

bae urban economics

Data Center Market Study

Prepared for Prince William County, Virginia

October 20, 2021

Executive Summary

As part of a larger study being led by Stantec to review the potential expansion of Prince William County's Data Center Overlay Zone, BAE Urban Economics prepared a market study of the data center industry. This report includes four components: 1) a data center emerging trends review, 2) a best practices/competitive assessment of economic development programs for data centers, 3) an economic impact analysis for a prototype data center, and 4) a data center demand analysis for Northern Virginia and Prince William County. Key findings of the report are summarized below.

Data Center Industry Emerging Trends

Key findings are as follows:

- The exponential increase in digital communications and services, and the corresponding demand for storing, managing, and distributing large amounts of data and information has led to substantial growth in the U.S. data center market.
- Data centers, which are centralized repositories of computer servers that provide electronic services, are a key resource for digital communications and services.
- More data centers are being built to meet the rising amount of data that is created and stored. The U.S. Data Center Market was valued at \$8.4 billion in 2020, and is projected to reach \$13.91 billion by 2026.¹
- The increased demand worldwide for data centers applies to both enterprise data center facilities owned and operated by the company they support (e.g., Amazon Web Services (AWS), Microsoft, Google, etc.) as well colocation data centers that rent out rack space to third parties for their servers or other network equipment.
- The COVID-19 pandemic has boosted the global data center market as it created increased demand for internet-related services beginning with 2020 lockdown. The pandemic also led to companies and governments migrating from locally hosted applications and data to cloud services provided by data centers.

¹ United States Data Center Market - Growth, Trends, COVID-19 Impact, and Forecasts (2021 - 2026). Retrieved from: https://www.researchandmarkets.com/reports/5120080/united-states-data-center-market-growth?utm_source=BW&utm_medium=PressRelease&utm_code=n662p8&utm_campaign=1532805+-+United+States+Data+Center+Market+Growth%2c+Trends%2c+COVID-19+Impact%2c+and+Forecasts+Report+2021-2026&utm_exec=chdo54prd

- The increased demand for data centers has led to large increases in the total inventory of data centers in North America. In the second half of 2020, the total inventory of data centers grew by 152.9 Megawatts (MW)² (5.9 percent) and 291.8 MW (11 percent) year-over-year.³
- Northern Virginia has the largest data center market in the U.S. Data centers in Northern Virginia make up 48 percent of the primary market inventory of data centers in the U.S.
- Real estate researchers predict continued market strength for the Northern Virginia data center market going forward. A large amount of pre-leasing in data centers under construction is contributing to supply and demand figures in 2021 and beyond.⁴
- Rental rates for data center space are relatively low in Northern Virginia versus other markets, which helps to keep demand high in the market.⁵
- Average power rates in Northern Virginia have consistently stayed at 5.2 cents per KWh for the last five years, which is lower than power rates in many other data center locations in the U.S.⁶ Since power makes up 40 percent of operating costs at a typical data center, this is a competitive advantage for Northern Virginia.⁷
- High demand for data centers in Northern Virginia is reflected in recent land sales for properties where data centers are allowed. A dwindling land supply has led to record price per acre land sale costs in the region; the seven most recent data center land sales had price per acre costs ranging from \$425,000 to \$3,020,000.⁸
- While the International Data Corporation (IDC) estimates the average age of a data center at nine years old, the exponential growth in digital data, services, and

² Growth in the data center real estate sector is measured in power, not square footage.

³ CBRE Research, “A Source of Stability: Digital Infrastructure in 2020, North American Data Center Report H2 2020.” Retrieved from <https://www.cbre.us/research-and-reports/North-American-Data-Center-Report-H2-2020>

⁴ Ibid.

⁵ JLL, “2020 Year-End Data Center Outlook: A Review of the Industry’s latest trends and what to expect in 2021.” Retrieved from <https://www.us.jll.com/en/trends-and-insights/research/data-center-outlook>

⁶ Ibid.

⁷ U.S Chamber of Commerce, “Data Centers, Jobs and Opportunities in Communities Nationwide.” (2017). Retrieved from <https://www.uschamber.com/report/data-centers-jobs-opportunities-communities-nationwide>

⁸ Cushman & Wakefield, “Data Center Update Americas: United States and Canada.” (2021). Retrieved from <https://www.cushmanwakefield.com/en/insights/americas-data-center-update>

communications is forcing data centers to modernize their platforms to support more capacity, reliability, scalability, and faster processing speed. It is generally far more cost effective to modernize the existing equipment in a data center than to relocate and build a new center.

Best Practices/Competitive Assessment – Economic Development Programs

Key findings are as follows:

- Data centers prioritize six key factors when selecting new sites for development: fiber connectivity, environment, access, access to electrical power, access to water, a skilled workforce, and incentives. Of these, the most critical is access to high bandwidth connectivity.
- The growth of the data center industry in Loudoun County beginning in the 1990s has been driven primarily by the density of fiber networks. Loudoun County continues to be the location of choice but land availability has become more limited.
- By proximity to Loudoun County, but also in its own right, Prince William County provides companies and data center operators convenient access to the most interconnected network in the world, with close access to inter-continental cables in New Jersey and Virginia Beach.
- Land use and economic incentives can help attract data centers, even though network connectivity is the most important factor for data centers when it comes to site selection. The two main economic incentives that jurisdictions offer data centers are reduced personal property tax rates, and reduced sales and use tax rates.
- Compared to the other Northern Virginia counties, Prince William County has the lowest personal property tax for data centers, at \$1.50 per \$100 of assessed value for eligible equipment (i.e., computer equipment, cooling equipment, etc.). Combined with Virginia's sales and use tax exemption for eligible purchases, this positions Prince William County competitively versus Loudoun and Fairfax counties.
- In terms of zoning ordinances, Loudoun, Fairfax and Henrico counties in Virginia allow by-right development of data centers in a range of commercial, office, and industrial zones. Fairfax County imposes additional size and design regulations for data centers in the denser nonresidential zones, while Henrico County permits by-right data center development in all office, business, and industrial zones.

- The two factors that are becoming increasingly important for the site selection process are the availability of land and the incentives/ease of development in places with available land.
- Despite regional interest in attracting data center from other parts of Virginia and certain locations in Maryland (i.e., Prince George’s County and Frederick County), data center developers will continue to seek available land in Prince William County to remain close to Loudoun County’s “Data Center Alley,” so the amount of data center development will ultimately be determined by the availability of land.

Economic Impacts of Data Centers

BAE used IMPLAN, an economic modeling software package, to estimate the impacts of data centers on the Prince William County economy. The analysis considers three types of impacts: jobs, worker compensation, and total economic output generated by data centers in Prince William County.

IMPLAN models the way income is spent and re-spent in other sectors in the economy, generating waves of economic activity and job creation, sometimes referred to as the “economic multiplier effect.” Once the economic events have been entered into the model, IMPLAN reports the following types of impacts:

- **Direct** – Direct impacts refer to the set of producer or consumer expenditures. This is the amount of spending available to flow through the local economy.
- **Indirect** – Indirect impacts are impacts of local industries buying goods and services from other local industries.
- **Induced** – Induced impacts refer to an economy’s response to an initial change (direct impact) that occurs through respending of income according to household spending patterns.

To conduct the analysis, BAE reviewed other data center economic impact studies for information on typical characteristics of data centers and developed a prototype data center. This prototype is one data center building; many data center complexes in Northern Virginia have two or three buildings similar to this prototype on their campuses. The building prototype is 250,000 square feet, and had construction impacts of \$1,100 per square foot for a total of \$275,000,000. It has 28 permanent jobs with 9,000 square feet per worker. Compensation per worker, including benefits is \$180,000 and total worker compensation is \$5,040,000.

The economic impacts from this data center prototype as described above are:

- With construction costs estimated at \$275 million over an assumed 12-month period, would support almost 1,700 estimated direct jobs and an additional 407 indirect jobs

at other business supporting the construction. There are also another 301 jobs resulting from worker expenditures.

- The indirect impacts in expenditures for construction amounts to \$73 million, while the induced impact is \$44 million during the construction period.
- Once the data center building is operating, there would be an estimated 28 direct full-time equivalent jobs. The demand for goods and services for the operation would support an additional 133 indirect jobs, and the expenditures of worker households would support 22 additional jobs.
- Project-related jobs (direct, indirect, and induced) would be equal to .09 percent of the County's total 2019 jobs. The wages of the permanent staff, which are relatively high, are equivalent to a higher proportion of the Prince William County wage totals, 1.30 percent of the current County average.

Market Demand Analysis

BAE analyzed both the current supply and the likely demand for data centers in Northern Virginia, specifically in Prince William County. According to Baxtel, a data center information clearinghouse, there are 180 data center sites in Northern Virginia, primarily in three counties: Fairfax, Loudoun, and Prince William.⁹ Most of the data centers in Northern Virginia are located in Loudoun County in an area known as "Data Center Alley" a long the Dulles Greenway (VA 267) which includes Ashburn, Sterling and Leesburg. Prince William County currently has 26 data centers, with seven another additional campuses under construction.

Through conversations with data center-focused real estate representatives, data center industry representatives and collected real estate data, BAE makes the following observations about the data center market in Prince William County:

1. **Land prices for data center properties are rising to unprecedented heights.** Land sales for data center sites in Loudoun and Prince William counties between March and August 2021 ranged from \$425,000 - \$3.02 million per acre.
2. **The primary drivers for data center real estate site selection are availability of power and access to fiber.** Data center real estate specialists indicate access to reliable power and access to fiber are the most important factors in data center site selection.

⁹ Baxtel, "Northern Virginia Data Center Market." Retrieved from <https://baxtel.com/data-center/northern-virginia>

3. **State economic incentives are important for attracting data centers, but not as important as availability of power and access to fiber.** The Commonwealth of Virginia offers an exemption of retail sales and use tax for qualifying computer equipment purchased by data centers that meet statutory investment and employment requirements. According to data center real estate specialists, these incentives but do not drive decisions.
4. **Local personal property tax rates are a factor, but they are not likely to be a primary consideration for data center site selection.** Prince William County has the lowest property tax rates among the Northern Virginia counties. The County recently elected to raise the property on IT equipment with a phased increase through 2024. The impact of this change is not yet known.
5. **Other serious competitors to Northern Virginia for data center investments are emerging.** Other areas in the broader region, including Henrico County and other jurisdictions in Virginia and Frederick County and Prince George's County in Maryland are working to attract data centers. Additionally, as of 2020, Maryland now exempts sales and use tax of qualified personal property for data centers.
6. **The demand for data centers, particularly in Northern Virginia, is extremely strong according to data center specialists and industry representatives and will likely remain so for many years.** Experts say there is practically unlimited demand in Northern Virginia for data centers. The high rate of growth in the sector will continue and be abated only by the lack of land availability.

