Project Oasis

Market Analysis for Data Center Investment in Southwest Virginia

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Executive Summary

BACKGROUND

Project Oasis seeks third-party validation for GO Virginia Region One (13 counties and 3 cities in Southwest Virginia) to become a location of choice in the Commonwealth for data centers based on power and broadband infrastructure along with the use of innovative, renewable energy applications unique to the region. Coalfield Strategies, a one-stop economic development shop spearheading a regional marketing and business attraction campaign, otherwise known as InvestSWVA, kicked off this project in 2019 with OnPoint Development Strategies as the project lead. The LENOWISCO Planning District Commission and the Southwest Virginia Energy Research and Development Authority served as strategic partners, while funding came from the GO Virginia Region One Council and the Virginia Department of Mines, Minerals and Energy (DMME).

Southwest Virginia has a legacy of driving energy production and manufacturing with its key role in the extractive economy. Metallurgical coal from the region has long been a contributing factor to the success of manufacturing in the United States, while wells drilled over 60 years ago still produce natural gas today. However, as the United States moves toward carbon-neutral energy and coal-based and other traditional industries decline, Southwest Virginia can lead by example by reinventing its economy around renewable energy as an economic driver.

Project Oasis gives the region a foothold in the new energy economy with the use of geothermal technology, which in this case can be a significant energy and cost-savings tool when leveraging a geologic attribute unique to Southwest Virginia. Billions of gallons of water at a constant temperature around 51 degrees are contained in vast pools below the surface of previously mined properties. Over the last several years, DMME has used its expertise to identify a significant number of former mine sites where flooded mine pools exist, and the agency has served as a technical advisor to private industry in exploring this technology.

Recognizing that this underutilized water resource could potentially be a source of cooling for industries with significant thermal loads, such as data centers, Project Oasis was initiated as a way for the region to highlight a competitive advantage and redefine itself as the energy innovation capital of the East Coast.

The five primary objectives of the project include:

- Examine the technical feasibility and economics of utilizing mine pool water from previously mined property as a cooling source for data centers and provide a preliminary design for a mine pool water-supplied HVAC cooling system.

- Conduct a market analysis of the data center industry to determine current trends, types of facilities that are being constructed and the associated infrastructure requirements (power, connectivity, water), and site selection criteria.
- Evaluate sites in GO Virginia Region One for data center suitability including sites with access to mine water and those without.
- Provide a competitive assessment of GO Virginia Region One proposed data center sites compared to other locations, considering electric power availability and cost, connectivity, water capacity, and availability of favorable tax structure and incentives.
- Determine the positive attributes of the region as a potential data center location and identify barriers that may limit success.

The study to examine the feasibility of utilizing mine water for data center cooling was conducted by PCCI, Inc. and Marshall Miller and Associates. Their report "Project Oasis – Case Study for Geothermal Feasibility of Mine Water Circulation to Augment Data Center Cooling", was completed in May 2020. The site that was evaluated was the former Upper Banner Mine near the Town of Wise, VA. OnPoint Development Strategies worked with PCCI and Marshall Miller to provide input on specifications for a "model" data center and associated cooling, water, and electric requirements. Additionally, OnPoint Development Strategies engaged the services of leading data center industry experts to assist with the development of this market analysis report. InterGlobix, a company specializing in data center connectivity solutions was contracted to provide an assessment of fiber and broadband assets for the primary data center sites in the region. Mangum Economics, a firm that has provided numerous economic impact studies for the data center and energy industries, conducted an analysis of the potential economic and fiscal impacts that could occur as the result of a large data center locating in Southwest Virginia. Data Energy Consulting provided expertise on developing an industry standard data center model that was used to evaluate power and cooling requirements.

With the assistance of economic development and other local government officials throughout the region and utility providers, sites were identified that could potentially support a data center of 250,000 square feet with an electric load of 36 megawatts (MW). A second level of sites that could support a data center of up to 10 MW were also identified. The 36 MW "hyperscale" data center would result in an estimated $464 million in capital investment and 40 high income direct jobs. An analysis of local property taxes that would apply to a new data center are included in the "Competitive Assessment of Incentives and Business Climate" section of this report.

SUMMARY OF FINDINGS

Virginia is the world's most significant data center market. The Northern Virginia market alone has over 13 million square feet of data center space and more than one gigawatt of commissioned power. Significant growth is projected for the data center industry over the next 5 years and Virginia is well positioned to capture a sizeable portion of this new investment. However, based on past trends, 70% of data center capital investment in Virginia has occurred in Northern Virginia. The dense fiber network, direct access to the nation's capital and the federal government, along with relatively low electric power costs have contributed to the tremendous data center growth in Northern Virginia. As data center suitable real estate becomes increasingly scarce and extremely expensive in Northern Virginia, other parts of the state with abundant power and fiber infrastructure have seen increased interest from data center developers. This has led to the modification of property tax and depreciation rates by many local governments designed to encourage new data center investment. No localities in GO Virginia Region One currently have a data center specific taxation class. However, discussions with local government officials in the region have indicated there is a willingness to review tax structure for potential future changes that would make them more competitive. A tax rate and depreciation schedule that is competitive with localities such as Henrico County and Chesterfield County will be necessary to make the region a cost-effective alternative for this capital-intensive industry. An analysis of Virginia local property taxes that would apply to a new data center are included in the "Competitive Assessment of Incentives and Business Climate" section of this report. Other observations and recommendations related to incentives and business climate are:

- Virginia's most significant incentive at the state level is a sales tax exemption for data centers that create at least $150 million in capital investment and 50 jobs (25 jobs in "distressed" localities). A reduction in the required capital investment threshold and reduction or elimination of the jobs requirement for rural areas could encourage the location of smaller data centers in rural areas and allow those areas to better compete with surrounding states such as North Carolina, Tennessee, and Maryland.
- A Construction Employment Tax Credit of 20% of wages paid for construction workers for a data center or similar capital-intensive project located in underserved and rural areas should be evaluated. Illinois adopted such a provision on January 1, 2020 and that was a factor in attracting a significant new data center to an underserved area of the state.
- Elected leaders at the state and federal level have recognized the significant benefits that data centers can provide to the state and the localities where they locate and have indicated a desire to encourage more data center development in rural areas. An enhancement of targeted incentives for data centers and other capital-intensive industries for rural areas would appear to have some level of political support across the state. The legislative delegation from Southwest Virginia has consistently worked to increase economic development opportunities in the region and would add additional support for any efforts to

increase the region's competitiveness through policy changes related to data center incentives. Any proposed legislative changes should be closely coordinated with data center industry stakeholders in Virginia to ensure broad based support.

Data centers have unique site and infrastructure requirements. There are multiple sites within GO Virginia Region One that could be suitable for a large data center. An assessment of available publicly controlled sites in the region of 25 acres or larger was conducted utilizing current data center industry site selection criteria.

- Six sites met the general criteria for a large 36 MW hyperscale data center and four additional sites could be suitable for a smaller data center of up to 10 MW. Three of the sites have opportunities for geothermal cooling through utilization of 51 degree mine water or underground space that provides a consistent 55 degree temperature.
- The identified sites are in varying stages of development readiness. Improved construction practices within the data center industry including new modular designs, are dictating that selected sites are development ready. A data center developer can acquire a new site and construct the facility in 12 months or less. Using the Virginia Economic Development Partnership's "Business Ready Sites Program" criteria, sites in the region ranged from Tier 2 to Tier 4 with Tier 4 being a site that is ready for development with current due diligence information. The availability of a current geotechnical analysis and environmental reports that confirm the developable areas of the site are particularly important. It is recommended that sites achieve at least a Tier 3 rating with a plan in place to attain a Tier 4 rating.
- The analysis of the utilization of mine water for data center cooling indicated that this resource could provide a more sustainable and cost-effective option for cooling. Additional study will be required to further validate the commercial viability and constructability at the Wise County site or others in the region. A pilot program potential utilizing resources through higher education and available grant funding should be considered that could be presented to data center companies with significant sustainability goals.

Additional observations about GO Virginia Region One and the region's suitability for data center development:

- Workforce – There is a reasonable pool of workers in the region with skills and training that are potentially transferrable to a data center environment. However, some key positions would likely be filled from outside of the region. Wages for IT workers such as network architects and information security analysts are 17% less in GO Virginia Region One than the national average. Strong IT training programs and resources exist with the community colleges in the region and the University of Virginia at Wise. Customizable training programs can be provided for specific data center skills.

- Sustainability Messaging – The availability of mine water for cost effective cooling and the region's desire to transform itself from a coal producing area to an innovative renewable energy hub, provides a compelling case for data centers who are increasingly mandating new facility locations that allow sustainability goals to be met.
- Low Disaster Risk and Diverse Geography- The region provides a low risk option from natural and man-made disasters and meets distance requirements for disaster recovery and back up from primary data center locations such as Ashburn, Richmond, and Boydton, VA (Microsoft). With the impacts of the COVID-19 pandemic and potential future yet-to-be-determined public health events likely continuing into the foreseeable future, a location that provides a diversity of geography and workforce so that back up sites can be manned and maintained is important. The electric transmission network that supplies the region has three transmission providers and is electrically diverse from data center hubs in Northern Virginia, Richmond, and North Carolina.
- Economic Impact – The economic and fiscal impact analysis that was conducted for Project Oasis estimated that a large data center locating in the region would result in over 2,000 jobs created during construction, 40 direct and 59 additional permanent jobs, $233 million in economic activity during construction, and over $50 million in economic activity annually once operations begin.
- Regional Data Center Marketing – Data Centers provide a significant opportunity for new tax revenues to state and local governments and substantial economic benefits to the regions where they locate. The competition to attract new data center investment is fierce and millions of dollars are spent annually to promote hundreds of locations around the globe and within Virginia. The sites that have been identified as potential data center sites within GO Virginia Region One are diverse with unique attributes. Some sites have opportunities for geothermal cooling, others have the potential to provide significant power capacity, and some would be great sites for smaller data centers. In order to gain recognition of the entire region's potential as a data center location, it will be important to develop and promote a consistent marketing message that reflects common themes – viable sites, aggressive incentives, diverse low-risk geography, competitive power costs, and renewable energy options. Maintaining strong partnerships with the region's power and broadband providers that leverage their marketing resources will provide an opportunity for more significant market outreach. The Southwest Virginia Energy Research and Development Authority is developing new renewable energy initiatives that will position the region as a renewable energy center and should be of interest to industries such as the data center industry that are increasingly focused on sustainability.

Data Center Industry Trends and Virginia's Market

The Commonwealth of Virginia is the leading Data Center market in the world. Northern Virginia has evolved to become a major Interconnectivity hub globally with over 13 million square feet of data center space. According to Loudoun County Economic Development Authority, over 70% of the world's Internet traffic passes through Northern Virginia each day.

Virginia has an established technically skilled workforce with a significant presence of government technology contracting companies providing a significant contribution to this pool of talented workers. Data center operators have been continuing their buildouts at a rapid pace over the last two decades. Increasing investments in building new and upgrading existing data centers that support the provision of cloud services is among the main drivers of growth. Tax incentives have further fueled the growth of data centers in the region despite land prices in "Data Center Alley" in Loudoun County that have approached $2 million per acre for some sites. Additionally, the cost of electric power which represents a significant operating cost for data centers, is one of the lowest of the major North American markets.

The Commonwealth of Virginia has recently received a significant boost to its global connectivity with the construction of four new transatlantic subsea cables that are "landing" in Virginia Beach. Until recently, in order for the international Internet traffic to leave the state of Virginia and reach its destination in other parts of the world, it had to be first sent to the state of NY, NJ or Florida. This new infrastructure will give the Virginia data center community more options for high-speed low-latency direct connectivity from Virginia to Europe, South America and beyond. The availability of these new connections and a fiber route to gain access, is already becoming a site selection factor for companies with international operations.

Other drivers of the data center growth forecast include growing use of big data analytics, Internet of Things (IoT) technology, and technologies like artificial intelligence, video streaming, social media, online banking and online healthcare are also leading to more data generation and data consumption. 1.7MB of data is created every second by every person during 2020. In the last two years alone, an astonishing 90% of the world's data has been created.

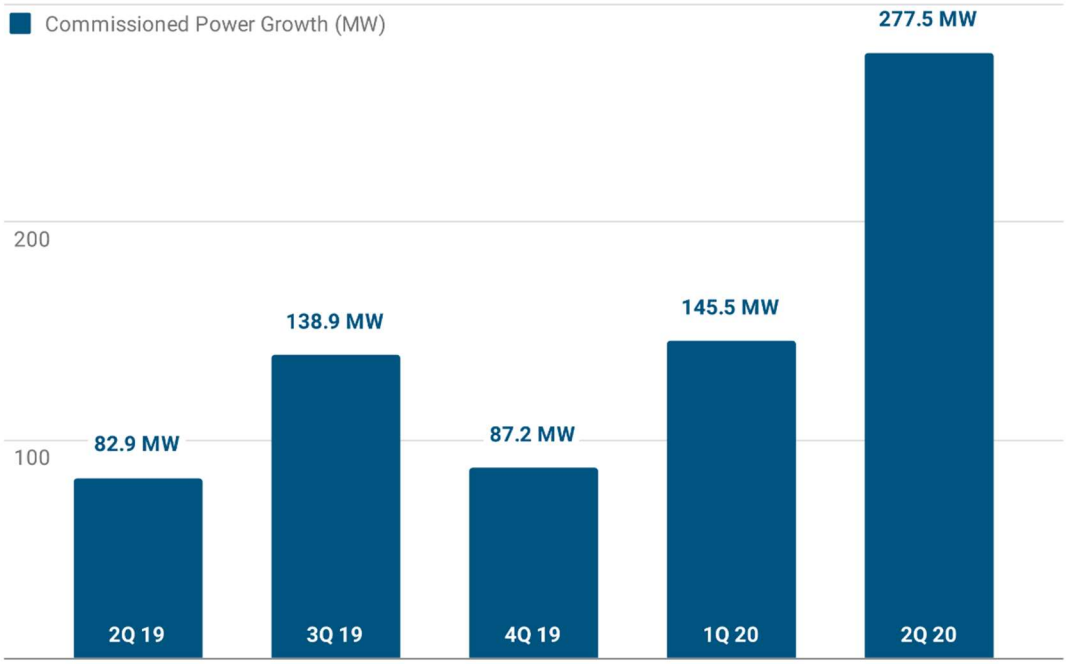
The impacts of the COVID-19 pandemic have highlighted the critical importance of data centers and the need for uninterrupted connectivity. The data center industry is one of the few industries that has adapted and continued to see significant growth in 2020. Northern Virginia is the largest data center market in the world and again led all other markets in growth in 2Q 2020. Even when factoring in the size of the market, the growth rate of commissioned power was more than triple the average rate of the previous four quarters. The chart below that is based on research by Data Center Hawk shows the significant increase in the top North American data center markets in 2020.

Top North American Data Center Markets' Growth

DATACENTER HAWK

2Q 2020 Top North American Data Center Markets' Growth

The top data center markets* in North America grew 277.5 MW during 2Q 2020 (includes pre-leasing), more than doubling the average growth of the same markets over the prior four quarters.

