under the same ownership as the data center), and a champion or incentives/policies that support heat reuse must be in place.

Ordinance Language

A Thermal Impact Mitigation Plan shall be submitted with the zoning application, including, at a minimum:

1. **Identification of primary sources of waste heat (air- and water-based).**

2. **Evaluation of potential off-site thermal impacts (including plume/heat discharge and localized heat islands) under representative seasonal conditions.**
3. **Description of design measures to minimize heat impacts (e.g., equipment siting, shielding, landscaping, cool roofs/paving where applicable).**
4. **Evaluation of feasible opportunities for waste heat reuse. Where reuse is not feasible, the reason(s) why should be given, in which case alternative mitigation shall be identified (e.g., vegetative or green roof and/or site design modifications).**
5. **Inclusion of a monitoring/verification approach if required by conditions of approval based on proximity to sensitive receptors or site constraints.**
6. **The Plan shall be prepared and certified by a professional engineer.**
7. **The Thermal Impact Mitigation Plan shall be subject to review and comment by the municipality. The municipality shall have the right to require supplemental or amended plans based upon comments by the municipality prior to any zoning approval.**

NOISE/VIBRATION

Large-scale data centers generate continuous and, at times, intermittent noise (in the case of generators) from mechanical and electrical equipment required to support their 24/7 operations. Primary sources of noise include rooftop chillers, cooling towers, dry coolers, large air-handling units, transformer hum from on-site substations, and backup diesel generators during testing or outages. While much of this equipment produces steady broadband "white" noise, certain components—particularly fans, compressors, and generators—can emit tonal or low-frequency sounds that travel farther and penetrate buildings more readily. In addition to airborne noise, vibration from some data center equipment can transmit through the ground or building structure if not properly isolated. For nearby residential areas, these conditions may result in sleep disturbance, reduced outdoor enjoyment, and other negative impacts. Low frequency sounds also negatively impact wildlife and farm animals, adding farms and conservation areas to the list of adjacent uses to treat with sensitivity.

Municipalities measure and regulate data center noise using established acoustical standards, typically expressed in decibels (dB), a logarithmic unit that quantifies sound pressure levels. Because human hearing is more sensitive to mid-range frequencies, most local ordinances rely on A-weighted decibels dB(A), which filter low and very high frequencies to approximate human perception. However, data center equipment such as ventilation fans can also produce significant low-frequency noise, which is better captured by C-weighted dB(C) measurements. Comparing dB(A) and dB(C) levels can help identify problematic low-frequency sounds.

To mitigate impacts, local regulations should consider buffering and location of equipment on the site (i.e., generators should be separated from any adjacent sensitive/public uses by a principal data center building). Additionally, local codes can require sound-attenuated enclosures for equipment, vibration isolation systems, or that equipment be fully housed indoors.

Regulations should be written to be enforceable. This can be done through establishing quantifiable maximum sound limits at the property line; requiring acoustical modeling studies prior to approval; requiring developers to conduct pre- and post-construction noise surveys; and data centers to permanently host on-site acoustic monitors to ensure sound levels remain within pre-determined limits. The dBA sound thresholds in the ordinance language provided are based on guidelines from the World Health Organization and US EPA. The use of c-weighted decibels accounts for low-frequency sound which may add 10–20 decibels of additional perceptible noise beyond the A-weighted measurement.

Ordinance Language

1. **Noise Studies.**
    a. **Pre-construction Noise Study. The applicant shall submit a pre-construction noise study prepared by an acoustical engineer establishing baseline ambient noise and vibration levels and shall include different times of day. The noise study shall include a narrative describing anticipated operational impacts to sound levels and it shall include an octave band analysis. The noise study shall account for any proposed electrical substations, on-site power generation facilities, and other data center accessory uses that may generate noise.**
    b. **Post-construction Noise Study. The applicant shall submit a noise study of existing operations no sooner than one month but no more than 12 months after the issuance of the first Certificate of Occupancy.**
    c. **Sound shall be measured at all property lines. The studies shall use full spectrum modeling to address low-frequency noise.**
    d. **If the pre-construction Noise Study establishes a baseline ambient noise level in excess of the maximum sound level permitted under this Chapter, the Post-Construction Study shall demonstrate that operations of the proposed use do not materially increase the baseline ambient noise level as measured at the property line. Any increase above the established baseline shall be deemed a violation unless specifically authorized as a condition of approval.**

e. **Noise mitigation measures may be required by the zoning officer when noise studies show that the use is generating noise approaching established limits.**