Introduction

BAE Urban Economics prepared a market study of the data center industry as part of a larger study being led by Stantec on a proposal to expand Prince William County's Data Center Opportunity Zone Overlay District. Included below are the four components of this market study: 1) a data center emerging trends review, 2) a best practices/competitive assessment of economic development programs for data centers, 3) an economic impact analysis for a prototype data center, and 4) a data center market demand analysis for Northern Virginia and Prince William County.

Data Center Industry Emerging Trends

The exponential increase of digital communication and services, demand for storing, managing, and distributing large amounts of data and information is reflected in the growth of the U.S. data center market. The number of internet users and applications has been rising dramatically for decades. Commercial users, such as retail and eCommerce companies, increasingly rely on the internet to provide their services and to store data. Traditional services

provided by brick-and-mortar businesses are going online. Consider Carvana, which is transforming how used cars are bought.¹⁰ Non-commercial users access the internet for emailing, texting, streaming videos and music, gaming, and social networking.

Data centers are a key resource for digital communications and services. They are centralized repositories of computer servers that provide these electronic services. Consequently, more data centers are built to meet the demand of the rising amount of data that is created and stored. The U.S. Data Center Market is valued at \$8.4 billion in 2020, and it is projected to reach \$13.91 billion by 2026, with a compound annual growth rate (CAGR) of 8.63 percent during the forecast period (2021-2026).¹¹

The increased demand worldwide for data centers applies to both enterprise data center facilities owned and operated by the company they support (e.g., Amazon Web Services (AWS), Microsoft, Google, or Apple), as well as colocation data centers. Colocation data centers rent out rack space to third parties for their servers or other network equipment. Colocation data centers are often used by businesses that do not maintain their own data centers, but want the benefits provided by data centers.¹²

The COVID-19 pandemic has also boosted the global data center market. Demand for data centers has grown due to:

- Increased demand for internet-related services resulting from COVID-19 lockdowns, leading internet traffic upsurges between 25 and 30 percent during the periods of the initial lockdown period (March-April 2020) worldwide, 10X times more than normal growth (~3 percent per month).¹³
- Companies and government migrating from locally hosted applications and data to cloud services provided by data centers.

The pandemic prompted organizations to consider enhancing their technology infrastructure, potentially accelerating the growth of the market in the near future. COVID-19 has led to

¹⁰ Retail & eCommerce Transformation Leads to Data Center Boom. Retrieved from: <https://www.vxchnge.com/blog/transformation-of-retail-to-data-centers>.

¹¹ United States Data Center Market - Growth, Trends, COVID-19 Impact, and Forecasts (2021 - 2026). Retrieved from: https://www.researchandmarkets.com/reports/5120080/united-states-data-center-market-growth?utm_source=BW&utm_medium=PressRelease&utm_code=n662p8&utm_campaign=1532805+-+United+States+Data+Center+Market+Growth%2c+Trends%2c+COVID-19+Impact%2c+and+Forecasts+Report+2021-2026&utm_exec=chdo54prd.

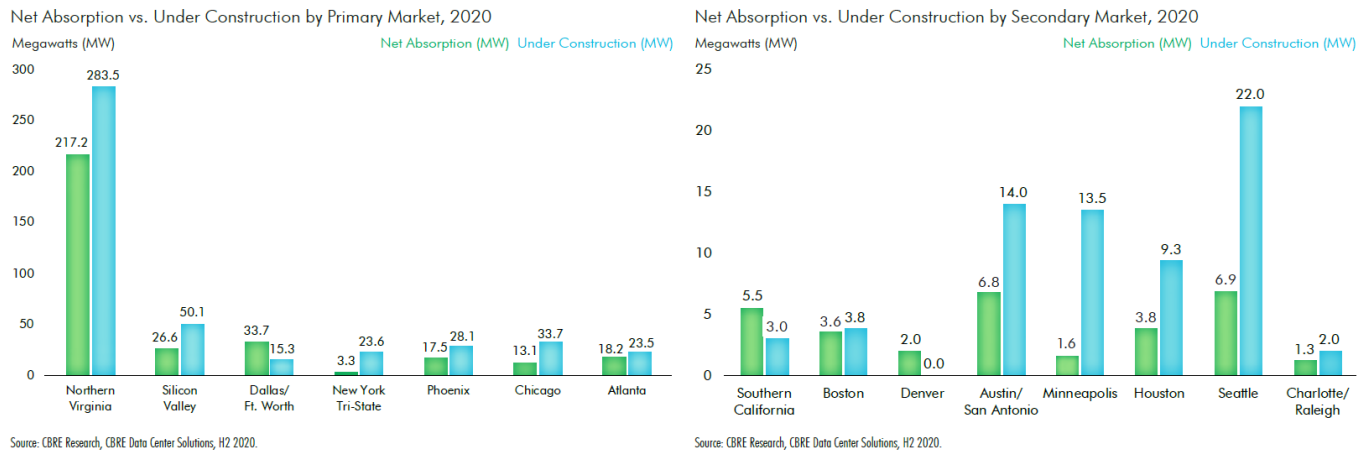
¹² <https://www.racksolutions.com/news/data-center-trends/what-is-a-colocation-data-center/>.

¹³ Diana Olick. (2021, March 9). Data center real estate is primed to boom after the pandemic forced lives online. CNBC. Retrieved from: <https://www.cnbc.com/2021/03/09/data-center-real-estate-reits-after-covid.html>.

increased awareness of the benefits of cloud services, as well as to increased pressure from boards and governance entities to provide more secure and robust IT environments. Wholesale rental demand for data centers, however, did fall 11 percent in 2020, due mostly to organizations freezing their IT budgets at the start of the COVID pandemic. However, the rental rate stabilized by H2 2020 to \$121 per kW/month, down from \$126 per kW/month in 2019.¹⁴

According to a report by CBRE Research, the research arm of CBRE, a major international commercial real estate brokerage, total inventory in primary markets grew by 152.9 Megawatts (MW) (5.9 percent) in H2 2020 and by 291.8 MW (11 percent) year-over-year. (Note: Growth in the data center real estate sector is measured in power, not square footage.) Construction capacity in the primary markets grew by about 84.2MW in H2 2020 from H1 totaling 457.8 MW, an increase of 182.9 MW from 2019. The following figure shows the demand (absorption) against the supply under construction for the primary and secondary data center markets in the U.S.¹⁵

Figure 1: Demand (Net Absorption) vs. Supply Under Construction 2020 for Primary & Secondary Markets



The following tables provide a snapshot of the fundamentals of the data center real estate for the primary and secondary markets in the U.S., which includes year-to-year change for the various key factors.¹⁶

¹⁴ CBRE Research, “A Source of Stability: Digital Infrastructure in 2020, North American Data Center Report H2 2020.” Retrieved from <https://www.cbre.us/research-and-reports/North-American-Data-Center-Report-H2-2020>

¹⁵ Ibid.

¹⁶ Ibid.

Table 1: 2020 Primary Markets Fundamentals

Market	Inventory	Y-o-Y Change	Available MW/ Vacancy Rate	Y-o-Y Change*	2020 Net Absorption	Y-o-Y Change	Rental Rates (kW/mo)**
Northern Virginia	1,376.7 MW	▲ 176.3 MW	76.9 MW / 5.6%	▼ -420 bps	217.2 MW	▼ -37.4 MW	\$85-\$120
Dallas/Ft. Worth	360.9 MW	▲ 39.5 MW	65.4 MW / 18%	▼ -40 bps	33.7 MW	▲ 7.9 MW	\$100-\$140
Silicon Valley	292.1 MW	▲ 24.3 MW	6.8 MW / 2.3%	▼ -110 bps	26.6 MW	▼ -9.0 MW	\$135-\$150
Chicago	288.5 MW	▲ 18.5 MW	42.7 MW / 14.8%	▲ 100 bps	13.1 MW	▼ -2.6 MW	\$96-\$110
Phoenix	238.9 MW	▲ 9.0 MW	15.9 MW / 6.7%	▼ -390 bps	17.5 MW	▲ 4.8 MW	\$115-\$130
New York Tri-State	149.1 MW	▲ 3.0 MW	13.1 MW / 8.8%	▼ -40 bps	3.3 MW	▼ -5.7MW	\$125-\$135
Atlanta	163.8 MW	▲ 21.2 MW	23.8 MW / 14.5%	▼ -10 bps	18.2 MW	▲ 3.6 MW	\$115-\$130

*Vacancy Y-o-Y changes are calculated by comparing the difference between H2 2020 and H2 2019. **Rental rates are quoted asking rates for 250+ kW at N+1/Tier III requirements. Source: CBRE Research, CBRE Data Center Solutions, H2 2020.

Table 2: 2020 Secondary Markets Fundamentals

Market	Inventory	Y-o-Y Change	Available MW/ Vacancy Rate	Y-o-Y Change*	2020 Net Absorption	Y-o-Y Change	Rental Rates (kW/mo)**
Austin/San Antonio	146.6 MW	▲ 5.4 MW	4.1 MW / 2.8%	▼ -110 bps	6.8 MW	▼ -5.8 MW	\$125-\$155
Houston	128.4 MW	▲ 1.0 MW	29.4 MW / 22.9%	▼ -210 bps	3.8 MW	▼ -12.2 MW	\$130-\$150
Southern California	127.1 MW	▲ 6.0 MW	24.0 MW / 18.9%	▼ -56 bps	5.5 MW	▼ -8.9 MW	\$130-\$160
Seattle	137.0 MW	▲ 5.3 MW	20.6 MW / 15.0%	▼ -182 bps	6.9 MW	▲ 6.4 MW	\$115-\$145
Denver	84.8 MW	▼ -1.2 MW	18.9 MW / 22.2%	▼ -341 bps	2.0 MW	▲ 1.6 MW	\$125-\$145
Boston	77.8 MW	► 0 MW	12.9 MW / 16.5%	▼ -470 bps	3.6 MW	▲ 1.2 MW	\$150-\$175
Charlotte/Raleigh	61.7 MW	▲ 1.2 MW	18.2 MW / 29.5%	▼ -80 bps	1.3 MW	▼ -1.6 MW	\$120-\$135
Minneapolis	52.0 MW	▲ 0.9 MW	14.7 MW / 28.2%	▼ -190 bps	1.6 MW	▼ -2.0 MW	\$130-\$145

*Vacancy Y-o-Y changes are calculated by comparing the difference between H2 2020 and H2 2019. **Rental rates are quoted asking rates for 250+ kW at N+1/Tier III requirements. Source: CBRE Research, CBRE Data Center Solutions, H2 2020.