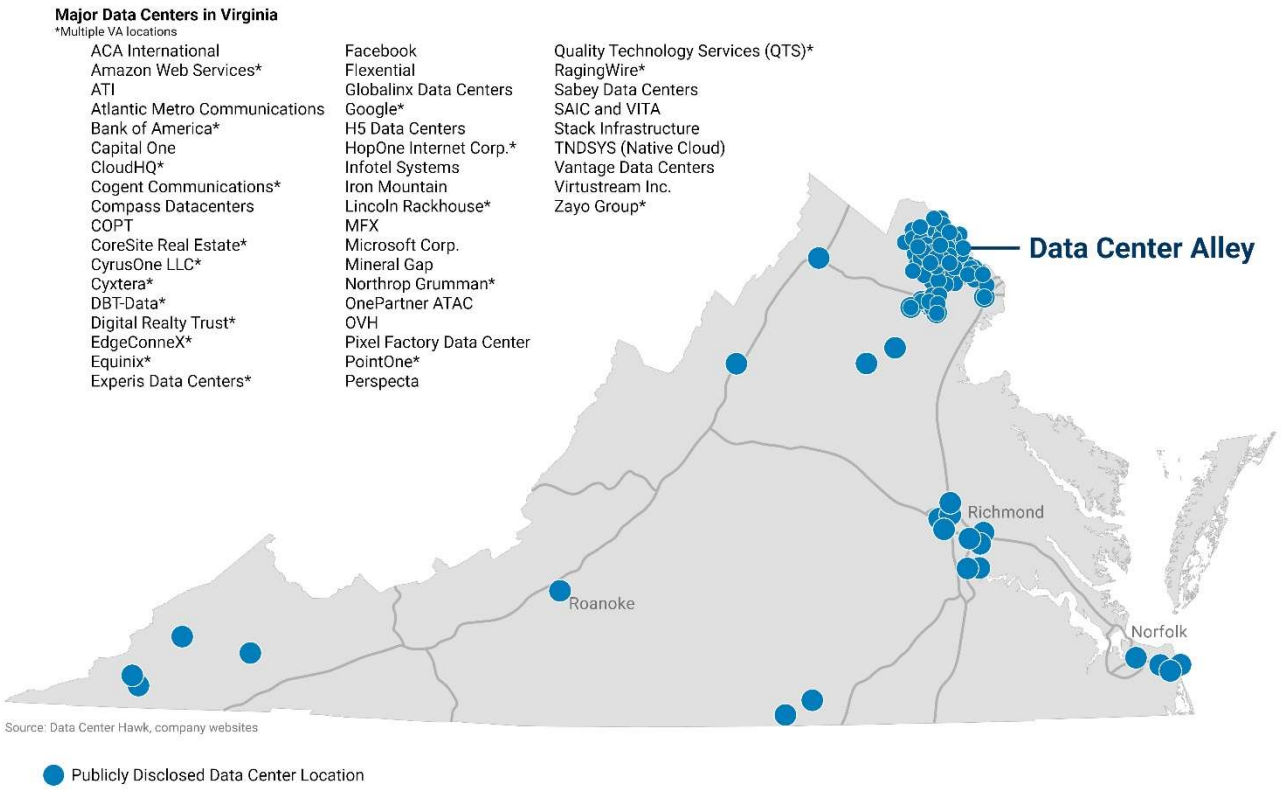


* Atlanta, Boston, Chicago, Dallas/Fort Worth, Houston, Los Angeles, Minneapolis, Montreal, New York, Northern California, Northern New Jersey, Northern Virginia, Phoenix, Portland (OR), Quincy, San Antonio, Seattle, Toronto

Market research reports from the real estate and data center industries indicate that a significant level of growth is likely to continue over at least the next two years. Virginia is well positioned to capture a sizeable share of the global market which is expected to be nearly $300 billion by 2023.

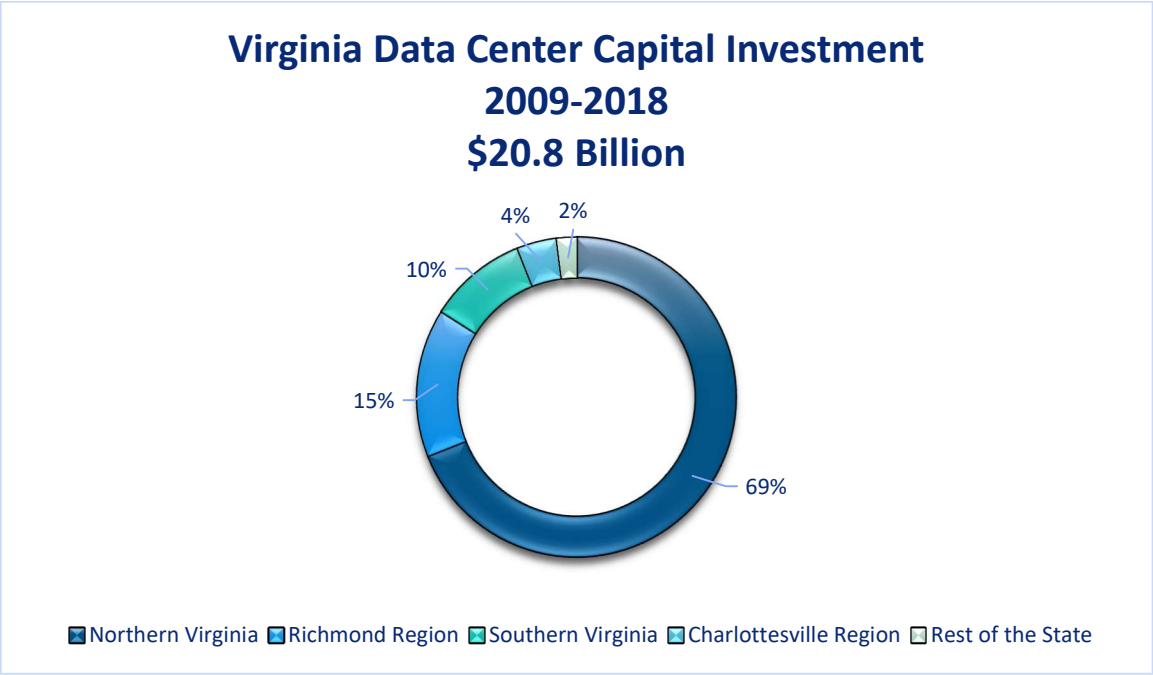
Virginia's data center market consists of a significant concentration of colocation data centers as well as enterprise and hyperscale facilities. The chart below shows the approximate locations of major publicly disclosed data centers in the state.

Major Data Centers in Virginia



The majority of data center growth and investment has occurred in Northern Virginia followed by the Richmond region and Southern Virginia. Microsoft's investments of over $2 billion in Mecklenburg County since 2010 represent most of the capital investment in Southern Virginia. Three data centers have been constructed in GO Virginia Region One in recent years. They are the OnePartner ATAC data center in Duffield in Scott County, the Northrop Grumman data center in Russell County, and most recently, the DP Facilities "Mineral Gap" data center in Wise County. These facilities are each less than 100,000 square feet. The chart below shows how the distribution of data center capital investment has occurred in Virginia over the last several years.

Virginia Data Center Capital Investment



Source: JLARC Report on Data Center and Manufacturing Incentives, June 2019

Project Oasis Data Center Model

DATA CENTER TYPES

Multiple types of data centers and service models exist in the industry. Their classification depends on whether they are owned by one or many organizations, how they fit into the topology of other data centers, what technologies they use for computing and storage, and even their energy efficiency. The primary types of data centers:

- Colocation
- Enterprise and Hyperscale Enterprise
- Edge and Micro Data Centers

Colocation

Most colocation data centers are owned and operated by real estate companies (REIT's) that lease space to cloud companies and a variety of tenants including corporate, health care, financial services, and government. Conditioned power, fiber and telecommunication connections, cooling and associated infrastructure, and security are provided. Leases are normally based on amount of conditioned power delivered ($ per kilowatt) to a designated space. Some characteristics of colocation data centers:

- Colocation Data Centers consist of one data center owner selling space, power and cooling to multiple enterprise and hyperscale customers in a specific location.
- Interconnection and proximity to major population centers are large drivers for businesses. Colocation data centers offer interconnection to Software as a Service (SaaS) such as Salesforce, or Platform as a service (PaaS) like Azure (Microsoft). This enables businesses to scale and grow their business at a lower cost.
- A large colocation data center can house 100s if not 1000s of individual customers and can also provide large amounts of space at a wholesale level to hyperscale customers.
- Major Colocation Data Center Providers: Digital Realty Trust, Equinix, Coresite, QTS, CyrusOne, NTT Communications (RagingWire), Cologix, Flexential, Zayo, CenturyLink

Colocation Data Center – CyrusOne in Sterling, VA

Enterprise and Hyperscale Enterprise (large corporate or content/service providers)

An enterprise data center is a facility that is built, owned and operated by the company it supports and is optimized for its end users. It is purpose-built to suit the specific requirements of only that company. The financial services sector often utilizes the enterprise data center model for their IT applications and data storage. Even though the large cloud companies provide services and applications to others, "hyperscale" data centers are still considered as enterprise. Project Oasis assumes a hyperscale enterprise data center model as the basis for the analysis in this report.

- They can be located on-premises as part of a larger campus or business site, but in many cases, they are located off-premises at a site chosen for connectivity, power, and security purposes.
- May have certain sections of the data center caged off to separate different sections of the business.
- May use external companies on initial fit-outs and network installation before being maintained internally.
- Has anywhere from 10 cabinets upwards and can be as large as 40MW+.
- A Hyperscale (or Enterprise Hyperscale) data center is a facility owned and operated by the company it supports. This includes large public cloud companies such as Amazon Web

Services, Microsoft, Google, and Apple. Data and applications may be hosted in multiple data centers located in diverse geographies.

- They offer robust, scalable applications and storage portfolio of services to individuals or businesses.
- Hyperscale computing is necessary for cloud and big data storage.
- Has anywhere from 500 cabinets upwards, and can be 100,000 sq. ft.- 300,000 sq. ft. or more in a single building.

Enterprise Hyperscale Data Center – Microsoft in Boydton, VA

Edge and Micro Data Centers

Edge data centers are smaller facilities located close to the populations they serve that deliver cloud computing resources and cached content to end users. They typically connect to a larger central data center or multiple data centers. By processing data and services as close to the end user as possible, edge computing allows organizations to reduce latency and improve the customer experience. Early indications show Edge data centers will support IoT, autonomous vehicles and move content closer to users, with 5G networks supporting much higher data transport requirements.

Dell Micro Data Center

DATA CENTER SIZES

Hyperscale

- Very large facilities that can be 350,00 SF or more in a single building or multiple buildings in a "campus" setting that can be 1 million SF or more.
- Large power requirements of 30-300 MW
- The largest Cloud providers such as Amazon Web Services, Google Cloud, and Microsoft Azure

Large

- Enterprise and colocation
- 100,000-200,000 SF
- 10-50 MW

Small

- Smaller enterprise and retail colocation, larger Edge data centers

- Less than 100,000 SF

Micro

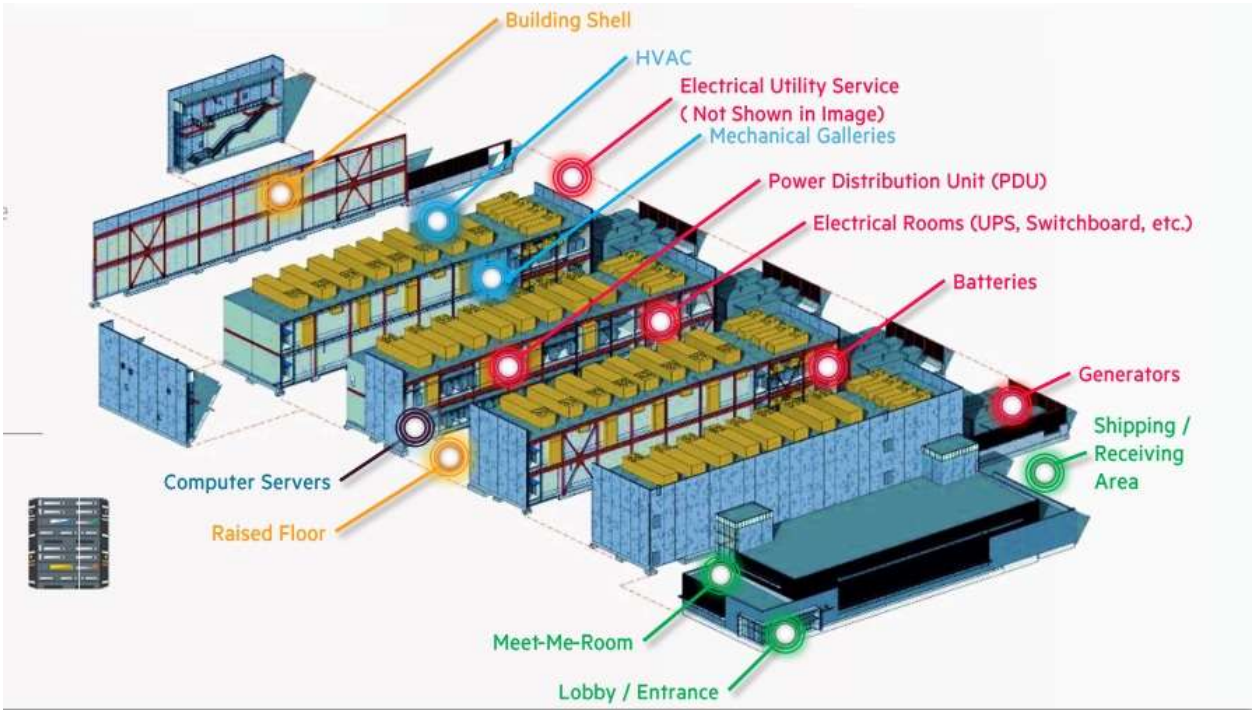
- Modular container with generally 10 or less servers
- Less than 10 SF

TYPICAL DATA CENTER DESIGNS

Designs for Enterprise, Colocation, and Cloud

Facilities can range significantly by size, layout, and ratio of raised floor space to total square footage. The following example is provided to give an indication of the spaces within the data center that are common to most designs. Although the configurations and ownership of equipment may be different, the spaces within the data center are similar for colocation and enterprise facilities. Recent advances in standardized designs and construction practices have reduced the time to complete these facilities from 12-18 months to 8-12 months.

