A Summary of the Current State of Data Center Electricity and Water Demand and Its Effects on Utilities.

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1. Introduction

As data centers have begun to rapidly increase in number and are being constructed at an increasingly high pace, it is important to take note of the industries that support them. The rapid expansion of things like Artificial Intelligence (AI), cloud computing, and other functions of computing is a commonly known driving factor in the rapid construction of many of the new data centers throughout the world. The adjacent industries of electrical power generation, electrical power distribution, and public water supply systems must ensure that they are able to grow to meet the increasing demand for electricity and fresh water from new data centers while ensuring the existing connections to each system remain operational and in "good working order." The purpose of this paper is to conduct an initial investigation into how much power and water data centers currently use, how much power and water data centers are projected to use in the future, and how data centers have been shown affect the adjacent industries mentioned above based on current data.

2. How Much Electrical Power do Data Centers Really Consume?

In a 2024 study that was conducted by several people from the Energy Analysis & Environmental Impacts Division of the Berkeley Laboratory, it was shown that the total power consumption of all data centers within the United States (US) was approximately 60 Terawatt-Hours (TWh) per year between the years of 2014 and 2016. That is between 1% and 2% of the total amount of power used by the entire US during each year. After 2016, the power usage of data centers on a national scale began to increase and hit 76 TWh during that year, or 1.9% of the total power used by the entire US in 2018. Since 2018, the power used by data centers has increased at an increasing rate. It was shown to have over doubled to 176 TWh or 4.4% of the total power used by the entire US in 2023. A similar trend is expected to continue into the future where the per year power usage of data centers on a national scale is expected to grow to between 325 TWh and 580 TWh of electricity, or between 6.7% and 12% of the total power used by the entire US by 2028 [9]. There are many factors driving this, including the more obvious factor of there just being more data centers built. While that is true, there are other factors in play.

As technology related to computing has advanced, there are new types of servers being used within data centers. While these new types of servers are more efficient in their use of electricity, they still use more overall power than older servers. There is also the introduction of larger scale central data centers known as "Hyperscale" data centers [9]. These Hyperscale data centers are characterized by their massive overall size and limited current use cases. Uses for Hyperscale data centers tend to be for large scale, internet-based services that

require more computational power than most other data center types, including cloud computing, AI, and other similar uses. These Hyperscale data centers, along with other large scale data center types, are often packed with newer server hardware, are becoming more popular, and make up many new data center projects [1, 5, 9]. The point of this being, data centers vary in size, shape, and use case. All of these factors affect how much power a data center can consume over any given period of time.

To give a comparable figure that can represent how Hyperscale data centers compare to legacy data centers from as recent as 2014, they can be compared to the average American household. The average American household consumes roughly 1000 kilowatt hours (kWh) or 1 megawatt hour (MWh) of electricity per month. The average legacy style data center, which often uses less efficient but overall less power-hungry hardware, has been shown to consume approximately 20 MWh of electricity per month on average. Modern Hyperscale data centers have been shown to consume 100 MWh of electricity or more a month depending on their specific uses and what types of equipment they contain [1, 9]. This is 5 times the usage of legacy style data centers and 100 times the usage of the average American household.

3. How Much Water do Data Centers Really Consume?

Data centers generally use water in 2 different ways. Those being, the direct use of water for cooling, and the indirect use of water in electric power generation. Water usage also follows a similar trend to electrical usage due to similar factors, including the increasing rate at which data centers are being built, as well as the presence of more Hyperscale data centers that use more power intensive hardware [1, 3, 9, 10].

The same 2024 study that was conducted by several people from the Energy Analysis & Environmental Impacts Division of the Berkeley Laboratory also found that data centers across the US directly used approximately 5.6 billion gal of water in 2014 and did not provide a value for indirect water consumption in 2014. The amount of water directly consumed by data centers was shown to have grown by over a factor of 3 to over 17.4 billion gallons of water in 2023. Indirect water consumption of data centers from water used during power generation in 2023 was shown to be approximately 210 billion gallons of water. This follows a remarkably similar trend to power usage of data centers during the time period this study covered and is projected to further grow in a similar way to electricity usage [1].