Key trends from CBRE's market survey include:¹⁷

- Data centers continue to be one of the fastest growing real estate sectors pre-pandemic and remained strong in 2020 as government agencies and businesses reconfigured their digital infrastructure to improve their remote work capabilities, and tech giants and cloud service providers raced to meet consumer and corporate demand.
- The CBRE data shows 329.6 MW of net absorption in 2020 across the seven primary U.S. data center markets: Northern Virginia, Dallas, Silicon Valley, Chicago, Phoenix, New York Tri-State and Atlanta. While down 11 percent from the peak in 2019, 2020 absorption was still higher than any other year on record. Meanwhile, vacancy at data centers fell to just 8.5 percent, despite an 11 percent growth in new supply.
- The handful of data center real estate investment trusts (REITs) were among the highest-performing in the REIT sector in 2020. They ended the year up 21 percent. Major names include CoreSite Realty, CyrusOne, Digital Realty, Equinix and QTS Realty Trust.¹⁸

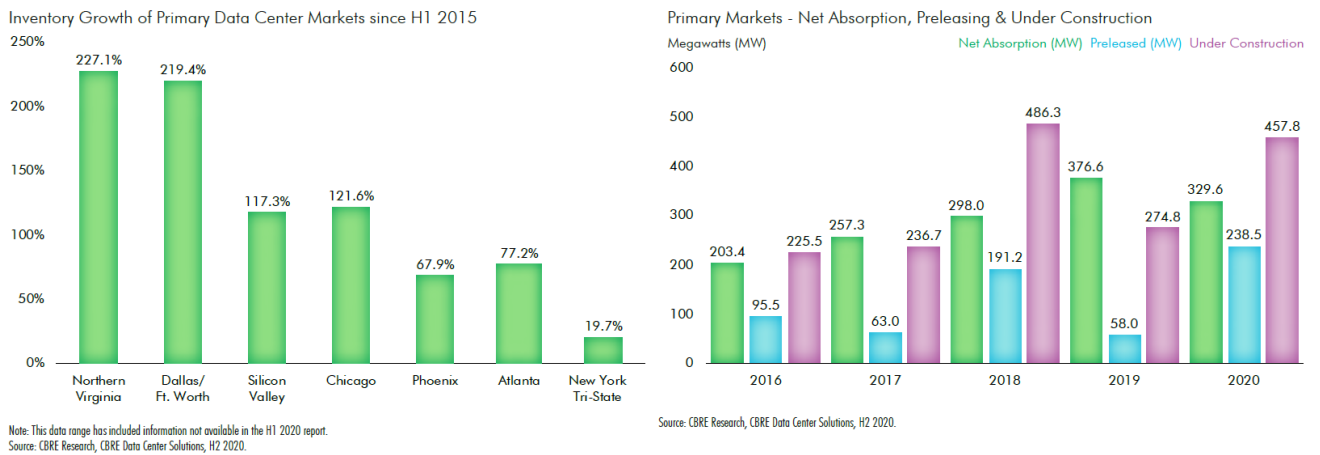
¹⁷ Ibid.

¹⁸ Diana Olick. (2021, March 9). CNBC.

- Strong demand and an uptick in investor interest in direct investment due to the strong performance of data center REITs in 2020 resulted in a 457.8-MW data center construction pipeline in the primary markets, up 62 percent from the end of 2019. More than half of the current pipeline is pre-leased.
- The importance of network connectivity/bandwidth and availability of power cannot be overstated for developing high-quality, robust data center capacity.

Figure 2 illustrates the historical trend of the Data Center Primary Markets fundamentals.¹⁹

Figure 2: 2015 - 2020 Primary Markets Fundamentals



Other Data Center Markets

For comparison purposes, the following figures summarize key data for four (4) of the primary data center markets outside of Northern Virginia: Atlanta, Chicago, Phoenix, and Silicon Valley.

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¹⁹ Ibid.

²⁰ Ibid.