Colocation Data Center Layout



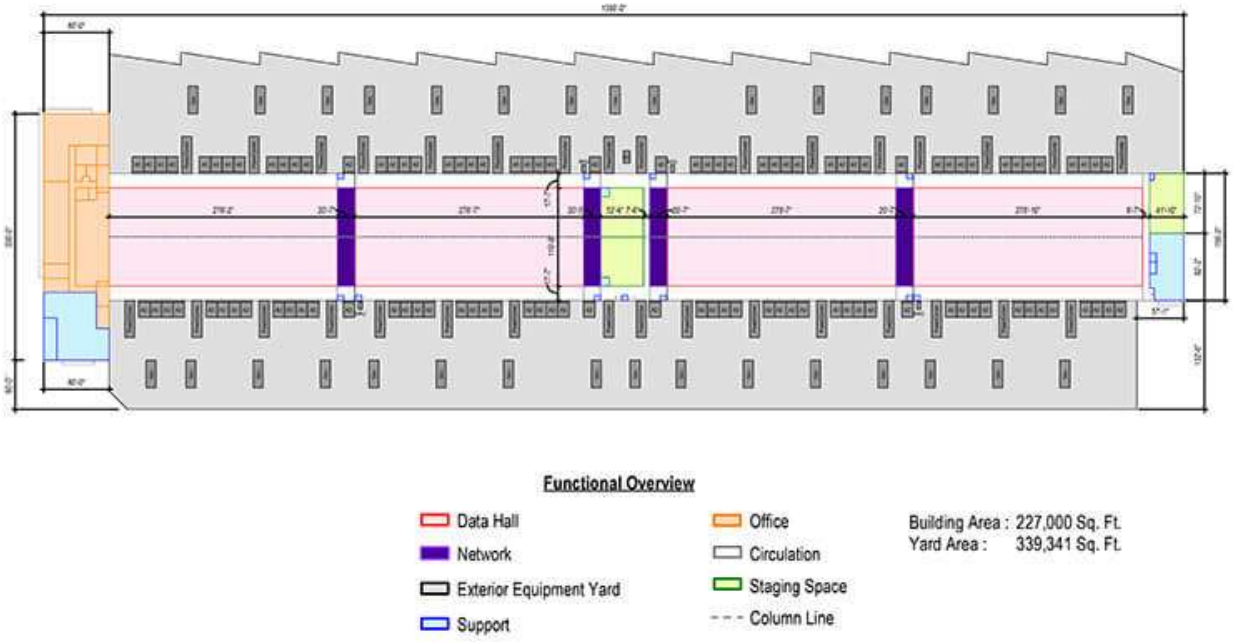
Courtesy of Digital Realty Trust

Modular

Modular data centers are a portable solution for deploying data processing capacity wherever it is required, delivering large amounts of power within a small footprint and a tight timescale. Modular

power units are built and tested in a factory-controlled environment to comply with the project specification. The portable power solutions are then shipped to site, fully built, tested and ready for immediate installation. Modular designs can be used for enterprise, colocation, or hyperscale facilities. A large modular data center can be installed in as little as 6 months.

Modular Data Center Design



Courtesy of Compass Data Centers

PROJECT OASIS MODEL DATA CENTER ASSUMPTIONS

To have a basis for determining the real estate, infrastructure, and cooling requirements for the Project Oasis model data center, it was necessary to make assumptions on the design, size, and other characteristics. The data center designs of some the top cloud companies have some common characteristics that are built into the development model for Project Oasis. However, the design model used by companies that construct enterprise data centers varies throughout the industry and can significantly impact the amount of capital investment. Factors such as power density, server cost ($$/server), Tier Rating, and cooling technology all impact the amount of investment in the data center. The Project Oasis team looked at industry typical averages for enterprise hyperscale data centers including companies such as Microsoft, Facebook, Apple, and Amazon Web Services. The data center model used for Project Oasis assumes a raised floor space of 150,000 sq. ft. with a total building size of 250,000 sq. ft. The raised floor space houses the IT equipment and servers. The remainder of building area will accommodate office space, telecom and cross connects, electrical/mechanical rooms, shipping/receiving, and security. Other assumptions are shown in the table below.

Assumptions for Project Oasis Data Center Model

Metric	Value
IT Capacity (MW)	36
Raised Floor Space (sq.ft.)	150,000
Total Building (sq.ft.)	250,000
Tier Rating	3
Power Usage Effectiveness (PUE)	1.1
Total Utility Power (MW)	39.6
Power Density (W/sq.ft.)	250
Thermal Load	21 MW
Cost per MW ($/M)	$6.6
Building Cost Capex ($M)	$262.5
IT Equip Cost Capex ($M)	$201.6
Total Capex ($M)	$464.1
Employees	40

Additional Design Assumptions for Project Oasis

- Information on cooling loads was developed and used as a basis for evaluating the technical feasibility and economics of data center cooling utilizing mine water, and for determining utility requirements and operating cost impacts for sites in the region without mine water access.
- Utilize air side economization and water side economization exclusively to provide low CAPEX and low Power Usage Effectiveness (PUE). PUE is an efficiency measure defined in white paper #49 of The Green Grid[1] Air and Water Side economization are defined within ASHRAE TC9.9. The cooler climate in Southwest Virginia will allow for more hours of “free cooling” which will

[1] Source: www.thegreengrid.org

utilize outside air for cooling over a significant number of hours annually thus providing lower operating costs.

- The Data center environment would be designed to operate within the new ANSI/ASHRAE Standard 90.4-2019, Energy Standard for Data Centers. This was recently updated to provide the most operational flexibility and accurate measures for the newest mechanical and electrical equipment being supplied.[2]
- One story building.
- Uptime Tier III design for reliability – N+1 for power and cooling and theoretically concurrently maintainable.
- Thermal load of this model data center is calculated based on industry standard.[3]

Definitions Per ASHRAE TC9.9

Air-side economization typically accomplishes cooling by bringing filtered outside air directly into the data center without any air conditioning or humidity control. In winter months when the outside air is cold, a comfortable working temperature inside the data center is maintained by mixing the incoming air with hot exhaust air from the IT equipment. It should be noted there are forms of indirect air-side economization that use a thermal wheel, heat pipes, or a plate air–to-air heat exchanger.

Water-side economization uses outdoor air for data center cooling, but indirectly. Outdoor air is used to chill liquid and the liquid is piped into the data center where air-handling units (AHUs) and/or computer room air handlers (CRAHs) use an air-liquid heat exchanger (cooling coils) to cool the data center air.

[2] Source: https://tc0909.ashraetcs.org/documents/ASHRAE_TC0909_Power_White_Paper_22_June_2016_REVISED.pdf

[3] Source: ASHRAE TC9.9: https://www.techstreet.com/ashrae/standards/ashrae-90-4-2019?product_id=2092750

Competitive Assessment of Incentives and Business Climate

VIRGINIA

Data centers are among the most capital-intensive industries that exist in today's economy. The thousands of servers that are housed in data centers perform a variety of tasks such as high-density computing, artificial intelligence, data storage, and a host of critical business and governmental functions. The cost of an individual server can range from $300 to $10,000 or more depending on the application. Additionally, servers are replaced or "refreshed" frequently to allow for the installation of updated equipment that provides greater computing power and increased efficiency. The refresh cycle varies among data center operators, but a three-year refresh cycle is typical throughout the industry. That means that a significant per cent of servers will be replaced with new equipment every three years on average.

Other capital-intensive components of the data center include robust HVAC equipment for cooling, electrical systems including UPS systems and generators, and telecommunications equipment.
The capital-intensive nature of this industry makes state and local tax policy an extremely important cost consideration for site location. Data centers can provide significant economic benefits to states and the localities and regions where they locate. The fact that the capital-intensive servers are replaced so frequently over the life of the facility that makes data centers different from most other industries. And provides a consistent source of significant tax revenue to local governments. Many states and countries have adopted data center friendly tax structures and incentives designed to attract new data center investment. More than 30 states in the United States have a sales tax exemption or have no sales tax for data centers. Many localities that have been successful in attracting data centers have adopted favorable business personal property tax structures that provide a lower cost of operations for data centers.
Virginia was one of the first states to adopt legislation that provided for an exemption of sales and use tax for data center equipment. Legislation was first passed in 2008 for the purpose of attracting a specific data center. The exemption has been broadened in subsequent years (2010, 2012, and 2016) to keep Virginia competitive with other states that have adopted new data center incentives.

The current legislation in Virginia provides a state sales tax exemption for computer equipment or enabling software purchased or leased for the processing, storage, retrieval, or communication of data, including but not limited to servers, routers, connections, and other enabling hardware, including chillers and backup generators used or to be used in the operation of a data center in the state. To qualify for the exemption, an enterprise or colocation data center (and its tenants) must have a new capital investment of at least $150 million and create at least 50 new jobs in a Virginia

locality. The minimum new job requirement is reduced to 25 if the data center is in an enterprise zone or in a locality with an unemployment rate at least 1.5 times the average statewide unemployment rate. New jobs must pay at least 1.5 times the annual average wage in the locality where the data center is located. The exemption expires June 30, 2035.

While Virginia's data center incentives have proven to be successful in helping to secure substantial new data center investments in the state, other states offer incentive programs that are less restrictive and provide greater opportunities to attract investment in rural areas. In June of 2019, Virginia's Joint Legislative Audit and Review Commission (JLARC) produced the results of a review and evaluation of economic development incentives as directed by the Virginia General Assembly. This included an evaluation of the data center sales tax exemption and benefits to the state. Some of the key findings of the JLARC report include the following:

- The data center sales and use tax and exemption appears to be relatively effective in attracting investment to the state. JLARC estimated that 90% of data center investment would have likely gone to other states without Virginia having the exemption in place. Data center investment and employment has increased as Virginia broadened its incentives.
- Other states are implementing more aggressive programs and incentives that could negatively impact Virginia's competitive position in the future. Virginia should regularly evaluate its competitive position compared to other states and assess initiatives that would encourage data center growth in distressed and rural areas. A study to address challenges in rural areas such as limited redundant telecommunications fiber, access to large capacity utilities, and workforce readiness was recommended.
- The exemption as currently structured, has not stimulated much growth in distressed areas. Nearly 70% of Virginia data center capital investment has occurred in Northern Virginia.
- Virginia's minimum thresholds for capital investment ($150M) and job creation (50 jobs, 25 for distressed areas) are more restrictive than many other states. Lowering or eliminating the job creation threshold could encourage data center growth outside of Northern Virginia.
- Localities with data centers reported data centers are important sources of tax revenue and they do not require substantial local government services. Data centers could provide substantial benefits for distressed areas.

Research on data center incentives indicates there is a wide range of requirements for data center operators to qualify to receive sales tax and other exemptions. The table below highlights some of the specifics of data center incentives in several states, and those that offer additional incentives or reduced qualification requirements for rural areas. Many of these states compete with Virginia for new data center investment.

Select States Providing Sales Tax Exemptions and Other Incentives for Data Centers

State	Min CAPEX Required	Min Jobs Required	Average Wage Requirement	Rural Component	Electricity Sales Exemption
Virginia	$150 Million	50	150% of locality average	25 Jobs for areas with unemployment rate of 150% of state average	No
North Carolina	$75 Million	None	NA	None	Yes
Tennessee	$100 Million	15	150% of state average	None	No
South Carolina	$50 Million	25	150% of locality average	None	Yes
Illinois	$250 Million	20	120% of locality average	Construction Employment Tax credit of 20% of wages for construction workers for projects in underserved areas	No
Indiana	$150 Million	None	NA	$25M CAPEX for counties less than 50,000 population	Yes
Iowa	$250 Million	None	NA	None	Yes
Georgia	$250 Million, $15 million for single user data center	20	110% of locality average wage	$100M CAPEX for designated counties	No
Texas	$200 Million	20	120% of locality average wage	None	Yes

Maryland	$5 million	5	150% of state minimum wage	$2M CAPEX (Tier 1 Counties, Opportunity Zones	No

Note that many states have a significantly lower threshold for data center capital investment that allows data center operators to qualify for a sales tax exemption than does Virginia. For example, Maryland's new data center sales tax exemption was effective on July 1, 2020. Under Maryland's legislation, a data center with a capital investment of as little as $2 million could qualify to receive the exemption in a Tier 1 County or Opportunity Zone. That could encourage the development of smaller data centers in distressed and rural locations in the state. Large data center operators that require multiple diverse locations to provide disaster recovery, business continuity services, and back up storage, may be more likely to consider sites in rural areas for such a purpose built data center given the opportunity to receive a sales tax exemption for qualifying equipment that would not be applicable in urban areas.

For states that have specific tax exemption qualification requirements for distressed and rural areas, the majority of those simply reduce the minimum requirements for new jobs created and/or amount of new capital investment. For those that have an annual salary requirement level for new jobs created, having the annual salary tied to the locality average wage, rather than the state average, provides a less restrictive method of meeting the eligibility requirements as the average salaries in rural localities are typically below the state average and data center jobs and associated wages are high compared to locality and state averages.

Illinois adopted new data center incentives effective January 1, 2020 that provide a sales tax exemption for investments of $250 million, and for a data center that locates in an underserved or rural area, also a tax credit of 20% of wages for construction workers. Facebook has recently announced plans for a new $800 million data center in DeKalb, Illinois which about 60 miles west of Chicago. The location is considered as "underserved" according to state statutory criteria and would qualify for the Construction Employment Tax Credit.

LOCAL PROPERTY TAX RATES AND DEPRECIATION

As with state sales tax, local tax rates for data center equipment and real estate are extremely important considerations for site selection due to the capital cost of equipment and frequency of server replacement. It is estimated that local property taxes on equipment can account for 10-15% of annual operating expenditures for a typical data center. The "effective" tax rate that takes into account the tax rate per $100 of assessed value in addition to depreciation

Local Property Tax Rates and Depreciation are extremely important for Data Centers.

factors (assessment ratios) over the life of the equipment, is used as the basis for comparing locations and tax implications. The depreciation rate is particularly important due to the frequent replacement of servers. Virginia Code allows localities in the state to establish a separate tax class for data center equipment. To encourage new data center investment and jobs to their communities, many localities in Virginia now have tax rates and depreciation schedules that are "data center friendly" and allow them to be more competitive. Computer and other data center equipment subject to property taxes would typically be taxed at the Business Personal Property rate if no special taxation class is designated, or unless negotiated on a case by case basis. The table below shows localities in Virginia that have established a taxation class for computer and data center equipment and how that rate compares to the Business Personal Property tax rate.

Virginia Localities with Reduced Property Tax Rates for Data Centers

Locality	Nominal Business Property Tax Rate (Per $100 of Assessed Value)	Property Tax Rate for Data Center Equipment (Per $100 of Assessed Value)
Brunswick County	$3.65	$0.40
Chesapeake	$4.08	$0.48
Chesterfield County	$3.60	$0.24
Danville	$3.50	$0.25
Fredericksburg	$3.40	$1.25
Goochland County	$3.95	$0.40
Henrico County	$3.50	$0.40
Prince William County*	$3.70	$1.25
Spotsylvania County	$5.95	$1.25
Stafford County	$5.49	$1.25
Virginia Beach	$4.00	$0.40

**Prince William County's rate on data center equipment will increase to $1.35 per $100 in fiscal 2021*
Source: "The Impact of Data Centers on the State and Local Economies of Virginia", Mangum Economics January 2020, and published tax rates of localities.

Currently, there are no localities within the GO Virginia Region One area that have a personal property taxation class for computer and other equipment used in a data center. Some localities in the region do provide for a more aggressive depreciation for Business Tangible Personal Property that is considered as "Computer Hardware". This provides a more competitive tax structure as it would apply to computer servers in the data center that represent a significant portion of capital investment. It should be noted that some localities in the region have a higher tax rate for computer hardware.

The table below shows the impact of local property tax rates and depreciation for a $1 million data center equipment investment over a 5-year period. This compares tax rates and depreciation schedules for select Virginia localities that have a data center taxation class with that of a representative Southwest Virginia locality. The tax rate and depreciation (assessment ratio) for Wise County was used for this analysis as that county's tax rate is neither the highest or lowest in the region and the assessment ratios are typical of many localities in GO Virginia Region One. This provides a representative snapshot of current SWVA tax structure compared with localities with a specific data center taxation class. Note that localities with the same or similar tax rate can have a different cumulative tax over 5 years due to varying depreciation schedules.