2. **Sound level.**
   a. **Sound levels at the property line shall not exceed 40 dB(A) and 50 dB(C) from 7:00pm to 7:00 am, nor shall they exceed 45 dB(A) and 60 dB(C) from 7:00am to 7:00pm.**
   b. **Where baseline ambient noise measured for the pre-construction noise study exceeds that of the maximum sound level above, sound levels at the property line shall not exceed the baseline ambient noise level (for dB(A) and dB(C)).**

EMERGENCY SERVICES

Data centers present unique challenges for emergency management. Issues include: data security and the threat of cyberattacks; a large amount of heat-generating electrified equipment and the risk of fire; buildings of great length and/or height; and hazardous materials such as refrigerants and batteries. Local emergency service providers may be unfamiliar with data center operations and the potential hazards involved and should receive training in advance of the data center becoming operational.

Ordinance Language

1. **An emergency response plan shall be required as part of the conditional use application and shall be prepared by a qualified professional. The Emergency Response Plan shall:**
   a. **Evaluate the impacts, both positive and negative, of the proposed data center upon emergency services and fire protection.**
   b. **Be reviewed by and acceptable to the local fire department and emergency management services as part of the conditional use process.**
   c. **Include detailed procedures for fire suppression, containment, ventilation, and evacuation.**
   d. **Ensure that all first responders receive adequate training specific to the installed system at the expense of the applicant.**
   e. **Include provisions for annual fire safety inspections demonstrating compliance with fire safety standards to be performed by a qualified professional on behalf of the data center.**

2. **Each Data Center shall provide 24-hour emergency contact signage that is visible at the main entrance. Such signage shall include the company name (if applicable), the owner/representative's name, the telephone number, and the corresponding local power company's name and telephone number.**
3. **The applicant shall coordinate with the municipal emergency management coordinator to ensure there is adequate radio coverage for emergency responders within all on-site buildings and facilities, based upon existing coverage levels of the municipal public safety radio communications system exterior to on-site buildings. The applicant shall install enhancement systems, as needed, to achieve compliance.**
4. **Data Centers and any Data Center Accessory use proposing battery storage or any other device or group of devices capable of storing energy in order to supply electrical energy at a later time, whether the energy is stored for use on-site or off-site, shall demonstrate compliance with National Fire Protection Association (NFPA) Standard 855, Installation of Stationary Energy Storage Systems, or similar standards and shall include fire suppression systems designed specifically for battery storage.**
5. **No Data Center shall be approved unless the applicant demonstrates that procedures for fire suppression, containment, ventilation, and evacuation are sufficiently protective of public health, safety and welfare.**

ELECTRONIC WASTE

Data centers produce large amounts of electronic waste, as well as batteries and hazardous materials. Servers are replaced with new ones at regular intervals, requiring disposal of large amounts of electronic equipment.

Ordinance Language

1. **An Electronic Waste Plan shall be submitted with the zoning application outlining procedures for safe removal and recycling and/or disposal of server infrastructure, hazardous materials, batteries, electronic waste, and related products that meet all state and federal requirements, which will apply in cases when the equipment within the data center is updated or decommissioned. The Report shall be subject to review and comment by the municipality. The municipality shall have the right to require supplemental or amended reports based upon comments by the municipality prior to any zoning approval.**

PARKING

Parking requirements for data centers are far less than would be required for another industrial use of similar size and are tied to the number of on-site jobs they generate. A traditional approach establishing a number of spaces per square feet of building would be likely to overestimate or underestimate the actual need. Instead, the ordinance should provide the applicant the opportunity to demonstrate the parking need based on expected operations, with a requirement to identify future reserve parking only if needed.