Figure 3: Atlanta Market Data and Trends

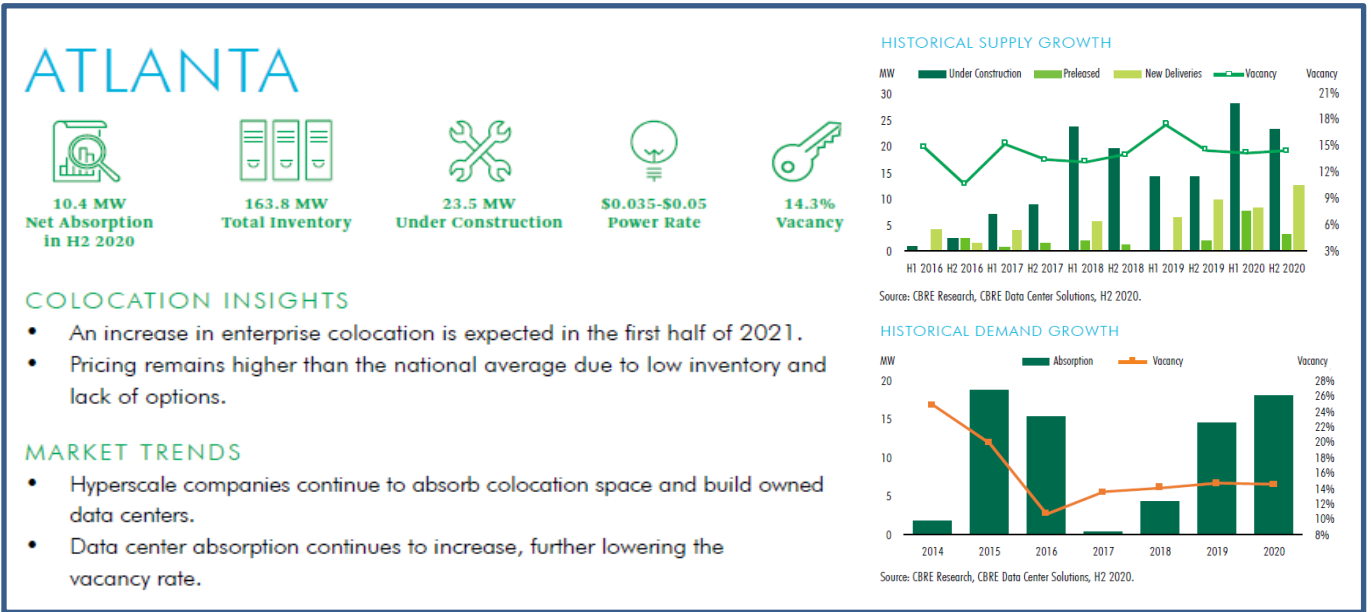


Figure 4: Chicago Market Data & Trends

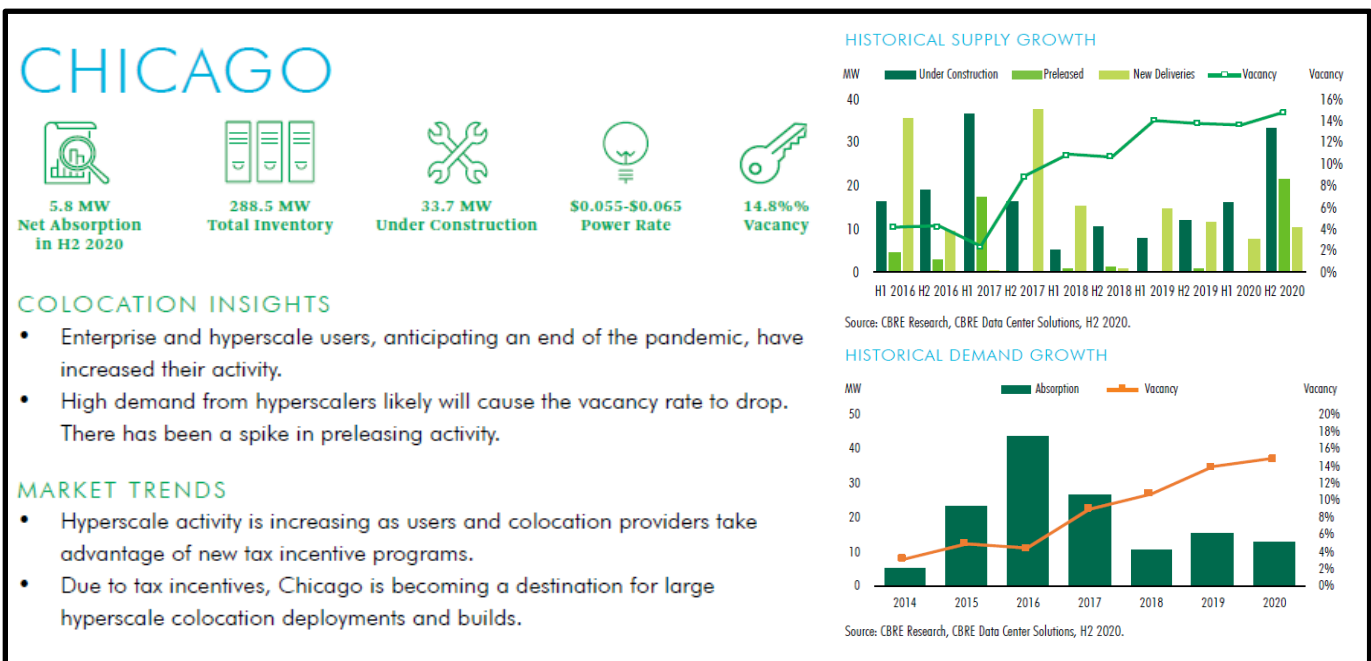


Figure 5: Phoenix Market Data & Trends

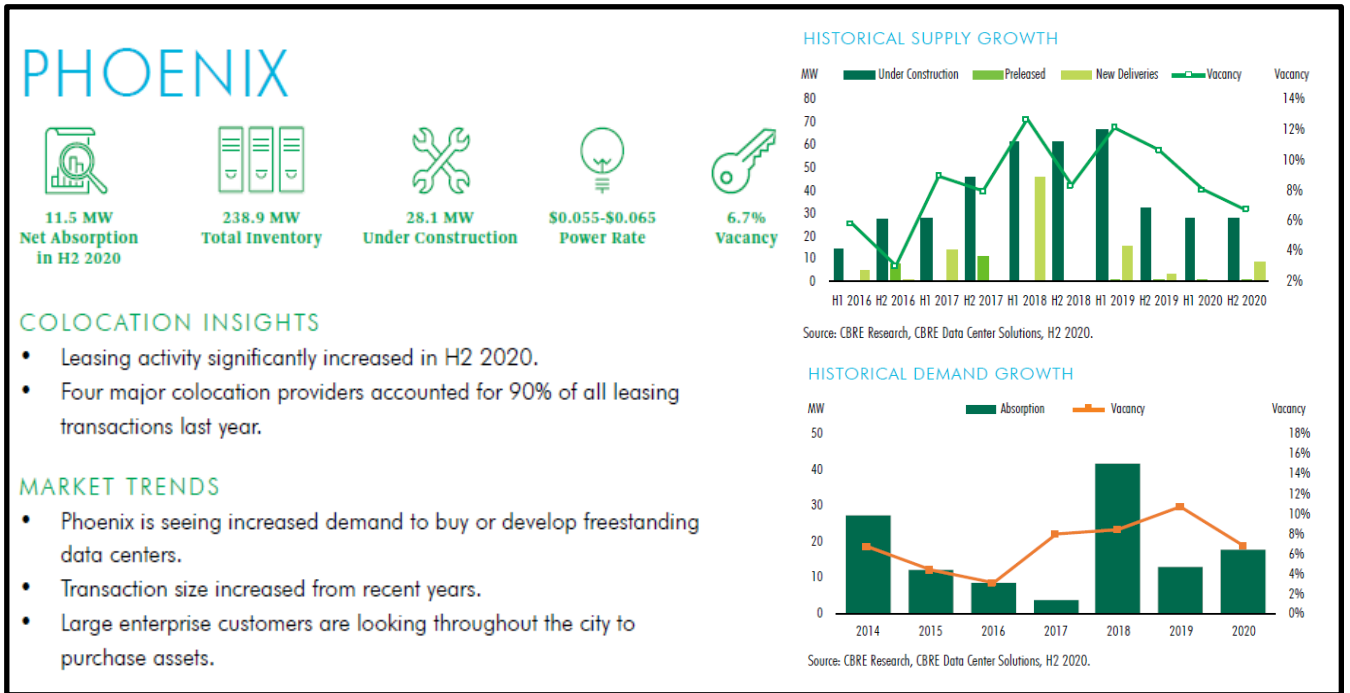
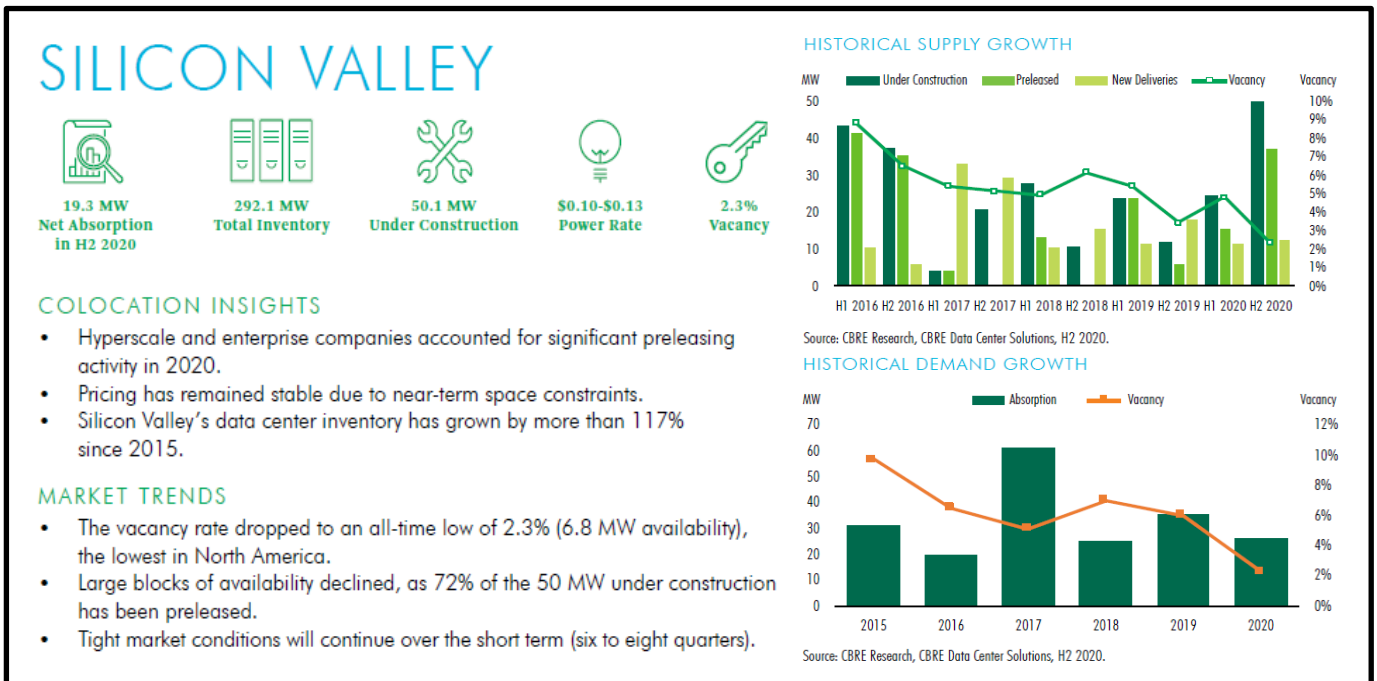


Figure 6: Silicon Valley Market Data & Trends

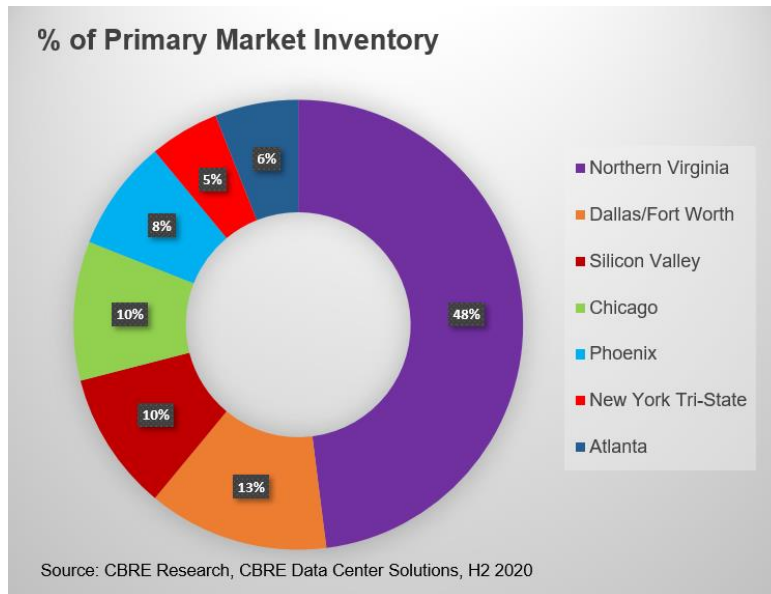


Northern Virginia Emerging Trends

Northern Virginia continues to be the largest data center market in the United States. (It is also the largest data center market in the world through 2020.²¹) As shown in Figure 7 below, data centers in Northern Virginia make up 48 percent of the primary market inventory of data centers in the United States. The next largest market for data centers in the United States is Dallas/Ft. Worth which has 13 percent of the primary market inventory. According to CBRE, historical supply growth of data centers, including what is under construction, preleased, or newly delivered, remained relatively high through 2020. Overall demand outpaced new supply, keeping the vacancy rate less than 8 percent.²²

Altogether, according to Jones Lang LaSalle (JLL), another international commercial real estate brokerage, the Northern Virginia data center market added 380 MW of single-tenant inventory and 230 MW of multi-tenant inventory in 2020. The Northern Virginia market had 323 MW of net absorption in 2020 with social media accounting for 176 MW or 54 percent of that.²³

Figure 7: Percentage of Primary Market Inventory



²¹ Northern Virginia Technology Council, “The Impact of Data Centers on the State and Local Economies of Virginia.” Retrieved from: https://www.nvtc.org/NVTC/Insights/Resource_Library_Docs/2020_NVTC_Data_Center_Report.aspx.

²² CBRE Research, “A Source of Stability: Digital Infrastructure in 2020, North American Data Center Report H2 2020.” Retrieved from <https://www.cbre.us/research-and-reports/North-American-Data-Center-Report-H2-2020>.

²³ JLL, “2020 Year-End Data Center Outlook: A Review of the Industry’s latest trends and what to expect in 2021.” Retrieved from <https://www.us.jll.com/en/trends-and-insights/research/data-center-outlook>.

All of the real estate research providers predict continued market strength for the Northern Virginia data center market in 2021. In its 2020 H2 data center market report, CBRE noted that a large amount of preleasing in the second half of 2020 will contribute to strong supply and demand figures in 2021. Additionally, CBRE reported 12 land transactions in Northern Virginia in 2020, which has contributed to a dwindling supply of available land.²⁴

Rental rates in the Northern Virginia market are relatively low compared to other markets. For example, rental rates for sub 250 KW space is \$125 on the low side and \$180 on the high side in Northern Virginia, which is lower than several other U.S. markets, including Atlanta, Austin/San Antonio, Dallas/Ft. Worth, Denver, New York, Northern California and Phoenix.²⁵

Average power rates in Northern Virginia have consistently stayed at 5.2 cents per KWh for the last five years. Again, this rate is lower than power rates in many of the data center locations in the U.S. including Austin/San Antonio, Boston, Chicago, Denver, Houston, Los Angeles, New Jersey, New York, Northern and Southern California, and Phoenix.²⁶ Since power makes up approximately 40 percent of the operating costs of a typical data center, Northern Virginia's relatively low power costs are a competitive advantage versus other markets.²⁷ Prince William County is primarily served by Northern Virginia Electric Cooperative (NOVEC), whose average industrial (vs. residential or commercial) power price is 6.66 cents per KWh.²⁸ Loudoun County is primarily served by Dominion Energy, whose average industrial power price is 6.05 cents per KWh.²⁹

Jones Lang LaSalle (JLL), an international real estate brokerage, offers the following market outlook for data center users in Northern Virginia:

- Historically low rental rates and additional concessions;
- Still many high-quality options for users to consider; and
- Competition for users will stay strong for the foreseeable future³⁰

²⁴ CBRE Research.

²⁵ JLL.

²⁶ Ibid.

²⁷ U.S Chamber of Commerce, "Data Centers, Jobs and Opportunities in Communities Nationwide." (2017). Retrieved from <https://www.uschamber.com/report/data-centers-jobs-opportunities-communities-nationwide>.

²⁸ FindEnergy.com, Northern Virginia Electric Cooperative Rate & Electric Bills. Retrieved from: <https://findenergy.com/providers/northern-virginia-electric-cooperative/>.

²⁹ FindEnergy.com, Northern Virginia Electric Cooperative Rate & Electric Bills. Retrieved from: <https://findenergy.com/providers/dominion-energy/>.

³⁰ JLL.