Impact of Tax Rates and Depreciation for $1 Million Data Center Equipment Investment

Locality	Tax Rate per $100 of Assessed Valuation	5 Year Tax for $1M Data Center Investment	Specific Tax Rate for Data Center Equipment
Prince William County	$1.25	$15,000	Yes
Fredericksburg	$1.25	$15,000	Yes
Virginia Beach	$0.40	$5,800	Yes
Henrico County	$0.40	$4,800	Yes
Danville	$0.25	$4,250	Yes
Chesterfield County	$0.24	$3,000	Yes
Representative Southwest VA Locality (Wise County)*	$1.65	$35,475	No

**Assumes Business Tangible Personal Property Tax rates and depreciation (assessment ratio) for computer hardware.*

To evaluate the total local tax liability for a potential data center considering locations in Virginia, the Project Oasis Model Data Center previously described was used. Of the estimated $464.1 million in total capital investment, this assumes the following:

- CAPEX subject to personal property taxes (computer servers, mechanical and electrical systems, generators, etc.) = $370.35 million (80% of total)
- CAPEX subject to real property taxes (land and building) = $75 million (16% of total)
- Construction costs not subject to ongoing local taxes = $18.75 million (4% of total)

The analysis looked at the business personal property tax rates and depreciation and the real property tax rates for Henrico County, Fredericksburg City, and Wise County. Again, Wise County's rates are used to provide a representative picture of how rates in the region compare to other

localities with data center specific tax structure. Henrico County was one of the first counties in the state to adopt a specific data center tax structure. The reduced tax rate and depreciation schedule applies to all equipment that is necessary for a data center to function, including computer servers, power supply equipment, and cooling systems. Their tax rate, in addition to an aggressive depreciation schedule, provides an extremely competitive tax structure for data centers. In April of 2017, the county cut their tax rate from $3.50 per $100 of assessed value to $0.40 for data centers by establishing the special taxation class for data centers. Several months later, in October 2017, Facebook announced that the company would be building a $750 million data center in the county. Similarly, localities in the Greater Fredericksburg Region including Fredericksburg City, Stafford County, Spotsylvania County, and Caroline County all agreed to lower their tax rates for data centers allowing them to provide a lower cost alternative to Loudoun County. Their rate of $1.25 per $100 of assessed value is one of the highest in the state among localities with a specific tax rate for data centers. However, the rate provides a more attractive option for data centers than most localities in Virginia that do not have a data center specific tax structure.

Project Oasis Data Center Model 5-Year Taxes by Locality

Henrico County					
Capital Investment Amount					**$370,350,000**
Tax Rate for Computer Equipment (Per $100)				**$0.40**	
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Depreciation	50%	30%	20%	10%	10%
Annual Tax	$740,700	$444,420	$296,280	$148,140	$148,140
5-Year Taxes on Computer Equipment					**$1,777,680**
Real Property Amount					**$75,000,000**
Real Estate Effective Tax Rate (Per $100)				**$0.78**	
5-Year Real Estate Taxes					**$2,925,000**
Total 5-Year Tax (Real Estate and Business Personal Property)					**$4,702,680**

Fredericksburg City					
Capital Investment Amount					**$370,350,000**
Tax Rate for Computer Equipment (Per $100)				**$1.25**	
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Depreciation	50%	35%	20%	10%	5%
Annual Tax	$2,314,688	$1,620,281	$925,875	$462,938	$231,469
5-Year Taxes on Computer Equipment					**$5,555,250**
Real Property Amount					**$75,000,000**

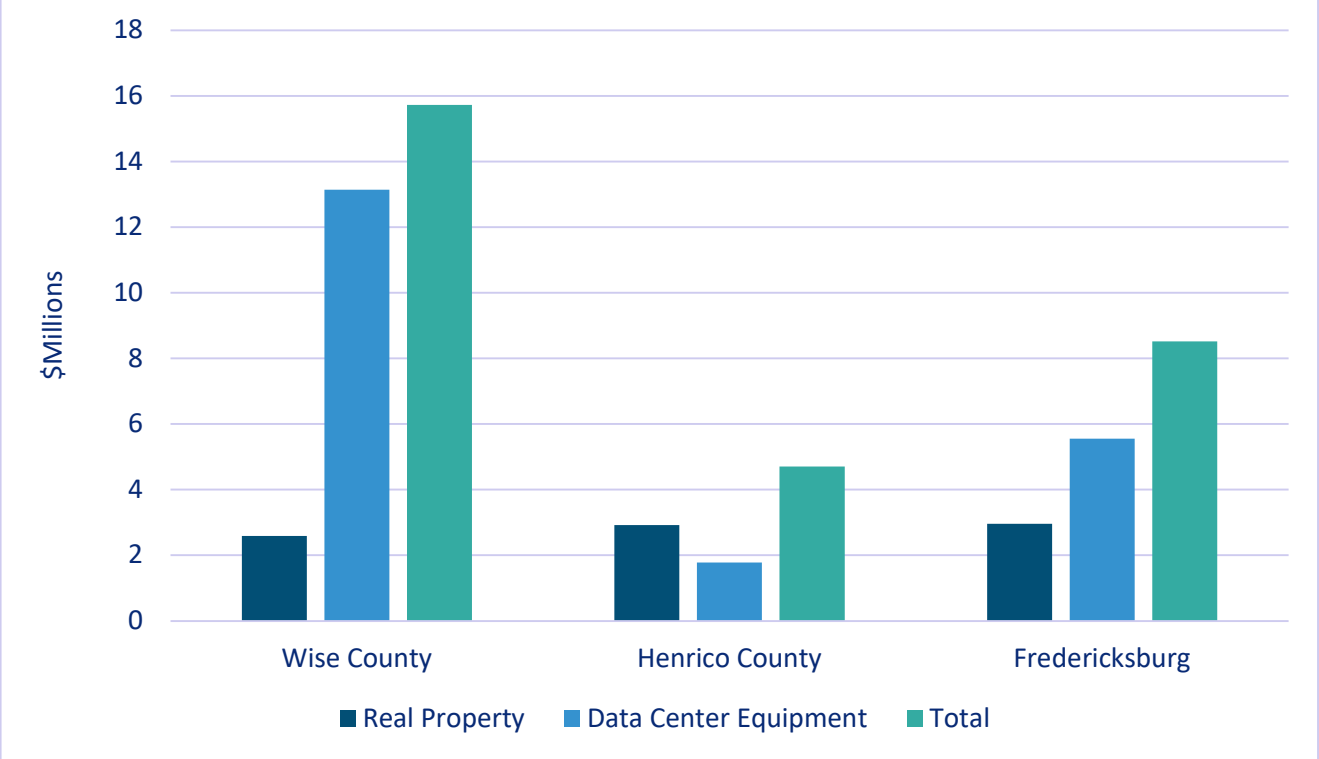
Real Estate Effective Tax Rate (Per $100)				**$0.79**	
5-Year Real Estate Taxes					**$2,962,500**
Total 5-Year Tax (Real Estate and Business Personal Property)					**$8,517,750**

SWVA - Wise County					
Capital Investment Amount					**$370,350,000**
Tax Rate for Computer Equipment (Per $100)				**$1.65**	
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Depreciation	80%	60%	40%	20%	15%
Annual Tax	$4,888,620	$3,666,465	$2,444,310	$1,222,155	$916,616
5-Year Taxes on Computer Equipment					**$13,138,166**
Real Property Amount					**$75,000,000**
Real Estate Effective Tax Rate (Per $100)				**$0.69**	
5-Year Real Estate Taxes					**$2,587,500**
Total 5-Year Tax (Real Estate and Business Personal Property)					**$ 15,725,666**

**The Wise County analysis assumes that all data center equipment is taxed at the rate and depreciation schedule for "Computer Hardware". In reality, non-computer hardware items such as power distribution systems, telecommunications equipment, and cooling equipment would be taxed at the same rate but with a less aggressive depreciation schedule (90%, 80%, 70%, 60%, 50%) for Business Tangible Personal Property. That would result in a higher tax liability over the 5-year period.*

Localities that can offer data center specific tax rates and aggressive depreciation schedules provide a more competitive operating cost environment for data center operators. The analysis of tax and depreciation rates and the chart below do not consider that some portion of servers will likely be replaced in years 3-5. The cost of servers is a significant capital expense and their regular replacement provides additional ongoing tax revenue for localities.

Project Oasis Data Center Model 5-Year Real Property and Data Center Equipment Taxes by Locality ($75M Real Property, $370M Data Center Equipment)



Local Utility Consumer's Tax on Electricity

Data centers are large consumers of electricity and as such, any local tax that applies to the volume of electricity used could be a competitive disadvantage. Data centers are considered as "Commercial" users for state and local taxation purposes and would be taxed at the commercial rate. All the localities in GO Virginia Region One have a maximum level or "cap" on electricity for commercial use. The tax amounts for all localities are nominal ranging from $3 to $100 per month. This is an advantage as some localities in the Commonwealth do not have a cap on commercial electricity use that result in significant annual cost for a data center operator. For example, the Consumer's Tax on Electricity for one Virginia locality (not in GO Virginia Region One) would be more than $100,000 annually for the volume of electricity consumed for the Project Oasis Model Data Center. This is pointed out to heighten awareness that tax policy changes such the elimination of a cap on commercial electricity use would have a detrimental effect on competitiveness for data center attraction.

INCENTIVES FOR DATA CENTERS IN GO VIRGINIA REGION ONE

There are several incentives that are available to make localities in GO Virginia Region One more competitive for economic development projects. Some of these such as the Tobacco Region Opportunity Fund and the Coalfield Regional Opportunity Fund, are only available to localities in SWVA or other rural areas in Virginia. Several of the primary incentives are described below and how they may apply to a potential data center project.

Opportunity Zones

Opportunity Zones are receiving a significant amount of attention from data center developers in the last two years due to the capital-intensive nature of the industry. Developers are building data centers in areas designated as economically distressed under the federal Opportunity Zone program and earning tax breaks to boost their returns as the need for more digital processing power surges across the United States.

Fewer than one in 10 data centers built in the past 10 years was in an area now designated as an opportunity zone, according to CoStar data. Today, however, more than 25 percent of the square footage proposed or under construction is scheduled for zones designated for special tax breaks under the program, according to CoStar.

Created by Congress in late 2017 as part of the Tax Cuts and Jobs Act, the opportunity zone program encourages long-term investments of at least five years before investors can defer portions of their capital gains taxes. Gains from opportunity fund investments would be tax-free if held for at least 10 years. Data center operations, driven by the exponential growth of big-data analytics, mobile communications, artificial intelligence, autonomous vehicles and the internet of things, require hundreds of millions of dollars in upfront construction spending in communities, which was also a goal of lawmakers in passing the program.

There are several sites within GO Virginia Region One that are designated as an Opportunity Zone. Nearly all the potential data center sites identified through the Project Oasis Site Assessment initiative are in an Opportunity Zone.

There are available resources through Opportunity Virginia to assist communities with marketing and with linking potential investors to Opportunity Zone areas that fit the requirements of projects. Opportunity Virginia's mission is to facilitate productive connections between investors, project sponsors, and communities to drive activity in Virginia's Opportunity Zones. Opportunity Virginia provides the education, tools, and resources to guide each stakeholder group through the process while maintaining a pulse on potential and realized impact in communities served. Specific to Southwest Virginia, Opportunity SWVA and the University of Virginia's College at Wise provide a

resource for business and communities to access financial and technical resources necessary to take full advantage of Opportunity Zone benefits.

A site that has been validated as a location that meets the infrastructure and other requirements of a major data center, and that is also located in an Opportunity Zone would provide a significant advantage to certain developers within the data center industry depending on their investor base and tax status.

Tobacco Region Opportunity Fund (TROF)

All localities in GO Virginia Region One are eligible to receive benefits from the TROF program. The performance-based grants and loans available through TROF have been instrumental in securing numerous economic development projects for Virginia. Any potential data center project considering the region would meet the minimum requirements of $1 million in new capital investment within 3 years. Approved funds through TROF can be delivered at the front end of a project and can be used for a host of activities such as site development, access roads, and infrastructure expansion that would reduce the cost of acquiring and developing a new site to a data center developer.

In addition to TROF, it should be noted that significant funding has been allocated by the Tobacco Commission to enhance broadband access and connectivity in GO Virginia Region One. Nearly $5 million in funding was provided in 2019 for various broadband projects. Investments in broadband infrastructure over the long term will not only provide a direct benefit to citizens but will also improve the regions' marketability for data centers and other industries that depend on robust connectivity.

Commonwealth Opportunity Fund (COF)

The COF is the Governor's discretionary deal closing fund. The minimum requirements for receiving COF funding is an economic development project must create at least 15 new full-time jobs and $1.5 million in capital investment. It is highly likely that a data center project considering SWVA would meet the minimum COF requirements. As with TROF, funds allocated through the COF can apply to numerous aspects of a project that would lower costs for the data center operator.

Workforce Training Incentives

There are several available programs in the region that would support the workforce training needs of data centers that locate in the region. Data centers do not typically utilize a large workforce but many of the jobs require highly specialized skills. The availability of funding to offset training expenses will lower the cost of onboarding employees as a large pool of workers with data center specific skills does not exist in the region currently. In addition to the resources of the community colleges and the University of Virginia at Wise, funding to support new worker training is available

through the Coalfield Regional Opportunity Fund (CROF), the Workforce Innovation and Opportunity Act (WIOA) administered by the Southwest Virginia Workforce Development Board, the Virginia Jobs Investment Program (VJIP), and the Virginia Talent Accelerator Program.

Workforce and Salary Competitiveness

While data centers do not require a large workforce compared to many industries, the average salaries of data center workers are higher than most. The Project Oasis Data Center Model assumes that the data center would require around 40 employees. Most of those jobs are highly skilled and include a variety of positions including network administrators, software engineers, hardware engineers, network architects, information security analysts, and electrical and HVAC technicians. Other positions include cleaning services, security guards and grounds management. The number of positions and salaries will vary among companies and type of data center. Annual salaries range from $25,000 for cleaning services to $120,000 or more for data center managers and network architects. Research provided by the UVA-Wise Office of Economic Development indicated that there is a reasonable pool of workers in GO Virginia Region One with job titles and skills that are potentially transferable to a data center environment. It is important to note that the average salaries of positions such as network architects and information security analysts are around 17% less in Go Virginia Region One than the national average. Although the number of jobs is not significant compared to other industries, a competitive salary structure is an extremely important location factor.

The ability to attract, train and retain a quality data center workforce is vitally important. As there is not an existing significant data center presence in GO Virginia Region One, it is likely that employees for some key positions will be recruited from other areas or potentially be relocated from other data center locations if the company has multiple locations.

Public Policy and Incentives Recommendations

The 2019 JLARC study highlighted the need to revise policies related to tax and incentive structure that would encourage more data center development in rural areas of Virginia. Elected officials at the state, local, and national level have indicated a strong desire to support policies that drive Virginia's continued data center growth and that would result in additional investment in rural parts of the state. The legislative delegation that represents Southwest Virginia in the Virginia General Assembly has tirelessly advocated for maintaining and enhancing the region's competitiveness to attract new jobs and investment. The legislators have indicated strong support for potential legislative changes that would allow the region to better compete for new data center investment. During a data center industry meeting on February 28, 2020 that included top data center industry executives, U. S. Senator Mark Warner stated *"If any of you would ever be willing to look at Southside or Southwest, I will move heaven and earth in terms of state and federal incentives*". As a significant

amount of federal business is currently housed in Virginia data centers, incentives that would provide cost or other inducements to companies that develop data centers in rural areas to support federal government applications should be considered. The federal government has implemented the Data Center Optimization Initiative (DCIO), that is designed to reduce IT costs, consolidate the number of data centers, and improve efficiency. Consequently, several agency and mission critical applications now reside in colocation data centers in Northern Virginia. Functions such as disaster recovery, business continuity, and back up storage often require multiple data center locations for federal contracts. Southwest Virginia provides a viable option for those locations due to diverse geography and workforce and available sites and infrastructure.