Ordinance Language

1. **One parking space shall be required for each employee, based upon the number of employees projected to work during the largest shift, plus 5 spaces for visitors.**
2. **The municipality may ask for an additional 25 percent of required parking spaces to be held in reserve.**

DECOMMISSIONING

Given the rapid expansion of data centers and the rapid evolution of the industry in general, there is some concern that 1) data centers could be functionally obsolete in the future, or processing could advance to take place in much smaller areas, making the scale and number of data centers too much. Even during this era of rapid data center build-out the market could become saturated and projects could be abandoned prior to completion.

The prospect of a data center building becoming vacant one day poses numerous challenges and is one which ordinances should address. For example, large scale data centers have massive buildings that are taller than most other uses, making their adaptive re-use challenging for another industry. They may also be sited in locations with access appropriate for a few dozen data center employees, but not for heavy truck traffic that another industrial use might require. For these reasons, data center proposals should include Decommissioning Plans to describe how the data center development will hedge against these concerns, and potentially to provide financial security for its demolition at the end of its useful life.

Ordinance Language

1. **A Decommissioning Plan prepared by a qualified professional shall be submitted. The plan shall outline the procedures for safe shut-down, removal of equipment, disposal or recycling of materials, and site restoration.**

2. **The owner shall submit a notification of closure if operations are permanently ceased.**
3. **Decommissioning shall begin within 1 year of cessation of data center operations, or upon notice of abandonment by the operator, whichever occurs first. An extension of 1 year may be granted by the municipality if the property owner can demonstrate that they are actively marketing the site for a compatible replacement use. Decommissioning shall be completed within 18 months thereafter, unless extended by the municipality for good cause.**
4. **Standards for Decommissioning:**
    a. **All above-ground structures, equipment, and accessory facilities shall be removed.**
    b. **Hazardous materials, including batteries, fuel, or refrigerants, shall be disposed of in compliance with state and federal law.**
    c. **Disturbed soils shall be stabilized and re-vegetated.**
    d. **Any utility connections shall be safely disconnected and capped.**
    e. **The site shall be restored to a condition compatible with surrounding land uses or consistent with the most restrictive adjacent zoning district.**

PUBLIC ENGAGEMENT

Large-scale data centers can have substantial impacts on surrounding communities. Past data center developments around the nation have resulted in many people feeling as if they were excluded from the planning process. The propensity of data center developers to use non-disclosure agreements (NDAs) with local governments coupled with the strong economic impact data centers can generate has increased the level of mistrust that many members of the public hold toward data center developers and local governments alike.

Ordinance Language

1. **The applicant shall hold a public meeting prior to the first planning commission meeting when the proposed land development or conditional use proposal is discussed. The purpose of the meeting shall be to inform the public about the nature of the proposed development, including the location, scale, and general characteristics. A representative(s) of the applicant with knowledge of the project and the ability to answer general questions from the public about the project's general location, scale, and parameters shall participate in the meeting. The public meeting shall be advertised consistent with**

"public notice" as defined by the Pennsylvania Municipalities Planning Code (PA Act 247).

2. **The applicant shall create and maintain a project website for viewing by the general public. The site shall explain the project parameters, including maps and elevations/renderings, beginning at least two weeks prior to the meeting discussed above, and until the time of final land development approval. The site shall provide a description of the proposed use, construction timelines and phasing plans, dates of public meetings with municipal bodies, and status of permits.**

APPENDIX A: COMMUNITY BENEFITS AGREEMENT (CBA)

Data centers—particularly hyperscale ones—have the potential to create great impacts on an area. In some communities, developers and community groups have established contractual agreements called community benefits agreements to help mitigate the negative side of data center development. These agreements can include commitments from the developer to take specified actions that benefit the community and possibly mitigate negative impacts of development.