For data center providers in Northern Virginia, JLL’s market outlook is as follows:

- Margins for providers are decreasing because of aggressive new competitors;
- Large hyperscale deployments on land owned by the providers is at historic highs; and
- Providers must be more flexible with users and offer more services and better connectivity options to the cloud.³¹

As noted above, there were several major site sales in Northern Virginia for data centers. Seven (7) of the most recent site sales, included in Table 3 below, document the increasing price per acre that is the result of dwindling land inventory for data centers.³²

Table 3: Northern Virginia Recent Site Sales

PROPERTY	SIZE (Acres)	SALE DATE	SALE PRICE	PRICE/ACRE	BUYER	SELLER
5945 Wellington Rd, Gainesville	58	Apr-21	\$52,400,000	\$903K	Amazon	Chuck Kuhn
8322 Bethlehem Rd, Manassas	5	Mar-21	\$2,750,234	\$546K	Iron Mountain	Lucky Seven Manassas Inc (David Warren)
11500 Prince William Pkwy, Manassas	17	Mar-21	\$7,371,625	\$425K	Iron Mountain	Warren family
Sycolin Rd, Leesburg	50	Mar-21	\$27,000,000	\$538K	TA Realty	John Andrews
Sycolin Rd, Leesburg	95	Mar-21	\$60,000,000	\$632K	TA Realty	NV Real Estate Two LLC (Jack O'Donnell)
14721 Avion Pkwy, Chantilly	46	Jan-21	\$55,900,000	\$1.2M	Amazon	Principal Financial
21445 Beaumeade Cir, Ashburn	7	Jan-21	\$21,500,000	\$3.02M	American Real Estate Partners, Harrison Street Investment Management	Chirisa Tech Centers

Source: Cushman & Wakefield, 2021.

Data center real estate specialists contacted for this study indicate that the biggest market challenge for Northern Virginia going forward is likely to be the lack of available development sites. Ashburn, which is home to about 80 percent of the data centers in Northern Virginia, no longer has any available land sites, short of some limited redevelopment options. Given those limits, data center providers have been focusing on the next best option, which is Manassas. At this juncture however, the data center real estate specialists stress there are actually relatively few land sites left in Manassas.

One concern sometimes cited is the risk of data center obsolescence. Industry research company International Data Corporation (IDC) puts the average age of a data center at nine (9) years old. However, the exponential growth in digital data, services, and communications is forcing data centers to modernize their platforms to support more capacity, reliability,

³¹ Ibid.

³² Cushman & Wakefield, “Data Center Update Americas: United States and Canada.” (2021). Retrieved from <https://www.cushmanwakefield.com/en/insights/americas-data-center-update>.

scalability, and faster processing speed. It is generally far more cost effective to modernize the equipment in a data center than to relocate and build one from scratch.

Data center real estate specialists also indicate that the pandemic has had minimal effect on the Northern Virginia data center market. If anything, there has been an acceleration of the data center market because it has caused a lot of smaller corporations to shift their workload to the cloud or to a more virtual environment, thereby increasing demand for data centers. The pandemic has had some impact on construction; the real estate community say they are beginning to see slight delays in construction, perhaps a month or two because of construction supply issues.

Finally, data center real estate specialists see Maryland's recent movement in encouraging the development of data centers as possible preparation for Northern Virginia reaching data center capacity limits. First, in 2020 the Maryland General Assembly established an exemption from Maryland sales and use tax on the purchase of qualified data center personal property for up to 20 years. Then, in June 2021, Quantum Loophole, a data center developer, and TPG Real Estate Partners announced the purchase of a 2,100-acre property in Frederick County, Maryland for data centers. The site, which is located approximately 26 miles from Ashburn across the Potomac River, is a former manufacturing site for Alcoa. The CEO of Quantum Loophole, Josh Snowhorn, indicates that that the reclaimed site has "the entitlement, power, water and proximity to Northern Virginia that the Internet industry needs for success." With land costs at less than \$50,000 per acre compared to \$400,000+ per acre in Northern Virginia, the Frederick County site has the potential to offer a lower cost alternative for data center providers and users.³³

Best Practices/Competitive Assessment – Economic Development Programs

This section provides an overview of best practices that state and county governments use to attract and retain data centers in their jurisdiction, assessing the extent to which these practices are helping other jurisdictions compete with Northern Virginia. As noted in above, Northern Virginia has by far the most data centers of any region in the United States. The region is a leader in establishing best practices for promoting by-right development of data centers and extracting community benefits from the industry. However, some of the assets and best practices that have propelled Northern Virginia to become the epicenter for the industry in the nation are not necessarily unique to the area. There is evidence that nearby areas in Maryland, and central and southwestern Virginia are also implementing similar best

³³ Massive Maryland property sells for \$100M. bizjournals.com. (2021, June 28). Retrieved from: <https://www.bizjournals.com/baltimore/news/2021/06/28/alcoa-sells-maryland-property.html>.

practices and are located close enough to major cities on the Eastern Seaboard, one of the primary assets of Northern Virginia as a data center hub.

While Northern Virginia will likely remain the largest data center hub in the nation for the foreseeable future, Prince William County may face competition from other attractive, nearby locations with similar land use policies and economic incentives, if land supply is limited. This analysis provides a summary of the key factors data centers and developers consider in site selection as well as a comparison of economic incentives by jurisdiction, focusing on nearby, competing areas. In so doing, it highlights both why Northern Virginia has become a dominant player in the market and why other nearby areas may also be attractive locations for future data centers.

Data Center Site Selection Criteria

Data centers tend to prioritize six key factors when selecting new sites for development: fiber connectivity, environment, access to electrical power, access to water, a skilled workforce, and policy incentives. Of these, by far the most critical is access to high-bandwidth connectivity, such as fiber. (It is worth noting that some companies are seeking to diversify the location of their data for added reliability and security,³⁴ although this is a nascent trend to continue monitoring.) The growth of the data center industry in Northern Virginia’s “Data Center Alley” in Ashburn has been driven primarily by the density of fiber networks. Studies, news reports, and interviews with data center and real estate experts interviewed for this report confirm that other factors are outweighed by the proximity of a data center to the fiber network infrastructure.

Northern Virginia’s history with fiber began in Ashburn in the 1990s with the development of some of the first-ever internet exchanges and data centers by companies like AOL and Equinix.³⁵ These networks attracted other businesses which led to high interconnectivity of the network, allowing for a speedy and efficient exchange of information for any company connected to the network. This history has helped the region evolve into the largest peering point, where Internet networks come together to exchange traffic between their networks in North America.³⁶ Even as land prices throughout Northern Virginia, increase to over \$1 million per acre, the upfront cost of land is becoming an increasingly small part of the total development cost, particularly in comparison to the market value of connectivity to the network. In an article in ‘Data Center Knowledge,’ a managing director at Jones Lang LaSalle,

³⁴ “Virginia’s land dilemma,” Data Center Dynamics (2020, January 6). Retrieved from: <https://www.datacenterdynamics.com/en/analysis/virginias-land-dilemma/>

³⁵ “Ashburn’s Fiber-Fueled Data Center Boom.” Data Center Knowledge (2018, March 14). Retrieved from: <https://www.datacenterknowledge.com/data-center-world/ashburn-s-fiber-fueled-data-center-boom>

³⁶ “Creating the Digital Infrastructure Capital of the World” Equinix. (2020, November 10). Retrieved from: <https://blog.equinix.com/blog/2020/11/10/creating-the-digital-infrastructure-capital-of-the-world/>

one of the largest real estate brokers for data centers in Northern Virginia, remarks “if real estate prices deterred people from moving into an area, places like Manhattan wouldn’t be what they are today.”³⁷ This echoes sentiments from experts and publications that high-bandwidth network interconnectivity is the main asset for the industry in Northern Virginia.

By proximity to Loudoun County but also in its own right, Prince William County provides companies and data center operators convenient access to the most interconnected network in the world, with close access to inter-continental cables in New Jersey and Virginia Beach. The stable growth in demand for data centers underscores this feature. Accordingly, site selection factors that affect the price of data center development and operations like tax breaks and other subsidies, will have marginal impact on the decision of data centers to locate there. As discussed in the next section, Loudoun County has a higher tax rate for business and personal property than Prince William County, but remains the epicenter of the industry and continues to draw demand for new development.

Northern Virginia also satisfies the other main criteria for data center site selection, with its relatively mild climate, lack of seismic activity, access to one of the most highly educated workforces in the country, and electrical power supply from utility providers that are actively responding to the needs of data centers. It is notable that access to cheap electrical power is itself not the main concern for data centers. Rather, it is that data centers have insisted on obtaining renewable energy, accelerating their shift towards more renewable energy for its grid. Together, these factors also help to position Prince William County to absorb more demand from data centers, increasing the County’s tax base. Not only is Prince William County in a position to continue absorbing data centers, given its prime location, the County could potentially extract additional community benefits, such as requiring data centers to use recycled, non-potable water for cooling purposes, a feature that already exists in Loudoun County. Many data center operators and developers emphasize sustainability, and Prince William County could easily leverage this desire to extract environmental concessions through its land use policy.

However, Prince William County is not the only jurisdiction adjacent to the center of Northern Virginia’s data center industry in Ashburn with all of the same environmental and electrical assets as well as available land. As available sites in Loudoun County are sold, and if land in other nearby areas like Prince William County is unavailable, there are other areas that could seize the demand for proximity to the hub in Ashburn, both within Virginia and other states, particularly in neighboring Maryland. Fairfax County, for example, is well-positioned to attract data centers, which it already does and will likely continue to do. Jurisdictions in Maryland, such as Frederick County, divided from Loudoun County only by the Potomac River, could attract data centers while offering many of the same assets. Quantum Loophole recently

³⁷ “Ashburn’s Fiber-Fueled Data Center Boom.” Data Center Knowledge (2018, March 14). Retrieved from: <https://www.datacenterknowledge.com/data-center-world/ashburn-s-fiber-fueled-data-center-boom>

agreed to develop data centers on a 2,100-acre property in Frederick County, with the intention of building a fiber ring to connect to the hub across the river.³⁸ This Frederick County site will certainly be more cost competitive than most Northern Virginia sites because the land prices are so much lower.

Northern Virginia is not even the only region in the state with its own unique network asset. Henrico County is home to the only network access point (NAP) in the country, which connects a variety of land-based data centers, such as those in Northern Virginia, to two high-speed underwater data cables to Spain and Brazil³⁹. These cables include the MAREA cable, which connects to Spain through Virginia Beach and is the fastest subsea cable in the world. The NAP serves as a hub for land-based data centers to connect to the subsea cables, positioning Henrico to attract significant attention from data centers seeking access to the NAP. In August 2020, Facebook completed the first phase of a \$1.75 billion, 2.3 million square foot data center project in Henrico County. In addition, as discussed further in the next section, Henrico County is actively seeking to attract data centers by implementing one of the lowest personal property tax rates for data centers in Virginia, at just \$0.40 per \$100 in assessed value. Henrico County is not only poised to build on the presence of the NAP to attract data centers as a destination itself, but also may be a prime candidate to absorb demand from Northern Virginia as available land for data center development runs out. Henrico County also has a talented workforce, with regional organizations and institutions, including Virginia Commonwealth University, which are fostering talent specifically to work in a growing local IT economy.