The preceding analysis of local business property tax rates and depreciation shows the significant impact of local tax structure on data center operating costs. Many localities in Virginia have adopted a data center specific taxation class for data centers. Localities in the Fredericksburg region collectively adopted such a change in tax policy to attract new data center investment in the region. In voicing support of the MOU between the four localities in the region that adopted the lower data center tax rate, Stafford Board of Supervisors Chairman Gary Snellings said the county is always looking for ways to diversify business offerings to better serve its residents' needs. "*Approving competitive and sound tax policy helps to ensure that we continue to attract a variety of businesses," he said. "The lower tax rate provides a bonus to a small component of existing businesses, and encourages new large e-commerce, warehouse, distribution, logistics, and data centers to take a serious look at Stafford*."

The following recommendations are provided for consideration:

- Virginia Sales Tax Exemption for Data Centers (Virginia Code § 58.1-609.3)
    - Lower the capital investment threshold required to receive the sales tax exemption from $150 million to $50 million or lower in rural localities.
    - Lower or eliminate the jobs requirement required to receive the sales tax exemption in rural areas. If a minimum number of jobs is to be required, then the average salary requirement should be lowered from 1.5 times the average wage rate in the locality to 1.2 times the average wage rate. Future legislated increases in the minimum wage in Virginia will increase average locality wage rates. Lowering the average salary requirement would allow data center companies to qualify more easily for the sales tax exemption while ensuring that the new jobs have higher wages than existing wages in the locality.
    - Proposed legislation should be closely coordinated with Virginia data center industry stakeholders.
- Construction Employment Tax Credit – Evaluate the applicability of a tax credit of 20% (or other Virginia-appropriate %) of wages paid for construction workers for projects located in

underserved and rural areas. This provision became effective in Illinois on January 1, 2020 and was a factor in attracting a significant new data center investment to an underserved area in the state.

- Virginia Data Center Industry Work Group – Ensure that GO Virginia Region One is represented in a data center industry work group as recommended by the JLARC Report. A primary goal of this working group is to examine actions needed to maintain the state's competitive position to attract data centers.
- Business Tangible Personal Property Taxes for Data Centers – For localities in GO Virginia Region One who have suitable sites for data center development and who have expressed a desire to attract data centers to the locality, evaluate the potential to establish a specific taxation class for data centers with a lower tax rate and more aggressive depreciation. This will require support of local elected officials and approval by the Board of Supervisors.
- Adoption of a Regional Data Center Tax Policy – Consider an approach such as that of the Fredericksburg Region where all the localities created a MOU and agreed to a consistent data center tax rate and depreciation schedule. This was designed to bolster the region's competitiveness as a whole and avoid inter-locality competition.
- Federal Data Center Business – Engage with Virginia's Congressional delegation to explore the potential for incentives that would provide an advantage to companies competing for federal data center business that locate facilities in rural areas.
- Pilot Program for Mine Water Cooling – Evaluate parameters and potential funding sources to construct facilities that would provide the primary cooling source for a data center. This would build on the analysis conducted by the Project Oasis Mine Water Cooling Study and would allow for more expedited development and construction of the systems needed to deliver the cooling source. This could potentially be accomplished through a partnership with a data center developer with assistance from state agencies, higher education, and state/regional funding sources such as the Tobacco Commission.

Evaluation of Potential Data Center Sites in SWVA

SITE SELECTION CONSIDERATIONS FOR DATA CENTERS & SITE EVALUATION METHODOLOGY

Data Centers have unique location requirements that are unlike virtually any other industry. The mission critical nature and significant capital cost of these facilities demands a stringent analysis of potential locations that will ensure a low risk of natural and manmade disasters and competitive operating costs. Although the respective ranking may vary depending on the type of data center and company, data center site location experts across the U.S. consider these seven site selection criteria as the top considerations for locating a new facility.

1. Availability, cost, and redundancy of electric power
2. Low/moderate risk of adverse weather events or natural disasters
3. High-quality construction that can be delivered to meet aggressive schedules at a reasonable cost
4. Telecommunications infrastructure and connectivity to major Internet interconnection hubs
5. Favorable business climate with competitive incentives and tax policy
6. Cooling technology/equipment/water availability
7. Quality of life

The Project Oasis Team utilized a comprehensive data center site assessment tool to evaluate the suitability of potential data center sites in GO Virginia Region One that could accommodate the 250,000 sq. ft. data center described in the previous section "Project Oasis Data Center Model". The evaluation process incorporated an assessment of the above and other site selection factors such as buildable acreage, available site due diligence, current zoning, and property control. The primary minimum requirements for a site to be considered were as follows:

- Electric Power: 10 MW of capacity available expandable to 36 MW – Data centers are extremely energy intensive and have strict reliability requirements. The data center model that is assumed for Project Oasis would require more than 36 megawatts (MW) of electric power at full buildout. Put in perspective, that would be equivalent to the electric energy consumed by nearly 24,000 homes. It would not be financially prudent nor technically practical for electric utilities to have idle capacity of this magnitude available throughout their service territories. The lead time to deliver this level of capacity would be a minimum of 2 years and may require new right of way and permitting. Data centers are demanding increasingly shorter construction schedules, in many cases, requiring a site that can be delivered with infrastructure in place in 12 months or less. Therefore, a site with close proximity to existing high voltage transmission lines (69kV or greater) and substations was the number one consideration in determining the sites in the region that could accommodate a large data center. Electric utility providers in the region provided an overview of electric

distribution and transmission infrastructure in the region and site-specific solutions for delivery of an initial 10 MW with expansion capability up to 36 MW. An electric power survey was completed along with interviews with the Project Oasis team.

- Site Buildability and Readiness for Development: Minimum of 25 acres with site due diligence information available (Tier 3 or higher) – The minimum site size requirement was 25 acres with a buildable area that could accommodate a 250,000 sq. ft. data center allowing for setbacks and buffer area from surrounding uses. Information was provided for site development issues such as zoning (appropriate for data center use), access to a public road, property control (publicly controlled property preferred), and availability of current due diligence information (wetlands delineation, floodplain study, geotechnical and environmental reports). The availability of a geotechnical report that confirms no karst topography exists on the site will be necessary to determine the feasibility of the construction of data center structures. To access the development "readiness" of the sites, the criteria used for the Virginia Economic Development Partnership's Business Ready Sites Program (VBRSP) was used for this purpose. The VBRSP establishes 100 acres as the minimum site size, but for the purposes of evaluating sites for Project Oasis, the minimum site size is 25 acres with all of the other criteria to be classified in a certain Tier category remaining the same. Given the extremely fast construction schedules of the vast majority of data center projects and the industry's sensitivity to risk, the Project Oasis team believes that third party validation of a site's readiness for development through a program such as the VBRSP or an equivalent level of up-front due diligence work will be required for a site to receive serious consideration as a potential location for a significant data center project. Sites that meet the VBRSP Tier 3 requirements, or a Tier 2 site with plans in place to get to the level of Tier 3, were considered for more extensive evaluation. A site with a Tier 4 or Tier 5 designation will have the highest level of marketability for data centers or other industries. Below are the criteria for the VBRSP Tier rankings.
    - Tier 1: Site under (a) public ownership, (b) public/private ownership, or (c) private ownership which such private owner(s) agreeable to marketing the site for economic development purposes and to allowing access to the property for site assessment and marketing purposes, but at no established sales price. Comprehensive plan reflects site as appropriate for industrial or commercial development and use, but site is not zoned as such. Site has minimal or no infrastructure. Minimal or no due diligence has been performed.
    - Tier 2: Site under (a) public ownership, (b) public/private ownership, or (c) private ownership with an option agreement or other documentation of a commitment by the private owner(s) to a competitive sales price, to permit access to the site for site assessment, construction, and marketing, and to market the site for industrial or commercial economic development purposes. Comprehensive Plan reflects site

intended for industrial or commercial development and use, but site is not zoned as such and a rezoning hearing needs to be scheduled. Site has minimal or no infrastructure. Minimal or no due diligence has been performed.

  - Tier 3: Site is zoned for industrial or commercial development and use. Site has minimal or no infrastructure. Due diligence including, among other things, a wetlands survey with Army Corps of Engineers approval within the last five years, geotechnical borings, boundary and topographical survey, cultural resources review, an Endangered Species review, and a Phase I Environmental Site Assessment, has been completed. Estimated costs of development have been quantified.
  - Tier 4: All infrastructure is in place or will be deliverable within 12 months. All permit issues have been identified and quantified.
  - Tier 5: All permits are in place and the site is ready for a site disturbance permit from the locality in which the site is located.

- Telecommunications/Connectivity – The availability of strong telecommunications infrastructure, multiple fiber providers with diverse routes, and connectivity to major Internet connection points are extremely important considerations for data center operators. The specific connectivity requirements may vary among data center companies, but all require infrastructure that provides route diversity and access to "dark" fiber. For a company considering a Virginia or East Coast location, connectivity to Ashburn/Northern Virginia (world's largest data center market), Atlanta, and the Richmond, Virginia NAP (Network Access Point) that provides connections to multiple international subsea cables via the new cable landing station in Virginia Beach, are all important. A comprehensive analysis of telecommunications infrastructure and fiber assets was conducted in partnership with the fiber providers in the region to assess the connectivity capabilities of the sites.
- Availability of Water for Cooling (236,000 gallons/day) – One of the primary goals of Project Oasis was to identify multiple sites in the region that could accommodate a large data center facility. A separate study was conducted to investigate the technical feasibility and economics for utilizing 51 degree mine water for cooling purposes. This study was limited to a site in Wise County in the Lonesome Pine Regional Business & Technology Park. The evaluation of all other sites assumes that a mine water cooling source was not available, and that the data center would be cooled by conventional mechanical cooling. Analysis of the cooling requirements for the Project Oasis Data Center Model determined that a water volume of 236,000 gallons per day would be required. The initial site assessment questionnaire that went out for each of the sites indicated that a minimum of 350,000 gallons per day would be required. Many of the water authorities in the region can provide the 350,000 gallons per day requirement. Data centers do not require a large volume of sewer capacity as most of the water is evaporated through the cooling process. The sewer requirement will vary depending

on the cooling technology utilized but is assumed to be around 5% of water volume which does not appear to be a limiting factor for water authorities in the region.

- Avoidance of Significant Risk Factors – The area within the GO Virginia Region One footprint is seen as a relatively low risk for natural disasters. The region is approximately 300 miles from the coast which minimizes any risk of hurricane activity. Southwest Virginia is considered as a low-moderate risk for seismic activity. Site specific risk factors that are considered by data center operations include: confirmation that the site is not within the 500-year floodplain, desire to be no closer than ½ mile from major natural gas pipelines and main line railroads, no closer than 1 mile to the production or storage of hazardous materials, and a location that is not in direct flight path of an airport. The risk factors were evaluated as part of the site evaluation process. In some cases, individual risk factors can be mitigated through orientation of the facility on the site and incorporation of appropriate buffer areas.

LIST OF SITES, SITE CHARACTERISTICS & REGIONAL MAP OF LOCATIONS

The general site requirements for the Project Oasis Data Center Model were submitted to localities in GO Virginia Region One. Information on 12 sites was provided by localities through the Project Oasis Site Assessment survey. Those sites represented diverse geography throughout the region. Analysis of that information and confirmation of utility capacities, available due diligence information, and other data center specific criteria, resulted in a determination that six sites that could potentially support data center development at this scale. The six sites shown in the table below met most of the minimum requirements for the Project Oasis 250,000 sq. ft. data center. Electric power capacity of up to 36 MW was a primary factor. Three of the six sites have the potential for geothermal cooling. Two sites, the Lonesome Pine Business & Technology Park, and the Red Onion Industrial Site, could potentially utilize mine water for data center cooling. A third site, the Sunbright Mine Site has a large underground area that maintains a constant 55-degree temperature. This site has been studied for data center use and could provide both above ground and underground space suitable for development.

Proposed Sites for 36 MW Data Center

Site Name / Locality	Parcel Size	Electric Power	Fiber / Connectivity	General Site Readiness	Comments
Lonesome Pine Regional Business & Technology Park/Wise Co	388 acres	Strong: 10 MW can be provided quickly. Construction of 69 kV transmission facilities to ODP owned substation site required to support 36 MW	Point Broadband's network is 1,152' away and SCTC has fiber 1200' from site.	Currently at a Tier 2 level with minimal due diligence required to advance to a Tier 3 or 4	Location of mine water-cooling site and study
Oak Park Center for Business and Industry/Washington Co	Multiple parcels of 42, 48, and 71 acres	Strong: 10 MW can be provided quickly, and AEP 138 kV line is adjacent to sites that would require minimum construction to support 36 MW.	Point Broadband and SCTC networks are approx. 1.5 mile from site. Other carriers within 2 miles of site are LIT Networks, Segra and Windstream.	Currently at a Tier 3 level with minimal work required to advance to Tier 4	Development ready
Progress Park/Wythe Co	Multiple parcels of up to 200 acres	Strong: Existing AEP substation in the park and three 138 kV lines can support growth of 50 MW or more.	Multiple carriers within 2 miles of site: Point Broadband, Segra, Shentel, Windstream, Citizens.	Currently Tier 4. AEP Certified Data Center Site	Development ready.
Red Onion Industrial Site/Dickenson Co	99 acres (largest contiguous parcel 15 acres)	Moderate: AEP 69 kV line can support loads of 50 MW but would require new substation	SCTC network is approx. .52 miles from site. Point Broadband is approx. 3.9 miles.	Currently at a Tier 2 level. A significant amount of due diligence may be required to advance to Tier 3	Available municipal water capacity to site may be limited without system upgrade. Site could potentially utilize mine water for cooling.
Sunbright Mine Site/Scott Co	166 acres plus 22 acres underground	Moderate: AEP substation adjacent to site can accommodate 10 MW but 36 MW would require a new major transformer or new substation.	SCTC network is 1.5 miles and Point Broadband is 2 miles. Windstream is approx. 1100' from site.	Some due diligence work completed for previous projects. Currently estimated to be at a Tier 2 level with some work required to advance to Tier 3	Site offers a unique opportunity for underground facilities. Adjacent major rail line may be a concern. A system upgrade may be required to provide required municipal water capacity.
Wildwood Commerce Park/Carroll Co	Multiple parcels of 25-100 acres	Strong: 138 kV AEP substation is slated for future construction and 10 MW of capacity is currently available	Wired Road's network backbone is on the site with dark fiber availability. In a 2.5-mile radius: Citizens, LIT Networks, Windstream, Telia	Tier 4	Development ready and only site with dark fiber availability.