It is important to note that community benefits agreements are not addressed by the Municipalities Planning Code (PA Act 247) and should not be codified in an ordinance. Municipalities cannot compel developers to participate in such an agreement (doing so risks being considered an exaction). Although municipalities may serve as facilitators of negotiations between a community or civic group or groups and the developer, the more involved a municipality is (particularly if any officials involved would be involved in a conditional use decision), the greater the risk that the end result may be deemed an exaction by the courts.

If a community benefits agreement is pursued, the best time to begin discussions with the developer about it is before the land development submission process.. Such engagement could be beneficial to both the developer and the community. If considering a CBA, municipalities should be aware how they have been used with some data center developments. Any agreement created should address mitigation actions that have a clear nexus and proportionality with anticipated negative impacts of the data center. Community benefits agreements should include elements that are programmatic and contractual in nature; these would not be regulatory requirements and cannot be enforced by a municipality (e.g., dimensional standards, air quality or sound levels, or water usage standards.

Some examples of programmatic community benefits that could be included in such an agreement include:

1. Emergency management including training provided by applicant and reimbursement for emergency response.
2. Community-wide funding for energy efficiency and solar projects.
3. Workforce training.
4. Schools, including cloud computing curriculum.

5. Economic development support surrounding a data center site in recognition of limited job presence in a commercial district.
6. Environmental protections outside of standard regulations.
7. Additional public engagement and ongoing transparency, such as maintaining websites that track environmental impacts like sound, air quality, water usage, and energy usage.

APPENDIX B: SOURCES AND MODELS REFERENCED

This Guide draws upon a range of publicly available model ordinances, professional guidance documents, and peer municipal examples that address the siting, regulation, and impacts of large-scale data centers. These sources were consulted to reflect current best practices, emerging regulatory approaches, and real-world municipal experience. The inclusion of these references does not imply endorsement of any single model, but rather informed the development of adaptable recommendations suitable for Pennsylvania municipalities.

Lancaster City Data Center Ordinance (Draft)
This draft ordinance was consulted for topics including the energy usage plan and some of its components.

PennFuture – Data Center Model Ordinance
PennFuture's model ordinance was consulted for its comprehensive treatment of data center impacts, including setbacks, environmental performance standards, energy generation, water usage, and noise considerations. The model provided a useful framework for identifying issues that municipalities may wish to address, particularly with respect to public health, environmental protection, and community compatibility.

Physicians for Social Responsibility Data Center Model Ordinance
This model influenced the sound guidelines used in this ordinance guide due to their relative simplicity to understand and apply, ability to measure quantitatively, and adherence to accepted healthy standards for noise from the WHO and EPA.

Urban Land Institute (ULI)
ULI reports and technical guidance on data centers were referenced for background information on data center typologies, site selection criteria, infrastructure needs, and emerging trends in design and operations. ULI materials also informed discussion of aesthetics, noise mitigation, and the evolving role of data centers in regional development patterns.

Prince William County, Virginia – Draft and Adopted Ordinance Provisions
Prince William County's data center regulations and draft noise ordinance updates were reviewed, particularly for their detailed treatment of acoustical analysis, baseline noise measurement, and mitigation standards. These materials helped inform recommended approaches to noise studies and enforcement mechanisms.

York County Data Center Model Ordinance
The model's sections on safety and emergency management were consulted and strongly influenced the guidance and draft ordinance language in this model.

Other Municipal and Professional References

Additional examples and technical resources were consulted as appropriate, including draft or adopted ordinances from other Pennsylvania and Mid-Atlantic municipalities, guidance from acoustical engineers and water resource professionals, and publicly available corporate sustainability and water-use reports. These sources contributed to the Guide's discussion of energy use, water demand, thermal impacts, emergency services, and decommissioning considerations.