If most of the environmental and electrical needs can be satisfied by other jurisdictions near Loudoun County, and other areas offer their own connectivity advantages, the main factor that will determine where data centers are developed will come down to the availability of land. Where land is available, the decision will likely come down to the incentives offered by competing jurisdictions, but existing policies in Prince William County are already competitive with incentives in other Northern Virginia counties and in Maryland. Accordingly, the availability of land will be the primary factor determining site selection in the near future. This suggests that if Prince William seeks to maximize the economic and fiscal potential of data centers, it must have enough available space to absorb demand.

Comparison of Incentives in Competing Areas

Land use and economic incentives can help attract data centers, even though network connectivity is by far the most important factor for data centers when it comes to site

³⁸ “Quantum Loophole buys 2,100-acre property in Frederick County, Maryland for gigawatt data center campus” Data Center Dynamics. (2021, June 28). Retrieved from: <https://www.datacenterdynamics.com/en/news/quantum-loophole-buys-2100-acre-property-in-frederick-county-maryland-for-gigawatt-data-center-campus/>

³⁹ “Henrico poised to become global internet hub.” Henrico Citizen. (2019, May 17). Retrieved from: <https://www.henicocitizen.com/articles/henrico-poised-to-become-global-internet-hub/>

selection. There are two main economic incentives that jurisdictions offer data centers: reduced personal property tax rates, and reduced sales and use tax rates. Table 4 summarizes tax rates for data centers in Virginia and select counties, and in Maryland and select counties. These jurisdictions represent direct competitors to Prince William County as these data centers take advantage of the access to the Northern Virginia network and Virginia Beach subsea cable while satisfying the other site selection criteria such as a stable environment and availability of renewable electrical power. As available land is seized up by data centers, or placed under easement in Northern Virginia, these markets would be particularly attractive to data centers for many of the same reasons Northern Virginia was attractive in the first place.

Table 4: Economic Incentives and Land Use Policies in Virginia and Maryland

Jurisdiction	Personal Property Tax Exemption	Personal Property Tax Rate for Data Center	Sales/Use Tax Exemption
Virginia			
State	No.	No State personal property tax.	Yes. Data center must invest \$150 million or more, hire 50 or more employees, pay at least 1.5 times the average local wage, and enter into an MOU with the Virginia Economic Development Partnership.
Prince William County	Yes.	\$1.50 per \$100 of Assessed Value. Rate for general business equipment is \$3.70	No.
Loudoun County	No.	\$4.20 per \$100 of Assessed Value.	No.
Fairfax County	No.	\$4.57 per \$100 of Assessed Value.	No.
Henrico County	Yes.	\$0.40 per \$100 of Assessed Value.	No.
Lonesome Pine Regional Industrial Facilities Authority (a)	Yes.	\$0.24 per \$100 of Assessed Value. Rate for general business equipment averages \$1.59 in the region.	No.
Maryland			
State	n.a.	No State personal property tax.	Yes. Exempt from sales and use tax of qualified personal property. Data Centers must create at least five qualified positions and make a minimum investment of: - At least \$2 million in qualified data center personal property for a business located within a Tier 1 Area, and - At least \$5 million in qualified data center personal property for a business located in any other area of the State. The benefit period expands to 20 years, subject to annual renewal, if the business invests at least \$250 million in qualified data center personal property within the first ten years after submitting an application.
Prince George's County	Yes.	Rate: \$250 per \$100 of Assessed Value Projects with \$200 million or more of investment and that create a total of 15 jobs or more may qualify for a 15-year personal property tax reduction in assessment as follows: (i) Years one through five — up to 100% reduction in assessment in personal property tax; and (ii) Years six through ten — up to 50% reduction in assessment in personal property tax; (iii) Years eleven through fifteen — up to a 25% reduction in assessment in personal property tax. Projects with \$50 million or more of investment and that create a total of five jobs or more may qualify for a 10-year tax personal property tax reduction in assessment as follows: (i) Years one through five — up to 90% reduction in assessment in personal property tax; and (ii) Years six through ten — up to 40% reduction in assessment in personal property tax.	No.
Frederick County	n.a.	No County personal property tax.	No.
Pennsylvania			
State	No.	No State personal property tax.	Yes. Sales and Use tax refund for tax paid on qualified computer data center equipment for a period of 15 years. Minimum investment of \$25 to \$50 million depending on size of given jurisdiction. Data center pay annual compensation of at least \$1 million to employees.

Source: BAE, 2021.

Of the Northern Virginia counties, Prince William has the lowest personal property tax for data centers, at \$1.50 per \$100 of assessed value for eligible equipment (i.e., computer equipment, cooling equipment, etc.). Combined with Virginia’s sales and use tax exemption

for eligible purchases, this positions Prince William County competitively compared to Loudoun and Fairfax counties. From a data center's perspective, the Virginia state sales and use tax exemption might seem relatively restrictive compared to the Maryland state sales and use tax exemption, which enables smaller data centers to utilize the incentive, whereas the Virginia exemption is aimed at larger-scale investments. However, Virginia's share of the market and inherent assets likely influence the policy, while Maryland is seeking to build its data center footprint in comparison. At the county level, only Prince George's County has its own incentive independent of Maryland's state-level incentive. This incentive is not necessarily more competitive than those found in Virginia counties. For example, Prince George's County offers a reduction in the business personal property tax assessment for certain periods of time, while maintaining its rate of \$4.25 per \$100 in assessed value. Prince William County, on the other hand, simply offers a much lower personal property tax rate of \$1.50.

In terms of zoning ordinances, Loudoun, Fairfax, and Henrico counties in Virginia allow by-right development of data centers in a range of commercial, office and industrial zones. Fairfax County imposes additional size and design and regulations for data centers in the denser nonresidential zones, as shown in Table 5. Henrico County permits by-right data center development in all office, business and industrial zones. Henrico County also has a Form Based Alternative Overlay District that also permits data centers. The purpose of the zone is to regulate the form of development as opposed to regulate the zone by land use, meaning data centers in this zone must comply with certain design and setback standards. Prince George's County in Maryland passed specific data center zoning ordinance permitting data centers in a range of non-residential zones, also shown in Table 5.

Table 5: Data Center Zoning Ordinances in Competitive Areas

Jurisdiction	Data Center-specific Zoning Ordinance	Data Center Allowed By Right in OFF/IND Zones	Zones Allowing By-Right Data Center Development
Virginia			
State	n.a.	n.a.	
Loudoun County	No.	Yes.	Commercial Light Industry, Office Park, Research and Development Park, Industrial Park, General Industry.
Fairfax County	No.	Yes.	With size limits: I-2, I-3, C-3, C-4 Without limits: I-4, I-5, I-6
Henrico County	No.	Yes.	All Office (O-1, O-2, O-3), Business (B-1, B-2, B-3), and Industrial (M-1, M-2, M-3) District, as well as the Form Based Alternative Overlay District, which is a zone that is intended to focus on built form as opposed to land use.
Maryland			
State	n.a.	n.a.	
Prince George's County	Yes.	Yes.	R-R (Rural Residential), C-O (Commercial Office), C-S-C (Commercial Shopping Center), M-A-C (Major Activity Center), R-S (Residential Suburban Development), E-I-A (Employment and Industrial Area), M-X-T (Mixed Use - Transportation-Oriented), and Industrial Zones
Frederick County	No.	No.	
Pennsylvania			
State	n.a.	n.a.	

Source: BAE, 2021.

Comparing incentives reveals the strength of Henrico County in particular compared to Northern Virginia as a potential competitor in the future. As mentioned in the previous section, Henrico County is home to the NAP, with its direct connection the MAREA subsea cable. This feature is driving demand in Henrico County, but this demand is independent of demand in Northern Virginia as access to the high-density dark fiber network in Ashburn remains a key attraction of Northern Virginia. Nonetheless, as land for data centers becomes increasingly scarce, Henrico County may also evolve into an alternative to Northern Virginia. With a personal property tax rate of just \$0.40 per \$100 in assessed value, Henrico County may accelerate the shift away from Northern Virginia, particularly if land scarcity increases faster than expected in Northern Virginia. Additionally, the member jurisdictions of the Lonesome Pine Regional Industrial Facilities Authority (Dickenson, Lee, Scott, and Wise counties, and the city of Norton) recently cut the personal property tax rate for data centers to the lowest in the state, at just \$0.24 per \$100 in assessed value. This rate might be particularly attractive for

smaller scale data centers that are unable to pay the premium for land in Northern Virginia as it runs out.

Summary

In terms of site selection factors, Northern Virginia satisfies the main criteria data centers are looking for other than connection to a high-speed, fiber network infrastructure that serves the Eastern seaboard as well as the large institutional customers like the government and defense companies in DC-Maryland-Virginia region. In terms of access to such a network, Northern Virginia, centered around Ashburn, provides the highest-density of fiber in the country, leading to a level of growth in the industry unmatched by any other market. However, regions immediately adjacent to Northern Virginia are transforming into viable alternatives given that they also satisfy site selection criteria and offer similar proximity to the network in Ashburn that Prince William County does. As a result, there are two factors that are becoming increasingly important to the site selection process for data centers: the availability of land, and incentives/ease of development in places with available land.

Limiting the amount of land available in Prince William County for data center development would help position Fairfax County, Frederick County (MD), and Prince George's County (MD) to accelerate growth of data centers as they are the next closest jurisdictions to Loudoun County. Other than available land, Prince William County offers a more competitive personal property tax exemption than Fairfax County, and a comparable exemption to that of Prince George's County (MD). However, the establishment of the NAP in Henrico County, and the MAREA subsea cable in Virginia Beach, as well as Henrico County's very low personal property tax rate, may accelerate demand in that region of the state independent of the hub in Northern Virginia. As the number of data centers increases in Henrico County as a result of this, it could help Henrico County also position itself as an alternative to Northern Virginia, particularly as land becomes unavailable for data centers. Nonetheless, despite the promise of other locations, data centers will continue to seek available land in Prince William County to remain close to Loudoun County's "Data Center Alley," so the amount of data center development will ultimately be determined by the availability of land.

Economic Impacts of Data Centers

Introduction

To provide an estimate of the economic impacts of data centers on the Prince William County economy, this analysis considers three types of impacts: jobs, worker compensation, and total economic output generated by data centers in Prince William County.