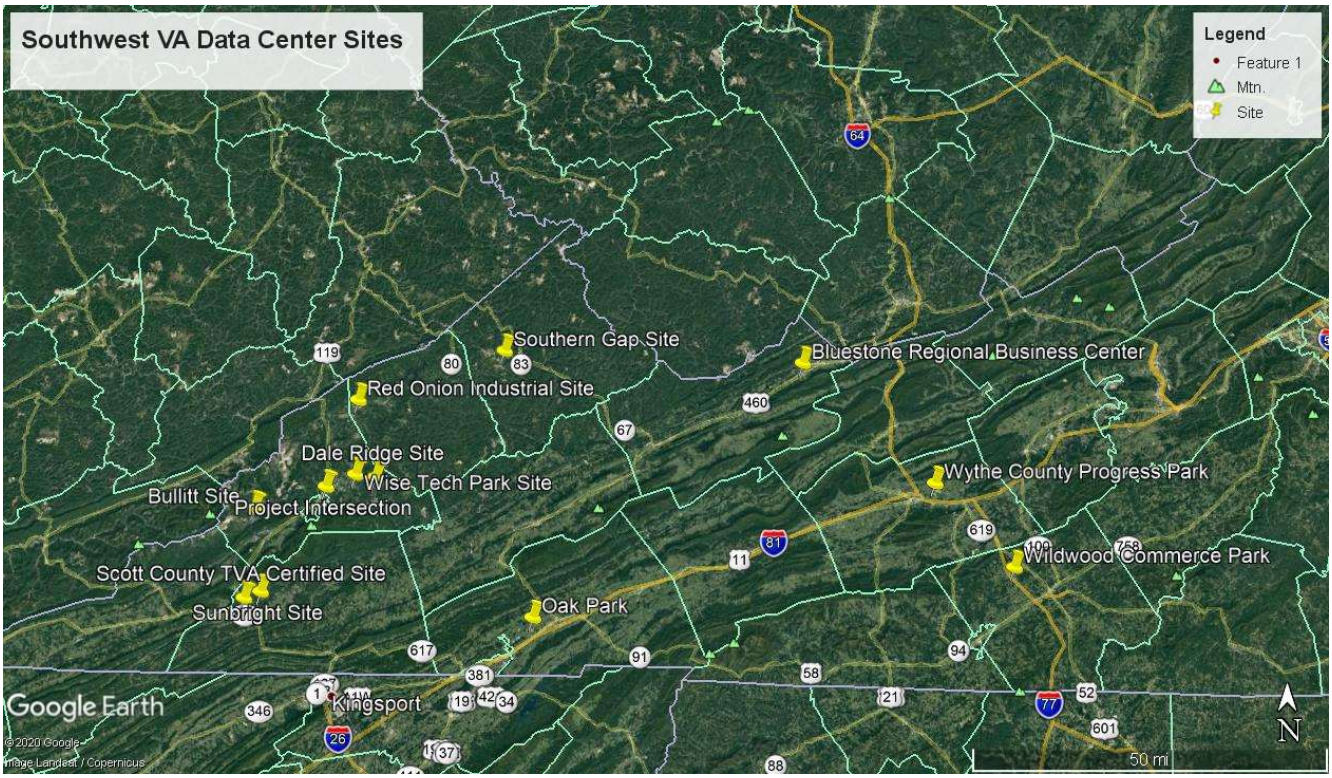
Four additional sites, the Bluestone Regional Business & Technology Center in Tazewell County (Tier 4 site), the Southern Gap Business Park in Buchanan County (Tier 2 with minimal due diligence required to advance to Tier 3), the Project Intersection Site in Norton (Tier 4 site), and the TVA Certified Data Center Site in Scott County met the minimum requirements in terms of site readiness and other criteria but would require significant lead time and expense to develop the electric power infrastructure required for the 36 MW data center. These sites may be suitable for a smaller data center of 10 MW or less and could provide a longer-term option for a larger data center with future electric infrastructure upgrades. TVA indicated that a new transmission line of 20 miles or more would be required to provide more than 30 MW for the Scott County site thus making that site likely cost prohibitive for a large electric user.

Potential Sites for a 10 MW or Less Data Center

Site	Locality	Parcel Size (Contiguous)
Bluestone Regional Business & Technology Center	Tazewell	100 acres
Southern Gap Business Park	Buchanan	40 acres
Project Intersection	Norton	30 acres
TVA Certified Site	Scott	12 plus adjoining 40 acres

Other sites that were evaluated that met some of the minimum requirements and that may be suitable as longer-term developable sites were the Dale Ridge and Bullitt Mine sites, both in Wise County. The Bullitt Mine site also has the potential of utilizing mine water as a cooling source. The list of twelve sites that were evaluated are shown on the map below.

Regional Map of Data Center Sites



ELECTRIC POWER

The availability, reliability, and price of electric power is one of the most critical site selection factors for data centers. The cost of electric power for servers, distribution infrastructure and cooling equipment can represent 50% or more of a data center's total cost. Increasingly, the availability of renewable energy is also a major consideration and a requirement for many newly constructed data centers. Many of the major cloud providers and hyperscale data centers such as Apple, Amazon, Facebook, and Microsoft have implemented plans to provide 100% of the power for their data centers from renewable energy sources. Options for renewable energy to supply a portion of the data center's electric use will be a site selection requirement for most data centers.

The electric power providers in the region that supply the sites that were evaluated for Project Oasis are Appalachian Power (AEP), Old Dominion Power Company (ODP) and TVA with distribution service provided by Powell Valley Electric Co-op. Electric rates are generally competitive for large customers such as data centers. Based on the energy use estimate for the Project Oasis data center, electric rates range from $0.0505 per kilowatt hour (kWh) to $0.061 per kWh for the regional providers. All the providers have economic development rates for qualified customers that would provide lower costs for a specific number of years. Considering economic development discounts, rates range from $0.048 - $0.056 per kWh. While not the lowest cost, regional electric costs compare favorably to other data center market regions and with other providers in Virginia. Dominion Energy who

provides service for most data centers in Northern Virginia, Richmond, Southern Virginia, and Eastern Virginia, has rates that range from $0.046 with economic development discounts to $0.054 without the discounts. Regional electric rates are also competitive with neighboring North Carolina and Tennessee whose rates are in the 5.5- 6.5 cents per kWh range. Municipal utilities such as Knoxville and Nashville in Tennessee have higher rates that are in the 8 cents per kWh range. A rate of 5 cents per kWh or less is considered extremely competitive within the data center industry. While electric rates in the region do compare favorably with other regions, there does not appear to be a significant competitive advantage based on electric costs except for the higher costs of some of the municipal utilities.

All the utilities in the region can provide a renewable energy option that would supply up to 100% of the power requirements. It should be noted that the renewable energy generation project does not have to necessarily be on or near the data center site. If located in the general electric market area and connected to the regional transmission network, that would typically be sufficient for most data center renewable energy contracts. In addition to having sites that meet the direct requirements of the data center, it will be important to also have sites in the region that can support the renewable energy requirements. Most new renewable energy projects for data centers in the current market utilize solar energy which requires a large land area (6-10 acres per megawatt). Having viable renewable energy options and sites will be a necessary component of the data center marketing effort for GO Virginia Region One. For the region's utilities, the current level of electricity generated from fossil fuel ranges from 44% to 99% so it will be important to highlight cost effective renewable options.

FIBER/CONNECTIVITY

The main functions of a data center are to centralize and consolidate information technology (IT) resources, house network operations, facilitate e-business and to provide uninterrupted service to mission-critical data processing operations. The availability of high capacity telecommunications infrastructure that connects the data center to end users through connections to major Internet access points, and the speed of those data transmissions (called latency) is a major consideration for the location of the data center. As with power, maintaining 100% reliability of the telecommunications infrastructure is also vitally important and multiple carriers with diverse routes are often a location requirement.

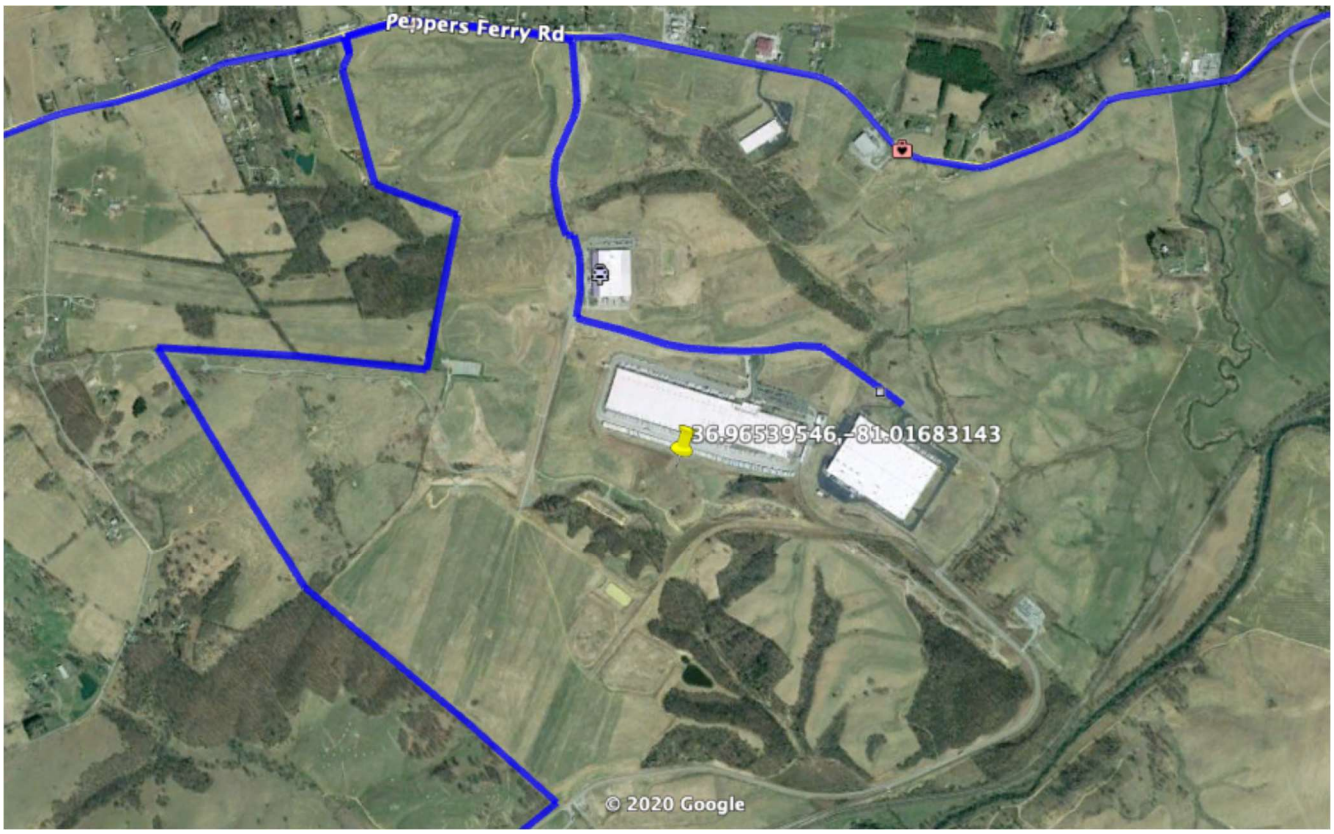
Virginia is in a unique position regarding global connectivity. The world's largest concentration of data centers is in Northern Virginia and the immense fiber network that supports that growth is perhaps the most significant global telecommunications hub. Additionally, new trans-Atlantic subsea cables that are becoming operational in Virginia Beach, are providing extremely high capacity connectivity to Europe, South America, and Africa.

InterGlobix, which is a global consulting and advisory firm focused on the convergence of data centers and subsea and terrestrial fiber, was added to the Project Oasis team to provide expertise regarding connectivity in the region. The analysis identified the specific telecommunications requirements for data centers and provided an assessment of the available fiber infrastructure for each of the sites in the region that met the general requirements of the 250,000 ft2, 36 MW Project Oasis data center. The TVA Certified Data Center site in Scott County and the Northrop Grumman site in Russell County were also included in the analysis as existing data centers are at those locations (Northrop Grumman and OnePartner/ATAC). The fiber providers that serve each of the Project Oasis sites responded to an extensive survey that included a description of their network and capacity, level of redundancy, proximity to the sites, and connectivity to major Internet access points. Maps were developed for each of the sites showing the general location of fiber and the carriers within a 2-mile radius. The connectivity and general routes to major Internet access points in Ashburn, VA, Richmond, VA and Atlanta, GA were examined.

The maps below for the Progress Park Site in Wythe County provide an example of the connectivity analysis that was done for each of the Progress Oasis sites.

Progress Park Site | Network Carriers (2-mile radius)

Citizens Network | Progress Park Site



Significant findings of the Fiber and Connectivity Report include the following:

- All the sites have one or more carriers with fiber either on the site or within 2 miles of the site. Several carriers and networks have a presence in the region including Point Broadband, Scott County Telephone, Wired Road, Citizens, Verizon, LIT Networks, Shentel, Segra, Windstream, Telia, and Zayo.
- The providers for most of the sites have connections to Internet access points in Ashburn, Atlanta, and Richmond, or can get there through relationships with other carriers and networks. Connections to the Richmond NAP provide the region an opportunity to benefit from the new subsea cable infrastructure and cable landings in Virginia Beach.
- Although multiple providers can provide long-haul services, the availability of dark fiber for a single user such as a data center is limited in the region. Only one site, the Wildwood Commerce Center, currently has an option for dark fiber. A new long-haul, dark fiber network from Haymarket, VA to Bristol, VA and continuing to Nashville, Tenn., is currently being constructed by Osprey Communications LLC. The Virginia portion will utilize Virginia Department of Transportation (VDOT) right of way primarily along the Interstate 81 corridor and will provide an additional connectivity option for the region.

- Some of the sites will require construction of new fiber over challenging terrain resulting in a greater cost per mile.
- Data center applications that are latency dependent such as financial transactions, video streaming, and online gaming, would not be a good fit for data centers considering GO Virginia Region One. Latency refers to the round-trip amount of time required to transmit and receive data. The physical distance of the fiber network to major population centers and the number of networks and associated equipment through which data must pass, impact the latency. Even a 1 millisecond delay due to high latency would result in millions of dollars impact for some applications.