Water consumption for every individual data center can vary greatly due to similar factors to electricity. These include size, use case, equipped hardware, and location climate, among other smaller factors [1, 3, 9, 10]. Due to the climate of the location of the data center being a major driving factor in its water consumption, it is difficult to further analyze how much water different types of data centers use on average. According to a research paper titled “Making AI Less “Thirsty”: Uncovering and Addressing the Secret Water Footprint of AI Models”, data centers can directly consume between 0.26 gal of water per kWh of

electrical power used and 2.37 gal of water per kWh of electrical power used depending on the previously mentioned factors [3]. Using these, we can calculate a range of possible water usage for data centers of different types based on their power consumption. To be consistent, the typical power usages for data centers mentioned in the previous section will be used. The results of said calculations are shown in the table below [1, 3, 9].

Scenario, Data Center Type	Predicted Amount of Water Used per Month (gal)
Minimum Usage, Legacy Style Data Center	5200
Maximum Usage, Legacy Style Data Center	47400
Minimum Usage, Hyperscale Data Center	26000
Maximum Usage, Hyperscale Data Center	273000

Table 1: *Estimated Amount of Water Used by Legacy Style and Hyperscale Data Centers.*

It is also worth noting that in some extreme cases data centers have been shown to consume millions of gallons of water per month in higher heat climates and during heat waves [1, 3].

4. How Does the Increasing Demand for Power and Water Affect Utilities?

As noted in the above sections, the power demand of data centers as well as their associated direct and indirect water consumption is actively increasing and is projected to continue to do so. With the demand on utilities continually increasing, there must come some level of infrastructure improvement. This has been especially noticed in the electrical power generation as well as the electrical power distribution sectors. So much so that Goldman Sachs published an article titled “Generational Growth: AI, data centers and the coming US power demand surge” which details more on how AI and the data centers it relies on are beginning to drive the expansion of the electrical power grid. This has also started to open new opportunities for investors to make money by at least partially funding the many new projects that will come along with the many new American data centers [1, 2].

The rest of the money that will be needed to improve existing infrastructure as well as expand it to meet demand will be passed on to the rate payers. This is already being felt on a nationwide scale as utility bills across the country have been steadily rising along with the power consumption of data centers. Since data centers are large single users, this problem is often exacerbated in the immediate areas around these facilities. [1, 5, 7] A particular area of note is central Ohio (OH) and the area surrounding the city of Columbus, OH. This area is home to 120 of Ohio’s 188 data centers. According to the local NBC news station, electricity bills rose $25.64 on average between April 2025 and July 2025 [5].

Loudoun VA, which is an area that is widely considered to have one of the highest concentrations of data centers in America, is currently facing massive residential rate increases to both water and electricity costs, despite even larger rate increases being passed off to data centers and similar large single-user customers. According to a study that was

commissioned by the Commonwealth of Virginia and was conducted by E3 to further investigate how data centers are impacting electricity costs in that area, as well as its accompanying report. Residential customers can expect a 12% increase to the generation and transmission aspects of their monthly electricity every year through 2050. This translates to an expected increase of between $14 and $37 per month every year [6, 8]

According to the website for Loudoun Water (the major water company for Loudoun County, VA), a cost increase cap of 7% per year through 2027 has been instituted. While a specific reason for this was not given, cost capping measures are often conducted to help stabilize the rate at which utility costs are expected to increase [4]. All of this being said, it is clear that the cost of utilities for everyone is set to continue to increase for the foreseeable future as the demand for more water and electricity from data centers increases.

There is also the problem of how long it will take to construct the new infrastructure to support data centers. Based on available data, the rate at which the electrical power generation industry near Loudoun, VA will need to expand to meet demand is nearing an unprecedented 3.8 GW per year of new generation capacity in some cases. That is enough power generation capacity to power over 3 million average US residential homes. This level of rapid growth is nearing the edge of feasibility. This also doesn't include the associated improvements to and expansion of the electrical transmission grid to get all the newly generated power to the customers who need it. If not executed properly, rapid growth like this can lead to a significant increase in stress on existing systems and an increased risk of system failures [6, 8, 9].

5. In Conclusion.

It has never been more important than right now to consider how all of this will affect both the local communities around these new data centers and the nation at large. Throughout the initial investigation that was conducted during the writing of this report, it was repeatedly noted by sources of all types that the data on how these facilities affect us is difficult to come by and is often only shared on a voluntary basis by select individuals. Further cooperation with these individuals to continue to further study this topic is vital, and bringing more into the proverbial fold is creeping closer to being required due to the lack of easily attainable data. Curbing this initial surge in construction of large single-user facilities like data centers is rapidly approaching becoming necessary in order to allow solutions to the problems detailed in this report to be fully solved, and/or for the adjacent industries to catch up with the rapid increase in demand.

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