Methodology

To estimate the anticipated economic impacts of data centers, this study uses IMPLAN, a widely used economic modeling software package. Core to the model is an input-output dollar flow table. For a specified region, the input-output table accounts for all dollar flows between

different sectors of the economy. Using this information, IMPLAN models the way income is spent and re-spent in other sectors of the economy, generating waves of economic activity and job creation, or so-called “economic multiplier” effects. Once the economic events have been entered into the model, IMPLAN reports the following types of impacts:

- **Direct Impacts.** Direct impacts refer to the set of producer or consumer expenditures applied to the predictive model for impact analysis. It is the amount of spending available to flow through the local economy. IMPLAN then displays how the local economy would then respond to these initial changes. The direct impacts may equal the amount of spending input into the model, depending on a variety of factors.
- **Indirect Impacts.** The indirect impacts refer to the impacts of local industries buying goods and services from other local industries. The cycle of spending works its way backward through the supply chain until all money leaks from the local economy, either through imports or by payments to income and taxes.
- **Induced Impacts.** The induced impacts refer to an economy’s response to an initial change (direct impact) that occurs through re-spending of income according to household spending patterns. When households earn income, they spend part of that income on goods and services, such as food and healthcare. IMPLAN models households’ disposable income spending and distributes it through the local economy.

To conduct the analysis, BAE has reviewed other data center economic impact studies for information on typical characteristics of data centers and developed a prototype data center with the characteristics as shown in Table 6. Actual data centers come in a variety of sizes, ranging from less than 100,000 square feet to well over one million square feet and employment per square foot can vary depending on the specific needs of each data center.

Table 6: Prototype Data Center in Prince William County

Metric	Value
Square Feet	250,000
Construction Cost per SF	\$1,100
Total Construction Costs	\$275,000,000 (a)
Square Feet per Worker	9,000
Permanent Jobs	28 (b)
Total Compensation per Worker	\$180,000 (c)
Total Worker Compensation	\$5,040,000

Note:

All dollar amounts in 2021 dollars.

(a) Includes labor and materials costs for building construction. Excludes IT equipment-related expenditures.

(b) Excludes construction jobs supported during construction period. See text for discussion of construction period impacts.

(c) Average compensation is for permanent jobs, not construction period jobs.

Source: BAE

The analysis here examines two categories of impacts from a prototype data center: the construction-related impacts, which are for the construction period only, and the impact of the ongoing operations of the prototype data center. As a final step for each of the two impact types, the analysis provides estimates of impact on a per 10,000-square-foot basis. All impacts considered are within Prince William County.

Impacts during Construction Period

As shown above, construction costs for the prototype were estimated at \$1,100 per square foot, or a total of \$275 million, excluding IT equipment-related costs. It is assumed for the purposes of this analysis that the construction period is one year; the resulting employment and output discussed here is only for that 12-month period. It is important to note that the resulting jobs and economic activity associated with construction of the facility do not continue after construction is completed.

The estimated employment, labor income, and economic output generated from construction of the prototype data center are shown below in Table 7. Over the assumed 12-month construction period, the construction activity would support a total of almost 1,700 estimated direct jobs (i.e., jobs at the construction site), an additional 407 indirect jobs at other businesses supporting the construction, and 301 jobs resulting from worker expenditures during the construction period.⁴⁰ The jobs over the construction period of approximately \$111 million in direct labor income⁴¹, \$23 million in indirect labor income, and \$12 million in induced labor income.

Along with the estimated \$275 million in direct expenditures for construction, the prototype data center would generate additional economic output as the construction dollars flow through the County's economy to businesses supporting and supplying the project, and from induced activity at businesses as worker households spend some of their earnings in the County. The indirect impact is estimated at approximately \$73 million, and the induced impact is estimated at approximately \$44 million during the construction period. This table also provides estimates of impact per 10,000 square feet, permitting further analysis of data centers of varying sizes.

⁴⁰ These are jobs in the study area, which in this analysis is limited to Prince William County. Additional jobs, labor income, and economic output may be supported outside of the County. The workers employed in the county may live elsewhere. The IMPLAN software factors out expenditures for materials obtained from outside of Prince William County. The IMPLAN software also includes a commute factor to exclude impacts of labor income expenditures for those workers residing outside the county.

⁴¹ Worker compensation includes wage and salary income and proprietor income, as well as benefits.

Table 7: Economic Impacts of Construction of Prototype Data Center in Prince William County

<u>Impact (a)</u>	<u>Employment</u>	<u>Labor Income</u>	<u>Output</u>
Direct	1,697	\$110,695,000	\$275,000,000
Indirect	407	\$23,166,000	\$73,394,000
Induced	301	\$11,747,000	\$44,400,000
Total	2,406	\$145,608,000	\$392,794,000

<u>Impacts per 10,000 SF</u>	<u>Employment</u>	<u>Labor Income</u>	<u>Output</u>
Direct	67.90	\$4,428,000	\$11,000,000
Indirect	16.28	\$927,000	\$2,936,000
Induced	12.05	\$470,000	\$1,776,000
Total	96.22	\$5,824,000	\$15,712,000

Notes:

Totals may not sum from parts due to independent rounding.

(a) Dollar figures given in 2021 dollars. Dollar amounts rounded to the nearest thousand dollars.

Sources: IMPLAN; BAE, based on various data center studies.

Annual Ongoing Operating Impacts

The inputs for the IMPLAN analysis are as shown above in Table 7 to estimate the annual economic impacts that the operation of the of a prototype data center would generate on an ongoing basis within the Prince William County. The key variables driving the analysis are the number of jobs and worker compensation. The IMPLAN sector assumed for the prototype data center is data processing, hosting, and related services (sector 436). The results are shown on an annual basis, e.g., labor income shows annual worker compensation.

Findings

The results of the IMPLAN analysis for ongoing operations are shown in Table 8. For the prototype 250,000 square foot data center, there would be an estimated 28 direct full-time equivalent jobs. The demand for goods and services available in the County to support the operations would support an additional 133 indirect jobs, and the expenditures of worker households (from direct, indirect, and induced jobs created) would support 22 additional induced jobs. Direct labor income is approximately \$5.0 million annually (as also shown in Table 6 above), with an additional \$5.9 million in annual indirect labor income and \$873 thousand in annual induced labor income. The total estimated regional economic output resulting from ongoing operations of the prototype data center would total approximately \$54.6 million annually. This table also provides estimated of impacts per 10,000 square feet, permitting further analysis of data centers of varying sizes.

Table 8: Annual Economic Impacts of Operation of Prototype Data Center in Prince William County

<u>Impact (a)</u>	<u>Employment</u>	<u>Labor Income</u>	<u>Output</u>
Direct	28	\$5,040,000	\$33,479,000
Indirect	133	\$5,889,000	\$17,915,000
Induced	22	\$873,000	\$3,302,000
Total	183	\$11,802,000	\$54,696,000

<u>Impacts per 10,000 SF</u>	<u>Employment</u>	<u>Labor Income</u>	<u>Output</u>
Direct	1.12	\$202,000	\$1,339,000
Indirect	5.32	\$236,000	\$717,000
Induced	0.89	\$35,000	\$132,000
Total	7.33	\$472,000	\$2,188,000

Notes:

Totals may not sum from parts due to independent rounding.

(a) Dollar figures given in 2021 dollars. Dollar amounts rounded to the nearest thousand dollars.

Sources: IMPLAN; BAE, based on various data center studies.

To provide some context, IMPLAN estimates that the data processing, hosting, and related services industry sector (NAICS 518) accounted for 624 jobs in 2019. The prototype data center would add 28 additional jobs in Prince William County, an increase of 4.5 percent, and would result in an increase of 11.4 percent in labor income within the sector.

Table 9: Direct Impacts for Data Center Industrial Sector

	<u>Employment</u>	<u>Labor Income</u>
Direct Project Employment (a)	28	\$5,040,000
Countywide Data Processing, Hosting, and Related Services	624	\$44,049,000
Project as % of County	4.5%	11.4%

Sources: IMPLAN; BAE.

Table 9 above shows the estimated impacts of ongoing operations of the prototype data center in comparison to the overall Prince William County economy. As shown in Table 10, IMPLAN estimates that project-related jobs (which includes direct jobs at the data center as well as indirect and induced jobs) would be equal to 0.09 percent of the County's total 2019 total jobs. Because of the relatively high wages for the permanent staff of the data center, labor income and value added are equivalent to a slightly higher proportion of the Prince

William County totals. On a per job basis, the prototype project provides a higher level of value added, at 130 percent of the current County average.

Table 10: Prototype Data Center as Percent of Regional Economy

	<u>Employment</u>	<u>Labor Income</u>	<u>Value Added</u>	<u>Value Added per Worker</u>
Project (a)	183	\$11,802,000	\$20,719,000	\$113,000
Prince William County (b)	214,985	\$11,414,945,000	\$18,793,006,000	\$87,000
Project as % of County	0.09%	0.10%	0.11%	130%

(a) Includes direct, indirect, and induced impacts in Prince William County.

(b) Value added is equivalent to gross domestic product.

Sources: IMPLAN; BAE.

Market Demand Analysis

A typical market study would review supply of what is being analyzed, in this case data centers in Prince William County, the potential market for those data centers, and with that information, provide an estimate of future demand for data centers. At the request of Prince William County, BAE provides most of the information about existing data centers in the County at the aggregate level, to show a general picture of the current supply. In certain cases, where public information is available about the data centers, BAE provides some more specific information about existing centers if it is critical to include in the overall analysis.

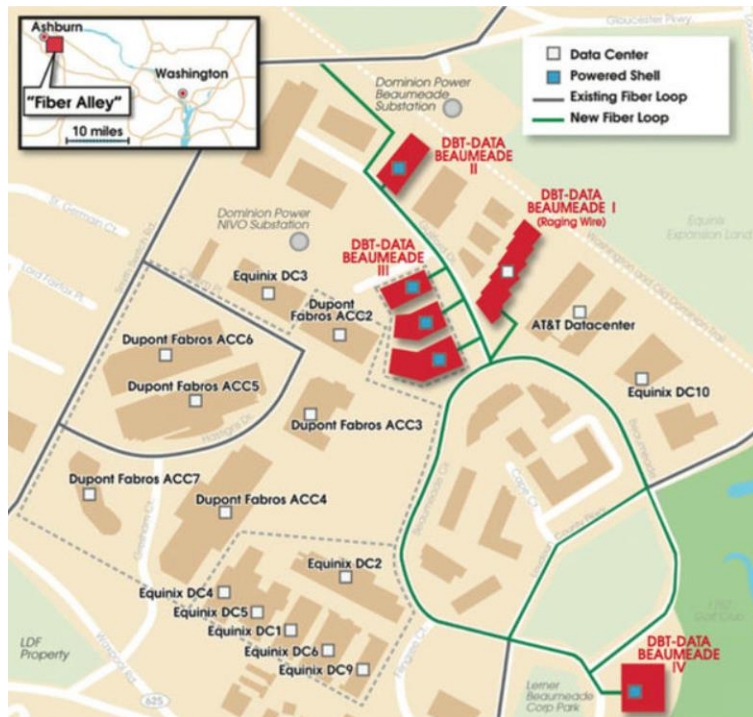
Information about existing data centers in Northern Virginia, which includes Prince William County, was obtained by reviewing industry reports, data center real estate reports, and interviews with state and local economic development representatives. Information about proposed data centers and land transactions was collected from articles in the local press or industry reports. (It should be noted that some specific information about current data centers in Prince William County is available to all on company websites.) Because of the limitations of providing specifics about the existing data centers in Prince William County, including the location of the centers, BAE market demand analysis is less specific and detailed in terms of identifying the range of demand and the geographic location of that demand than what would be typical for a market study. Nonetheless, the conclusions of the study should provide guidance on the demand for data centers in the County as a part of what is considered when deciding whether the data center overlay zone should be expanded.