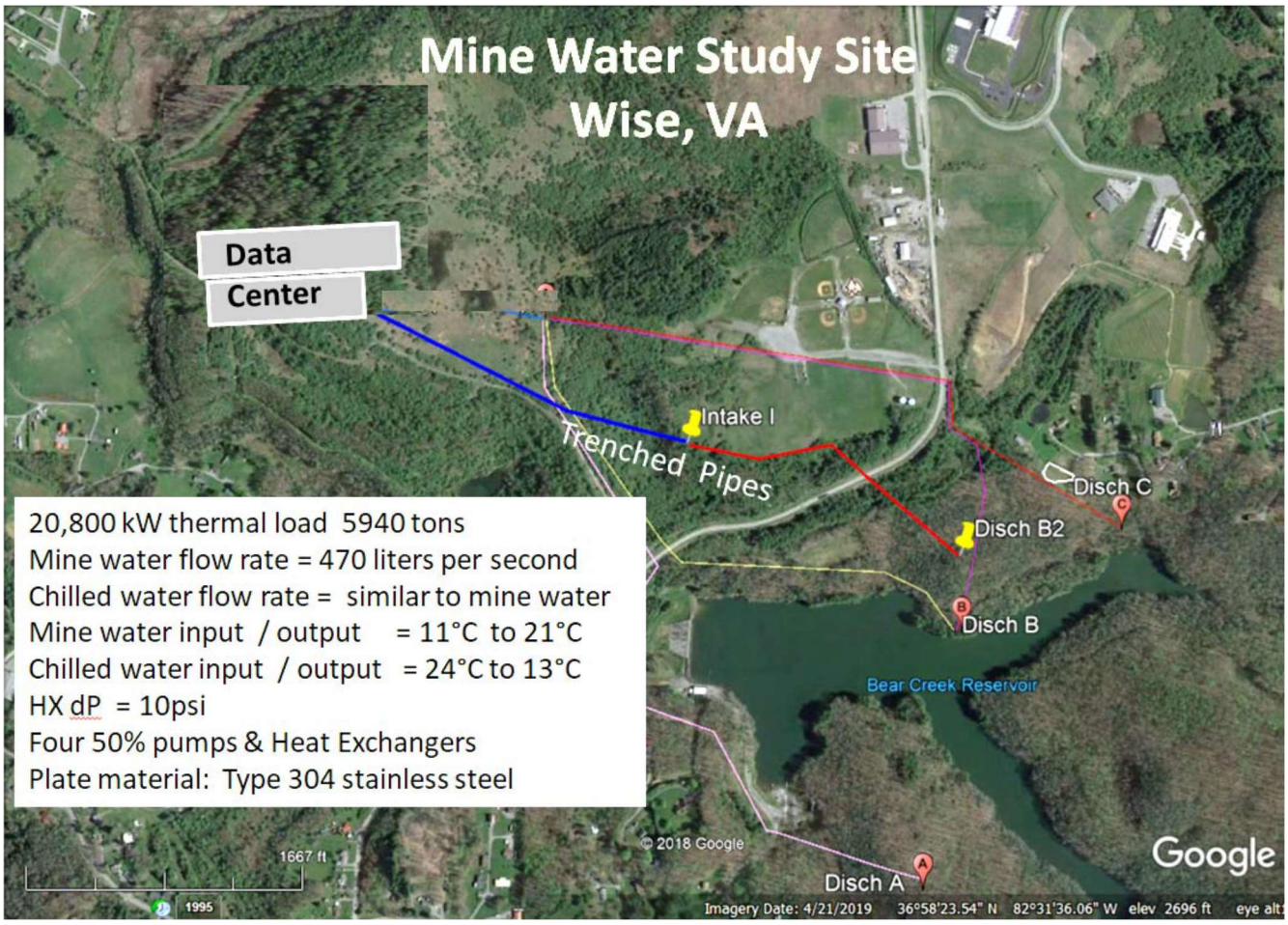
UTILIZATION OF MINE WATER FOR COOLING

One of the key objectives of the Project Oasis initiative was to evaluate the technical and economic feasibility of utilizing water from flooded coal mines as a cooling source for data centers. The availability of billions of gallons of water at a constant temperature of around 51 degrees could potentially provide a sustainable and cost-effective cooling solution for a data center operator. PCCI, Inc. (Alexandria, VA) and Marshall Miller & Associates (Bluefield, VA) were contracted by LENOWISCO to conduct a geothermal feasibility study to circulate water from a flooded coal mine that would be used to furnish the required cooling for a data center. The Project Oasis team worked closely with PCCI and Marshall Miller on this effort. The Project Oasis Model Data Center metrics used elsewhere in this report and the estimated electric power and cooling requirements were used as a basis for the engineering study. The location of the study was the Upper Banner Mine located near the Town of Wise, with the data center being located on property in the Lonesome Pine Regional Business and Technology Park in Wise County.

The study by PCCI and Marshal Miller evaluated potential designs for the cooling system, the suitability of the mine water as a cooling source, and the mine's stability that could be impacted by the withdrawal and reinjection of water at various well locations. The suggested design incorporates the use of plate heat exchangers and pumps that would circulate 51-degree mine water through the heat exchangers that would chill the water loop from the data center.

The diagram below shows the potential location of intake and discharge wells and the data center.

Mine Water Study Site



From "Case Study of Geothermal Feasibility of Mine Water Circulation to Augment Data Center Cooling", by PCCI, Inc. and Marshall Miller & Associates, May 20202

Some of the findings of the PCCI/Marshall Miller study:

- Cool mine water from the mine appears suitable for use as a cooling source.
- Adequate portions of the mine appear to be geologically stable to extract and inject adequate volumes of water by using multiple wells
- Heat exchangers, pumps, and piping equipment are commercially available and capable of supporting the expected flow rates.
- The mine water cooling system could reduce the electricity required for cooling the data center by 90%. The mine water cooling system would also substantially eliminate the need for the purchase of large volumes of municipal water that would be evaporated through cooling towers in a conventional mechanical cooling system.
- The annual savings would be over $1 million annually in reduced electric costs and municipal water purchases.

- The capital cost for the mine water cooling system is expected to be around $7 million more than for a conventional mechanical cooling system. However, factoring in savings for avoided maintenance and other costs for the conventional system, the mine water system would provide a favorable return on investment and result in net annual savings for the data center operator.

Data center operators are increasingly focused on sustainable solutions for power and water. The utilization of mine water as a cooling source would allow the data center to meet sustainability goals for electric energy and water, and at the same time, lower annual operating costs. The availability of the mine water resource that is unique to the Coal Fields Region, is an opportunity that should be explored further. If validated as a proven technology, it would further enhance the marketability of the region for future data center development, and in particular, those sites with access to a mine water resource.

Economic Impact of Data Center Development in SWVA

As previously noted, the significant amount of capital investment and high paying jobs that would occur as a result of a new data center locating in GO Virginia Region One would provide substantial economic benefits to the locality where the data center is located and also for the region. To assess the economic and fiscal impact of a large new data center locating in the region, Mangum Economics was contracted to assist the Project Oasis team with a targeted impact analysis. Using the IMPLAN economic impact model, an estimate of construction impacts, direct and indirect jobs, and economic output was developed. The Project Oasis Data Center Model which assumes a capital investment of $464.1 million and 40 direct data center jobs, was used as a basis for the impact analysis.

As GO Virginia Region One covers a large geography and multiple Metropolitan Statistical areas, the impact analysis was conducted for three locations within GO Virginia Region One: Scott County, Wise County, and Wythe County. Although the resulting economic impacts are different among the three localities, the variance is not significant. The estimated economic impacts for the three individual localities and the spillover effects for the surrounding region would be expected to be similar for other localities in GO Virginia Region One. The entire study "Potential Impact of Data Center. Development in Southwest Virginia", is included in Appendix B of this report. A summary of the estimated impacts (direct and indirect) for Wise County is shown below.

- 2,048 jobs supported during the 18-month construction period
- 40 data center jobs created, and 59 additional jobs supported once data center operations begin
- $55.2 million over the 18-month period in total pay and benefits
- $7.3 million in annual pay and benefits once operations begin
- $233 million during the construction period in total economic output
- $50.3 million annually once operations begin
- $15.7 million in real estate and property tax revenues over first 5 years of operation

In addition to the impact on the Wise County economy, spillover effects would be created in the surrounding region. The following impacts could be expected.

- 184 jobs supported during the 18-month construction period
- 12 jobs supported once data center operations begin
- $8 million over the 18-month construction period in total pay and benefits

- $900,000 in annual pay and benefits once operations begin
- $34.9 million during the construction period in total economic output
- $5.9 million annually once operations begin.

Appendix A – Qualifications of the Project Oasis Team

ONPOINT DEVELOPMENT STRATEGIES LLC

OnPoint Development Strategies LLC provides consulting services that specialize in economic development strategic planning, site selection and associated due diligence, and business recruitment assistance for data centers and energy intensive industries. The company is owned and managed by R Kent Hill who has over 40 years of experience in the energy industry and in economic development leadership. Mr. Hill led the economic development program for Dominion Energy, one of the nation's largest energy companies for more than 25 years. He is a Certified Economic Developer (CEcD) and is a past president of the Virginia Economic Developer's Association. In 2016, he was the recipient of the prestigious "Cardinal Award" that recognizes individuals for outstanding leadership in the field of economic development. Mr. Hill is a graduate of N.C. State University with a BS in Agricultural Engineering and is a graduate of the Economic Development Institute at the University of Oklahoma. Mr. Hill has been a featured speaker at numerous national data center industry conferences regarding site selection, mission critical facility location process, and energy related topics.

OnPoint Development Strategies LLC delivers customized client solutions guided by years of proven experience, established industry relationships, and continued access to a strong network of economic development and data center industry professionals.

MANGUM ECONOMICS LLC

Founded in 2003, Mangum Economics has become known as a leader in industry analysis, economic impact assessment, policy and program evaluation, and economic and workforce strategy development. The Mangum Team specializes in producing objective and actionable quantitative economic research that our clients use for strategic decision making.

Since 2003, Mangum Economics has produced over 300 reports for a variety of private and public sector clients, including the American Petroleum Institute; Apex Clean Energy; Brookfield Renewables; Clearway Energy; GO Virginia; Illinois Chamber of Commerce; Maryland Chamber of Commerce; Mid-Atlantic Broadband Communities Corporation; Newport News Shipbuilding; Next Era Energy; Northern Virginia Technology Council; Open Road Renewables; sPower; SunPower; Verizon; Virginia Cable Telecommunications Association; Virginia Chamber of Commerce; Virginia Economic Development Partnership; Virginia Manufacturers Association; Volvo Group North America; and Walmart.

Key Staff

Fletcher Mangum, Ph.D.

Fletcher Mangum is the Founder and CEO of Mangum Economics. He has three decades of experience in quantitative analysis and policy development at both the state and federal levels. Fletcher was appointed by Virginia Governor Bob McDonnell to serve on the Governor's and General

Assembly's Joint Advisory Board of Economists in 2010, and was reappointed to that position in 2014 by Governor Terry McAuliffe, and again in 2018 by Governor Ralph Northam. He is also a past President of the Virginia Association of Economists and serves on the board of the Virginia Council on Economic Education. Fletcher earned his Ph.D. in Economics from George Mason University in 1995, where he specialized in applying economic insights to public policy questions.

David Zorn, Ph.D.

David Zorn is an economist with Mangum Economics. He has over 20 years of experience as an economist at the US Food and Drug Administration where he worked on issues of food safety, nutrition, bioterror vulnerability, drug importation, tobacco marketing and quantitative risk assessment. He finished his time at FDA as the Director of Social Sciences. In that role, he led research on the economic effects of FDA policies. He has published several papers on subjects including food safety and nutrition, quantitative risk assessment and data quality. He earned a Ph.D. in economics from George Mason University with fields in industrial organization, public choice, and law and economics. He is an adjunct professor at the Antonin Scalia Law School.

Martina Arel, M.B.A.

Martina Arel is a Researcher and Economic Development Specialist with Mangum Economics. In prior work as an independent consultant, she has been involved in a variety of economic development consulting projects for communities and non-profit organizations. Martina has performed SWOT analyses, developed comprehensive community assessments and comparative analyses for strategic economic development plans, as well as produced industry analyses and corporate briefs for business retention and growth programs. She previously was also a Project Research Specialist with the Virginia Economic Development Partnership where she prepared customized marketing proposals for high-profile corporate recruitment projects and quantified incentive packages for clients. Martina is fluent in German and conversational in French. She holds an M.B.A. from Virginia Commonwealth University.

INTERGLOBIX LLC

Vinay Nagpal, President - 25+ years of global experience in Data Center & Connectivity industry specializing in Product & Business Management

Vinay Nagpal is an industry leader and visionary with global experience developing products and solutions in wholesale and retail colocation data centers with a strong focus on connectivity, subsea and terrestrial fiber. Currently, he is the President of InterGlobix LLC, a global consulting and advisory firm focused on the convergence of data centers, subsea and terrestrial fiber. Vinay is also the Co-Founder and Member of QTS Richmond NAP, which is a global Internet Interconnection hub in Virginia offering the lowest-latency, highest-capacity subsea connectivity. He is the Founding Member

& Executive Director of Internet Ecosystem Innovation Committee (IEIC), an independent global committee that promotes Internet diversity and forming of Internet nexus points.

Vinay also serves on the Leadership Board of NVTC Data Center & Cloud Committee, and actively leads Northern Virginia's data center and connectivity initiatives. Vinay has been involved in the subsea developments in Virginia. He also serves on the LINX NoVA Customer Advisory Board, and on NVTC's Executive Circle as an advisor to the NVTC Board of Directors. As an active participant in industry forums, Vinay is a member of the PTC Membership Committee, Marketing & Communications Committee and SubOptic Diversity & Inclusion Working Group.

Vinay's past endeavors include being part of the Open-IX Association board to build open standards for data centers and IXPs. As the Vice President of Product Management at Digital Realty / DuPont Fabros (DFT), he led product management of DFT's Data Center, Connectivity and Managed Services. During his tenure, he developed company's carrier-neutral data center connectivity and peering services, designed and implemented dark fiber networks and supported customers' network requirements. His senior-level network-centric positions at Tata Communications, Verizon, MCI, Digex and UUNET allowed his to productize data center and connectivity services across US, Canada, London, Singapore, Australia and India.

Vinay holds an MBA in Information Systems, a B.S. in Computer Science, an ITIL certification and a Higher Diploma in Software Engineering. He has authored white papers, blogs, and industry publications on datacenter and connectivity services. He has been invited a speaker to several renowned conferences across the world.

DATA ENERGY CONSULTING LLC

Phillip Sandino is the founder and Principal of Data Energy Consulting LLC (DEC). DEC consults with data centers, electric utilities, and local development authorities to drive sustainable development, regional resilience, and overall competitive advantage. Phillip began his career at General Electric as a field engineer specializing in the installation and commissioning of industrial gas turbines around the world. He has worked as an operations and business leader for NRG Energy, Dominion Energy and RagingWire/NTT Data Centers and previously co-founded Digital Redline, a digital gaming company in Los Angeles. Phillip has negotiated large energy supply agreements as both a client and utility representative. As Dominion's regional leader in Northern Virginia, Phillip provided leadership to the recovery efforts after Hurricane Sandy and the Derecho storm of 2012. He was Dominion's representative to the Department of Homeland Security's Regional Resiliency Assessment Program (RRAP) for Data Center Alley and led the Northern Virginia Infrastructure Plan for Dominion which master planned the electrical infrastructure resilience for Fairfax County's Tysons Comprehensive Plan and Data Center Alley. Phillip hold a BS MET from Texas Tech University and an MBA from

University of Southern California and is a Veteran of the US Navy. Phillip is an adult leader for Scout BSA's Troop 1525 in Fairfax, Virginia. He lives in Annandale, Virginia with his wife, Kim, and three sons.

Appendix B – Potential Impact of Data Center Development in Southwest Virginia

AUGUST 14, 2020

POTENTIAL IMPACT OF DATA CENTER DEVELOPMENT IN SOUTHWEST VIRGINIA

MANGUM economics

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About Mangum Economic Consulting, LLC

Mangum Economics, LLC is a Richmond, Virginia based firm that specializes in producing objective economic, quantitative, and qualitative analysis in support of strategic decision making. Much of our recent work relates to IT & Telecom Infrastructure (data centers, terrestrial and subsea fiber), Renewable Energy, Economic Development, and Tax and Regulatory Policy. Examples of typical studies include:

POLICY ANALYSIS

Identify the intended and, more importantly, unintended consequences of proposed legislation and other policy initiatives.

ECONOMIC IMPACT ASSESSMENTS AND RETURN ON INVESTMENT ANALYSES

Measure the economic contribution that business, education, or other enterprises make to their localities.

CLUSTER ANALYSIS

Use occupation and industry clusters to illuminate regional workforce and industry strengths and identify connections between the two.

The Project Team

David Zorn, Ph.D.
Economist

A. Fletcher Mangum, Ph.D.
Founder and CEO

Martina Arel, M.B.A.
Researcher and Economic Development Specialist

Illustrations of the Development Potential of a Data Center in Southwest Virginia

We illustrate the economic and fiscal impact potential if just one new large data center were to locate in Southwest Virginia.[1] Specifically, we estimate the economic and fiscal impact of constructing and operating the hypothetical data center in three counties in Southwest Virginia – Scott, Wise, and Wythe. Because there is a significant amount of economic interactivity within the region, our analysis estimates the degree to which a new data center in Scott, Wise, or Wythe counties would also affect the rest of the region in terms of jobs supported, worker pay and benefits, and economic output. We use the IMPLAN model to estimate these impacts.[2]. Like all economic impact models, the IMPLAN model uses economic multipliers to quantify economic impact. Economic multipliers measure the ripple effects that an expenditure generates as it makes its way through the economy.