Data Centers in Northern Virginia

According to the data center information clearinghouse Baxtel, there are currently 180 data center sites in Northern Virginia primarily in three counties: Fairfax, Loudoun, and Prince William.⁴² Northern Virginia is the largest data center market in the world. The area makes up 48 percent of the primary market inventory of data centers in the United States.⁴³

Most of the data centers in Northern Virginia are located in Loudoun County. Specifically, the largest concentration of data centers is in an area known as “Data Center Alley” along the Dulles Greenway (VA 267) which includes Ashburn, Sterling, and Leesburg. By far the largest concentration of data centers in Data Center Alley is in Ashburn, in the area surrounding the Equinix campus and Beaumeade Circle, as shown in Figure 8. The data center structures that are considered part of the Data Center Alley or Fiber Alley are shown in red in this graphic.

Figure 8: Ashburn Data Center



⁴² Baxtel, “Northern Virginia Data Center Market.” Retrieved from <https://baxtel.com/data-center/northern-virginia>.

⁴³ CBRE Research, “A Source of Stability: Digital Infrastructure in 2020, North American Data Center Report H2 2020.” Retrieved from <https://www.cbre.us/research-and-reports/North-American-Data-Center-Report-H2-2020>.

All of the major players in the industry have data centers in Loudoun County including Amazon Web Services, Google, Microsoft Corp., CyrusOne, Digital Realty Trust, and Equinix. As shown in Table 11, four of the five largest data centers in Northern Virginia are located in Loudoun County. Each of these four is located in Ashburn, the largest of which is QTS Ashburn Lockridge with 105 MW of power.

Table 11: Largest Data Centers in Northern Virginia

Company	County	Site Name	Total Building SqFt	Gross SqFt	Power (MWs)
QTS Data Centers	Loudoun	QTS Ashburn Lockridge	NA	NA	105.0
Digital Realty Trust	Loudoun	Digital Realty Loudoun Ashburn Campus	1,700,000	NA	80.0
Equinix	Culpepper	Equinix Culpeper Campus	850,000	172,534	62.5
Digital Realty Trust	Loudoun	44372 Round Table: Digital Realty	223,200	NA	60.0
Aligned Energy	Loudoun	Aligned Ashburn	881,755 (est. at full buildout 12/31/2020)	200,000 (est. at full buildout 12/31/2020)	100.0 (at full buildout 12/31/2020)

Source: Baxtel, BAE, 2021

Note: Where NA is noted, this information was not available. Typically, data center size is measured in megawatts.

While land options are becoming more limited, there are still several data centers in Loudoun County currently under construction or in the planning stage. According to Loudoun County Economic Development, the County has 25 million square feet of data centers currently operational, with another four million square feet in development. The County attributes much of the continued growth in the data center market to comparatively inexpensive power available from Dominion Energy and to the Loudoun’s County’s Fast Track Program which provides priority reviews for economic development projects that have a significant impact on the tax base. Data centers are part of the fast track group—19 projects sought fast track approval between July 2020 and December 2020 alone.⁴⁴

Prince William County also has a growing data center market. According to Prince William County economic development officials there are currently 26 data centers in the County, with seven additional campuses currently under construction. There are also three or four other campuses that Prince William County expects to be under construction within the next two years. According to the 2021 Cushman & Wakefield report “Data Center Update Americas: United States and Canada,” one of the planned centers is a 1,100,000 square foot Amazon Web Services data center with 150 MW of power.⁴⁵

⁴⁴ Miller, Rich. “Data Center Construction Surging Amid Supply Constraints in Top Markets.” Retrieved from <https://datacenterfrontier.com/data-center-construction-surging-amid-supply-constraints-in-top-markets/>.

⁴⁵ Cushman & Wakefield, “Data Center Update Americas: United States and Canada.” (2021). Retrieved from <https://www.cushmanwakefield.com/en/insights/americas-data-center-update>.

Companies with data centers in Prince William County presently include Iron Mountain, Amazon Web Services (multiple facilities), CloudHQ, COPT, Equinix, Evoswitch, Opus Interactive, QTS, and VAZATA. The largest of these is Iron Mountain which has two data centers on its 83-acre campus. According to Iron Mountain's website (www.ironmountain.com), the first Iron Mountain building (VA-1) is 168,000 square feet and has 14 MW of power. The second building (VA-2) has 221,500 square feet of space and 24 MW of renewable power. The master plan for Iron Mountain includes two additional buildings totaling approximately 600,000 square feet of space.

Overall, in 2020 in the Northern Virginia market, 380 MW of single-tenant (e.g., Amazon Web Services, Microsoft, etc.) data center inventory was added, while 230 MW of multitenant inventory was added.⁴⁶ As of Summer 2021, there is an estimated 3 percent vacancy rate for data centers in the Northern Virginia market.⁴⁷

Current Market Demand for Data Centers

From interviews with data center real estate specialists, interviews with state and local economic development officials in Virginia and Maryland, and industry reports, strong demand for data centers persists in Northern Virginia. It is widely agreed that Loudoun County continues to enjoy most of that demand, but Prince William County is poised to be the recipient of more demand for data centers going forward if Loudoun County runs out of space. Everyone contacted for this study indicated the growth potential for data centers in Prince William County is quite strong. Current growth in the market overall in Northern Virginia is “explosive” as one data center real estate specialist indicated. As Prince William County leaders review a proposal to expand the data center opportunity zone overlay district, which would allow data centers by right, the following observations should be kept in mind:

- 1) Land prices for proposed data centers are rising to unprecedented heights – Land sales for data center sites in Loudoun and Prince William counties between March and August 2021 have ranged from \$425,000 - \$3.02 million per acre. In July 2021, Microsoft purchased two parcels in Prince William County for a combined \$95.1 million or just over \$1 million per acre. In August 2021, Amazon Web Services purchased 17.15 acres in Loudoun County for \$32.5 million or over \$1.85 million per acre.⁴⁸

⁴⁶ JLL, “2020 Year-End Data Center Outlook: A Review of the Industry’s latest trends and what to expect in 2021.” Retrieved from <https://www.us.jll.com/en/trends-and-insights/research/data-center-outlook>.

⁴⁷ Cushman & Wakefield, “Data Center Update Americas: United States and Canada.” (2021). Retrieved from <https://www.cushmanwakefield.com/en/insights/americas-data-center-update>.

⁴⁸ Cordell, Carten. “Amazon Web Services Pays \$32.5 million for Yet Another Data Center Parcel in Loudoun.” Washington Business Journal. (August 13, 2021). Retrieved from

- 2) The primary drivers for data center real estate site selection are availability of power and access to fiber – Data center real estate specialists indicate access to reliable power and access to fiber are the most important factors in data center site selection. Dominion Energy, which is the primary power source for Loudoun County, is the preferred power provider for data centers. Though Prince William County gets its power from Northern Virginia Elective Cooperative (NOVEC), Dominion provides transmission power to Prince William County.
- 3) State economic incentives are important for attracting data centers, but not as important as availability of power and access to fiber – The Commonwealth of Virginia offers an exemption for retail sales and use tax for qualifying computer equipment purchased by data centers that meet statutory investment and employment requirements. General eligibility is \$150 million of new capital investment, 50 new jobs located at the data center in applicable locality (this job threshold is frequently met by having multiple data centers owned by a company on a campus in a Virginia county), and each new job at the data center must be paid at least 150 percent of prevailing wage in the locality where the data center is located.⁴⁹ These incentives are helpful, but do not drive decisions according to data center real estate specialists.
- 4) Local personal property tax rates are a factor, but are not likely to be a primary consideration for data center site selection – Different localities in Virginia charge different personal property tax rates for data center personal property. In the more populated parts of the state, these range from \$0.40 per \$100 of assessed value in Henrico County to \$4.57 per \$100 of assessed value in Fairfax County. Prince William County recently elected to raise the property tax on IT equipment, with a phased increase through 2024 that shifts the rate from \$1.35 per \$100 to \$2.00 per \$100. It is not yet known if this would affect demand in Prince William County.
- 5) Other serious competitors to Northern Virginia for data center investments are emerging – Though demand for data centers in Northern Virginia remains quite strong, a few other areas in the broader region are offering both sites and improved incentives that may sway some data center interests in the longer-term including Henrico County and Frederick County, Maryland. Of particular note is a June purchase of 2,100 acres in Frederick County, Maryland by a joint venture of Quantum Loophole and TPG Real Estate Partners for \$100 million in cash (\$47,619 per acre). The CEO of Quantum Loophole indicates the site has “the entitlement, power, water and proximity to

⁴⁹ There are lower thresholds for capital investment and jobs in “distressed localities,” but this would not apply to Prince William County.

Northern Virginia that the internet industry needs for success.”⁵⁰ Additionally, as of 2020, Maryland now exempts sales and use tax of qualified personal property for data centers. Data centers in Maryland must create at least five positions at the data center and make a minimum investment of \$5 million in qualified data center personal property in most parts of the state, and \$2 million in distressed areas or federal Opportunity Zones.

- 6) The demand for data centers, particularly in Northern Virginia, is extremely strong according to data center real estate specialists and industry representatives and will likely remain so for many years. Most of these experts say there is practically unlimited demand for data centers in Northern Virginia. They stress that the first choice location for data center operations is Loudoun County, but the second choice is Prince William County. The high rate of growth in the sector will continue and be abated only by the lack of land availability.

⁵⁰ Massive Maryland property sells for \$100M. bizjournals.com. (2021, June 28).
<https://www.bizjournals.com/baltimore/news/2021/06/28/alcoa-sells-maryland-property.html>.