The impact of constructing and operating the same facility in different metropolitan statistical areas varies because different areas are home to different industries that will feed off of the new development. The more populated and more economically diverse a regional economy is, the more of the economic impact the area can absorb. When new development occurs in less populated and less economically diverse areas, then more of the economic development impact spills over into the surrounding areas.

THE HYPOTHETICAL LARGE DATA CENTER PROJECT

The hypothetical large data center that we use for illustration would require a $464.1 million investment for construction of the building and for purchase and installation of the computer equipment inside the building. We assume that for a data center of this scale, $183.3 million would be spent for construction within Southwest Virginia over an 18month period. We assume that about $201.6 million would be spent on computer equipment that is almost always sourced outside of the region of interest and does not contribute to local economic activity. We also assume that $42 million would be spent on cooling and electrical equipment and materials sourced from outside of Southwest Virginia.

After construction and preparation activities have been completed, the computer equipment is installed and operations can begin. We assume that once it is operational, a data center of this size would hire 40 direct employees, not counting contractors that provide services such as security and maintenance. We also assume that $17 million would be spent annually on the purchase of 252,288,000kWh of electricity. Our assumptions and calculations are based on expert opinion, actual large enterprise data center projects, and information about expenditures from data center industry sources.

[1] We define Southwest Virginia as GO Virginia Region 1: the cities of Bristol, Galax, and Norton; and the counties of Bland, Buchanan, Carroll, Dickenson, Grayson, Lee, Russell, Scott, Smyth, Tazewell, Washington, Wise, and Wythe.
[2] IMPLAN is produced by IMPLAN Group, LLC.

The Economic Impact in Scott County, Virginia

Scott County is part of the Kingsport–Bristol, Tennessee-Virginia Metropolitan Statistical Area, which is a component of the Johnson City–Kingsport–Bristol, Tennessee-Virginia Combined Statistical Area (also, commonly referred to as the Tri-Cities region). Metropolitan and combined statistical areas are defined as a combination of separate local political geographies whose economies are interrelated. As such, a large economic development project would affect employment in Tennessee and in Virginia. Our report only measures the impact within Southwest Virginia. Construction of a large data center as well as its ongoing operation would potentially create a direct impact supporting approximately:

- 1,605 total construction jobs over the 18-month construction period,
- 40 full-time new operational jobs,
- $54.7 million in associated pay and benefits for construction workers,
- $4.3 million in associated pay and benefits annually for operating employees,
- $183 million in economic output in the Scott County economy over the 18-month construction period, and
- $28 million in economic output annually in the Scott County economy once operations begin.

After accounting for all of the additional effects that the project would cause as the new investment ripples through the Scott County economy, a new large data center would have a potential total economic impact on the Scott County economy supporting approximately:

- 1,958 jobs supported during the 18-month construction period,
- 40 data center jobs created and 40 additional jobs supported once data center operations begin,
- $65.7 million over the 18-month construction period in total pay and benefits,
- $5.1 million in annual pay and benefits once operations begin,
- $232.2 million during the construction period in total economic output, and
- $32.2 million annually once operations begin.

In addition to the impact on the Scott County economy, the impact of the hypothetical data center would create spillover effects in the Southwest Virginia economy outside of the Scott County boundaries. After accounting for all of the additional effects that the project would cause as the new investment ripples through the regional economy, a new large data center would have a potential total economic impact in Southwest Virginia (in addition to the impact on the Scott County economy) during the 18-month construction period of approximately:

- 66 jobs supported,
- $2.9 million in total pay and benefits, and
- $13.1 million in total economic output.

Table 1 summarizes the total impacts of all of the new economic activity associated with a new data center in Scott County and the entire state of Virginia.

Table 1: Total Economic Impacts of a Hypothetical Large Data Center in Scott County

Scott County	One-Time Construction Period	Ongoing Annual Operation
Total Jobs Supported	1,958	80
Total Pay & Benefits	$65,700,000	$5,100,000
Total Economic Output	$232,200,000	$32,200,000
Southwest Virginia	**One-Time Construction Period**	**Ongoing Annual Operation**
Total Jobs Supported	2,024	80
Total Pay & Benefits	$68,600,000	$5,100,000
Total Economic Output	$245,300,000	$32,200,000

The Economic Impact in Wise County, Virginia

Wise County is not part of a larger combined statistical area. A large data center located in Wise County would draw its workforce from Wise and surrounding counties. The economic activity that it would generate would also spill over into surrounding counties. Construction of a large data center as well as its ongoing operation would potentially create a direct impact supporting approximately:

- 1,737 total construction jobs over the 18-month construction period,
- 40 full-time new operational jobs,
- $42.5 million in associated pay and benefits for construction workers,
- $4.3 million in associated pay and benefits annually for operating employees,
- $183 million in economic output in the Wise County economy over the 18-month construction period, and
- $28 million in economic output annually in the Wise County economy once operations begin.

After accounting for all of the additional effects that the project would cause as the new investment ripples through the Wise County economy, a new large data center would have a potential total economic impact on the Wise County economy of approximately:

- 2,048 jobs supported during the 18-month construction period,
- 40 data center jobs created and 59 additional jobs supported once data center operations begin,
- $55.2 million over the 18-month construction period in total pay and benefits,
- $7.3 million in annual pay and benefits once operations begin,
- $233 million during the construction period in total economic output, and
- $50.3 million annually once operations begin.

In addition to the impact on the Wise County economy, the impact of the hypothetical data center would create spillover effects in the Virginia economy outside of the Wise County boundaries. After accounting for all of the additional effects that the project would cause as the new investment ripples through the state economy, a new large data center would have a potential total economic impact in Virginia (in addition to the impact on the Wise County economy) of approximately:

- 184 jobs supported during the 18-month construction period,
- 12 jobs supported once data center operations begin,
- $8 million over the 18-month construction period in total pay and benefits,
- $900,000 in annual pay and benefits once operations begin,
- $34.9 million during the construction period in total economic output, and
- $5.9 million annually once operations begin.

Table 2 summarizes the total impacts of all of the new economic activity associated with a new data center in Wise County and the entire state of Virginia.

Table 2: Total Economic Impacts of a Hypothetical Large Data Center in Wise County

Wise County	One-Time Construction Period	Ongoing Annual Operation
Total Jobs Supported	2,048	99
Total Pay & Benefits	$55,200,000	$7,300,000
Total Economic Output	$233,000,000	$50,300,000
Southwest Virginia	**One-Time Construction Period**	**Ongoing Annual Operation**
Total Jobs Supported	2,232	111
Total Pay & Benefits	$63,200,000	$8,200,000
Total Economic Output	$267,900,000	$56,200,000

The Economic Impact in Wythe County, Virginia

Wythe County is not part of a larger combined statistical area. A large data center located in Wise County would draw its workforce from Wythe and surrounding counties. The economic activity that it would generate would also spill over into surrounding counties. Construction of a large data center as well as its ongoing operation would potentially create a direct impact supporting approximately:

- 1,422 total construction jobs over the 18-month construction period,
- 40 full-time new operational jobs,
- $62.4 million in associated pay and benefits for construction workers,
- $4.3 million in associated pay and benefits annually for operating employees,
- $183 million in economic output in the Wythe County economy over the 18-month construction period, and
- $28 million in economic output annually in the Wythe County economy once operations begin.

After accounting for all of the additional effects that the project would cause as the new investment ripples through the economy of Wythe County, a new large data center would have a potential total economic impact on the Wythe County economy of approximately:

- 1,833 jobs supported during the 18-month construction period,
- 40 data center jobs created and 55 additional jobs supported once data center operations begin,
- $78.1 million over the 18-month construction period in total pay and benefits,
- $6.2 million in annual pay and benefits once operations begin,
- $243.7 million during the construction period in total economic output, and
- $40.2 million annually once operations begin.

In addition to the impact on the Wythe County economy, the impact of the hypothetical data center would create spillover effects in the Virginia economy outside of the Wythe County boundaries. After accounting for all of the additional effects that the project would cause as the new investment ripples through the state economy, a new large data center would have a potential total economic impact in Southwest Virginia (in addition to the impact on the Wythe County economy) during the 18-month construction period of approximately:

- 77 jobs supported during the 18-month construction period,
- $2.9 million over the 18-month construction period in total pay and benefits, and
- $12.2 million during the construction period in total economic output.

Table 3 summarizes the total impacts of all of the new economic activity associated with a new data center in Wythe County and the entire state of Virginia.

Table 3: Total Economic Impacts of a Hypothetical Large Data Center in Wythe County

Wythe County	One-Time Construction Period	Ongoing Annual Operation
Total Jobs Supported	1,833	95
Total Pay & Benefits	$78,100,000	$6,200,000
Total Economic Output	$243,700,000	$40,200,000
Southwest Virginia	**One-Time Construction Period**	**Ongoing Annual Operation**
Total Jobs Supported	1,910	95
Total Pay & Benefits	$81,000,000	$6,200,000
Total Economic Output	$255,900,000	$40,200,000

The Known Tax Impacts in Selected Counties in Virginia

We have estimated the local tax impact of a hypothetical, large data center in the selected Virginia counties by relying on the Virginia Economic Development Partnership's *Guide to Local Taxes on Business;* and using information from county websites, county officials and people familiar with taxes in the counties. We take the construction costs and server equipment purchase costs as the assessed value.

These are underestimates of total tax revenue because the construction and operation of the data center and its employees would generate other direct tax revenue. Moreover, we do not estimate the additional tax revenue generated by the additional indirect and induced economic activity that the data center will create. Additionally, data centers would be subject to other taxes, such as the state corporate income tax. However, we only have information to estimate these three sources of revenue.

SCOTT COUNTY

During its ongoing operational phase, the hypothetical data center would provide Scott County with tax revenue from two primary revenue sources – real property tax ($0.80 per $100) and computer hardware tax ($0.90 per $100). Computer hardware has a schedule for the taxable percentage of valuation of 50%, 35%, 25%, 15%, and 5% in years 1 through 5, respectively. Relative to real property and computer hardware taxes, the local energy tax on electricity consumption is negligible. Table 4 shows our estimates of those tax revenues from a large data center with $75 million in real property and $370.35 million in computer equipment in Scott County.

Table 4: Estimated First Year Tax Revenues in Scott County from the Operation of a Hypothetical Large Data Center

Revenue Source	Year 1	Year 2	Year 3	Year 4	Year 5	5-Year Total
Real Estate Effective Tax Rate	0.80%	0.80%	0.80%	0.80%	0.80%	
Real Estate Revenue	$600,000	$600,000	$600,000	$600,000	$600,000	$3,000,000
Computer Hardware Effective Tax Rate	0.450%	0.315%	0.225%	0.135%	0.045%	
Computer Hardware Revenue	$1,666,600	$1,166,600	$833,300	$500,000	$166,700	$4,333,200
Total Revenue	**$2,266,600**	**$1,766,600**	**$1,433,300**	**$1,100,000**	**$766,700**	**$7,332,800**

Our calculations conservatively assume that none of the computer equipment is replaced during the first 5 years. That would be unusual. In general, the computer equipment in most data centers is replaced on a three-year cycle. So, a lower depreciation rate would apply to the computer equipment that wasn't original to the data center.

WISE COUNTY

During its ongoing operational phase, the hypothetical data center would provide Wise County with tax revenue from two primary revenue sources – real property tax ($0.69 per $100) and computer hardware tax ($1.65 per $100). Computer hardware has a schedule for the taxable percentage of valuation of 80%, 60%, 40%, 20%, and 15% in years 1 through 5, respectively. Relative to real property and computer hardware taxes, the local energy tax on electricity consumption is negligible. Table 5 shows our estimates of those tax revenues from a large data center with $75 million in real property and $370.35 million in computer equipment in Wise County.

Table 5: Estimated First Year Revenues in Wise County from the Operation of a Hypothetical Large Data Center

Revenue Source	Year 1	Year 2	Year 3	Year 4	Year 5	5-Year Total
Real Estate Effective Tax Rate	0.69%	0.69%	0.69%	0.69%	0.69%	
Real Estate Revenue	$517,500	$517,500	$517,500	$517,500	$517,500	$2,587,500
Computer Hardware Effective Tax Rate	1.32%	0.99%	0.66%	0.33%	0.25%	
Computer Hardware Revenue	$4,888,600	$3,666,500	$2,444,300	$1,222,200	$916,600	$13,138,200
Total Revenue	**$5,406,100**	**$4,184,000**	**$2,961,800**	**$1,739,700**	**$1,434,100**	**$15,725,700**

It is important to note that this estimate of tax revenues is an underestimate for a number of reasons. First, we assume that all data center equipment is taxed at the rate and depreciation schedule for computer hardware. In reality, power distribution systems, telecommunications equipment, cooling equipment, and similar business tangible personal property would be taxed at a less aggressive depreciation schedule (taxable percentage of valuation 90%, 80%, 70%, 60%, and 50% in years 1 through 5, respectively), but at the same rate. So, some equipment will be taxed at a higher rate than we estimate. Secondly, our calculations conservatively assume that none of the computer equipment is replaced during the first 5 years. That would be unusual. In general, the computer equipment in most data centers is replaced on a three-year cycle. So, a lower depreciation rate would apply to the computer equipment that wasn't original to the data center. And, as mentioned at the beginning of this section, the construction and operation of the data center and its employees would generate other direct tax revenue. Moreover, we do not estimate the additional tax revenue generated by the additional indirect and induced economic activity that the data center will create. Finally, data centers would be subject to other taxes, such as the state corporate income tax.

WYTHE COUNTY

During its ongoing operational phase, the hypothetical data center would provide Wythe County with tax revenue from three primary revenue sources – real property tax, personal property tax, and utilities tax. Table 6 shows our estimates of those tax revenues from a large data center in Wythe County.

During its ongoing operational phase, the hypothetical data center would provide Wythe County with tax revenue from two primary revenue sources – real property tax and personal property tax ($2.32 per $100 with a 50% taxable percentage of valuation). Relative to real property and computer hardware taxes, the local energy tax on electricity consumption is negligible. Table 6 shows our estimates of those tax revenues from a large data center with $75 million in real property and $370.35 million in computer equipment in Wythe County.

Table 6: Estimated Revenues in Wythe County from the Operation of a Hypothetical Large Data Center

Revenue Source	Year 1	Year 2	Year 3	Year 4	Year 5	5-Year Total
Real Estate Effective Tax Rate	0.54%	0.54%	0.54%	0.54%	0.54%	
Real Estate Revenue	$397,500	$397,500	$397,500	$397,500	$397,500	$1,987,500
Computer Hardware Effective Tax Rate	1.16%	1.16%	1.16%	1.16%	1.16%	
Computer Hardware Revenue	$4,296,100	$4,296,100	$4,296,100	$4,296,100	$4,296,100	$21,480,500
Total Revenue	**$4,693,600**	**$4,693,600**	**$4,693,600**	**$4,693,600**	**$4,693,600**	**$23,468,000**

Again, it is important to note that this estimate of tax revenues is an underestimate for a number of reasons. First, our calculations conservatively assume that none of the computer equipment is replaced during the first 5 years. That would be unusual. In general, the computer equipment in most data centers is replaced on a three-year cycle. So, a lower depreciation rate would apply to the computer equipment that wasn't original to the data center. And, as mentioned at the beginning of this section, the construction and operation of the data center and its employees would generate other direct tax revenue. Moreover, we do not estimate the additional tax revenue generated by the additional indirect and induced economic activity that the data center will create. Finally, data centers would be subject to other taxes, such as the state corporate income tax.